



FIRE FIGHTING AND FIRE ALARM DBR

VOL -VI

CONSTRUCTION OF PROPOSED CENTRE OF
EXCELLENCE OF FIRE TESTING TRAINING AND
RESEARCH LABORATORY AT IIT, PATNA

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A. FIRE FIGHTING SYSTEM

1. SCOPE

This specification covers design, engineering, supply, delivery, erection, testing and commissioning of fire protection and firefighting system for equipment. The system design and equipment shall conform in all respects to high standard of engineering, design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the owner.

The system planning and design shall be done keeping in view of the following criteria –

Live Fire testing and training facility to be designed as per the fire rating of 4 hours and the specifications and designing criteria to be followed as per the NBC clause – 4.1.

All fire equipment and firefighting systems for the live fire testing and training facility shall be designed on the building's outer façade, with appropriate provisions to extend hose reels from the exterior into the interior rooms during fire scenarios.

- a. National Building Code 2016: Fire and Lift Safety.
 - b. Local Byelaws
 - c. NFPA and TAC Manuals
 - d. Consultation with local Chief Officer
 - e. Relevant BIS Code as per Annexure.
1. The scope of work include complete earthwork (i.e. excavation, back filling etc.) for the entire piping (underground & overhead) for the system, valve pits and pipe/support structures for buried, entrenched and over ground piping.
 2. The equipment offered shall comply with the relevant Indian Standards and shall meet the requirement called for in the latest revision of relevant Indian Standard at the time of tendering.
 3. Ambient temperature for design of all equipment shall be considered as 50°C.
 4. The Contractor shall prepare detailed layout and piping drawing based on this technical specification and approved layout drawing.

5. Detailed layout and piping drawing shall be made with future extension prospective and it should not be obstruct other firefighting accessories under the present scope of work.
6. Fire Notice for Fire Fighting and evacuation from the building shall be prepared and to be displayed at all vulnerable places of building.
7. First Aid Fire Fighting arrangement in the style of placing suitable type of portable Fire Extinguishers, Fire Buckets etc. in all floors and vulnerable location of the premises shall be made in accordance with IS: 2190 – 1992.
8. EPC Contractor needs to get NOC from Fire State Department and all the firefighting safety needs to be in accordance to the Fire Department requirement.

2. NBC Requirement

The proposed Live Fire Testing & Training Facility including the High-Temperature Material Testing & Simulation Lab and the Large-Scale Fire Testing Laboratory is classified under special industrial building occupancy as per NBC Part IV (2016). Accordingly, the design incorporates robust firefighting systems, fire detection, and emergency response provisions to ensure compliance with statutory norms, safety of personnel, and effective control of large-scale fire scenarios.

- **Firefighting Equipment & External Façade Provision- Live Fire Testing and Training Facility**
 - a. Firefighting equipment, control panels, and hose reels are proposed along the **external façade** of the facility.
 - b. A **dedicated fire control panel** will be installed **outside the Live Fire Testing & Training Facility** for quick access by emergency responders.
 - c. Design complies with **NBC Part IV, Clause 3.4 & Clause 5.1** and **IS 3844:1989** (Installation of Internal Fire Hydrants & Hose Reels).
 - d. **External hydrants** shall be installed as per **IS 13039:1991**, ensuring adequate coverage for mass fire control.

- **High-Temperature Material Testing & Simulation Lab**
 - a. Recognized as a **special hazard area** under **NBC Part IV, Clause 4.1**.
 - b. Equipped with:
 - c. **Automatic suppression systems** (foam/gas flooding/water mist depending on test configuration).
 - d. **Fire detection & alarm system** as per **IS 2189:2008**.
 - e. **Heat and smoke detectors** with response tied to the fire alarm control panel.
 - f. Compliance with **IS 15301:2003** (Fixed Firefighting Installations for Special Hazards).
- **Large-Scale Fire Testing Laboratory**
 - a. **Categorized under NBC Part IV, Clause 4.1 & Clause 5.1.3 for large-scale testing hazards.**
 - b. **Fire protection systems include:**
 - c. **Automatic sprinklers as per IS 15105:2002 (Water Mist System) or IS 15104:2002 (Foam System), selected based on material fire load.**
 - d. **Compartmentalization with fire-rated walls and enclosures (120–240 minutes as per IS 1641/42/43).**
 - e. **Emergency control provisions as per NBC Clause 7.1, including remote shutdown and monitoring.**
- **Fire Detection, Alarm & Control Room**
 - a. **A fire control room will be provided in accordance with NBC Clause 7.1.2.**
 - b. **It shall include:**
 - i. **Main fire alarm panel (IS 2189:2008 compliant).**
 - ii. **Public Address (PA) system for emergency communication.**
 - iii. **Emergency power back-up to maintain functionality during fire scenarios.**
 - iv. **Monitoring of all detectors, suppression systems, and hydrants.**
- **General Building Fire Safety Provisions**
 - a. **Means of Egress:** Designed as per **NBC Clause 3.1.4**, with adequate staircases and exit routes.

- b. **Fire Doors:** Installed as per **IS 3614:1992** with 120–180 minutes fire rating.
- c. **Electrical Safety:** All installations as per **IS 1646:2017** (Fire Safety of Buildings – Electrical Installations).
- d. **Smoke & Heat Ventilation:** Natural and mechanical ventilation systems to exhaust smoke and maintain tenable conditions.
- e. **Fire Compartmentation:** All laboratories and testing bays separated with fire-rated walls (NBC Clause 6.1).

3. STANDARDS

Sl.No.	Code	Description
1	IS:1646	Code of practice for fire safety of buildings (General: electrical installation)
2	IS :1647	Code of practice for fire fighting of buildings
3	IS:1648	Code of practice for fire fighting of buildings, fire fighting equipment and its maintenance.
4	IS:2189	Code of practice for erection, installation and maintenance of automatic fire detection and alarm.
5	IS:2190	Selection, installation and maintenance of first aid fire extinguisher code of practice.
6	IS : 1641/42/43	<i>Code of Practice for Fire Safety of Buildings (General): General Principles of Fire Grading and Classification</i>
7	IS 195	<i>Methods for Fire Tests of Building Materials</i>
8	IS 3809	<i>Fire Resistance Test for Electric Cables</i>
9	IS 17044	<i>Specification for Fire Retardant Coatings</i>
10	Tariff Advisory Committee Manual.	
11	National Fire Protection Authority of America Manual.	
12	Consultation with Local Fire Officer	

4. TECHNICAL SPECIFICATION

Work under this sub-head consists of furnishing all Labour, Materials, equipment and accessories necessary and required to completely install the Fire Fighting equipment etc.,

specified hereinafter and given in the Without restricting to the generality of the foregoing the work of Fire Fighting System shall include the followings:

- Providing G.I pipe line main including Valves, Fire Hydrants, Excavation for Pipe, Laying of pipe, Painting of pipe and Making Connection to supply system.
- G.I Pipe, Mains Laterals, Branches, Valves, Hangers and Appurtenances.
- Hose Reels, Rubberized fabric lined hose pipes, Hose cabinets, Sprinkler heads and Landing Valves.
- Portable Fire Extinguishers (ABC & Carbon dioxide type) and Foam Type. Clean agent in Record Room and Gas suppression system in server room must be incorporated.
- Fire Fighting Pumps, diesel operated pumps, panels and all connected accessories including suction & delivery pipes.
- Testing Commissioning and giving live demonstrations to the various Inspection Authorities and Obtain their “No Objection Certificate” (NOC) for occupation of the building.

5. GENERAL REQUIREMENTS

All materials shall be of the best quality conforming to the Specifications and subject to the approval of the Engineer-in-Charge.

Pipes and Fittings shall be fixed truly Vertical, Horizontal or in slopes as required in a neat workman like manner.

Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause any obstruction in shaft, passage etc.

Pipes shall be securely fixed to walls and ceiling by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceilings.

Valves and other appurtenance shall be so located that they are easily accessible for operation, repairs and maintenance.

