

AUTOMATIC FIRE SUPPRESSION SYSTEM

DOC. NO.	OAB REDEVELOPMENT, NLSIU, BENGALURU	PROJECT NO.
AFS / 001	MATERIAL SPECIFICATION – AUTOMATIC FIRE SUPPRESSION SYSTEM	AD/0123

A. GENERAL REQUIREMENTS

1.0 SCOPE OF WORK & SPECIAL CONDITION

The scope of work includes complete design, supply, installation, erection, testing, and commissioning the Fire Downcomer system, Hose Reel system, First aid fire extinguishers with all necessary accessories, associated civil and electrical works of the fire protection system for the proposed project '**OAB REDEVELOPMENT AT NLSIU**'.

- 1.1 The fire protection system shall be designed as per requirements of Amendment No.3 to National Building Code of India NBC-2016 and specific requirement of **BANGALORE** State Fire Services.
- 1.2 It is not the intent to specify completely herein all details of design and construction of the equipment/system. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous operation.
- 1.3 The contractor shall furnish a warranty for the entire fire protection system for a defect liability period of Twelve (12) months after final official hand over date of the installation. This period shall include maintenance, replacement of parts, regular periodic visits by qualified personnel of the contractor and attending emergency calls at short notice.
- 1.4 The contractor shall quote separately for comprehensive Annual Maintenance Contract (including all material and labour) for full Three (3) years period after the defect liability period (DLP). The contractor shall bear full responsibility for all kinds of maintenance which include periodic maintenance as well as attending to all break-down and emergency calls at short notice whenever called. During this 3-year period the scope of annual maintenance includes repair and replacement of one or all parts as required. Besides, the replenishment of all consumables is also to be included in the scope of maintenance.

The contractor shall furnish a list of recommended spares along with quantity and unit price schedule to the Employer along with the bid. Employer reserves the right to order the required spares during the tenure or on completion of the Annual Maintenance Contract (AMC) at the prices quoted which should be valid for the entire maintenance period i.e., 3 years after DLP. Further the Employer reserves the right to place the order on the successful contractor. Prices quoted for AMC shall be considered for evaluation.
- 1.5 The complete fire protection system will be evaluated based on the Item rate contract for the enclosed Bill of Materials (BOM). The contractor should indicate unit rates for all the items. Contractor to note that the bill of material is indicative and for tender purpose/evaluation only. Payment shall be made as per the actual installed quantities after certification from the Engineer at site and not as per the BOM.
- 1.6 The Contractor shall furnish along with bid unit rates for all equipments/piping/valves/instrumentation/ fitting etc., included in the scope of work. These unit rates will be used for price adjustment. Bids without unit rate will not be considered for evaluation. Also any conditions on unit rates quoted in the offer are not acceptable.

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2.0 SITE CONDITIONS

Temperature : Maximum 36 °C
Altitude : 949 feet

3.0 APPLICATION CODES AND STANDARDS

The work shall be carried out in accordance with the regulations of local bodies, if any and the following specifications and codes which may govern the requirements of the system.

IS 13039 - 1991	Code of practice for provision and maintenance of external fire hydrant.
IS 2190 - 1992	Code of practice for selection, installation and maintenance of portable First-aid Fire Extinguishers.
IS 2189 - 1988	Automatic Fire Detection and Alarm System
IS 908 - 1975	Fire Hydrant & Stand Post Type.
IS 3809 - 1979	Fire Resistance Test of Structures.
IS 1648 - 1961	Fire Safety of Buildings
IS 884 - 1985	First Aid Hose Reel For Fire Fighting.
IS 2171 - 1985	Portable Fire Extinguishers
IS 934 - 1989	First Aid Fire Extinguishers
IS 14609 – 1999	Dry Chemical powder for fighting ABC class fires – Specification.
IS 2871 – 1983	Specification for Branch Pipe, Universal, For Fire Fighting Purposes (First Revision).
IS5306	Code of practice for fire extinguishing installation and equipment on premises
IS 5132 – 1968	Hose reel tubing for the fire protection system.
IS 8090 – 1992	Specifications for coupling, branch pipe, nozzle used in hose reel tubing for fire fighting.
IS 906 – 1988	Specification For Branch Pipe With Revolving Head For Fire Fighting Purposes (Third Revision).
IS 901 – 1988	Specification For Couplings, Double Male And Double Female, Instantaneous Pattern For Fire Fighting (Third Revision).
IS 902 – 1992	Specifications for suction hose couplings for firefighting purposes.

