

PROJECT IMPLEMENTATION UNIT GANDHINAGAR



TECHNICAL SPECIFICATION FOR FOR FIRE FIGHTING WORKS

Name of Work: -New Construction of 30 Bedded Community Health Center
at.Thangadh, Ta.Thangadh, Dist.Surendranagar.

**Project Implementation Unit
4th Floor, PIU/RDD/NHM Building,
Civil Hospital Compound, Sector-12,
Gandhinagar – 382 012.**

A) TECHNICAL SPECIFICATIONS:

SCOPE OF WORK:

Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install electrically operated and diesel driven fire pumps, wet riser, fire hydrant system/fire extinguishing as required by the drawings and specified hereinafter or given in the Tender.

Without restricting to the generality of the foregoing, the work shall include but not limited to the following:-

Fire Pumps, Motor, Engine and Accessories:

- a) Electrically operated and diesel driven fire fighting pumps with motors, base plate and accessories.
- b) Pressure gauge with isolation valves.
- c) Mild Steel / Galvanized Pipes, fittings, valves, suction strainers, suction & delivery headers & accessories.
- d) Foundations, vibration eliminator pads and foundation bolts.
- e) Pressure vessel, pressure switches etc.

Fire Hydrant System:

- a) M.S. / G.I. Piping for wet riser/hydrant systems.
- b) Fire Hydrant valves, RRL hose pipes, hose reels, hose cabinets, connections to fire mains.
- c) Isolation & non-return valves, pipe supports/welding/Fire Brigade inlet and accessories.

Fire Sprinkler System :

- a) M.S. / G.I. Piping for sprinkler systems.
- b) Fire Alarm control valves/Installation Control.
- c) Sprinkler heads, Spare Sprinkler. d) Inspection & Testing assemblies.

Hand Appliances /Fire Extinguishers :

Supply and installation of fully charged and tested fire extinguishers hand appliances Clean Agent type, trolley mounted extinguisher, water CO₂, foam, dry chemical powder type, ABC stored pressure type, CO₂ gas cartridge type as required by these specification and drawings.

Hydraulic Calculations :

The tenderer shall be responsible for providing fully detailed hydraulic calculations of sprinkler and hydrant system to comply with IS 15105 and NBC-2016 to the requirements of Fire Services.

HYDRANT SYSTEM DESCRIPTION:

The Separate Hydrants and Sprinkler System shall consist of electric pump of 2280LPM at 125 m head with suitable Motor, standby diesel engine driven pump of 2280 LPM at 125 m head and separate jockey pumps for hydrant and sprinkler system of 180 LPM at 125 m head with suitable Motor. The system shall be complete with all required accessories including valves, strainers, special fittings, instrumentation, control panels and any other components required to complete the system in all respects.

The Hydrant system shall be kept pressurized all the times.

In the event of fire when any of the hydrant valves in the network is opened, the resultant fall in the pressure shall start the jockey pump first through pressure switch automatically. In case jockey pump fails to maintain the pressure common hydrant pump shall start at the preset pressure. In case of further drop in pressure the diesel standby pump shall start.

The hydrant risers shall be terminated with air release valve at the highest points to release the trapped air in the pipe work.

To provide for an air cushion for counteracting pressure surges/ water hammer, an air vessel shall be furnished in the pump room near the fire pumps. The air vessel shall normally be kept partly full of water.

One No. four way Fire Brigade Inlet Connections shall be provided for filling of Underground Fire tank in case of emergency and in addition one no. four way Fire Brigade connection shall be made to internal and external Fire riser in case fire pumps fail to start.

External fire hydrant will be provided on the ring main. Hydrant shall be located at least 2M away from the building.

Hydrant stations and cabinet shall be provided at all designated location inside and along with external hydrants. The hydrant stations shall be located in M.S steel fire cabinet as per drawing and will contain all items described in bill of quantity.

SPRINKLER SYSTEM DESCRIPTION:

The automatic sprinkler system will be installed to protect the entire building with permitted exception e.g. electrical switch room, power transformer and DG room as identified. There is a separate hydrant & sprinkler pump of 2280 LPM at 125 m head in the pump house to be provided and Diesel Engine shall also support the sprinkler system.

The Sprinkler System shall be fed both from an underground tank and also from the overhead tank.

Installation control valve shall be provided for alarming in case of fire. Installation control valve comprising of main stop valve, alarm valve with accessories, strainer and water motor gong.

For the sprinkler system the building shall have a riser of 150 mm dia, tapped on each floor to feed the sprinkler system. On each floor, at the tapping from the sprinkler riser, there shall be butterfly valve of suitable diameter and flow switch or Zone control valve with test drain assembly. The Zone control valve/flow switch shall be connected to the Annunciation Panel

through electrical cables.

FIRE PUMPS, MOTORS, ENGINE AND ACCESSORIES:

General:

The pumps shall be single stage/multistage designed for continuous operation and shall have a continuously rising head characteristic without any zone of instability.

Pumps (excluding the jockey pump) shall be able to operate sequentially. 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 Pump with motor, base plate, coupling device and coupling guard shall be coupled at the works of the manufacturer.

The motor shall have a 15% margin of power rating over the rated pump input power.

The pumps shall be capable of delivering a minimum of 150 percent of rated capacity at a total head of not less than 65% of the total rated head. The total shut-off head shall not exceed 120 percent of total rated head on the pump.

The pump shall be tested at the factory and test curve shall be submitted showing the performance and horse power requirement based on this test before final acceptance.

Contractor shall provide necessary test certificates, type test certificates, technical data sheets performance curves and NPSH curves of the pumps, dimension detail, foundation detail from the manufacturer while submitting data sheet for approval.

Pumps coupled with motor or engine on a common platform shall perform smoothly without any excessive noise or vibration.

Each pump shall be provided with a plate giving, in the case of centrifugal pumps, the delivery head, capacity and the number of revolutions per minute, and in the case of reciprocating pumps, the diameter of the steam cylinders and water plungers and the length of the stroke, as also the ratios of the effective aggregate areas of the suction and the delivery valves to the area of the water plungers.

Pump:

The pump shall be horizontal split casing type or as described in the Schedule of Quantities.

The impeller shall be secured to the shaft and shall be retained against circumferential movement by keying, piping or lock rings.

All screwed fasteners shall tighten in the direction of normal rotation.

Pump shall be provided with approved type of mechanical seals.

Pumps Casing:

The casing of horizontally split pumps shall be hydrostatically tested to 1.5 times the maximum working pressure but in no case less than 250 PSI.

Pressure classification of flange connections shall correspond to casing working pressures.

Casing material shall be close grained, accurately machined, cast-iron, and precision manufactured for best performance and long-term duty and fitted with gunmetal wearing ring.

Water discharge diffusers shall be included to reduce radial torque to impellers.

Wearing Ring :

Wearing rings shall be suitable for an individual application. Rings shall be replaceable, and positively keyed to prevent rotation.

Bearing :

Bearings shall be heavy-duty ball bearings with a minimum average life of 100,000 hours. The bearings shall be self-sealed, and housed in malleable-iron housing aligned to bearing bracket by means of large precision registers. Bearings shall be removable without dismantling any rotating element or pumps.

Impeller:

Impeller shall be one-piece, phosphor bronze, and the bush of gun metal. The impeller shall be hydraulically and dynamically balanced.

Impellers of pumps shall be fully enclosed suction type and hydraulically balanced.

Impellers shall be accurately keyed to the shaft and positioned axially by shaft sleeves and separate snap rings.

Impellers shall be fully protected against damage from reverse rotation.

Shaft:

Shaft size shall be selected on the basis of maximum combined shear stress.

The shaft shall be of stainless-steel ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibrations and torques coming in during operation.

Length of the shaft sleeves must extend beyond the outer faces of the mechanical seal and plate so as to distinguish between the leakage between shaft and shaft sleeve.

Shaft sleeves shall be securely fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly shall ensure concentric rotation. The sleeve shall be of stainless steel.

The shaft sleeve be made of bronze ASTM B584-932 and shall be locked in place by threaded, bronze shaft sleeve nuts. And 'O'-ring shall be furnished under the sleeve to prevent leakage.

Pump Shaft-Motor Shaft Coupling:

All shafts shall be connected with adequately sized flexible couplings of suitable approved design. Necessary guards shall be provided for the couplings.

Base Plate:

A common base plate mounting both for the pump and drive shall be provided. The base plate shall be rigid construction, suitably ribbed and reinforced.

Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust etc.

Vibration & 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.

Installation :

Installation of the Fire Fighting Pump set shall be carried out exactly as per manufacturer recommendation.

Foundation :

The foundation of Fire Fighting Pumps & Electrical motor shall be constructed as per the requirement/recommendation of manufacturer of Fire Fighting Pumps/motor/Diesel Engine.

Anti-vortex Plates :

Anti-vortex plates shall be installed at the end of the Fire Pump suction inside tanks.

Instruction Manual & Tools/Spares:

A comprehensive instruction manual shall be provided by the contractor indicating detailed requirements for operation, dismantling and periodic operation and maintenance procedures.

ELECTRIC MOTORS:

Electrically driven pumps shall be provided with totally enclosed fan cooled induction motor. The motor shall be full load duty & shall be capable of handling the required starting torque of the pumps. Speed of motor shall be compatible with the speed of the pump.

Motors shall have a dust tight construction with suitable means of breathing.