6. PIPES

Providing, laying, testing & commissioning of IS 1239 marked Galvanised iron pipe including all fittings i.e bend, elbows, tees, flanges, reducing socket, nuts and bolts, gaskets etc fixed with welded / screwed joints. including necessary excavation, backfilling, removal of surplus soil etc. min. 1 mtr deep excavation and wrapping with anticorrosive treatment with 4 mm thick asphalt tape as per IS:10221, refilling the trench etc. OR fixed with screwed or welded joints, hanged with clamps, hanger supports S Galvanised, dash fasteners, bolts, nuts, rubber insertions etc including threading, cutting, welding, edge preparation, painting of approved colour over two coat of primer, cutting & making good the wall/ floor wherever required, complete as required or as directed by engineer in charge. All fasteners support system selected should be such they can handle the full water pressure during the case of fire.

7. PIPE FITTINGS

Pipes and fittings include tees, elbows, couplings, flanges, reducers, and other connecting devices required to finish the piping work. Fabricated fittings are not permitted for pipe sizes of 50 mm or less. When used, they must be manufactured, welded, and inspected in workshops under the supervision of an Engineer-in-Charge whose welding techniques have been certified by the TAC in accordance with TAC rule 4102 for sprinkler systems and applicable to hydrants and sprinkler systems. Pipes must be bored and reamed before making "T" connections. Cutting with gas or electrical welding is not permitted.

8. JOINTING

Joint for black steel pipes and fittings shall be metal-to-metal thread joints. A small amount of red lead may be used for lubrication and rust prevention. Joints shall not be welded or caulked. (With screwed MS forged fittings).

8.1. Welding (65 mm dia and above)

Joints between MS pipes and fittings shall be made with the pipes and fittings having "V" groove and welded with electrical resistance welding in an approved manner. Buried pipes will be subject to X Ray test from an approved agency as per the TAC norms at the cost of contractor. (With welded M.S. fittings heavy class with V-Groove). The welding machine shall be 3 Phase rectifier of required current and capacity. The vendor for welding will be approved by Engineer-in-Charge.

8.2. Flanges

Flanged joints shall be provided on:

- Straight runs not exceeding 30 m on pipelines 80 mm dia and above.
- Both ends of any fabricated fittings e.g. bends, tees etc. of 65 mm dia or larger diameter.
- For jointing all types of valves, appurtenances, pumps, connections with other type of pipes, to water tanks and other places necessary and required as good for engineering practice.
- Flanges shall be as per IS 6392-1971, Table 17/18 with appropriate number of G.I. nuts and bolts, half threaded of with 3 mm insertion neoprene gasket complete.

8.3. Unions

Provide Approved type of dismountable unions on pipes lines 65 mm and below in similar places as specified for flanges shall be provided.

9. PIPE PROTECTION

All pipes above ground and in exposed locations shall be painted with one coat of Red Oxide Primer and two or more coats of Synthetic Enamel Paint of approved shade. All black steel pipes under floors or below ground shall be provided with protection against corrosion by application of 100mm wide and 4mm thick layer of PYPKOTE/ MAKPOLYKOTE over the pipe, as per manufacturers specifications.

10. PIPE SUPPORTS

All pipes shall be adequately supported from ceiling or walls from existing/new inserts by Structural clamps fabricated from M.S. Structural e.g. Rods, Channels, Angles and Flats as per details given in drawings and specifications. All clamps shall be painted with one coat of red lead and two coats of black Enamel paint. Where inserts are not provided, the Contractor shall provide anchor fasteners. Anchor fastener shall be fixed to walls and ceilings by drilling holes with Electrical drill in an approved manner as recommended by the manufacturer of the fasteners.

11. TESTING

All pipes in the system shall be tested to a hydraulic pressure of 1.5 times of the working pressure or minimum of 15 kg/cm² without drop in the pressure for at least 2 hours. Rectify all leakages, make adjustment and retest as required.\

12. ANCHOR BLOCK

Contractor shall provide suitable cement concrete, anchor blocks of ample dimensions at all bends, tee connection and other places required and necessary for overcoming pressure thrusts in pipes. Anchor blocks shall be of cement concrete 1:2:4 mixes (1 cement: 2 coarse sands: 4 stone aggregate 20 mm nominal size).

13. VALVES

Valves, Gauge and Orifice Plates Sluice Valves above 65 mm shall be of Cast Iron body and Bronze/Gunmetal seat. They shall conform to type PN 1.6 of IS:780-1980, valves up to 65mm shall be of Gunmetal Full way Valve with wheel tested to 20 kg/cm² class-II as per I.S: 778-1971. Valve wheels shall be of right hand type and have an arrow head engraved or cast thereon showing the direction for turning open and closing. Non-return valves shall be of Cast Iron body and Bronze/Gunmetal seat. They shall conform to class of IS: 5312 and have flanged ends. They shall be swing check type in horizontal runs and lift check type in vertical runs of piping. They shall not be spring-loaded type.

14. EXTERNAL YARD HYDRANTS

The Contractor shall provide External Fire Hydrant in the Ring or on External Fire Line, as per specifications and as shown in drawings. The spacing of the hydrants and the distance from the building shall be maintained as per relevant requirements of latest relevant codes, unless specified herewith. Each External Fire Hydrant shall be provided with an External Fire Hose Cabinet of M.S of size 76.8 x 61.44 x 25.80 cm, as approved by the Architect to equip 2 nos. of 63 mm dia length 15m controlled percolating hose and accessories as required. The cabinet shall be installed near the Hydrant as per details, approved by the Engineer-in-Charge / Architect.

15. INTERNAL HYDRANTS

The Internal Hydrant outlet shall comprise “Single Headed Single Outlet Gunmetal Landing Valve” conforming to type ‘A’ of IS: 5290-1977. Separate valve on the head shall form part of the landing valve construction. A cap with chain is provided on one head of the outlet. The hydrant will have an instantaneous pattern female coupling for connecting to Hose Pipe. The Landing Valve shall be fitted to a Tee connection on the wet riser at the landing.

16. FIRST-AID HOSE REEL EQUIPMEN

First aid hose reel equipment shall comprise reel, hose guide fixing bracket hose tubing globe valve, stopcock and nozzle. This shall conform to IS:884 - 1969. The hose tubing shall confirm to IS:1532- 1969. The hose tubing shall be 20 mm dia and 36.5m long. The GM nozzle 5mm and globe valve shall be of 20 mm size. The fixing bracket shall be of swinging type. Operating instructions shall be engraved on the assembly. This heavy duty mild steel and cast iron brackets shall be conforming to IS: 884 - 1969. The first-aid hose reel shall be connected directly to the MS pipe riser taken independently from ring.

17. HOSE PIPES, BRANCH PIPES AND NOZZLES

18.1. Hose Pipes

Two numbers Hose Pipes shall be rubber lined woven jacketed and 63mm in dia. 15m long. They shall confirm to type A (Reinforced rubber lined) of IS:636 - 1979. The hose shall be sufficiently flexible and capable of being rolled. Each run of hose shall be complete with necessary coupling at the ends to match with the landing valve or with another run of hose pipe or with branch pipe. The couplings shall be of instantaneous spring lock type. This shall be conforming to IS: 903.

18. BRANCH PIPE

18.1. Branch Pipes

Branch pipe shall be of Gunmetal 63 mm dia and be complete with male instantaneous spring lock type coupling for connection to the hose pipe. The branch pipe shall be externally threaded to receive the nozzle.

18.2. Nozzle

The nozzle shall be of Gunmetal 20 mm in (internal) diameter. The screw threads at the inlet connection shall match with the threading on the branch pipe. The inlet end shall have a hexagonal head to facilitate screwing of the nozzle on to the branch pipe with nozzle spanner. End Couplings, Branch pipe, and Nozzles shall conform to IS:903 - 1985. Two C.P hoses of 15m length with couplings shall be provided with each External (Yard) Hydrant. Two RRL hoses of 15m length, as specified, with couplings shall be provided with each Internal Hydrant.

One nozzle and one branch pipe with coupling shall be provided with each Yard Hydrant and Internal Hydrant.