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IS 903 – 1993	Specification for Fire Hose Delivery Couplings, Branch Pipe, Nozzles and Nozzle Spanner (Third Revision).
IS 904 – 1983	Specifications for 2-way and three way suction collecting heads for firefighting purposes.
IS 905 – 1980	Specifications for delivery breechings, dividing and collection, instantaneous pattern, for firefighting purposes.
IS 906 – 1988	Specification for revolving branch pipe for fire fighting.
IS 907 – 1988	Specification for suction strainers, cylindrical type for firefighting purposes
IS 908 – 1975	Specification for fire hydrant stand post type.
IS 5714 – 1981	Specification For Hydrant, Stand Pipe For Fire Fighting (First Revision).
IS 909 – 1975	Specification for Underground Fire Hydrant, Sluice Valve Type (Second Revision).
IS 5290 1984	Specification For Landing Valves (Second Revision).
IS 3844 – 1989	Code of Practice for Installation and Maintenance Of Internal Fire Hydrants And Hose Reel On Premises (First Revision).
IS 9668 – 1990	Code of practice for provision and maintenance of water supplies and firefighting.
IS 8423 –1977	Controllers for collating hose for firefighting.

4.0 SHOP DRAWINGS

The drawings enclosed herewith are for the general guidance to the Contractor. The contractor shall upon the award of the work, furnish detailed and coordinated shop drawings necessary to carry out the work at site. These shall be submitted to the Engineer for the approval and the work shall be commenced only after the approval of drawing by the Engineer.

- 4.1 Drawing/Information Required from Successful contractor on award of work:
 - 4.1.1 Pump GA and Cross sectional drawings.
 - 4.1.2 Performance curve for the pump.
 - 4.1.3 Necessary civil scope drawing for the system.
 - 4.1.4 Bar chart showing engineering, manufacturing and dispatch of each equipment and erection services.
 - 4.1.5 Drawing, literature and technical particulars of all bought out items.

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- 4.1.6 Control logic diagram for the pump to start.
- 4.1.7 Schedule for valves and piping material.

5.0 INSPECTION AND APPROVAL

The contractor shall arrange all necessary inspection by Fire Brigade Authority. He shall also arrange for the tests and obtain and deliver to the Employer any approval required as per local bye laws / statutory requirements.

6.0 WELDING

The two ends of GI pipes shall be cut to the perfect level with the machine. Both the ends of the pipe shall be chamfered in-order to achieve a V groove at the welding joint. The tack welding shall be done first at required points. After checking the perfect level and alignment continuous welding shall be done. Contractor to clear all the carbon formations on the pipe surface and make the joint shiny.

7.0 PAINTING OF ABOVE GROUND PIPES AND EQUIPMENTS

All piping, equipment, cabinets etc., furnished under this specification shall be properly painted with two coats of synthetic enamel paint over a coat of primer of approved color and make. There shall be sufficient time gap between the coats of paint and the primer to ensure that all the coats are dried properly. The contractor shall guarantee both the material and workman ship of first class quality corresponding to standard engineering practice. Any defective materials / workman ship shall be rejected, the contractor has to rectify / replace at his own cost. Guarantee certificate of the materials supplied shall be handed over to the company. Paint used for this work will be lead free quality.

8.0 WRAPPING AND COATING OF UNDERGROUND PIPES

All underground pipes and fittings shall be cleaned by rough cloth. First coat of bituminous paint shall be applied, over which 400 micron polyethylene sheet of suitable width is to be wrapped spirally by overlapping at least by 15mm. Similarly second coat of bituminous paint shall be applied over which PVC wrapping followed by second layer of PVC sheet wrapping. It is important to ensure that PVC sheet wrapping joints, of both the layers, are staggered. All the joints shall be tested and approved by the engineer. The joints shall be painted with one coat of primer and two coats of approved enamel paint. The paint shall be same color for pipes and joints.

9.0 GUARANTEE:

The contractor shall guarantee the material and workmanship of the entire system is of first class quality and shall correspond to standard Engineering Practice. All the equipments/apparatus shall be guaranteed to yield the specified rating and design capacities, speeds. Any defective equipment/material/workmanship found short of the specified quality shall be rejected. Contractor shall make good the rejected items at his own cost. Guarantee certificate of equipments from suppliers/manufacturers shall be handed over to the Employer.

10.0 DEFECTS & LIABILITY

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All the equipment/material and the system shall be guaranteed against defective material and workmanship for a period of 12 months from the date of commissioning and handling over the Employers along with all relevant documentation. The contractor shall repair/rectify or replace all the defective materials, components free of cost. In addition, normal maintenance shall be carried out periodically during the defects liability period including replacement of spares, as required.