The motor shall be designed not to draw starting current more than 3 times normal running current. Motor for fire pump 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.

All Components shall be of adequate mechanical strength and robustness and shall be constructed of metal unless otherwise approved.

The rating and design shall conform to (IS:325) specification.

The motors shall be wound for Class-F insulation and the winding shall be vacuum impregnated with heat and moisture resisting varnish and glass wool insulated to withstand tropical conditions.

Two independent earthing points shall be provided on opposite sides of the motor for bolted connections.

415 Volt power terminals shall be suitable for receiving 1.1 kV grade armoured power cables.

The cable boxes and terminations shall be designed to enable easy disconnection and replacement of cables.

The motor shall have Power factor of not less than 95% under rated load condition. If motor are provided with less than 95% Power factor, provide Power factor correction in near the motor to maintain the Power factor of 95% or greater under rated load conditions.

Provide other specific requirements required by governing energy conservation codes.

DIESEL ENGINE:

General:

The engine rating shall be decided considering the de-rating factors which are based on Site conditions as per BS : 5514.

The diesel engine shall be of multi cylinder type four/six stroke cycle with mechanical (airless) injection, cold starting type.

The Engine shall be direct injection type, capable of being started without use of wicks, cartridge, and heater plugs at an engine room temperature of 7°C and shall accept full load within 15 seconds from the receipt of the signal to start.

The Engine shall be turbo-charged and water cooled.

The Engine shall be capable of operating continuously on full load at the site elevation for a period of 8 hours and no major overloads before 300 hours of operation.

The Engine shall be provided with an adjustable governor to control the Engine speed within 10% of its rated speed under any condition of load up to the full load rating. The governor shall be set to maintain rated pump speed at maximum pump load.

The Engine shall be provided with an in-built tachometer to indicate R.P.M. of the Engine.

Engine, after correction for altitude and ambient temperature, shall have bare engine horse power rating equivalent to the higher of the following two values :-

- a) 20% in excess of the maximum brake horse-power required to drive the pump at its duty point.
- b) The brake horse power required to drive the pump at 150% of its rated discharge.

The coupling between the Engine and pump shall allow each unit to be removed without disturbing the other.

The engine shall be designed with regard to ease of maintenance, repair, cleaning and inspection.

All parts susceptible to temperature changes shall have tolerance for expansion and contraction without resulting in leakage, misalignment of parts or injury to parts.

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.

Provision shall be made for two separate methods of Engine starting viz.

- a) Automatic starting by means of a battery powered high torque D.C. electric starter motor incorporating the axial displacement type of pinion, having automatic repeat start facilities initiated by a fall in pressure in the water supply pipe to the hydrant installation.
- b) Manual starting by
 - i) Electric Starter motor.

Note : The starter motor used for automatic starting may also be used for manual starting provided there are separate batteries for manual starting.

Engine shall be able to start without any preliminary heating of combustion chamber, manual cranking mechanism shall also be provided. All controls/mechanisms, which have to be operated in the starting process, shall be within easy reach of the operator.

The high torque D.C 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 storage batteries. The battery capacity shall be adequate for ten consecutive starts without recharging with a cold engine under full compression. Battery shall be lead acid type of 12 V, 180 Ah capacity.

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 & boost chargers. After start of the engine the charger shall be disconnected. The battery being fed from the engine alternator.

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.

An over speed shutdown device to shutdown the engine at speed approximately 20% above rated engine speed with manual reset, so that the automatic engine controller will indicate an over speed signal until the device is manually reset to normal operating position.

Fuel System:

The Engine fuel oil shall be of quality and grade specified by the Engine manufacturer.

The diesel engine shall be suitable to run on High Speed Diesel (HSD), the tank provided being enough to hold the volume required for 8 hours (minimum) continuous operation. The tank shall be of MS sheet of 3.0 mm thickness.

The fuel tank shall be of welded steel construction to relevant Indian Standard. The tank shall be mounted above the Engine fuel pump to give gravity feed otherwise recommended by the manufacturer. The tank shall be fitted with an indicator showing the level of the fuel in the tank.

Cooling System:

The engine shall be water cooled with cooling water drawn from the discharge side of the pump and with pressure reducing valve, strainer and all necessary accessories.

A heat exchanger, the raw water being supplied from the fire pump discharge (taken off prior to the pump discharge valve) via a pressure reducing device, if necessary, to limit the applied pressure to a safe value as specified by the engine manufacturer. The raw water outlet connection shall be so designed that the discharged water can be readily observed. The water in the closed circuit shall be circulated by means of an auxiliary pump driven from the engine and the capacity of the closed circuit shall not be less than that recommended by the engine manufacturer. If the auxiliary pump is belt driven there shall be multiple belts so that should half of the belts break, the remaining belts shall be capable of driving the pump.

Tachometer:

A tachometer shall be provided to indicate revolutions per minute of the engine.

Oil Pressure Gauge:

The engine shall be provided with oil pressure gauges indicating lubricating oil pressure.

Temperature Gauge:

The engine shall be provided with a temperature gauge to indicate cooling water temperature.

Automatic Control Wiring:

All connecting wires for automatic controllers shall be harnessed or flexibly enclosed, mounted on the engine and connected in an engine junction box to terminals numbered to correspond with numbered terminals in the controller, for ready wiring in the field between the two/sets of terminals.

Signal for Engine Running and Crank Termination:

The engine shall be provided with a speed sensitive switch to signal engine running and crank termination. Power for these signals shall be taken from a source other than the engine generator.

Engine Exhaust Pipes :

The exhaust pipe shall be galvanized steel pipe and sized in accordance with the manufacturer's recommendations. The exhaust pipe shall be insulated with 50 mm of fibreglass with aluminum jacket for its entire length.

A stainless steel flexible connection shall be provided between the engine exhaust outlet and the exhaust pipe. An exhaust silencer shall be provided as required to satisfy the acoustic requirements.

Battery Charging :

The means of charging the batteries shall be by a 2-rate trickle charger with manual selection of boost charge and the batteries shall be charged in position. Where separate batteries are provided for automatic and manual starting, the charging equipment shall be capable of trickling charging both the batteries simultaneously. Equipment shall be provided to enable the state of charge of the batteries to be determined.

Installation :

Installation of the Diesel Engine shall be carried out exactly as per manufacturer recommendation.

Foundation and Anti Vibration Mounting :

Foundation :

The foundation shall be constructed as per the requirement of Diesel Engine Manufacturer.

Anti Vibration Mounting :

Suitable vibration mounting duly approved by the authorized representative shall be employed for mounting the unit so as to minimize transmission of vibration to the structure. The isolation efficiency achievable shall be clearly indicated.

Accessories:

The engine shall be mounted on a base plate of fabricated steel construction. Adequate access shall be provided to the big end and main bearing, camshaft and governor drives, water jackets etc.

The engine shall be provided with inlet filter and silencer, outlet muffler, expansion joints, dampers etc. as necessary for efficient operation. Intake air shall be taken from inside the building in which the engine is located, but the exhaust shall be discharged into the air at location as desired by the employer.

The contractor shall provide all accessories, fittings and fixtures necessary and required for a complete operating engine set.

Instrumentation:

The diesel engine shall be provided with instrumentation as under:-

6.16.1.1 Engine Starting System:

It shall be with lead acid batteries heavy duty of minimum 180 AH capacity, higher if so required by the engine manufacturer, 2 Nos. and self-starter switch.

Engine Instruments and Standard Control Panel:

It shall be complete with required connections and comprising of following items:

- a) Inlet and outlet water temperature gauge (dial type) with key.
- b) Lubrication oil pressure gauge.
- c) Lubrication oil temperature gauge.
- c) Automatic start stop device (push button type).
- e) Auto /Manual Selector switch shall also be provided.
- f) Manual: the Engine can be manually operated by means of Push Buttons.
- g) Start Stop and failure control device.

h) Start key for manual starting. i) Stop Push

Button for manual stopping of engine. j) Starting

failure indication by lamp and horn unit.

k) Engine temperature control with failure indication by red lamp indication.

l) Engine temperature 'very high' indication by audio alarm and automatic stopping of engine.

m) Engine set is 'running' and 'in operation' indication by green lamp.

n) Mains supply available indicated by yellow lamp.

o) Push Button for Audio Alarm reset.

p) Push Button Failure indication by lamps.

q) The Panel shall also have an auto/manual/test/off selector switch.

SETTING OF PRESSURE SWITCHES/OPERATING CONDITIONS FOR FIRE PUMPS:

The fire pumps shall operate on drop of pressure in the mains as given under clause below.

The pump operating sequence shall be arranged in such a manner to start the pump automatically but should be capable of being stopped manually by stop push buttons only.

Operating Conditions for the Hydrant Pumps :

The Pressure Switches mounted on the pressure vessel would be set as under (all figures in kg/cm²).

| | Cut in | Cut out |
|------------------------------------|--------|---------|
| Working Pressure | 16.0 ← | → 16.0 |
| Jockey Pump | 15.0 | 16.0 |
| Main Fire Pump (Sprinkler/Hydrant) | 14.0 | Manual |
| Diesel Engine Driven Pump | 13.0 | Manual |

It is thus to be noted that;

- i) Jockey Pumps shall start and stop automatically through pressure switches.
- ii) Jockey Pump shall stop when main pumps start.
- iii) Main/Diesel Engine driven fire pumps shall start automatically when pressure falls below the above specified limits, but stopping shall be manual.