19. HOSE CABINET

The internal hose cabinet shall accommodate the Hose pipes, branch pipe, Nozzle First aid Hose Reel and Hydrant Outlets and shall be fabricated from 2 mm thick or 14 mm gauge MS/aluminum sheet. The overall size shall be 2100x900x715 mm, or as specified in the Architectural details. This shall have lockable centre opening glazed doors as per the requirement and as per Architectural details. Where the niche for wet riser is provided with shutters, separate hose cabinet as above may be dispensed with. The hose cabinet shall be painted red and stove enameled and words FIRE written in front glazed portion.

20. FIRE BRIGADE INLET CONNECTIONS

Fire Brigade Inlet connection shall be provided near the pump house and to the wet riser system as specified, for the following purposes:

- Fire Brigade suction connection for fire static tank with provision of foot valve.
- Fire brigade inlet connection to fire static tank.
- Fire brigade inlet connection to the wet riser system. Each connection shall be provided with similar dia of Sluice valve and Non return valve.

The locations of this Fire brigade connection shall be suitably decided with the approval of Consultant/Landscape Architect and with a view that these are easily accessible to the fire brigade, without any possible Hindrance.

21. HYDRAULIC SIREN

A siren shall be provided in the system, to indicate the flow of water in the wet riser system. Alternative arrangements may also be adopted. This shall be turbine type.

22. VALVE CHAMBERS

Contractor shall provide suitable Brick Masonry Chamber in cement mortar 1:5 (1 cement: 5 coarse sand) on cement concrete foundations 150 mm thick in 1:5:10 mix (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) 15 mm thick plaster inside and outside

finished with a floating coat of neat cement inside with cast iron surface box approved by fire brigade including excavation, back filling complete.

Valve chambers shall be of following size:

- For depths 100 cm and beyond 90x90x100 cm

23. PORTABLE FIRE EXTINGUISHER

Portable fire extinguishers shall be provided as per the drawing and shall confirm to IS:2190-1979. Diesel generator shed and inflammable liquid storage areas shall be provided with foam type fire extinguisher and fire bucket.

- Two 9 lit. water CO2 type for every 600 m2 area with minimum of 1 extinguishers per floor as per IS:15683
- Dry Chemical powder type of 6 Kg. Capacity as per IS:15683
- CO2 type of 4.5 kg capacity as per IS: 15683.
- Foam type
- Clean Agent modular type extinguisher

24. SPRINKLER HEADS

Sprinkler heads shall be provided at approximate spacing to with c/c>or = 3-3.5 m area (Pendent Sprinkler) to cover 9 to 12 m2 per Sprinkler head. The spacing shall however, be in conformity with the drawings and properly coordinated with Electrical Fixtures, Ventilation Ducts and Grills and other services along the ceiling. Sprinkler heads shall be chrome finished Brass/Gunmetal with quartz bulb with a temperature rating of 68°C. Sprinkler heads shall be of type and quality approved by the local fire brigade authority. The inlet shall be screwed. Sprinkler heads shall be pendent, recessed or special application side wall Sprinkler types as shown in drawings. All Sprinklers should have the Specifications. Contractor shall supply spare Sprinkler Heads of each type as per requirement and one Spanner for each type of sprinkler neatly installed in a steel box with glass shutters at locations approved by the Engineer-in-Charge. All sprinkler system shall be designed as per IS15105:2002 and whenever required as per the guidelines of TAC and NFPA codes shall be consulted.

25. ALARM VALVE & AUTOMATIC WATER MOTOR GONG VALVE

The alarm valve & water motor gong valve UL approved shall be provided on the Sprinkler main delivery pipe complete in all respects.

26. SHOP DRAWINGS & SPECIFICATIONS

Shop drawings shall be submitted for the following conditions: • Structural supports/hanging/laying and jointing details for all types of pipes as required. • Fire Fighting layout plans as required and for any changes in the layout of Fire Fighting/Architectural drawings. The Contractor can only commence the work after the approval of above documents by Consultant

B. WATER SUPPLY/FIRE FIGHTING PUMPS & EQUIPMENTS AND WATER TREATMENT UNITS ETC.

1. PUMPS AND WATER TREATMENT EQUIPMENT

Work under this sub-head consists of furnishing all labor, materials, equipment and accessories necessary and required to completely install pumping system for various water supply services and water treatment as per drawings, specified hereinafter. Without restricting to the generality of the foregoing, the work of pumps and water treatment equipment shall include the followings:

- Raw water pumps.
- Fire pumps.
- Motor control panels, power and control cabling and allied electrical works.
- Pipes, valves, accessories, hangers, supports, delivery and suction feeders and connection to proposed pipe work.

2. PUMP SET

2.1. Water Supply Pumps

Water supply pumps shall be suitable for clean water. Pumps shall be multistage, monoblock vertical centrifugal pumps with Cast Iron body and Cast Iron impeller, stainless steel shaft and coupled to a TEFC electric motor by means of a flexible coupling. Each pump should operate a curve 10m below specified head. Pump and motor shall be mounted on a common M.S. structural base plate or as required as per site conditions. Each pump shall be provided with a totally enclosed fan cooled induction motor. Each pumping set shall be provided with a 150mm dia or of suitable size gunmetal “Burden” type pressure gauge with gunmetal isolation cock and connecting piping. Provide vibration-eliminating pads appropriate for each pump. Provide rate of flow measuring meter with bypass arrangement with every set of pumps. All water supply pumps shall be provided with mechanical seals.

3. FIRE FIGHTING PUMPS

3.1. Electrical Operated Main Fire, Sprinkler and Jockey Pumps

Pumping sets shall be single stage horizontal centrifugal single outlet with cast iron body and dynamically balanced bronze impellers. Connecting shaft shall be of stainless steel with bronze sleeve and grease-lubricated bearings.

Pumps shall be connected to the drive by means of spacer type love-joy coupling which shall be individually balanced dynamically and statically.

The coupling joining the prime mover with the pump shall be provided with a sheet metal guard.

Pumps shall be provided with approved type of mechanical seals.

Pumps shall be capable of delivering not less than 150% of the rated discharge at a head of not less than 65% of the rated head. The shut-off head shall not exceed 120% of the rated head.

The System shall meet the requirements of the National building Code 2005 (NBC).

Necessary 'Y' strainer on the suction side and pressure gauge with GM cocks on the delivery side including bypass arrangement (with 50 valve and up to 5M G.I. Medium pipes) for periodical testing of the working of the pumping set shall be provided.

Pump shall be mounted on common base frame fabricated from MS channel as per manufacturer's specification.

Suitable RCC Pump-foundations as per manufacturer's design and 4 nos. Dunlop (cushy foot) heavy duty Ant-vibration mounting pads shall be provided.

3.2. Motors for Electric Driven Pumps

Electrically driven pumps shall be provided with totally enclosed fan cooled induction motors.

Motors for fire protection pumps shall be at least equivalent to the horse power required to drive the pump at 150% of its rated discharge and shall be designed for continuous full load duty and shall be design proven in similar service.

Motors for fire pumps shall meet all requirements and specifications of the tariff advisory committee.

Motors shall be suitable for 415 volts, 3 Phase, 50 cycles A.C supply and shall be designed for 33OC ambient temperature.

Motors shall conform to I.S: 325. Motors shall be designed for two start system.

Motors shall be capable of handling the required starting torque of the pumps.

Contractor shall provide heating arrangements for the main fire pump motor to ensure that motor windings shall remain dry.

3.3. Air Vessel for Fire Pumps

Provide an air vessel fabricated from 10mm M.S. sheet with dished ends and suitable supporting legs, air vessel shall be provided with a 100mm dia flanged connection from pump, one 25mm dia drain with valve, one gunmetal water level gauge and 25mm sockets for pressure switches. The vessel shall be 450mm in dia and 2000 mm high and tested to 10.0Kg/cm² pressure.

The fire pumps shall operate on drop of 1 Kg/cm² pressure in the mains. The pump operating sequence shall be arranged in a manner to start the pump automatically but should be stopped manually by starter push buttons only.