11.0 INSTRUCTION MANUAL / COMPLETION DRAWING / TRAINING

The contractor shall furnish detailed instruction and operation manuals in quadruplicate. The contractor shall also furnish detailed completion drawings & Fire Safety Plans on a tracing paper to approved scale. The drawings shall be inclusive of control schematic, if any. The contractor shall train the Employer's personnel in the operation and maintenance of the system for one month.

B. FIRE HYDRANT SYSTEM

1.0 GENERAL

Without restricting to the generality, the fire hydrant system shall include the following:

- 1.1 Supply, installation, testing and commissioning of fire hydrant system with all inter related works as per standards.
- 1.2 Galvanized Iron Class "C" fire riser main within the building and as well outside the building.
- 1.3 Landing valves, hose reels, hose cabinets, fire brigade connections and connections to pumps and appliances.
- 1.4 Terrace Booster pump, panel and its accessories.
- 1.5 All materials shall be of the best quality conforming to these specifications and subject to the approval of the Client.
- 1.6 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.
- 1.7 Pipes and fittings shall be fixed to walls and ceilings by suitable clamps at intervals specified. Only approved types of anchor fasteners shall be used for RCC ceilings and walls.
- 1.8 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat manner.
- 1.9 Valves and other appurtenances shall be as located that they are easily accessible for operation, repairs and maintenance.
- 1.10 Pipes for wet risers within the Building shall be GI tubes conforming to IS 1239 (heavy duty 'C' class) with flanged / welded joints.
- 1.11 Fittings for black steel pipes shall be malleable iron or approved type cast iron fittings with screwed / welded joints.

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- 1.12 Joints 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 be welded when approved by the Engineer.
- 1.13 Stand pipe 80mm dia for single headed yard hydrant & 100mm dia for double headed yard hydrant shall be of GI class 'C' as per IS 1239 PI-90 and FBA approved make.

2.0 PIPING

Under ground piping shall be of heavy duty GI Class 'C' conforming to IS – 1239. The piping shall be laid not less than one meter below the ground level, suitable masonry supports, and concrete anchor blocks of suitable design shall be provided at every change in direction of pipeline either horizontal or vertical and near every pipe joints, where soil conditions are unsatisfactory. All fittings shall be G I 'heavy' grade confirming to IS: 1239.

Above ground piping shall be heavy duty GI class 'C' tubes confirming to IS: 1239 Part – I. GI pipes shall be provided with welded joints only unless flanges are warranted. All fittings shall be heavy duty wrought iron or GI confirming to A 234 Gr. WPB sch.40 (IS: 1239 Part II). The flanges shall be drilled as per relevant Indian standards. The pipes above 150 mm dia shall be fabricated as per IS: 3589.

Flanges shall be faced and shall have jointing of rubber insertion of Neoprene Gasket. In case of Tyton pipes, the joint shall be made by using rubber gaskets as per manufacturers' specification. The joints shall be capable of withstanding a pressure of 10.0Kg/sqcm. All the above ground piping shall be supported by angle iron brackets on walls or suspended by hangers from ceiling or concrete pedestals at some places. Piping above ground shall be painted with two coats of approved enamel over a coat of primer after the installation and testing.

Pipes shall be carefully laid to the alignment, levels and gradients shown on the plan and sections and great care shall be taken to prevent any sand, earth or other matter from entering the pipes during laying.

Pipes shall be kept thoroughly clean during the course of laying. The ends of pipes shall be blocked with wooden plugs wedged home, at the end of each day's work to prevent dirt, rodents and insects etc., entering the pipe.

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

GI class 'B' pipes conforming to IS: 1239 with all necessary fittings as per the specifications mentioned above shall be used for Diesel engine exhaust pipe.

PIPE HANGERS, SUPPORTS, CLAMPS, BRACKETS ETC.

All vertical/horizontal pipes shall be fixed by G.I./M.S. Clamps truly vertical.

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All horizontal pipes running below roof slab shall be supported by Hi-tech supports made out of GI/MS adjustable rods threaded for a sufficient length to adjust the height of support along with clamping arrangement for holding the pipes of anchor fastening arrangement design. The design of the hanger shall conform to specifications as indicated in NFPA 13.

Structural clamps shall be fabricated from M.S. structural members e.g. rods, angles, channels, flats as per detailed drawing or as directed. Contractor shall provide all nuts, bolts, welding and paint the clamps with two coats of zinc chromate primer and two coats of epoxy paint. Wooden saddles shall be provided free of cost.