INTERLOCKING :

The following inter-locking between the two main fire pumps (i.e. wet riser pump & sprinkler pump), the jockey pump and the diesel engine driven pumps will be followed.

Only one category of pumps will work at a time i.e. either jockey pump or main fire pumps (Sprinkler/Hydrant pumps can come up at a time) and/or diesel driven pump.

| S.No. | Jockey Pump | Sprinkler/Hydrant Pump | Diesel Driven Pump |
|-------|-------------|------------------------|--------------------|
| i) | ON | OFF | OFF |
| ii) | OFF | ON | OFF |
| iii) | OFF | OFF | ON |
| iv) | OFF | OFF | OFF |

PIPE, FITTINGS, VALVES, SUPPORTS AND OTHER ACCESSORIES :

Pipes, Fittings & Supports :

General :

- a) All materials shall be new of the best quality conforming to the specifications and subject to the approval of the Project Manager.
- b) Pipes and fittings shall be fixed truly vertical, horizontal as required in a neat workmanlike manner.
- c) 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.
- d) 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.
- e) Valves and other appurtenances shall be so located that they are easily accessible for operations, repairs and maintenance.

Pipes and fittings of following types (depending upon the description of item) and ISI marked only shall be used:

| Type | Size | Grade | Ends/Fitting | Code |
|------------------------|---|--|---|------------------------|
| G.I. / M.S Pipes | Upto 50 mm dia | Heavy grade | Screwed | IS: 1239 (Part I) |
| G.I. / M.S Fittings | Upto 50 mm dia | Heavy grade | MS Forged, Screwed ends | IS: 1239 (Part II) |
| G.I. / M.S Pipes | above 50 mm dia and upto 150 mm dia | Heavy grade | Grooved Fittings / Bevel, Butt Welded, 3 layers forms/screwed | IS: 1239 (Part I) |
| G.I. / M.S Fittings | above 50 mm dia and upto 150 mm dia | Heavy, machine formed from ISI marked heavy grade pipes | Grooved Fittings / Bevel, Butt Welded, 3 layers forms/screwed | IS: 1239 (Part III) |
| G.I. / M.S Pipes | Above 150 mm dia | 6.0 mm wall thickness up to 200 mm 8.0 mm wall thickness up to 300 mm | Grooved Fittings / Bevel, Butt Welded, 3 layers forms/screwed | IS: 3589 |
| G.I. / M.S Fittings | -do- | Schedule 40 | -do- | IS: 3589 |

For G.I. / M.S pipes upto and including 50 mm dia screwed fitting jointing shall be adopted, while for pipes above 50 mm Grooved fittings shall be used for G.I. / MS and screwed

connection for Galvanized. Only Electro Galvanized nuts /bolts shall be used.

The piping system and components shall be capable of withstanding 150 % of the working pressure including water hammer effects and test pressure upto 12 kg/cm².

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

Flange thickness shall be as per table below IS : 6392 – 1971. Table – 17/18.

| | | |
|------------|---|---------|
| 250 mm dia | : | 26 mm ; |
| 200 mm dia | : | 24 mm ; |
| 150 mm dia | : | 22 mm ; |
| 125 mm dia | : | 22 mm ; |
| 100 mm dia | : | 20 mm ; |
| 80 mm dia | : | 20 mm ; |
| 65 mm dia | : | 18 mm . |

G.I. / M.S. Fittings for pipes above 50 mm or and upto 150 mm dia shall be fabricated from seamless pipe pieces of minimum 5 mm wall thickness. For tees and other fittings where seamless sections are not available, the fittings shall be fabricated from Electric resistant welded pipes as given in the approved makes. However Galvanized fitting will be screwed. The fittings shall have a minimum 5 mm wall thickness. The fittings shall with stand pressure of upto 21 kg/cm²

Fittings below 50 mm or shall be M.S. Forged Screwed ends. The fittings shall be threaded at both ends. The fittings shall withstand pressure of upto 21kg/cm².

For tappings of 50 mm/40mm/32mm/25mm from headers, half socket connections with one side threading shall be employed. The half socket shall be welded at the centre of the header, either on the side or on the top.

Wherever two horizontal headers are to run side by side, the two headers shall be located at different levels, if possible, so as to avoid unnecessary bends at tapping off from the headers. Accordingly, the supports shall also be staggered to support pipes at two levels.

Pipe Support:

All pipe clamps and support shall be mild steel.

Pipe shall be hung by means of expandable anchor fastener of approved make and design (Dash Fasteners or equivalent). The hangers and clamps shall be fastened by means of galvanised nut and bolts. The size/diameter of the anchor fastener and the clamp shall be suitable to carry the weight of water filled pipe and dead load normally encountered.

Hangers and supports shall be capable of carrying the sum total of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipelines movements as necessary. All guides, anchors, braces, dampeners, expansion joints and structural steel to be attached to the building/structure, trenches etc shall be provided by the contractor.

Hangers and components for all piping shall be approved by the PMC's Engineer In-charge. Anchoring fasteners shall be rated to take minimum 2 tons load and shall be of approved make.

While all piping shall have clevis type hanger supports from the ceiling with fasteners, for pipe headers of 100 mm dia and above, additional wall/column mounted supports shall be taken. Clevis type hanger supports shall be at 3.0 m intervals and at every turn, at both ends. MS angle supports at wall and columns shall be at 18 m intervals. The angles shall be cut by gas cutter and evened out by grinder. All welding to angles shall also be cleaned by grinder. Angles shall not be less than 40 x 40 x 6 mm size.

For fixing clevis hanger and angle support, only dash fasteners shall be used. Exposing of steel reinforcement and welding to them shall not be permitted except in exceptional circumstances.

Pipes in vertical shafts shall have MS angle brackets at alternate floor level. The bracket shall be mounted behind the pipe. A base plate of 50 wide x 6 mm thick shall be welded to the bracket. The base plate shall be fixed to the wall by means of fasteners. GI U clamps shall be used to fix the pipe to the bracket.

Each riser shall also be anchored to the floor slab with MS angles mounted on the slab. The angles shall be 40 x 40 x 5 size, one mounted before the pipes and the other after the pipes. Extra cleat pipe pieces shall be welded to the pipes at this point which shall be welded to the angle iron support.

Wherever angle type supports are being used, profiled packing materials or wood or materials as approved by the PMC shall be used. The packing materials shall be at least 25 mm thick, and tight fitted with the pipe.

External Hydrant:

Each external hydrant station shall consist of one No. Single headed hydrant valve along with 2 Nos. hoses and one branch nozzle.

The underground piping for external hydrants shall be G.I. with wrapping-coating arrangement. The maximum spacing between two external hydrants shall not be more than 45 mtrs.

One No. four way Fire Brigade Inlet connection shall be provided for filling of underground Fire tank in case of emergency and in addition one No. four way Fire Brigade connection is made to External Fire Ring Main as well as to wet riser in case fire pumps fail to start.

External Fire Hydrant will be provided on the ring main. Hydrant shall be located at least 2M away from the building.

A masonry chamber of required dimension shall be built to accommodate sluice valve/Butterfly valve placed in external ring main in at least two positions as shown in the drawing.

Excavation:

Excavation for pipelines 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 1.2 meter or as shown on

drawings.

Wherever required contractor shall support all trenches or adjoining structures with adequate timber supports.

On completion of testing and pipe protection, trenches shall be refilled with excavated earth in 15 cms layers and consolidated.

Contractor shall dispose off all surplus earth within a lead of 200m or as directed by the Authorised Representative.

Anchor Thrust Blocks:

- a) Contractor shall provide suitably designed anchor blocks in cement concrete to encounter excess thrust due to water hammer & high pressure.
- b) Thrust blocks shall be provided at all bends & tees & such other location as determined by the Authorised Representative.
- c) Exact location, design, size and mix of the concrete block shall be approved by the Authorised Representative prior to execution of work.

Pipe Protection :

All pipes above ground and in exposed locations shall be painted with two coats of Red Oxide primer and two coats of synthetic enamel paint of approved shade.

Pipes buried below ground level shall be protected against corrosion to give a uniform with multilayer anticorrosive treatment as per IS:10221 by using non woven polyester mat of 4 mm thickness. The application of pipe coat primer and multi layer tape shall be as specified by the manufacturer.

Jointing

Welded Joints :

Before welding, the ends shall be cleaned by wire brushing, filing or grinding. Each weld-run shall be cleaned of slag before the next run is deposited.

Welding shall be done by certified welders only.

Welding at any joint shall be completed uninterrupted. If this cannot be followed for some reasons, the weld shall be insulated for slow and uniform cooling.

Welding shall be done by manual oxy-acetylene or manual shielded metal arc process. Automatic or semi-automatic welding processes may be done only with the specific approval of purchaser.

Socket weld joint shall be done with low hydrogen type covered electrodes with manual shielded metal arc process.

Joints between M.S./ G.I. Pipes and fittings shall be made with the pipes and fittings having "V"

groove and welded with electrical resistance welding in an approved manner.

Weld Electrodes shall be of one of the approved makes, of grade and type as suitable for the job and meeting the approval of the PMC.

As far as possible welding shall be carried out in flat position. If not possible, welding shall be done in a position as close to flat position as possible.

Joints shall be given a first weld in full width without burrs on the full dia of the pipe. Welding shall be carried out vertically from the surface to be welded. Weld fluxes shall not be so plastic such as to fall or drip down.