3.4. Operating Conditions for the Service Pumps

Fire Service Pump	Nos.	Cut in Pressure	Cut Out Pressure	Remarks
Jockey pump	2	8.0 kg/cm ²	6.7 kg/cm ²	To auto start and auto stop on pressure switch on air vessel.
Main pump	2	6.2 kg/cm ²	Push button manual	To auto start on pressure switch on air vessel and manual off.
Diesel Fire Pump	2	5.7 kg/cm ²	Push button manual	To auto start on pressure switch on air vessel and manual off.
Sprinkler Pump	1	6.7 kg/cm ²	Push button manual	To auto start on pressure switch on air vessel and manual off.

4. Diesel Fire Pump

4.1. Scope

This section covers the details of requirements of the standby fire pump, operated by a diesel engine.

4.2. General

The diesel pump set shall be suitable for automatic operation, complete with necessary automatic starting gear, for starting on wet battery system and shall be complete with all accessories. Both engine and pump shall be assembled on a common bed plate, fabricated from mild steel channel.

4.3. Drive

The pump shall be only direct driven by means of a flexible coupling. Coupling guard shall also be provided. The speed shall be 1450/1800 rpm.

4.4. Fire Pump

The fire pump shall be horizontal split casing centrifugal type. It shall have a capacity to deliver 2280 lpm as specified, developing adequate head so as to ensure a minimum pressure of 3.5 Kg. per cm² at the highest and the farthest outlet. The delivery pressure at the pump outlet shall be not less than 8 Kg. per cm² in any case. The pump may be single stage or multi stage as specified. The pump shall be capable of giving a discharge of not less than 150% of the Rated discharge at a head of not less than 65% of the rated head. The shut off head shall be within 120% of the rated head. The pump casing shall be of cast iron to grade FG 200 to I.S: 210 and parts like impeller shaft sleeve, wearing-ring etc. shall be of non-corrosive metal like bronze/brass/gunmetal. The shaft shall be of stainless steel. The pump shall be provided with mechanical seal. The pump casing shall be designed to withstand 1.5 times the working pressure. Bearings of pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.

4.5. Diesel Engine

Environmental Conditions – The engine shall be required to operate under the conditions of environment as required as per site conditions.

Engine Rating - The engine shall be cold starting type without the necessity of preliminary heating of the engine cylinders or combustion chamber (for example, by wicks, cartridge, heater plugs etc). The engine shall be multi cylinder/vertical 4 stroke cycle, water cooled diesel engine, developing suitable HP at the operating speed specified to drive the fire pump. Continuous capacity available for the load shall be exclusive of the power requirement of auxiliaries of the diesel engine, and after correction for altitude, ambient temperature and humidity for the specified environmental conditions as mentioned. This shall be at least 20% greater than the maximum HP required to drive the pump at its duty point. It shall also be capable of driving the pump at 150% of the rated discharge at 65% of rated head. The engine shall be capable of continuous non-stop operation for 8 hours and at least 3000 hours of operation before major overhaul. The engine shall have 10% overload capacity for one hour in any period of 12 hours continuous run.

Engine Accessories - The engine shall be complete with the following accessories:-

- Fly sheet dynamically balanced.
- Direct coupling for pump and Coupling Guard.
- Radiator with hoses, fan, water pump, drive arrangement and guard.
- Corrosion Resister
- Air cleaner, oil bath type/dry type
- Fuel service tank support, semi-rotary pump and fuel oil filter with necessary pipe work.
- Pump for lubricating oil and lub. oil filter
- Elect. starting battery (2x12 v)
- Exhaust silencer with necessary pipe work
- Governor
- Instrument panel housing all the gauges, including Tachometer, hour meter and starting switch with key (for manual starting).
- Necessary safety controls
- Winterization arrangement, where specified.

Cooling System - The engine cooling system shall be radiator water cooled system. The radiator assembly shall be mounted on the common bed plate. The radiator fan shall be driven off the engine as its auxiliary with a multiple fan belt. When half the belts are broken, the remaining belts shall be capable of driving the fan. Cooling water shall be circulated by means of an auxiliary pump of suitable capacity driven by the engine in a closed circuit.

Fuel System - The fuel shall be gravity fed from the engine fuel tank to the engine driven fuel pump. The engine fuel tank shall be mounted either over or adjacent to the engine itself or suitably wall mounted on brackets at a height not less than 60 cm above the fuel injection pump. The fuel filter shall be suitably located to permit easy servicing. All fuel tubing to the engine shall be with copper, with flexible hose connections where required. Plastic tubing shall not be permitted. The fuel tank shall be of welded steel construction (3mm thick) and of capacity sufficient to allow the engine to run on full load for at least 8 hours. The tank shall be complete with necessary floor mounted supports, level indicator (protected against mechanical injury) inlet, outlet, overflow connections and drain plug and piping to the engine fuel tank. The outlet should be so located as to avoid entry of any sediment into the fuel line to the engine. A semi rotary hand pump for filling the daily service tank together with hose pipe 5 mtr. long with a foot valve etc. shall also form part of the scope of work.

Lubricating Oil System - Forced feed lub. oil system shall be employed for positive lubrication. Necessary lub. oil filters shall be provided, located suitably for convenient servicing. **Starting System** - The starting system shall comprise necessary batteries (2x12 v), 24 volts starter motor of adequate capacity and axle type gear to match with the toothed ring on the fly wheel. By metallic relay protection to protect starting motor from excessively long cranking runs suitably integrated with engine protection system shall be included within the scope of the work. The battery capacity shall be suitable for meeting the needs of the starting system. The battery capacity shall be adequate for 10 consecutive starts without recharging with cold engine under full compression. The scope shall cover all cabling, terminals, initial charging etc.

Exhaust System - The exhaust system shall be complete with silencer suitable for outdoor installation, and silencer piping including bends and accessories needed for a run of 5 meter from the engine manifold. (Adjustment rates for extra length shall also be given). The total back pressure shall not exceed the engine manufacturer's recommendation. The exhaust piping shall be suitably lagged.

Engine Shut Down Mechanism - This shall be manually operated and shall return automatically to the starting position after use. **Governing System** - The engine shall be provided with an adjustable governor to control the engine speed within 5% of its rated speed under all conditions of load up to full load. The governor shall be set to maintain rated pump speed at maximum pump load.

Engine Instrumentation –

- Engine instrumentation shall include the following:-
- Lubricant oil pressure gauge.
- Lubricant oil temperature gauge.
- Water pressure gauge.
- Water temperature gauge.
- Tachometer.
- Hour meter.

The instrumentation panel shall be suitably resilient mounted on the engine.

Engine Protection Devices - Following engine protection and automatic shut down facilities shall be provided: -

- Low lub. oil pressure
- High cooling water temp.
- High lub. oil temperature
- Over speed shut down.

Pipe Work - All pipe line with fittings and accessories required shall be provided for fuel oil, lub. oil and exhaust systems. Copper piping of adequate sizes shall be used for lub. oil and fuel oil. M.S. piping will be permitted for exhaust.

Anti-Vibration Mounting - Suitable vibration mounting duly approved by Engineer-in-Charge shall be employed for mounting the unit so as to minimise transmission of vibration to the structure. The isolation efficiency achievable shall be clearly indicated.

Battery Charger - Necessary float and boost charger shall be incorporated in the control section of the power and control panel, to keep the battery under trim condition. Voltmeter to indicate the state of charge of the batteries shall be provided.

5. CABLES

Contractor shall provide all power control cables (should be FRLS) from the motor control center to various motors, level controllers and other control devices.

Cables shall conform to I.S: 1554 and carry ISI mark.

Wiring cables shall conform to I.S 694.

All power and wiring cables shall be aluminum conductor PVC insulated armored and PVC sheathed of 1100 volts grade.

All control cables shall be copper conductor PVC insulated armored and PVC sheathed 1100 Volt grade.

All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer's name.

All cable joints shall be made in approved manner as per standard practice.

6. CABLE TRAYS

Contractor shall provide M.S slotted cable trays at locations. Cable trays shall be supported from the bottom of the slab at intervals of 60cms at both ends by anchor fasteners.