Slotted angle/channel supports on walls shall be provided wherever shown on drawings or as required. Angles/channels shall be fixed to brick walls and bolts embedded in cement concrete blocks and to RCC walls with suitable anchor fasteners. Holes required in RCC walls shall be neatly drilled by electric drills and no manual chiselling will be allowed. The spacing of supports horizontally shall not exceed 1.8 M.

Wherever M.S. clamps are required to be anchored directly to brick walls, concrete slabs, beams or columns, nothing extra shall be payable for clamping arrangement and for making good with cement concrete 1:2:4 as directed by the Engineer.

3.0 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 and color. The below ground pipes shall be coated protected using polymer based material.

The GI pipes laid in outdoor trenches/buried in earth shall be initially brushed to remove all foreign matter and two coats of primer shall be applied over the pipe. Primer is allowed to dry until the solvent evaporates and surface becomes tacky. The pypkote membrane consisting of seven layers of polyethylene polymerized bitumen and polyester mat with 4mm thick and 150 / 250mm wide shall then be wound in a spiral fashion and bonded completely to pipe by thermo fusion process. The overlap to be maintained at 15mm uniformly.

Pipes passing through masonry walls, foundation, beams shall be taken through embedded pipe sleeve of same material. The pipe sleeve size to be at least one and a half times (1.5) diameter of the crossing pipeline. The pipeline running below floor shall be given anticorrosive treatment same as for underground piping.

4.0 EXCAVATION

Excavation for pipelines shall be in open trenches to line and grade shown on the drawings or as required at site as per the instruction of the Engineer. Pipelines shall be buried to a minimum depth of 1000mm in all types of soil including soft rock, hard rock and disintegrated rock for laying fire water supply pipes.

The contractor shall support all trenches or adjoining structures with adequate wooden/steel supports wherever required.

On completion of testing, anti-corrosive treatment with wrapping and coating of the pipelines, trenches shall be refilled with selected earth available from the trench excavation including watering and consolidation in layers of 15cms layers and

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consolidated. The back fill soil shall be graded soil free from stones, pebbles, clay lumps and vegetation and any organic matter. The surplus earth after backfilling shall be deposited to an initial lead of 30 m or as directed by the Engineer.

5.0 PIPE SUPPORT BLOCKS

Contractor shall provide suitable Burnt Brick Masonry blocks of suitable dimensions at regular intervals of 3 meters to support the pipes and at every change in direction of the pipes running on terrace. Masonry blocks shall be constructed using Table Moulded Class I Bricks in CM 1:6 and plastered in CM 1:3, finished with a neat smooth coat of cement. Size of Blocks shall be 600mm x 600mm x 450mm. The construction of masonry blocks shall be measured as part of piping item.

6.0 BUTTERFLY VALVES

Butterfly valves shall be provided for pipes 50mm dia and above. The valves shall conform to IS 5312 and shall be CI construction, including nuts, bolts, washers, 3mm thick insertion rubber gasket complete as per the specifications. The valves shall be tested to pressure of PN 10 for Pump room valves and PN 16 for Other areas.

Butterfly Valves shall conform the following specification:

Body : High duty cast iron to IS 210 Gr. FG 220 and BS 1452 Gr. 220.

Seating : Molded insitu resilient lining of black nitrile rubber.

Disk : Nylon coated S.G. Iron to IS 1865/SG 400/12 and BS 2729 Gr.420/12.

Shaft : The shafts are made of stainless steel AISI 431. Only flanged end valves to be used with flanges drilled to BS 10 Table F. Valves shall be capable of being locked in open position. Hand wheel shall be with vertical gear unit for smooth opening and closing of the valve. Key rods with M.S. coated extended spindles to be provided wherever the valves are not approachable from the ground surface.

7.0 NON-RETURN VALVES

Non-return valve shall be of cast iron with gunmetal seat, non-return valves shall be of flanged type. Spring-loaded valves shall not be used. The valves shall be tested to pressure of PN 20 for Pump room valves and PN 16 for other areas.

8.0 STRAINERS

Strainers shall be preferably of approved 'Y' type or pot type as specified in the tender schedule with GI or fabricated steel bodies. Strainers up to 50 mm shall be of gun metal type. Strainers shall have a removable bronze screen with 3 mm perforations and permanent magnet. Strainers shall be provided with flanges. They shall be designed so as to enable blowing out accumulated dirt and facilitate removal and replacement of all screen without disconnection from the main pipe. Strainers shall be provided with isolating valves so that they may be cleaned without draining the entire system. The valves shall be tested to pressure of PN 20 for Pump room valves and PN 16 for Other areas.