The root of butt joints shall be such as to achieve full penetration with the complete fusion of root edges. The weld projection shall not exceed 3 mm inside the pipe.

After application of first coat the weld shall be ground and then another layer of welding shall take place. The weld shall also be cleaned by grinding.

For pipes with wall thickness less than 3 mm, oxy-acetylene welding is recommended.

All pipe cutting shall be by oxy acetylene gas cutting only. The cut surface shall be cleaned and ground by an electric grinder before further welding.

Pipe cutting or welding in inaccessible areas shall be avoided. Pipes shall not be welded in trenches unless the bottom edge of the pipe does not have clear space for working with electrode.

Fillet welds shall be made by shielded metal arc process regardless of thickness and class of piping. Electrode size shall not exceed 10 SWG (3.25 mm). At least two runs shall be made on socket weld joints.

For supports, angle pieces shall be cut by oxy acetylene gas and cleaned by electric grinder. All cutting for bolt inserts shall be by electric drill.

Tappings (nipple pieces, etc.) for Hydrant from the risers shall be fabricated separately and then welded to the riser. A tool piece of 80 mm dia or as required shall be first prepared, one end shall be cut as per profile of riser pipe on which it shall be finally welded. The other end shall have the flange welded to it. The flange holes shall be set so as to receive the hydrant head correctly. Inside of the flange shall also receive a single layer of welding. The welding shall then be cleaned with a grinder. The tool piece shall then be welded to the riser. This procedure shall also be applied for all flanges.

As a rule no backing ring shall be used for circumferential butt welds.

Welding carried out in ambient temperature of 5 Deg C or below shall be heat treated.

Grooved Joints:

9.7.2.1 Remove all loose dirt scale & grease from the pipe surface.

9.7.2.2 Wrap the tape around the pipe, make sure the tape is not twisted & make the groove by

machine as per the requirement of coupling manufacturer.

9.7.2.3 Joints between the pipes and grooved fitting shall be made with the pipe by making square groove by grooving machine without reducing the thickness of pipe wall and fixed with the help of grooved coupling, nut, bolts & gasket etc.

Grooved Mechanical Couplings for Joining Carbon Steel Pipe :

Grooved Mechanical Couplings: Manufactured in two segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12. Gaskets shall be pressure-responsive synthetic rubber, grade to suit the intended service, conforming to ASTM D-2000. (Gaskets used for potable water applications shall be UL classified in accordance with ANSI/NSF-61 for potable water service.) Mechanical Coupling bolts shall be zinc plated (ASTM B-633) heat treated carbon steel track head conforming to ASTM A-449 and ASTM A-183, minimum tensile strength 110,000 psi (758450 kPa) as provided standard.

- a. Rigid Type: Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with ANSI B31.1, B31.9, and NFPA 13.
- b. Flexible Type: Use in locations where vibration attenuation and stress relief are required. Flexible couplings may be used in lieu of flexible connectors at equipment connections. Three Couplings shall be placed in close proximity to the vibration source.

Flange Adapters: For use with grooved end pipe and fittings, for mating to ANSI Class 125 / 150 flanges.

Grooved couplings shall meet the requirements of ASTM F-1476.

Gasket: Synthetic rubber, wide width, conforming to steel pipe outside diameter and coupling housing, manufactured of elastomers as designated in ASTM D-2000.

Grooved End Fittings

Fittings shall be cast of ductile iron conforming to ASTM A-536, Grade 65-45-12, with grooved ends for direct connection into grooved piping systems with steel forged steel conforming to ASTM A-234, Grade WPB 0.375" wall (9.53 mm wall), or fabricated from Std. Wt. Carbon Steel pipe conforming to ASTM A-53, Type F, E or S, Grade B. Fittings provided with an alkyd enamel finish or hot dip galvanized to ASTM A-153 with fire lock arrangement. Zinc electroplated fittings and couplings conform to ASTM B633.

Grooved Hole-Cut Branch Outlets:

- a. Bolted Branch Outlet: Branch reductions on 2 1/2"(DN65) through 6"(DN150) header piping. Bolted branch outlets shall be manufactured from ductile iron conforming to ASTM A-536, Grade 65-45-12, with fire lock type synthetic rubber gasket, and heat treated carbon steel zinc plated bolts and nuts conforming to physical properties of ASTM A-183.
- b. Strapless Outlet: 1/2"(DN15) or 3/4"(DN20) NPT outlet on 4" (DN100) and larger header sizes rated for 300 PSI (2065 kPa).

- c. Strapless Thermometer Outlet: To accommodate industrial glass bulb thermometers with standard 1-1/4"-18 NEF 2B extra fine thread and 6" (152mm) nominal bulb length on 4" (DN100) and larger header sizes rated for 300 PSI (2065 kPa).

Lubricant for fixing the Gasket on pipe should be oil free by manufacture and capable to give the cherectic as required.

Flanged joints (65 mm dia and above)

Flanged joints with flanges conforming to IS: 6392 shall be provided on

- a. Straight runs at intervals not exceeding 25-30m on pipe lines of 50 mm dia and above andas directed by the Project Manager.
- b. For jointing all types of valves, appurtenances, pumps, connections with other type of pipes, to water tanks and other places necessary and as required for good engineering practice and as shown/noted on the drawings.
- c. Flanges shall be with GI bolts and nuts and 3mm insertion gasket of natural rubber conforming to IS: 11149.

Unions (upto 50 mm dia)

Approved type of dismountable unions shall be provided on pipe lines of 40 mm dia and smaller dia, in locations similar to those specified for flanges.

Hose Reel:

Wall mounting the swinging type first aid hose reel with drum shall conform to IS : 884-1985.

The rubber tubing shall be 20 mm diathermoplast hose 30.0 m long as per IS : 12585 with SS / Gum Metal shut off nozzle having 6.5 mm dia orifice and control valve, shut off valve of approved make. The wall mounted bracket shall be fixed by means of fasteners. The hose reel shall have a stainless steel nozzle.

The hose reel shall be connected directly to the riser by means of 25 mm dia MS / G.I. pipe with threaded bends, union & one no. ball valve.

The drum can swing up to 170 degree.

Hose Cabinets:

Hose cabinet shall be fabricated from 16 gauge MS powder coated sheet of fully welded construction with hinged single/double door partially glazed door with suitable locking arrangement, stove enameled fire red paint with 'Fire Hose' written on it prominently. Glass panes shall be 4 mm thick.

The hydrant cabinet shall hold double headed hydrant, 2 nos. Hoses and 1 no. branch pipe.

The cabinet shall have two pipe studs of 200 mm dia in MS with base which shall be fixed to the

back of the cabinet and shall be used to hold the RRL hose.

RRL Hoses :

The hoses for the internal and external hydrant system should be rubber impregnated woven jacketed type conforming to IS:636 Type-A. Each fire hose shall be provided with quick coupling, branch pipes, nozzles, spanners etc.

Hose pipes of all types shall be capable of withstanding an internal water pressure of not less than 3.5 Kg/Sq.cm without bursting. It must also withstand a pressure of 21 Kg/Sq.cm without undue leakage or sweating.

Each hose shall be fitted with instantaneous spring lock type couplings at both ends. Hose shall be fixed to the coupling ends by copper rivets and the joint shall be reinforced by 1.5 mm galvanised mild steel wires and leather bands.

Branch Pipes and Nozzle :

Gun Metal / Stainless steel Standard Branch Pipe shall be used conforming to IS : 903 with Stainless steel nozzle of 16mm dia to fit standard instantaneous type 63mm dia hose coupling. Suitable spanners of approved design shall be provided in adequate numbers for easy assembly and dismantling of various components like branch pipes, nozzles, quick coupling ends.

Hydrant Valve :

Gun Metal / Stainless steel Hydrant valve shall be of oblique pattern provided as per IS: 5290 complete with hand wheel, quick coupling connection, spring and blank cap and chain.

The hydrant shall have flanged inlet of 100 mm dia and 63 mm female instantaneous type outlet. The hydrant shall have a rubber plug with chain fixed to the main body of the Hydrant.

Pressure Switch:

The pressure switches shall be employed for starting and shutting down operation of pumps automatically, dictated by line pressure. The Pressure switch shall be diaphragm type, it shall be suitable for line pressures upto 15 kg/cm².

The switch shall be suitable for consistent and repeated operations without change in values.

The enclosure shall be of aluminium and pressure element and wetted parts shall be of stainless steel. The switch shall be snap acting type with 1 no. N O/NC contact.

Air Vessel:

The air vessels shall be provided to compensate for slight loss of pressure in the system and to provide an air cushion for counter acting pressure surges whenever the pumping set comes into operation. It shall be normally partly full of water, the remaining being filled with air, which will be under compression when the system is in normal operation.

Air vessel shall be fabricated from MS plate conforming to IS:2002 grade 2A having 8mm thickness shell with 10 mm thick dished ends and suitable supporting legs. It shall be provided with a 80 mm dia/100 mm dia flanged connections from pump, one 25 mm drain with ball valve and 15 mm sockets for pressure gauge and pressure switches. The air vessel shall be hydraulically tested to 20 kg/cm² pressure for 30 minutes.

The pressure vessel shall be provided for hydrant and sprinkler system. The pressure switches shall be mounted on the drain end of each air vessel. The air vessel shall also be provided with safety valve mounted at the top.