7. EARTHING

There shall be an independent earthing station. The earthing shall consist of an earth tape connected to an independent plate made of copper or G.I. having a conductivity of not less than 100% international standard. All electrical apparatus, cable boxes and sheath/armor clamps shall be connected to the main bar by means of branch earth connections of appropriate size. All joints in the main bar and between main bar and branch bars shall have the lapping surface properly tinned to prevent oxidation. The joints shall be riveted and sweated. Earth plates shall be buried in a pit of 1.20x1.20M at minimum depth of 3M below ground. The connections between main bar shall be made by means of three 10mm brass studs and fixed at 100mm centers. The pit shall be filled with coke breeze, rock salt and loose soil. A G.I. pipe of 20mm dia with perforations on the periphery shall be placed vertically over the plate to reach ground level for watering. A brick masonry manhole 30x30x30cm size shall be provided to surround the pipe for inspection. A bolted removable link connecting main bar outside the pit portion leading to the plates shall be accommodated in this manhole for testing.

8. CONTROL PANELS / STARTERS

Switch board cubicles of approved type shall be fabricated from 16-gauge M.S. sheet with dust and vermin proof construction. It shall be painted with powder-coated finish of approved make and shade. It shall be fitted with suitable etched plastic identification plates for each motor. The cubicle shall comprise of the followings:-

- Incoming main isolation MCCB of required capacity.
- Fully Aluminum taped Bus Bar of required capacity.
- Isolation MCCB one for each motor.
- Fully automatic as specified D.O.L/Star Delta starters suitable for motor H.P. with push buttons one for each motor and on/off indicating neon lamps. (DOL up to 7.5 HP and Star Delta from more than 7.5 H.P)
- Single phase preventer of appropriate rating for each motor.
- Panel type ampere meters one for each motor with selector switch.

- Panel type voltmeter on incoming main with rotary selector switch to read voltage between phase to neutral and phase-to-phase.
- Neon phase indicating lamps for incoming main and on/off indicating lamps for each motor.
- Rotary switch for manual or auto operation for each pump (manual/auto off).
- Fully taped separate aluminum bus bars of required capacity and with required outlets.
- Space for liquid level controllers as specified + 1 extra space.
- The panel shall be pre-wired with color-coded wiring. All interconnecting wiring from incoming main to switch gear, meters and accessories within the switchboard panel.
- Provision of main incoming cables from the top of the panel.

All switch gears and accessories shall be of approved make such as “Siemens, Larsen & Toubro” or equivalent.

Switchboard cubicles shall be floor or wall mounted type as recommended by manufacturers. All floor-mounted switchboards shall rest on minimum 225mm high platform. The contractor shall provide the shop drawings for base and panels.

9. VIBRATION ELIMINATORS

Provide on all suction and delivery lines double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump. Length of the connector shall be as per manufacturer’s details.

C. ILLUMINATED FACSIMILE ANNUNCIATOR PANEL

1. SCOPE

Scope of this section comprises the supply, installation, testing and commissioning of illuminated facsimile annunciation panel.

1.1. Illuminated Facsimile Annunciator

Illuminated facsimile enunciator shall be provided with facsimile of the building, constructed of acrylic panels of suitable dimensions, showing the Basement, Ground floor plans and section

showing the location of Zonal Panels on each typical floor, entry points, various facilities shown with enamels in various colors.

Alarm lights to indicate fire location shall be arranged within the acrylic panel and shall be either automatically lighted by operation of any automatic fire detection devices or manual station, or by control of push button incorporated in the control desk.

Indicator of each building or facility shall include two lamps connected in parallel and so arranged that the failure of either of the lamps is readily apparent when a call or test is made.

Power for the Enunciator shall be supplied from the power supply for the control desk.

Representation of the various plans/Drawings on the acrylic of the Enunciator shall be by negative film processing with colored Discrimination of various zones for which the drawings shall be furnished for approval.

2. WATER FILTER

Water filter shall be of dual filter media pressure filter downward or upward flow type suitable for a rate of filtration. Filter shall be vertical type of required diameter. The shell shall be fabricated from M.S. plate suitable to withstand a working pressure as given below. The minimum thickness of shell will be 8mm and dished ends shall be 10mm. The filter shall have at least one pressure tight manhole cover. Filter shall be provided with screwed or flanged connections for inlet, outlet, individual drain connections and all other connections necessary and required. Filter shall be painted inside with two or more coats of non-toxic corrosion resistant paint, one coat of red oxide primer outside with two or more coats of synthetic enamel paint of approved shade.

2.1. Under Drain System

Filter shall be provided with an efficient under drain system comprising of collecting pipes, gunmetal/polypropylene nozzles of manufacturer's design. The entire under drain system be provided on M.S. plate or cement concrete supports.

2.2. Face Piping

Filter shall be provided with interconnecting face piping comprising of inlet, outlet, and backwash pipe complete with pipes, valves and accessories, as per requirement. Piping shall be G.I/M.S. piping, medium duty, as per I.S: 1239 and valves shall be cast iron double flanged

sluice valves on SOUNDERS pattern with C.I. body and Neoprene rubber diaphragm (Suggested make LABLINE, NKI or equivalent).

2.3. Accessories

Each filter shall be provided with following accessories:-

- Air release valve with connecting piping.
- 150mm dia dial burden type gunmetal pressure gauges with gunmetal isolation cock and connecting piping on inlet and outlet.
- Sampling cocks on raw water inlet and filtered water outlet.
- Individual drain connection with gunmetal full way valve.
- Connection with valve for air scouring.

3. PIPING

Pipes for suction and delivery shall be galvanized/M.S tube (heavy duty) confirming to I.S:1239 up to 150mm dia and as per I.S:3589 for dia 200mm and above. The M.S flanges shall confirm to I.S:6392-1971.

Gate valve and check valve above 65mm dia shall be C.I. double flanged conforming to I.S:780 manufactured by the reputed manufacturers or C.I. double flanged butterfly valves.

Full way and check valves 65mm dia and below shall be gunmetal tested to 20Kg/cm² pressure certified and conforming to I.S:778.

Suction strainer or foot valves shall be C.I., confirming to I.S:4038 – 1979

3.1. Joints

All pipes and fittings shall be provided with flanged joints, with flanges either screwed or welded complete and jointed with 1.5mm thick gasket complete with nuts, bolts and washers etc.

3.2. Testing

All G.I pipes (except fire pipe) shall be tested hydrostatically for a period of 30 minutes to a pressure of 7 Kg/cm² without drop in pressure and all G.I pipes for fire shall be tested hydrostatically for a period of 30 minutes to a pressure of 10 Kg/cm² without drop in pressure.

4. 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 Engineer-in-Charge. 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, Engineer-in-Charge 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 Engineer-in-Charge.

D. FIRE ALARM WITH DVC AND FFT SYSTEM

1. SCOPE

This section of the specification includes the furnishing, installation, and connection of a microprocessor controlled, addressable fire alarm equipment required to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control panels, auxiliary control devices, annunciator, power supplies, and wiring as per shop drawings and specified herein. The system shall be designed such that each loop shall limited to only 80% of its total capacity at initial installation. All equipment/components shall be new & the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system. All equipment and components shall be installed in strict compliance with each manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc. before beginning system installation. Refer to the riser/connection diagram for all specific system installation/termination/wiring data. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2. SUBMITTALS AND SHOP DRAWING

Sufficient information shall be clearly presented and shall include manufacturer's name, model numbers, power requirements, equipment layout, device arrangement and complete wiring. Sequence and description of operation. Product Data for each type of equipment, initiating device, signal device, peripheral device and cable provided on the project. Shop drawings shall include battery calculations, floor plans and wiring diagrams.

3. BASIC SYSTEM

The system shall be a complete, electrically supervised fire detection and evacuation system using fire fighter telephone with microprocessor based operating system having the following; capabilities, features and capacities:

Communication between network nodes, each supporting an interactive, self-standing, intelligent local control panel, with system wide displays. Any network node shall be capable of supporting a local system in excess of 4000 input/output points.

The local system shall provide status indicators and control switches for all of the following functions:

Audible and visual notification alarm circuit zone control.