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9.0 RUBBER HOSE REEL

Contractor shall provide standard fire hose reels with 19mm dia high pressure Dunlop rubber hose of 30m length with gunmetal nozzles and control valve, shut off valve, all mounted on a circular hose reel drum of mild steel construction and cast-iron bracket. The hose reel along with 63mm dia landing valve and 2 nos 15M long 63mm dia hose pipes shall be installed in fire hose cabinet inside the building.

10.0 HYDRANT VALVE (LANDING VALVES) AND CP HOSE PIPE

The landing valve (internal) shall be gunmetal double headed type conforming to IS: 5290 complete with hand wheel, quick coupling, spring and blank cap.

Instantaneous pattern double headed hydrant valve, branch pipe and nozzle to be provided in the fire hose cabinet. The landing valves shall be fitted with instantaneous coupling conforming to IS: 901. The coupling shall be fitted with an internal plug secured by a chain. Landing valves shall be installed on hydrant risers at a height of 1.0 to 1.2 mtrs from the finished floor level. The landing valves shall be connected to the wet riser stand pipes by means of a suitable tee, the cost of which is deemed to be included in the unit rate for piping.

11.0 HOSE PIPES

Heavy duty hose pipe 63mm dia 2 nos 15M length in FHC inside the building and 2nos. of 15 mts length in external hose cabinet with 63mm dia. The hose shall be made as per IS: 636,

12.0 HOSE CABINET

Hose cabinet shall be glass (4 mm thick) fronted with double hinged door and lock. The cabinet shall be made of 16 SWG M.S sheet and spray painted to scarlet red color with word "FIRE". The hose cabinet shall be of suitable size to accommodate the following: -

- Landing valves (Single Headed).
- 63 mm hose pipe (2 lengths of 15 mtrs each).
- Branch pipe and nozzles (one set).
- Two keys of break glass recess for keys.

13.0 BRANCH PIPE AND NOZZLE

Branch pipes shall be of gun metal to fit into the instantaneous coupling. Nozzle shall be of spray or fog type of diameter of not less than 16 mm and not more than 25mm. Branch pipe and nozzle shall be of instantaneous pattern.

14.0 FIRE BRIGADE CONNECTION

Fire brigade inlet connection to the wet riser shall be comprised of four instantaneous pattern 63 mm dia. inlets with caps and chains complete with non-return valve housed in a 16 gauge MS cabinet with 4mm thick glass fronted door. The cabinet shall be 1000

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mm x 300 mm x 400 mm size for recess mounting. Similarly, fire brigade inlet connection for tank filling comprised of two instantaneous pattern 63mm dia inlets with caps and chains with non- return valve housed in 750mm x 300 x 400mm cabinet.

15.0 AIR RELEASE VALVES

Provide 20mm screwed inlet GM single acting air release valve on all high points in the system or as shown in the drawings.

16.0 DRAIN VALVES

Provide 50mm dia GI pipe conforming to IS 1239 heavy class with 50mm Butterfly valve for draining any water in the system in low pockets.

17.0 TESTING

After laying and jointing, the piping shall be pressure tested by hydrostatic method. The piping shall be slowly filled with water in order to expel all the air. The piping shall then be allowed to stand full of water for 24 hours. Any leakages at flanges or elsewhere shall be rectified. The pressure shall then be applied by means of a test pump (either electric or hand operated). The test pressure shall not be less than 1.5 times the working pressure of the system.

Pressure gauges used for the test shall be accurate and shall preferably have been recalibrated before the test. The open ends of the piping shall be plugged during the test. Capacity of pumps shall be checked with respect to the contractor's piping and equipment layout. Tests shall be conducted to determine the delivery head, flow and BHP of pumps after installation. All the test results shall correspond to the performance curves. All the leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer.

The system shall also be tested for its desired performance and function by opening hydrant valves on each floor separately and four landing valves simultaneously. The flow of water at the top most hydrants shall be checked when three landing valves below are open. The cutting in and cutting out pressure setting of starting device shall also be checked for its correct operation.

Contractor to rectify all leakage, make adjustment and retest as required and directed to the satisfaction of the FBA authorities and the Employer.

The test results shall be recorded and countersigned by Engineer and the same shall be submitted in triplicate for approval to the Engineer.

C. FIRST AID FIRE EXTINGUISHERS

1.0 Work under this section shall consist of furnishing all labour material appliances and equipment necessary and required to install fire extinguishing hand appliances.