Fire Department Connections:

Fire Brigade Inlet (4 Way) to Hydrant Ring/Hydrant Riser :

- a) Gun Metal four way fire brigade tank filling connection having 63 mm dia instantaneous type inlet and 150 mm dia flange outlet conforming to IS : 904 with blank cap and chain with necessary 150 mm dia MS (heavy duty pipe) and flanges, nuts and bolts etc.
- b) The inlet assembly shall be in glass fronted wall box and size of wall box shall be adequate to allow hose to be connected to the inlets, even if the door cannot be opened and the glass has to be broken.
- c) Each box shall have fall of 25 mm toward the front at its base and shall be glassed with wired glass with "FIRE SUPPLY" painted on the inner face of the glass in 50 mm size block letter.
- d) Each such box shall be provided with a steel hammer with chain for breaking the glass.

Tank Filling Connection :

- a) Gun Metal four way fire brigade tank filling connection having 63 mm dia instantaneous type inlet and 150 mm dia flange outlet conforming to IS : 904 with blank cap and chain with necessary 150 mm dia MS (heavy duty pipe) and flanges, nuts and bolts etc.
- b) The inlet assembly shall be in glass fronted wall box and size of wall box shall be adequate to allow hose to be connected to the inlets, even if the door cannot be opened and the glass has to be broken.
 - c) Each box shall have fall of 25 mm toward the front at its base and shall be glassed with wired glass with "FIRE SUPPLY TO TANK" painted on the inner face of the glass in 50 mm size block letter.
- d) Each such box shall be provided with a steel hammer with chain for breaking the glass. The inlets shall be provided with ABS quality plastic blank caps with chain.

Valves:

Sluice Valves:

Sluice valve of 50 NB and above shall be flanged / grooved end valve with Ductile iron body. The spindle, wall seat and wedge nuts shall be of bronze / ductile iron. They shall generally have rising stem and shall be of the particular duty and design called for. All sluice valves will be provided with supervisory switch.

The valves shall be supplied with suitable flanges, non-corrosive bolts and asbestos fiber gasket. Sluice valves shall conform to Indian Standard IS: 14846: 2000 and IS: 2906. Sluice valves for water works purposes suitable for seat test pressure of 16 Kg/Sq.cm.

Butterfly Valve :

The butterfly valve shall be suitable for water works and tested to minimum of 25 Kg/Sq.cm pressure.

The body shall be of Ductile iron/ cast iron to IS : 210 in circular shape and of high strength to take the water pressure of 25 Kg/Sq.cm. The disc shall be heavy duty ductile iron with anti corrosive epoxy or nickel coating.

The valve seat shall be of high grade elastomeric or nitrile rubber. The valve in its closed position shall have complete contact between the seat and disc throughout the perimeter. The elastomeric rubber shall have a long life and shall not give away on continuous applied water pressure. The shaft shall be EN 8 grade carbon steel.

UL/FM Global approved, 300 psi (2065 kPa), grooved ends, polyphenylene sulfide (PPS) coated ductile iron body (ASTM A-536, Grade 65-45-12). Ductile iron disc, synthetic rubber encapsulated suited for the intended service, with integrally cast stem. Complete with weatherproof actuator and pre-wired supervisory switches.

The valves shall be supplied with manual gear operated opening/closing by lever.

The valves shall be supplied with supervisory switch.

Gun Metal Valves :

Gun metal valves shall be used for smaller dia pipes, and for threaded connection. The valves shall bear certification as per IS: 778-1984 and shall be rated to 15 Kg/Sq.cm pressure.

The body and bonnet shall be of gun metal to IS : 318. The steam gland and gland nut shall be forged brass to IS: 319. The hand wheel shall be of cast iron to IS: 210.

The hand wheel shall be of high quality finish to avoid hand abrasions. Movement shall also be easy. The spindle shall non rising type.

All valves shall be approved by the Authority Representative before they are allowed to be used on the work.

Non-Return Valve :

Non-return valves shall be ductile iron grooved end type. An arrow mark in the direction of flow

shall be marked on the body of the valve. The valve shall bear IS : 5312 certification.

The valve shall be of ductile iron body and cover. The internal flap in the direction of water shall be of cast iron and hinged by a hinge pin of high tensile brass or stainless steel. Cast iron part shall be as per IS : 210.

The gasket shall be of high quality rubber and flap seat ring of leaded gunmetal. At high pressure of water flow the flapper shall sit tightly to the seat. The valve shall be capable of handling pressure up to 25 Kg/Sq.cm.

Air Valves :

9.16.5.1 Provide 25 mm dia screwed inlet cast iron single acting air valves, on all high points in the system as shown on the drawing.

Drain Valve :

Provide 50 mm dia between steel pipe to IS : 1239 (heavy class) with 50 mm gunmetal full way valve for draining any water in the system in low pockets.

Drain valves shall be provided at low points of all water riser and mains to ensure that all sections of pipe works and plant can be drained.

Foot Valve:

Foot valves of water supply system shall be heavy duty construction with integrated flanges connection and have cast iron body, all bronze trims with stainless steel spring and stainless steel strainer.

The flow area on strainer shall be at least three times of Pipe size.

Valve Chamber :

A masonry chamber of internal dimension 1.20m x 1.20m x 1.5m depth shall be built to accommodate sluice valves placed in external ring main, 230mm thick walls shall be of 75 class designation brick work in cement mortar 1:5 (1 cement : 5 fine sand) with CI medium duty manhole cover. The top slab RCC shall be of 1:2:4 mix (1 cement : 2 coarse sand : 4 graded same aggregate 20 mm nominal size) and inside plastering with cement mortar 1:3 (1 cement : 3 coarse sand) 12 mm thick finished with a floating coat of neat cement all complete.

Pressure Gauge:

Pressure gauge shall be provided near all connections to hydrant system and isolation valves of sprinkler system and where required. Pressure gauge shall be stainless steel 100 mm dia gunmetal Bourdon type with a scale range from 0 to 15 Kg/cm² and shall be constructed as per IS 3624. Each pressure gauge shall have a siphon tube connection with ball valve, tapping and connecting pipe and nipple. The gauge shall be installed at appropriate level and height for easy readability

Branch Pipe:

Gun Metal Standard Branch Pipe shall be used conforming to IS : 903 with gun metal nozzle of 16mm dia to fit standard instantaneous type 63mm dia hose coupling.

Pendent /Upright Type Sprinkler Head:

Sprinkler heads shall be of quartzoid bulb type with bulb, valve assembly, yoke and the deflector. The sprinkler shall be of approved make and type with 15 mm nominal dia outlets.

The bulb shall be made of corrosion free material strong enough to withstand any water pressure likely to occur in the system. The bulb shall shatter when the temperature of the surrounding air reaches at 68⁰ C.

The nominal bore shall be 15 mm dia and color of liquid shall be Red.

The Sprinkler head shall bear approval of FOC/UL/FM.

Installation Control Valve For Sprinkler:

Black enamel coated ductile iron body conforming to ASTM A-536, grade 65-45-12, aluminum bronze clapper, stainless steel spring and shaft, EPDM seal, and Nitrile seat O-rings. Valve internal parts shall be replaceable without removing the valve from the installed position. Water working pressure is 300 psi. Suitable for constant and variable pressure systems with optional Series 752 retard chamber. It shall be vertically mounted and the direction of water travel shall be indicated on the surface. It shall be rated to 12 kg/cm² and tested to 25 kg/cm² pressure.

A by-pass check valve shall be fitted to adjust minor and slow variations in water pressure for balancing so as to avoid any false alarm.

The valve shall also be provided with a test control box. The box shall house a lever to test and operate the ICV. A brass strainer shall also be provided at the point of water supply to the alarm gong. A retarding chamber shall also be provided. The chamber shall be able to balance the water pressure in case of water line surges.

Each installation control valve shall have two sets of pressure gauges with brass ball valve type shut off.

A water motor Alarm shall also be provided. This shall be mechanically operated by discharge of water through an impeller. The drive bearing shall be weather resistant. A strainer shall be provided on line before the nozzle.

A brass automatic ball drop valve with the retard chamber shall also be provided.

a) Flow Switch:

Flow switch shall have a paddle made of flexible material of the width to fit within the pipe bore.

The terminal box shall be mounted over the paddle/pipe through a connecting socket. The switch shall be potential free in either N O or N C operation of a single sprinkler head. The terminal box shall have connections for wiring to the Annunciation panel. The seat shall be of stainless steel. The flow switch shall have IP : 55 Protection. It should operate even with the flow of one Sprinkler bursting.

b) Fire Lock Commercial Zone Control Riser Module

Zone control valve with drain assembly shall be of commercial class of grooved or flanged type including the module body integrated with a shut off valve, test and drain valve combination with different orifice sizes, a UL listed and FM approved flow switch, and a pressure gauge of horizontal and vertical type. The terminal box shall be mounted over the paddle/pipe through a connecting socket. The switch shall be potential free in either NO or NC operation of a single

sprinkler head. The terminal box shall have connections for wiring to the Annunciation panel. The seat shall be of stainless steel. The flow switch shall have IP:55 Protection. It should operate even with the flow of one Sprinkler bursting.