Status indicators for sprinkling system water-flow and valve supervisory devices. (if any) Any additional status or control functions as indicated on the drawings, including but not limited to; emergency generator functions, fire pump functions, door unlocking and security with bypass capabilities.

Each intelligent addressable device or conventional zone on the system shall be displayed at the fire alarm control panel by a unique alphanumeric label identifying its location.

The design shall generally confirm to IS 2189:2008 (Selection, Installation and maintenance of automatic fire detection and Alarm System – Code of practice) & National Building Code 2016.

- i. Fire alarm system consist of a multi loop analogue addressable fire alarm panel located in the main fire Control room in ground floor level.
- ii. Fault Isolators shall be provided after every 20 Detectors.

- iii. Heat Detectors shall also be provided above false ceiling in common area on each Floor wherever the void exceeds 800mm.
- iv. Spacing between detectors shall be restricted to IS guidelines. Each Loop shall have Approx. 100 Addressable Detectors & 100 addressable Devices.
- v. Response Indicator shall be provided outside of every closed room for indication.
- vi. Hooter & manual call point shall be provided near fire staircases at ground level and upper floors as well as in Basements (If any).
- vii. Addressable Control Module shall be provided for hooters and addressable Monitor Modules for Flow Switches. 6. Fire Detection/Alarm System Addressable Intelligent fire detection and Alarm system of latest technology with Fire alarm panels, multi-Sensor detectors, smoke detectors, heat detectors, beam detectors, response indicators, manual call point and hooters, light strobe etc. shall be provided. It shall meet the requirement of NBC 2016/NFPA/CPWD Specifications/ State By laws. License/Approval of Local Fire Authorities shall be provided for the complex. There shall be the proper Zoning of the building considering the Non-Critical & Critical areas of buildings. Repeater panels shall be provided in various buildings as required.
- viii. There shall be independent fire panel for Buildings as per the requirements. and all fire control panels shall be interconnected with each other.
- ix. Fire Detectors and devices of different buildings/ blocks shall be connected to Fire Control Panel of the Admin building through necessary cables in DWC HDPE pipes.
- x. The monitoring of whole complex shall be in the Main Fire Control Room of Admin Building.
- xi. For Central Monitoring of all the Fire Panels, necessary devices like PC, Printer, modules & Software etc. of latest technology with minimum 1 TB hard disk shall be provided in the Control room.
- xii. Fire Alarm control Panel shall not have more than 100 devices and 100 detectors in one loop.

4. PROPOSED DETAIL SYSTEM:

- i. Addressable intelligent dual type Fire Detectors is suggested.
- ii. Detectors should be with inbuilt short circuit isolator & automatic addressing. Detectors should be installed as per coverage defined in NFPA 72.

It should include all areas as per the requirements of NBC-2016 i.e., rooms, halls, storage areas, basements (if any), attics, lofts, and spaces above suspended ceilings including plenum areas utilized as part of the HVAC system. In addition, coverage

should include all closets, elevator shafts, enclosed stairways (Directional Sounder), dumbwaiter shafts, chutes, and other subdivisions and accessible spaces.

- iii. Each detector & devices shall have integrated short circuit isolator.
- iv. Suitable numbers of input/ output (C/M) relay modules are suggested for connecting other equipment like Electrical Panels, lifts, firefighting system, AHUs etc.
- v. Spacing between two detectors shall not be more than 8 Mtrs. or it shall be as per relevant code & manufacture standards.
- vi. Cabling shall be with Fire Survival Armoured copper cable.
- vii. Suitable addressable loop powered sounders/ hooters for 100db sound level are suggested.
- viii. Addressable manual call boxes shall be provided near all exits; stair cases lift lobbies etc. as per relevant Norms.
- ix. The Response Indicators shall be used in the waiting areas, Corridors, Common Area conference Hall or in large rooms etc.
Microprocessor IP based fire alarm control panel (fully redundant) for number of required loops with 24 hrs. Battery backup with LCD display, printer etc. shall be located in the fire control room.
- x. k) Fire Alarm Panels shall be integrated with PA system and with BMS also.
- xi. Two Way communication Fire Fighters Telephone Jack & Handset with necessary accessories are to be provided in all the buildings as required.
- xii. Addressable Monitor Module for Sprinklers, Panic Bars & other Third Party In puts. The monitor module shall monitor potential free contacts. The device shall have an LED which shall blink in normal state & gets tea donatives action to monitor the heath status of the device. Addressing shall be with use friendly rotary decimal switches. Module shall be supplied with mounting plate from OEM fore as of installation & maintenance.
- xiii. Addressable Isolator Module for isolating short/de-wired/loose circuits with automatic resetting arrangement. Isolator Base can also be proposed, however in that case needs

to be considered with each detector & module. The device shall have an LED which shall blink in normal state & get steady on activation to monitor the health status of the device. Addressing shall be with user friendly rotary decimal switches. Module shall be supplied with mounting plate from OEM for ease of installation & maintenance.

4.1. TALK BACK SYSTEM

Talk Back System / Fire Fighter Telephone System shall be provided on all landings of Fire Staircase for use by security and fire personnel for communication with Security Room located in ground floor.

4.2. CONTROL & MONITORING OF MISCELLANEOUS SERVICES

In case of fire, Fire Alarm Panel shall be equipped to control and monitor other services of the building like necessary annunciation for control of Smoke Exhaust and Pressurization Fans, Monitoring of Flow Switches for Sprinkler System and Activation of Clean Agent Fire Suppression Systems.

The Fire Alarm Panel shall also provide signal for controlled operation of elevators through potential free contact.

4.3. WIRING

Wiring to detectors shall be carried out with PVC insulated FRLS (IS-964:1990) copper conductor wires / FR screened & shielded copper conductor wires in MS conduits.

Wiring to Critical Loads viz. Ventilation Fans Panels, Pressurization Fan Panels, Fire Pump Panels shall generally be carried with XLPE Insulated Aluminum Conductor Armored Cables.

4.4. FIRE SUPPRESSION SYSTEM

This is applicable for IT room, Record room/Document room, Electrical panel room. Tube based Fire suppression system is proposed. For tube based fire suppression system Clean agent storage system will be considered with Novac 1230 along with its sensor and required panel system.

All other accessories (Release Device, Manual Activator, Discharge hose, Gas Nozzle, Screw release tool, agent release valve, Photo electric Smoke Detector, Agent release panel, Gas cylinder, Manual Gas release switch, Manual Gas abort switch etc.) to be planned to operate the system smoothly.

4.5. PUBLIC ADDRESS SYSTEM (PA SYSTEM):-

PA system shall be provided in the campus as required. Speakers in the Ceiling/Wall shall be provided in corridors, lift lobbies and other common areas as per **NBC2016**/relevant IS codes.

- i. Box type speaker shall be provided in the entrance lobby.
- ii. Horn type speaker are suggested in the basement (If any).
- iii. Recessed speakers in the false ceiling areas.
- iv. Proper zoning are to be done considering the user requirement, critical areas & floor etc.
- v. Control console shall be located in the fire control room with pre amplifiers, amplifiers, CD,
- vi. DVD/Pen-drive, FM Player & gooseneck microphone.
- vii. System shall have the facility to make announcement on all floors simultaneously or on individual floors.
- viii. Wiring shall be done with twin twisted tinned copper wire in the conduit.
- ix. The system shall be integral with Fire alarm panel and with the BMS also.

E. COMMISSIONING & GUARANTEE

1. SCOPE OF WORK

Work under this section shall be executed without any additional cost. The rates quoted in this tender shall be inclusive of the works given in this section.

Contractor shall provide all tools, equipment, metering and testing devices required for the purpose.

On award of work, Contractor shall submit a detailed proposal giving methods of testing and gauging the performance of the equipment to be supplied and installed under this contract.

All tests shall be made in the presence of the Architect or his representative or any inspecting authority. At least five working days notice in writing shall be given to the inspecting parties before performing any test.

Water flow rates of all equipment and in pipe lines through valves shall be adjusted to design conditions. Complete results of adjustments shall be recorded and submitted.