2.0 Without restricting to the generality of the foregoing, the work shall consist of the following.

2.1 Fire Extinguishers shall conform to the following Indian Standard Specifications as revised and amended up to date.

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Soda Acid Type	:	IS 934-1967
Foam Type	:	IS 933-1967
Dry Powder Type	:	IS 2171-1962
Fire Buckets	:	As per ISI
Carbon Di-oxide	:	IS 2878/1976
Water Base ABV	:	IS 940/1976
Mechanical Foam Type	:	IS 10204

3.0 Fire Extinguishers shall be installed as per Indian Standard Code of practice for selection, installation and maintenance of portable first aid appliances IS 2190-1971.

4.0 The appliances shall be installed in readily accessible locations with the appliances brackets fixed to wall by suitable anchor fasteners.

5.0 Operating instruction shall be provided and mounted in a brushed stainless steel frame with a clear plastic cover adjacent to the control panel. The instructions shall include the following:

5.1 Procedure to follow when fire is detected.

5.2 How to reset and test the entire system after trouble or fire is detected.

5.3 Scaled sketch of the building showing location, type and the zone to which all detectors and manual pull stations are connected.

D. PUMPS AND ACCESSORIES

1.0 GENERAL

Firewater to the complete fire protection system shall be catered through Overhead Tanks of capacity **10000 Lts.**

The pumps shall be exclusively used for firefighting purposes and shall be provided as per the requirements of the National Building Code-2016.

1.1 GENERAL REQUIREMENT

The electrical pump shall be horizontal centrifugal Single stage; Single outlet pump designed for continuous operation and shall have a continuously dropping head characteristic without any zone of instability. The power capacity characteristic shall be non over loading type.

The head vs. capacity, input power vs. capacity characteristics, etc., shall match to ensure load sharing and trouble free operation throughout the range.

In case of accidental reverse flow through the pump, the driver shall be capable of bringing the pump to its rated speed in the normal direction from the point of maximum possible reverse speed.

The contractor under this specification shall assume full responsibility in the operation of the pump and the drive as one unit.

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

An automatic air release valve shall be provided to vent air from the pump discharge and also to admit to the pump to dissipate the vacuum there, upon stopping of the pump. This valve shall be located at the highest point in the discharge line between the pump and the discharge check valve.

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

1.2 PUMP CASING

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

1.3 IMPELLER

The impeller shall be of standard bronze and shall be dynamically balanced. The impeller shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings.

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

1.4 SHAFT

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

The shaft shall be of stainless steel AISI-410 (ASTM – A – 276 Type 410) (BS 970 410 S 21) ground and polished to final dimensions and shall be adequately sized to withstand all stresses from motor weight, hydraulic loads, vibrations and torques coming in during operation.

Pump Shaft-Motor Shaft Coupling All shafts shall be connected with adequately sized flexible couplings with spacer of suitable approved design. Necessary guards shall be provided for couplings.

1.5 BASE PLATE

A common base plate mounting both for the pump and drive shall be provided with anti vibration mounting pads. The base plate shall be of 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.,

The Fire protection system contractor shall give all necessary details, drawings, foundation bolts, necessary templates and other relevant details to the civil contractor for carrying out the structural foundation for installing all the pumps.

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1.6 VIBRATION AND BALANCING

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

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

1.7 INSTRUCTION MANUAL AND TOOLS/SPARES

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

Recommended tools / spares shall be provided and their unit rate breakup shall be provided by the contractor.

1.8 ELECTRIC MOTORS

The motor shall be rated not to draw starting current more than 6 times normal running current. Motor shall be capable of driving the pumps at 150% of its rated discharge and shall be designed for continuous full load duty. The motor shall be capable of handling the required starting torque of the pumps. Speed of motor shall be compatible with the speed of the pump.

The cooling fans shall be directly driven from motor shaft.

Motor situated out door or exposed to the weather shall be weather protected.

Motors shall be enclosed type and shall have dust tight construction with suitable means of breathing and drainage to prevent accumulation of water from condensation. Drain holes shall exclude bodies greater than 6mm diameter.

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

All motors shall be dynamically balanced.

The enclosure shall be designed to provide an effective sealing between the primary and secondary air circuits.

Winding insulation shall be class B 415V AC motor and winding shall be vacuum impregnated with heat and moisture resistant varnish glass fiber insulated.

Two independent earthing points shall be provided in accordance with IS: 3043 on opposite sides of the motor for bolted connection.