Fire Man's Axe :

Fire man's axe for firefighting purpose shall be used conforming to IS:926- 1985

Painting:

All hydrant pipes shall be finished with post office red colour paint. All M.S. pipes shall first be cleaned thoroughly before application of primer coat. After application of 3 coats of Red oxide primer, two coats of enamel paint shall be applied. Wherever required all pipe headers shall be worded indicating the direction of the pipe and its purpose such as " TO RISER NO 1" etc.

Testing :

All piping in the system shall be tested to hydrostatic pressure of 16.5 Kg/Sq.cm without drop in pressure for atleast 2 hours.

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

FIRE EXTINGUISHERS:

Scope of Work:

Without restricting to the generality of the foregoing the work shall inter-alia consist of the following:

- a) Installation of fully charged and tested fire extinguishing hand appliances clean agent, CO₂ and dry chemical powder type as required by these specifications and drawings.

Portable Fire Appliances Requirement, Type and Location as per Fire Authority:

Portable Fire appliances as mentioned below :-

- a) Dry Chemical powder fire extinguisher IS : 15683
- b) CO₂ Gas Fire extinguisher IS: 15683
- c) Fire bucket IS : 2546 4 Nos. shall be installed at following places :-
 - (i) Electric meter Rooms. (ii)
 - Lift machine Rooms. (iii)
 - Pump Rooms.

d) ABC Dry powder type fire extinguisher IS:15683 & CO₂ Gas fire extinguisher IS:15683
 –
 4.5 Kg on each floor should be provided in each office.

e) Clean agent type Fire extinguisher

f) Trolley Mounted Fire Extinguisher.

General Requirements :

Fire extinguishers shall conform to IS:15683:2006 and standards as revised and amended upto date and shall be with BIS approved stamp.

- a) CO₂ type/
- b) Clean agent type
- c) CO₂ type Water Expelling (9 liters capacity)
- d) Mechanical form (9 liters capacity)
- e) ABC Type Stored Pressure
- f) Trolley Mounted Fire Extinguisher

Hand appliances shall be installed in readily accessible locations with the appliance brackets fixed to wall by suitable anchor fasteners or by means of floor mounted supports.

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

All appliances shall be fixed in a true workman like manner truly vertical and at correct locations. Identical type of extinguishers shall be of same make and shall have similar method of operation.

ABC Type Fire Extinguishers :

- a) Code : IS : 15683
- b) Capacity : 4.5 Kg
- c) Body : Material – MS sheet, MIG

Weld Minimum Thickness – 2mm

- d) Valve : Brass Forging – IS :

6912 Threads conf : IS : 2643

Handle – MS, Epoxy coated upper & lower level for squeezing.

- e) Pressure Gauge : Brass Shell, Nickel plate d, water proof
- f) O' Ring Washer : Rubber IS : 5382
- g) Spindle : Brass – IS : 319
- h) Spring : Carbon Steel – IS : 4454

i) Siphon Tube : Outer dia (nominal) – 16 mm

Inner dia (nominal) – 12 mm Length – (nominal) – 350 mm

j) Discharge Hose : Braided Rubber

Length (nominal) – 500 mm Internal Dia (nominal) – 10 mm Bursting

Pressure – 50 Kg/cm²

k) Charge : Mono ammonium phosphate base

dry Chemical powder (IS 14609) Weight – 5 Kg \pm 2%

Propellant gas – Nitrogen Working Pressure – 15 Kg/cm²

l) Performance : Discharge – Duration – 15-20 Seconds
Jet throw – minimum 4 mtrs Minimum %age discharge – 85%

Water CO₂ Type Extinguisher :

- a) Code : IS : 15683
- b) Capacity : 9.0 ltrs
- c) Body : 4 mm skin thickness, CRCA sheet, IS : 513
- d) Cap : Brass Forged
- e) Treatment : Anti-corrosive, body coated with epoxy powder coating/phosphating
- f) Hydraulic test : 30 Kg/cm²
- g) Charge : Water and CO₂ cartridge fixed inside Cylinder (120 Gms)
- h) Finish : Fire red Epoxy polyester powder coating
- i) Accessories : Wall mounting brackets
- j) Jet Range : 6mtrs
- k) Minimum Discharge : 95%
- l) Discharge time : 60-120 Seconds.
- m) Empty Weight : 5.5 Kg
- n) Full Weight : 14.5 Kg

Carbon-Die-Oxide/ Clean Agent type Fire Extinguisher :

- a) Code : IS : 15683
 - b) Capacity : 4.5 Kg
 - c) Body : Material–Manganese, seamless tube conforming IS : 7285
- Over all length (nominal) – 620 mm Outer Dia (Nominal) – 140 mm Wall Thickness (Nominal) – 4.5 mm Base Thickness – 12-16 mm
Mass Empty (Nominal) – 11.3 Kg Full Weight – 18.4 Kg
- d) Testing Pressure : 250 Kg/cm²
 - e) Working Pressure : 150 Kg.cm² at 15°C
 - f) Neck Ring : Threads – As per IS : 3224 Type – Wheel Type
 - g) Valve : As per IS : 3224 : 2002
Working pressure – 158 Kg/cm²
 - h) Hose : Internal dia – 10 mm Length – 1 mtr
Working Pressure – 140 Kg/cm² Bursting Pressure – 275 Kg/cm²
 - i) Discharge Tube : MS, Swivel joint type with rubber cover Rotation – 360°
 - j) Discharge Horn : Property – Non Conductive
Material – Fiber Glass/Polythene Length – 250 mm
Internal dia at discharge – 62 mm
- k) Charge : Carbon Dioxide confirms IS : 15222 Filling Ratio – 0.667
- Outer dia – 19 mm Inner dia – 9 mm Thickness – 3 mm
- m) Painting : Fire Red
 - n) Maintenance : As per IS : 2190
 - o) Siphon Tube : Brass – IS : 407
 - p) Performance : Discharge Duration – 10 – 18 Seconds

Minimum %age of discharge-95.

Measurement and rates:

Fire extinguishers shall be measured by numbers and shall include full charge of extinguishing agent, installation and all items necessary and required and given in the specifications.

ELECTRICAL INSTALLATION:

GENERAL:

Work shall be carried out in accordance with the specifications, Indian Electricity Act 1910 as amended upto date, and rules and regulations of local electricity authority and Indian Standard Code of practice No. IS: 732-1963 (revised).

MV SWITCHGEARS/PANELS/SUB-PANELS/DISTRIBUTION BOARDS:

System Rating:

All the Main MV switchgears/Panels/Motor control centres shall be suitable for operation on three phase/ single phase, 415/230 volts, 50 Hz neutral solidly grounded at transformer and short circuit level not less than 50 kA /35 kA at 415 Volts.

The Distribution boards shall be designed to withstand heaviest condition at site, with maximum expected ambient temperature of 45 degree Celsius, 80 percent humidity and dusty weather.

Standards And Codes:

The Distribution boards shall comply with the latest edition of relevant Indian Standards and Indian Electricity Rules and Regulations. The following Indian Standards shall be complied with :

IS 1394 - L.V. switchgear and control gear Part-I Part I -1993
Generalrules.

IS 5578-85 Guide for marking of insulated conductors.

IS 11353-85 Guide for uniform system of marking and identification of conductors and apparatus terminals.

IS 2147-62 Degree of protection provided by enclosures for low voltage switch gear and control gears.

IS: 2675-83 Enclosed distribution fuse boards and cutouts for
Voltages not exceeding 1000 V.

IS 2551-82 Danger notice plates.

IS 13947-1993 Circuit breakers.(Part-II)

IS 13947-1993 Switches, Disconnectors, switch disconnector (Part-III) and
Fuse combination units.

IS 1818-72 Alternating current isolators (disconnectors) and earthing switches.

IS 8623-77 Factory built assemblies of switchgear and control gear for voltages upto and including 1000 V AC & 1200 V DC.

IS 8828 Miniature air break circuit breakers for voltages not exceeding 1000 V.

IS 9926 Fuse wires used in rewirable type Electric fuses upto 650 Volts.

IS 2208 HRC fuse links IS 2705 (Part- I, II & III)

Current Transformers IS 3156 (Part- I, II & III) Voltage

Transformers IS 1248 Indicating Instruments

IS 13947-93 (Part - 5) Control devices and switching elements. Section- 1

IS 13947-93 (Part - 4) Contactors and motor starter section 1 Section- 1 Electromechanical.

IS 3231 Relays

IS 375 Marking and arrangement of bus-bars Indian Electricity Act and Rules.

Shop Drawings:

Prior to fabrication of the Switchgears, Distribution boards, the contractor shall submit for PMC's Engineer In-charge for approval of the shop/ vendor drawing, and design calculations, indicating type, size, short circuit rating of all the electrical components used, details & schedule of components & model Nos. type, rating etc., busbar size, internal wiring size, Distribution board dimension, colour, mounting detail etc., The contractor shall submit manufacturer's catalogues of the electrical components installed in the distribution.

Inspection:

At all reasonable times during production and prior to transport of the distribution boards to site, the contractor shall arrange and provide all the facilities at their plant for inspection by PMC's Engineer In-charge.

Test Certificates:

Testing of Distribution boards shall be carried out at factory and or at site as specified in Indian Standards in the presence of PMC's Engineer In-charge .The test results shall be recorded on prescribed forms. The test certificates for the test carried out at factory or at site shall be submitted in six copies to the PMC's Engineer In-charge for approval.