Contractor shall ensure proper balancing of the hydraulic system and for the pipes / valves installed in his scope of work by regulating the flow rates in the pipe line by valve operation. The contractor shall also provide permanent Tee connection (with plug) in water supply lines for ease of installing pressure gauge, temperature gauge & rota meters. Contractor shall also supply all required pressure gauge, temperature gauge & rotameter for system commissioning and balancing. The balancing shall be to the satisfaction of Consultant / Project Manager.

Three copies of all test results shall be submitted to the Engineer in A4 size sheet paper within two weeks after completion of the tests.

2. PRECOMMISSIONING

On completion of the installation of all pumps, piping, valves, pipe connections, insulation etc. the Contractor shall proceed as follows:

- i. Prior to start-up and hydraulic testing, the Contractor shall clean the entire installation including all fitments and pipe work and the like after installation and keep them in a new condition. All pumping systems shall be flushed and drained at least once through to get rid of contaminating materials. All pipes shall be rodded to ensure clearance of debris, cleaning and flushing shall be carried out in sections as the installation becomes completed.
- ii. All strainers shall be inspected and cleaned out or replaced.
- iii. When the entire systems are reasonably clean, a pre-treatment chemical shall be introduced and circulated for at least 8 hours. Warning signs shall be provided at all outlets during pre-treatment. The pre-treatment chemical shall:
 - Remove oil, grease and foreign residue from the pipe work and fittings;
 - Pre-condition the metal surfaces to resist reaction with water or air.
 - Establish an initial protective film;
 - After pre-treatment, the system shall be drained and refilled with fresh water and left until the system is put into operation.

- Details and procedures of the pre-treatment shall be submitted to the Architect for approval.
- iv. Check all clamps, supports and hangers provided for the pipes.
- v. 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.

3. FIRE PROTECTION SYSTEM

Fire protection system shall be designed and executed for passive fire protection system. Fire stop system for all MEP applications should have 2 hours' fire rating when tested in accordance with ASTM E 814/ UL 1479 standards & IS 12458:2019, and all points shall be tested in accordance to ASTM E 1966 & façade joints between Transom and rated flow shall be tested in accordance with ASTM E 2307.

- i. Check all hydrant valves by opening and closing : any valve found to be open shall be closed.
- ii. Check all the piping under hydro test.
- iii. Check that all suction and delivery connections are properly made for all pump sets.
- iv. Check rotation of each motor after decoupling and correct the same if required.
- v. Test run each pump set.
- vi. All pump sets shall be run continuously for 8 hours (if required with temporary piping back to the tank).

4. COMMISSIONING AND TESTING

- i. Pressurise the fire hydrant system by running the jockey pump and after it attains the shutoff pressure of the pump , then
- ii. Open bypass valve and allow the pressure to drop in the system. Check that the jockey pump cuts- in and cuts-out at the preset pressure. If necessary adjust the pressure switch for the jockey pump. Close by-pass valve.

- iii. Open hydrant valve and allow the water to below into the fire water tank in order to avoid wastage of water. The main fire pump shall cut-in at the preset pressure and shall not cutout automatically on reaching the normal line pressure. The main fire pump shall stop only by manual push button. However, the jockey pump shall cut-out as soon as the main pump starts,
- iv. Switch off the main fire pump and test check the diesel engine driven pump in the same manner as the electrically driven pump,
- v. 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.
- vi. 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 do not fit into the other properly shall be replace by the Contractor. Each landing valve shall also be checked by opening and closing under pressure.
- vii. Check all annunciations by simulating the alarm conditions at site.

5. STATUTORY AUTHORITIES' TESTS AND INSPECTIONS

As and when notified in writing or instructed by the Architect/Engineer in charge, the Contractor shall submit shop drawing and attend all tests and inspections carried out by Local Fire Authorities, Water Authority and other Statutory Authorities, and shall forthwith execute free of charge any rectification work ordered by the Architect as a result of such tests and inspections where these indicate non- compliance with Statutory Regulations. Some of these tests may take place after the issue of Practical Completion of the Main Contract and the Contractor shall make all allowances in this respect.

The Contractor shall be responsible for the submission of all necessary forms and shop drawings to the Statutory Authorities which shall conform in layout to the latest architectural plans submitted to and kept by these Authorities.

The submission shall comply with the requirements set forth in the current Codes of Practice and circular letters of the Statutory Authorities. The shop drawings to be submitted shall be forwarded to the Architect for checking before submission.

The Contractor shall allow for at least two submissions of complete sets of shop drawings to the Authorities, one to be made within six months after the award of the Contract but not less than six weeks before the inspection. The Architect may at his discretion instruct the Contractor for additional submissions to the Local Authorities whenever necessary.

The Contractor shall notify the Architect at least seven days in advance of his application for local Authority tests and inspections. On receipt of a confirmed date for test and inspection the Contractor shall inform the Architect without delay.

6. FINAL ACCEPTANCE TESTS

Following commissioning and inspection of the entire installation, and prior to issue of the Completion Certificate, the Contractor shall carry out final acceptance tests in accordance with a programme to be agreed with the Architect/Engineer in charge.

Should the results of the acceptance tests show that plant, systems and/or equipment fail to perform to the efficiencies or other performance figures as given in this Specification, the Contractor shall adjust, modify and if necessary, replace the equipment without further payment in order that the required performance is obtained.

Where acceptance tests are required by the relevant Authorities having jurisdiction, these tests shall be carried out by the Contractor prior to the issue of Completion Certificate to the acceptance of the Authorities.

7. REJECTION OF INSTALLATION / PLANT

Any item of plant or system or component which fails to comply with the requirements of this Specification in any respect whatsoever at any stage of manufacture, test, erection or on completion at site may be rejected by the Architect/Engineer in charge. either in whole or in part as he considers necessary/appropriate. Adjustment and/or modification work as required by the Architect so as to comply with the Authority's requirements and the intent of the Specification shall be carried out by the Contractor at his own expense and to the satisfaction of the Authority/Architect.

After works have been accepted, the Contractor may be required to carry out assist in carrying out additional performance tests as reasonably required by the Architect/Employer.

8. WARRANTY AND HANDOVER

The Contractor shall warrant that all plant, materials and equipment supplied and all workmanship performed by him to be free from defects of whatsoever nature before handover to the Owner.

9. HANDING OVER OF DOCUMENTS

All testing and commissioning shall be done by the Contractor to the entire satisfaction of the Owner's site representative and all testing and commissioning documents shall be handed over to the Owner's site representative.

The Contractor shall also hand over all maintenance and operation manuals, all certificates and all other documentation as per the terms of the contract to the Owner's site representative.

10. PIPE COLOUR CODE

S.No.	Pipe Lines	Ground / Base Colour	First Colour Band	Second Colour Band
1	Cooling Water	Sea Green	French Blue	
2	Boiler feed	Sea Green	Gulf Red	
3	Condensate	Sea Green	Light Brown	
4	Drinking Water (All cold water lines after filter)	Sea Green	French Blue	Single Red
5	Treated Water (Soft Water)	Sea Green	Light Orange	
6	Domestic Hot Water	Sea Green	Light Grey	
7	Compressed air upto 15/Kg/Sqcm	Sky Blue		
8	Steam	Silver Grey		
9	Drainage (Storm Water)	Black		
10	Drainage (Sewage Water)	Brown		
11	Gas	Canary Yellow		
12	Fire System	Post Office Red		

11. CHECK LIST FOR COMMISSIONING

11.1 Fire Protection System

- i. Check all hydrant & other valves by opening and closing. Any valve found to be open shall be closed.
- ii. Check all clamps, supports and hangers provided for the pipes.
- iii. All the pump sets shall be run continuously for 30 minutes (with temporary piping back to tank from the nearest hydrant, using canvas hose pipes).
- iv. Fire Hydrant System - Pressurize the fire hydrant system by running the jockey pump and after it attains the shutoff pressure of the pump, then

Open bypass valve and allow the pressure to drop in the system. Check that the jockey pump cuts- in and cuts-out at the preset pressure. If necessary adjust the pressure switch for the jockey pump. Close by-pass 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 shall cut-in at the preset pressure and shall not cutout automatically on reaching the normal line pressure. The main fire pump shall stop only by manual push button. However the jockey pump shall cut-out as soon as the main pump starts,. Operate booster pump continuously for 30 minutes with piping back to underground tanks from the hydrant nearest to plant room.