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

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2.7 INSTRUMENTATION

Operating Condition for Pumps

Operating Pressure	Start	Stop
Terrace Booster Pump	2.5 kg/sq.cm- Automatic	3.5 kg/sq.cm.- Automatic

F. 415 VOLTS FIRE PUMP PANEL

1.0 SCOPE OF WORK:

This Section covers the detailed requirements of medium voltage switch panel for 415 V, 3 phase 50 Hz 4 wire system. These shall be branded and fabricated from a factory of repute. All switch gears shall be fully rated at an ambient of 45°C.

2.0 GENERAL INFORMATION:

The medium voltage switch board panel shall comprise of any one of the following types of switch gears or combination thereof as specified.

(a) Air Circuit breakers draw out or fixed type.

(b) Switch Disconnector Fuse Units fixed type, MCCBs of suitable Ics ratings. MCCBs shall invariably be Current Limiting type. Features like Double Break, Positive Isolation functions shall be preferred.

The Panel shall be indoor type having incoming sectionalization and outgoing switch gears as specified. The design shall be of Form 4A/3B type. The degree of enclosure protection shall be IP 42 as per IS 13947 (Part-I).

3.0 CODES AND STANDARDS:

The equipment covered by this specification shall unless otherwise stated be designed, constructed and tested in accordance with the requirements of the Indian Electricity Act and Rules and latest revision of the following standards.

IS 375	:	Arrangement of bus bars, main connection and auxiliary wiring
IS 722	:	AC Electricity Meters
IS 1248	:	Direct acting electrical indicating instruments.
IS 1822	:	Motor starters AC for voltages not exceeding
IS 8544	:	1000 V Direct-on-line AC starters
IS 2147	:	Degrees of protection provided by enclosures for low voltage switchgear and control gear
IS 2419	:	Dimensions of panel mounted electrical indicating and recording instruments

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IS 2705	:	Current Transformers
IS 2959	:	Contactors for voltages not exceeding 1000 V AC or 1200 V DC
IS 3231	:	Electrical relays for power system protection
IS 4064	:	Air-break switches, air-break disconnectors, air break switch disconnectors and MCC units for voltages not exceeding 1000 V AC or 1200 V DC
IS 3842	:	Application guide for electrical relays for AC System
IS4237	:	General requirements for switchgear and control gear for voltages not exceeding 1000 volts.
IS 4483	:	Preferred panel cutout dimensions for electrical relays
IS5124	:	Induction motor starters, AC (voltage not exceeding 1000 V) installation and maintenance code of practice.
IS 5987	:	Selection of switches (voltage not exceeding 1000 V)
IS 6875	:	Control switches for voltages upto and including 1000 V AC and 1200 DC
IS 8588	:	Code of practice for thermostatic bimetals Part-I general requirements and method of tests
IS 8623	:	Factory built assemblies of switchgear and control gear for voltages up to and including 1000 V AC and 1200 V DC
IS 8828	:	Miniature air break circuit breakers for voltages not exceeding : 1000 Volts.

4.0 DESIGN REQUIREMENT

- 4.1 The switchboards shall be designed for 400/440 V, 3 phase 4 wire, 50 c/s supply.
- 4.2 Switchboards shall be suitable for direct online starting of all motors.
- 4.3 Control power supply of the Switchboards shall be 415 Volts, single phase, 50 Hz AC supply tapped for the respective module itself.
- 4.4 The switchboards manufacturers shall apply all de rating factors necessary to all components of the switchboards to comply with the conditions detailed in this specification.

5.0 CONSTRUCTIONAL FEATURES:

- 5.1 The switchboard shall be floor mounted free standing totally enclosed and extensible type. It shall be made from CRCA sheet steel of 1.6 mm thickness for body , 2mm thickness for frame work and covers, 3mm thickness for gland plates with stiffeners where ever required and shall be dust and vermin proof construction. It shall be suitable

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for the climate conditions as specified. The design shall include all provisions for safety of operation and maintenance personnel. The general construction shall conform to IS 8623:1993 for factory assembled switch board. The panel must be a vibration free structure which is chemically treated with seven tank process before painting for surface treatment and powder coated with two coats of Zinc chromate primer and two coats of paint of approved shade. Fire and corrosion resistant coating similar to VIPER FR-1101 applied in two coats with necessary primer. The panel must be have suitable capacity extensible type TPN copper/Aluminium bus bars, Fire retardant DMC/SMC fillings for openings around bus bar near the sectional barriers.

Any panel exceeding 1.5 m shall be made in parts(sections) not exceeding 1.5 m.