CONSTRUCTION FEATURES:

The power supply and control panel shall be metal enclosed sheet steel cubical indoor type, dead front, floor mounting/wall mounting type. The panel shall be totally enclosed, completely dust and vermin proof, Gaskets between all adjacent units and beneath and all covers shall be provided to render the joints dust proof. These Panels shall be arranged in multitier formations. All doors and covers shall be lockable.

All mild steel sheets used in the construction of panels shall be 2mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all slag ground off and welding pits wiped smooth with plumber metal.

All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with check nuts. Self threading screws shall not be used in the construction of control panels. Base channel shall of 75mm x 75mm x 5mm thick shall be provided at the bottom. Minimum clear space of 200mm between the floor of panel and bottom most units shall be provided.

The panels shall be of adequate size with a provision of 25% spare space to accommodate possible future additional switchgear. Knockout holes of appropriate size and number shall be provided in the control panels in conformity with the location of incoming and outgoing conduits/cables, all equipment such as meters and indicating lamps, etc shall be located adjacent to the unit with which it is associated and care shall be taken to achieve a neat and symmetrical arrangement. Facility shall be provided for termination of cables from both above and below the control panel. Where cables enter below, cables boxes shall be fitted at the rear and arranged in tiers to facilitate making connections to the upper and lower units. Clamps shall be provided to support the weight of the cables. All incoming and outgoing feeders shall be brought out to a terminal block of adequate size at suitable location inside the control panel. All wiring inside the control panel shall be colour coded and labelled with approved plastic beads for identification. Circuit diagrams showing the arrangement of circuits shall be pasted on the inside of the panel door and covered with transparent plastic sheet and all labeling shall be provided on the front face of the panel board.

Circuit Compartments:

Each circuit breaker, contactor and relay shall be housed in a separate compartment and shall be enclosed on all sides. Sheet steel hinged lockable door shall be duly interlocked with the breaker in the 'ON' position. Safety interlocks shall be provided to prevent the breaker or Contactor from being drawn out when the breaker is in ON position. Instruments and indicating lamps shall not

be mounted on the panel compartment door. Sheet steel barriers shall be provided between the tiers in a vertical section.

Instrument Compartment:

Separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control fuses etc. These shall be accessible for testing and maintenance without any danger of accident contact with live parts of the circuit breaker and bus bar.

Bus Bars and Bus Bar Connection:

The bus bar and interconnections shall be of aluminium and of rectangular cross sections suitable for full load current for phase bus bars and half rated current for neutral bus bars and shall be extensible on either side. The bars and interconnections shall be insulated with PVC sleeve tapes and colour coded. All bus bars shall be supported on unbreakable, non-hygroscopic insulated supports at regular intervals, to withstand the forces arising in case of short circuit in the system. Bus bars shall be provided in separate chamber main control panels shall be done by clamping, no holes shall be drilled in bus bars. If holes have to be drilled for making connections, extra cross section of busbars shall be provided.

All bus bar connections in smaller control panels shall be done by drilling hole and connecting by brass bolts and nuts. Additional cross section of bus bars shall be provided in small control panels to cover up the holes drilled in the bus bars.

All connections between the bus bar and breaker and between breaker and contactor, shall be through aluminium strips of proper size to carry full rated current and shall be insulated with PVC sleeves.

Terminals:

The outgoing terminals and neutral links shall be brought out to a terminal block suitably located in the control panels. The current transformer for instruments, metering and for protection shall be mounted on the bus bars. Separate cable compartment shall be provided for incoming and outgoing cables.

Wire Ways:

A horizontal wire way screwed covers shall be provided at the top to take in the connecting control wiring different vertical sections.

Cable Compartments:

Cable compartments of adequate size shall be provided in the control panels for easy termination of all incoming and outgoing cables entering from bottom or top. Adequate and proper supports shall be provided in cable compartments to support cables. All incoming and outgoing terminals shall be brought out to terminal blocks in the cable compartment.

Materials:

All materials shall be of the best quality complying with the appropriate Indian Standard specifications, Materials used shall be subject to the approval of the PMC's Engineer In-charge and sample of the same shall be furnished where required.

Moulded case circuit Breaker (MCCB):-

MCCBs shall satisfy the requirements of IS-2516 and shall be of current limiting type. MCCB shall provide type 'C' protection to the contactors as per IEC 158-1B. MCCBs shall be quick make, quick break, independent manual type with trip free feature with mechanical ON, OFF, and TRIP indications. A trip button shall be provided for tripping the breaker.

Rotary Switches:

Switches upto 60 amps shall be rotary type with compact and robust construction, built up from one or more stacks with contacts and a positioning mechanism, with stop as required. The terminals shall be shrouded with insulation to prevent accidental contact with live parts. Rotary switches shall be backed up with moulded type HRC fuse fittings of appropriate rating.

Selector Switch:

When called for, selector switches of rated capacity shall be provided in control panels, to give the choice of operating equipment in selective mode.

Switches:

Switches beyond 60 amps shall be panel mounted double break type and suitable for load break duty, quick make and break action, manufactured in accordance with IS: 4047 - 1967. Switch contacts shall be silver plated and shall be backed up with HRC fuses of appropriate rating. The switch handles shall be located at the front.

HRC Fuses:

Fuses shall be high Rupturing capacity and shall be in accordance with IS: 3208 - 1962 and having rupturing capacity of not less than 20 MVA at 415 volts. The back up fuse rating of each motor/heater/equipment shall be so chosen that the fuse does not operate on starting of motor/heater/equipment. Fuses shall be of the same make as the switches.

Starters:

Each motor shall be provided with a starter of suitable rating. Starter shall be in accordance with IS: 1822 - 1967. Direct on line starters shall be provided for motors.

All starters shall have auxiliary contacts for inter locking, control & indication. Starters (contactors) shall have 3 main and 4 auxiliary contacts and shall be air break type suitable for making and breaking contact a minimum power factor of 0.35. For design consideration of contactors, the starting current of connected motor shall be assumed to be 6 times the full load current of the motor in case of direct-on-line starters and 3 times the full load current of the motor in case of star delta/reduces Voltage starters. In case of soft starters the current shall be limited to 1.8 times.

Main and auxiliary contacts shall be silver or silver alloy. The insulation for contactor coils shall be of class "E". Operating coils of contactors shall be suitable for $230 \pm 10\%$ volts AC, 50 cycles supply system. The contactor shall drop out when voltage drops to 90% of the rated voltage. The housing of the contactors shall be heat resistant and having high impact strength. Each starter shall have thermal overload protection on all three phases.

Over Load Relays:

Contactors shall be provided with a three element, positive acting ambient temperature compensated time lagged hand-reset/self reset type thermal over load relay with adjustable setting. Hand reset button shall be flush with the front door for resetting with starter compartment door closed, Relays shall be directly connected for motors below

35 HP capacity. C.T. operated relays shall be provided for motors above 35 HP capacity. Heater circuit contactors may not be provided with overload relays.

Current Transformers:

Current Transformer shall be of minimum accuracy class 1.5 and suitable VA burden for operation for the connected meters and relays.

Single Phase Preventers:

Single phase preventers shall be provided as per schedule of quantities and shall be in conformity with relevant ISI standards. Single phase preventers shall act when the supply voltage drops down to 90% of the rated voltage or on failure of one or more phases.

Time Delay Relays:

Time delay relays shall be adjustable type with time delay adjustment from 0-180 seconds and shall have one no. auxiliary contacts for indicating lamp connection.

Indicating Lamp and Metering:

All meters and indicating lamps shall be in accordance with the relevant ISS. The meters shall be flush mounted and draw out type. The indicating lamp shall be neon type and of low burden. Each main panel shall be provided with operated ammeter of suitable range with three Nos. CTs of suitable ratio with three way and off selector switch, phase indicating lamps, and other indicating lamps as called for. Each phase indicating lamp shall be backed up with 5 amps fuse and toggle switch. Other indicating lamps shall be backed up with fuses as called for.

Toggle Switch:

Toggle switches, where called for, shall be in conformity with IS: 3854-1969 and shall be of 5 Amps rating.

Push Button Stations:

Push button station shall be for manual starting and stopping of motors/equipment as called for. Red and Green colour push buttons shall be provided for starting and stopping operations. Start or stop indicating flaps shall be provided for push buttons. Push buttons shall be suitable for panel mounting/projection mounting and accessible from front without opening door, lock lever shall be provided for stop push button. One set of normally open and one set of normally closed contacts shall be provided in push button stations. The push buttons contacts shall be suitable for 15 Amps current capacity.

CABLING/WIRING SYSTEM :

All power cabling shall be carried out with 650/1100 volt grade PVC insulated PVC sheathed, armoured, aluminium conductor cables laid on the cable tray/racks/pipes. Cables shall be sized for starting current and by applying proper derating factor. All control wiring shall be carried out by using 650/1100 volts PVC insulated copper conductor wires in wire ways or in conduit. Minimum size of control wiring shall be 1.5 sq.mm. Wherever control wiring in the Scope of AC contractor has to be done in conduits (exposed or concealed) no additional cost for conduiting shall be paid.

CABLE LAYING:

Cable shall be laid generally in accordance with Indian Standard Code of practice. Cable shall be laid on 2 mm thick perforated M.S. sheet cable trays as approved by the PMC's Engineer In-charge. Easy access to all cables shall be provided to allow cable withdrawal/replacement in the future. Where more than one cable is running, proper spacing shall be provided to minimise the loss in current carrying capacity.