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 do not fit into the other properly shall be replaced by the Contractor. Each landing valve shall also be checked by opening and closing under pressure.

Automation of pumps should be in such a way that if the jockey pump fails to maintain the required pressure then main pump starts if both fails or both are not working mechanical pump should start automatically. Check air cushion tanks on the terrace for proper functioning.

12. SIGNAGES

Signage drawings, content, plan of signage installation to be provided by agency itself and the same should be approved from the department before installation.

12.1 DIRECTION SIGNAGES:

Supply & Installation of AUTOGLO self maintain signages 1 mm thick aluminium with frame sheet A25 10000 dark glow GP31SS Temperature -40 to +120 degree centigrade photoluminescent with strong self adhesive, working self Extinguishing, non radioactive, non peelable, non scratchable, non breakable, UV cured silk screen printed GP31SS PSPA Class- A/DIN 67510 Part 49111090 Outdoor use glow period > 8 hrs Make PROLITE/AUTOGLO of size 150x300 mm all complete as per specification and direction of Engineer-in-charge. Design, Content and size to be approved at the time of installation by E/I.

12.2 EVACUATION PLAN:

Supply and installation of evacuation plan self maintain signages on art board sheet 250 GSM with strong self adhesive of size 300x450 mm or A1 size as per the direction of E/I and per the requirement approved drawing ,all complete as per specification and direction of Engineer-in-Charge. Drawing (to be provided by agency itself), Content and size to be approved at the time of installation by E/I.

12.3 EXIT GUIDE LIGHT:

Supply & Installation of self contained rechargeable maintained decorative Exit/Fire Exit, Guide lights/safety lights /Egress light PAL LED EM Glow period for 3 hrs IP 20 single sided(surface type) IP 20 battery duration+10% 16 to 24 hrs recharging period IS-10322 GP31SS Epoxy polyester powder coating , white in color multiple LEDs Make PROLITE / AUTOGLO of size 65 x190 x 50 mm all complete as per specification and direction of Engineer-in-Charge. Design, Content and size to be approved at the time of installation by E/I.

DO'S AND DON'T DURING FIRE, FIRE EXTINGUISHER USE METHOD : Design, Content and size to be approved by BCD as per decision/direction of E/I at the time of installation.

13. MAKE LIST

FIRE FIGHTING WORK				
S. No	Details of Equipment / Material	Make / Manufacturer		
	Diesel engine driven pump	Kirloskar	Ashok Leyland	Mather & Platt
	Air Break Contractors	Seimens	L&T	Cimbrio
	Air Release Valve	Rb	Tbs	Cimbrio
	Alarm valve & Hydraulic (Alarm motor with coupling)	HD fire protect	Mather&Platt	
	Alternator	Stamford	Lorey Somer	Kirloskar
	Ammeter, Voltmeter, PF, kW, Hz, meter (Analogue), Energy Meter	AE	Enercon	Conzerve
	Ball Valve	Rb	Zoloto	Leader
		Rapid	Castel	Emerald Audco
	Battery	Exide	Amco	Amaraja
	Butt welded fitting (UL Listed)	V.S.Forge	True Forge	DRP-M
	Butterfly valves / C.I. Double flanged sluice Valves & check valves	Interval	Leader	Audco
	Cable lugs and glands	Comet	Dowell	Lotus
	Cables	Universal	CCI	Gloster
		Finolex		
	Control / Potential / Current Transformer	Precise	Gillbert & Maxwel	AE
	Deluge valve	Eversafe	HD	Tyco
	ELCB	MG	MDS Legrand – Lexic	L&T Hager
	Electrical Motors	Kirloskar	Seimens	Crompton
	Epoxy Paint	ICI	Berger	Nerolac
	Fire Aid / Fire Hose Reels, GM short branch pipe, 2/3/4 FB inlet/draw off connection	Ceasefire	Newage	Safeguard
	Fire Buckets	Safex	Minimax	Peter Autokit
	Fire Extinguisher	Safex	Minimax	Peterautokit
		Ceasefire	Newage	Exflame
	Fire Hose Pipes	Ceasefire	Newage	Safex
	Fire Hydrant Valves	Ceasefire	Newage	Safeguard
	Fire Man's Axe	Ceasefire	Newage	Safeguard
	Flexible trailing cable for lifts	Lapp Kabel	Approved equivalent	
	Flow switch	Potter	System sensors	Rapid flow
	Foot Valve (Cast iron/ Gunmetal)	Kirloskar	Neta	Leader Z
	Forged steel fitting	V.S.Forge	True Forge	DRP-M

	Forged Steel Fittings & Flanges (For Welded joints)	Rohini	Kanwal	
	GI clamps	Hilti	Chilly	GMGR
	GI , MS Pipes	Jindal Hissa	Praksh Surya	BST
	Gunmetal Branch Pipe	Newage	Ushafire	Safeguard
	Gunmetal Valves (fullway Check and Globe Valves)	Audco	Interval	Advance
	Hose Reel	Minimax	Usha Fire	Omaxe
		Ceasefire	Safeguard	
	Hydrant Valves	Newage	Minimax	Peterautokit
	Indicating Lamps & Push Buttons	L&T	Technico	Led Type
	Non-Return Valve – Swing	Intervalve	Audco (Cast Iron)	Zoloto
	Nozzle	Newage	Safeguard	Usha Fire
	Over Load Relays	GE	L&T	Siemens
	Pipe coat material (pipe protection)	Pypcoat	Makphalt	Safex
	Pipe External Protection	Pipe Kote (4mm thick)	Equivalent or other approved makes	
	Pipe Hangers	Chilly	GMGR	
	Power/auxiliary Contactors	MG	Siemens	
	Pressure guage	Fiebig	H.GURU	
	Pressure Switch	Danfoss	Indfoss	Switzer
	Push Buttons, Indicating lamps LED	MG	L&T	Schneider
	RRL Hose	Safeguard	Ceasefire	Ushafire
	Single Phase Preventer	L&T	Minilac	Eversafe
	Sluice Valves	Kirloskar	Audco	Unik
	Solenoid valve, Spray nozzle	Parker	HD	Tyco
	Sprinkler (ICV)	HD	Tyco	Reliable
	Sprinkler Heads /Water Curtain Nozzle	Grinnel	Eversafe	Firesafe
	Steel flexible extension	Eversafe	Safex	Tyco
	Suction “Y” Type Strainer	Kirloskar	Leader	Zoloto
	Vibration Eliminator	Resistoflex	D waren	Kanwal
	Weld Electrodes	Advan	ESAB	L&T
	Deluge valve	Tyco	Viking	HD
	Fire Hydrants (Landing Valves)		Safegaurd	Newage
	Hose Reel Drum & Tube	Padmini	Safegaurd	Newage
	Hose Pipes	Padmini	Safegaurd	Newage
	Branch Pipes	Padmini	Safegaurd	Newage
	Fire Brigade Inlet & Draw Off Connections	Padmini	Safegaurd	Newage
	Fire Men,s Axe	Padmini	Safegaurd	Newage

	Fire Extinguishers	Padmini	Safegaurd	Newage
	Flexible Pipe for Sprinkle	Padmini	Safegaurd	Newage
	Sprinkler Head	HD	Tyco	Newage
	Fire Pumps	Kirloskar	M&P	
	Installation Control Valve/ Fire alarm Valve	HD	Viking	
	Flow Switch	System Sensor	Rapid Control	Potter
	Stainless Steel Railing, Accessories etc in Grade SS 316	Dorma	Kich	Koncept
FIRE ALARM SYSTEM				
	Fire Alarm System	Honeywell Notifier	Honeywell Esser	Siemens
	Response Indicator	Reputed Brand as approved by Architect		
	PA System	Honeywell	Bose Prasedio	Ahuja