Cable shall be suitably supported with wooden cleats when run on wall/floor ducts. When buried, they shall be covered with a layer of fine sand and protected with cement concrete tiles bricks. Special care shall be taken to ensure that the cable are not damaged at bends. The radius of bend of the cables when installed shall not be less than 12 times the diameter of the cable.

CABLE/WIRE/STARTER SIZES:

For all single phase/3 phase wiring, 650/1100 volts grade PVC insulated copper conductor wires shall be used. The equipment inside plant room shall be connected to the control panel by means of insulated aluminium conductor wires of adequate size in exposed conduits. Final connections to the equipment shall be through wiring enclosed in M.S. flexible conduits rigidly clamped at both ends.

An isolator shall be provided near each motor/equipment wherever the motor/equipment is separated from the supply panel through a partition barrier or through ceiling construction. PVC insulated single strand aluminium conductor wires shall be used inside the control panel for connecting different components and all the wires inside the control panel shall be neatly dressed and plastic beads shall be provided at both ends for easy identification.

- a) The minimum size of control wiring shall be 1.5 sq.mm. PVC insulated stranded soft drawn copper conductor wires drawn through conduit to be provided for connecting equipment and control panels.
- b) All the switches, conductors, push buttons stations, indicating lamps shall be distinctly marked with a small description of the service installed. Circuit wiring diagram of control panel shall be fixed to the cover of control panel for verification.

EARTHING:

Shall be carried out with galvanised Iron Strips/wires, or copper strips /wires as specified below:

a) G.I. Earthing:

The main panel shall be connected to the main earthing system of the building by means of 32mm x 6mm GI strips. All single phase metal clad switches and control panels shall be earthed with minimum 3mm diameter GI conductor wire. All 3 phase motors and equipment shall be earthed with two numbers distinct and independent GI wires/tapes as follows:

- | | |
|--|---------------------------|
| i. Motors upto and including wires including 10 HP rating. | 2 Nos. 4mm dia GI |
| ii. Motors 12.5 HP to 40 HP capacity. | 2 Nos. 6mm dia GI wires |
| iii.i Motors 50 to 75 HP capacity. | 2 Nos. 25 x 3mm GI strips |
| v. Motor above 75 HP | 2 Nos. 25 x 6mm GI strips |

All the switches shall be earthed with two numbers distinct and independent GI wires/tapes as follows:

- | | |
|---|-------------------|
| i. 3 phase switches and control wires panels upto 60 Amps rating. | 2 Nos. 4mm dia GI |
|---|-------------------|
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- | | | |
|--|--------------------------------|------------------|
| ii. 3-phase switches and control panel wires 63 Amps to 100 Amps rating. | Nos. 8mm dia GI | |
| iii. 3 phase switches and control panels tapes. 125 Amps to 200 Amps rating. | 2 Nos. 25 x 3mm GI | |
| iv. 3 phase switches and Control panels, Amps rating. | 2 Nos. 25mm x 6mm GI bus ducts | above 200 tapes. |

DRAWINGS:

Shop drawings for control panels and wiring of equipment showing the route of conduit/cable shall be submitted by the electrical contractor for approval of PMC's Engineer In-charge before starting the fabrication of panel and starting the work. The Fire Fighting contractor shall co-ordinate, interact and furnish necessary engineering information of the motor thermal curves, starting time, requirement of protection & interlocking & other miscellaneous requirement so that same can be incorporated before manufacture is taken up. On completion, four sets of completion "As-installed" drawings incorporating all details like, conduit routes, number of wires in conduit, location of panels, switches, junction/pull and cable route etc. shall be furnished by the Contractor.

TESTING:

Before commissioning of the equipment, the entire electrical installation shall be tested in accordance with Code of practice IS: 732-1963 (Revised) & Indian Electricity Rule and test report furnished by a qualified and authorised person. The entire electrical installation shall be got approved by Electrical Inspector and a certificate from Electrical Inspector shall be submitted. All tests shall be carried out in the presence of Owner/his authorised representative. At the completion of the works, the entire installation shall be subject to following tests:-

- a) Wiring continuity checks with respect to approved wiring diagram.
- b) Insulation resistance test with 500V megger between phase to phase and phase to earth.
- c) Earth continuity test.
- d) Electrical current readings in Amps of full & average load running and starting together with name plate current of each electrical motor.
- e) Operating tests on all protective relays to prove their correct operation before energizing the main equipment including secondary injection test at site.
- f) Operating tests on all starters, circuit breakers etc.

All tested and calibrated equipments for testing, labour, materials and incidentals necessary to conduct the above tests shall be provided by the contractor at his own cost.

PAINTING:

All sheet steel work shall undergo a process of degreasing, through cleaning, and painting with a high corrosion resistant primer. All panels shall then be backed in an over the finishing treatment shall be by application of synthetic enamel paint of approved shade. The panels in the erection scope of Fire Fighting contractor shall be given 2 coats of suitable paint of approved colour when all work has been completed. Various feeder & panel name shall be painted with approved colour as per the single line diagram details.

PRECOMMISSIONING :

On completion of the installation of all pumps, piping, valves, pipe connections, and water level controlling devices the contractor shall proceed as follows :-

Electrical works:

The following tests shall be carried out on the MCC:

- a) Insulation resistance test with 500 V megger, before and after high voltage test, on all power and control wiring.
- b) High voltage test at 2000 V AC for one minute on all power and control wiring.
- c) Low Voltage continuity test (6 V) on power wiring of each feeder, between bus bars and the outgoing terminals with switches and contactors in closed position.
- d) Low voltage continuity test (6 V) on all control wiring.
- e) 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 contactors shall be checked for the presence of humming and chattering.
- f) Earth continuity test with voltage not exceeding 6 V between various non-current carrying metallic parts of equipment, steel work etc. and the earth bus provided in the MCC.
- g) Operation of all instruments and meters provided on the MCC.

Pipe Works :

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

Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specification. If any leakage is found, rectify the same and retest the pipes.

Fire Protection System :

Check all hydrant valves by opening and closing any valve found to be open shall be closed.

Check all the piping under hydro test.

Check that all suction and delivery connections are properly made for all pump sets.

Check rotation of each motor after decoupling and correct the same if required.

Test run each pump set.

All pump sets shall be run continuously for 8 hours (if required with temporary piping back to the tank).

COMMISSIONING & TESTING :

Hydrant System

Pressurise the fire hydrant system by running the main fire pump and after attaining the required pressure shut off the pump.

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

Open hydrant 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 pre-set pressure and should not cutout 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. Switch off the main fire pump and test check the diesel engine driven pump in the same manner as the electrically driven pump.

When the fire pumps have been checked for satisfactory working on automatic controls, open fire hydrant valves simultaneously and allow the hose pipes 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.

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.

Sprinkler System:

Start the sprinkler pump and develop the required pressure in the sprinkler pipes.

Open the test valve to test the automatic starting of the pump. If necessary, make necessary adjustments in the setting of pressure switch. The sprinkler installation valve and associated water-gong alarm shall also operate when the test valve is open. This operation is to be done for each and every section of the sprinkler system and the alarm for each section (via flow switch) shall be checked for operation.

After satisfactory operation of the pump the Contractor shall set up mock fire and test the system.

Check all annunciations by simulating the alarm conditions at site.

HANDING OVER :

All commissioning and testing shall be done by the contractor to the complete satisfaction of the Project Manager, and the job handed over to the Project Manager, or his authorized representative.

Contractor shall also handover, to the Project Manager, all maintenance & operation manuals and all other items as per the terms of the contract.

GUARANTEE:

The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.

The form of warranty shall be as approved by the Project Manager.

The warranty shall be valid for a period of one year from the date of commissioning and handing over.

The warranty shall expressly include replacement of all defective or under capacity equipment. Project Manager may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.

The warranty shall include replacement of any equipment found to have capacity lesser than the rated capacity as accepted in the contract. The replacement equipment shall be approved by the Project Manager.

QUALITY ASSURANCE AND QUALITY CONTROL

The work shall conform to high standards of design and workmanship, shall be structurally sound and aesthetically pleasing quality standards prescribed shall form the backbone for the quality assurance and quality control system.

At the site level the Contractor shall arrange the materials, their stacking/storage in appropriate manner to ensure the quality. Contractor shall provide equipment and manpower to test continuously the quality of materials, assemblies etc. as directed by the PMC's Engineer in- Charge. The test shall be conducted continuously and the result of tests maintained. In addition the Contractor shall keep appropriate tools and equipment for checking alignments, levels, slopes and evenness of surface.

The PMC's Engineer in-Charge shall be free to carry out tests as may be considered necessary by him at his sole discretion, from time to time, in addition to those specified in this document. The Contractor shall provide the samples and labour for collecting the samples nothing extra shall be payable to the Contractor for samples or for the collection of the samples.

The test shall be conducted at the site laboratory that may be established by PMC's Engineer in-Charge or at any other standard Laboratory selected by PMC's Engineer in-Charge.

The contractor shall transport the samples to the laboratory for which nothing extra shall be payable. In the event of Contractor failing to arrange transportation of the samples in proper time PMC's Engineer in-Charge shall have them transported and recover two times the actual cost from the Contractor's bills.

Testing charges shall be borne by the PMC's Engineer in-Charge.

Testing may be witnessed by the Contractor or his authorized representative. Whether witnessed by the Contractor or not, the test results shall be binding on the Contractor.