5.1.2 Cubical Type Panels

Cubical type panels shall be fabricated out of sheet steel not less than 1.6 mm thick. Wherever necessary, such sheet steel members shall be stiffened by angle iron frame work. General construction shall employ the principle of compartmentalization and segregation for each circuit. Unless otherwise approved, incomer and bus section panels or sections shall be separate and independent and shall not be mixed with sections required for feeders. Each section of the rear accessible type panel shall have hinged access doors at the rear. Overall height of the panel shall not exceed 2.3 meters. Operating levers, handle etc. of highest unit shall not be higher than 1.7 meters. Multi-tier mounting of feeder is permissible. The general arrangement for multitier construction shall be such that the horizontal tiers formed present a pleasing and aesthetic look. The general arrangement shall be approved before fabrication. Cable entries for various feeders shall be either from top or bottom. Through cable alleys located in between two circuit sections, either in the rear or in the front of the panel. All cable terminations shall be through gland plates. There shall be separate gland plate for each cable entry so that there will not be dislocation of already wired circuits when new feeders are added. Cable entry plates shall therefore be sectionalized. The construction shall include necessary cable supports for clamping the cable in the cable alley or rear cable chamber Cubicle panels with more than 1000 Amps bus shall be made of tested structural modular sections.

5.2 Bus Bar and Connections

The panel must be have suitable capacity extensible type TPN copper/Aluminium bus bars of high conductivity electrolytic quality and of adequate section. Fire retardant DMC/SMC fillings for openings around bus bar near the sectional barriers. Current density for copper shall not exceed 120 amps/sq. cm., and 80amps/sq.cm. The bus bar system may comprise of a system of main horizontal bus bars and ancillary vertical bus bars run in bus bar alleys on either side of which the circuit could be arranged with front access cable entries.

In the case of rear access, horizontal bus system shall run suitably either at the top or bottom. All connections to individual circuits from the bus bar shall preferably be solid connections; however flexible connections shall also be permitted as per recommendations of the Panel Manufacturer. All bus bars and connections shall be suitably sleeved / insulated in approved manner.

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5.3 Incomer / Termination

Incomer termination shall be suitable for receiving bus trunking / cables (Bottom/Top entry). Cable terminations shall invariably be through terminal blocks (PVC Polyamide or superior) or brought out solid terminals.

5.4 Instruments

All voltmeters and ammeters shall be flush mounted of size minimum 96 mm conforming to class 0.1 of IS 1248 for accuracy. All voltmeters shall be protected with MCB.

5.5 Indicating Lamps

On all the incomers of M.V panels, ON/OFF indicating LED lamps shall be provided and shall be suitable for operation on AC supply. Phase indicating LED lamps shall be associated with necessary ON/OFF toggle switch.

5.6 Small Wiring

All small wiring for Controls, Indication etc. shall be with suitable PVC insulated 2.5 sq.mm FRLS copper conductor cables. Wiring shall be suitably protected within switch board. Runs of wires shall be neatly bunched, suitably supported and clamped. Means shall be provided for easy identifications of the wires. Where wires are drawn through steel conduits, the works shall conform to NEC General Specifications for Electrical Works as the case may be. Identification ferrules shall be used at both ends of the wires. All control wiring meant for external connections are to be brought out of terminal board.

6. OPERATIONAL REQUIREMENTS

The indoor type MV panel shall conform to the following: -

- (a) The panel shall comprise of incomers, outgoing feeders and bus coupler as specified. The incomer shall be either a double break / contact repulsion MCCB or an Air Circuit Breaker. The bus coupler shall be either a circuit breaker or a double break / contact repulsion MCCB or switch dis-connector fuse unit as specified. The outgoing feeders shall be circuit breakers/ MCCBs as specified.
- (b) Bus bars for phase and neutral shall have a rating as specified in the format of Appendix II.
- (c) The entire switch panel shall be cubical type generally conforming to IS 8623:1993 for factory assembled switch board.
- (d) The incomer panel shall be suitable for receiving bus trunking or MV cable of size specified either from top or from bottom.
- (e) All incoming AIR CIRCUIT BREAKER/ MCCB shall have suitable adjustable tripping current and the time delay settings.
- (f) The entire panel shall have a common earth bar of size as specified with two terminals for earth connections.

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6.1 RATING AND REQUIREMENTS

6.1.1 Air Circuit Breaker

All Air Circuit Breakers shall be 3/4 pole, EDO type, with minimum 65 KA breaking capacity (35 MVA at 433V) conforming to IS 13947 (Part-II). Rated current shall be as per capacities specified. The equipment shall be complete with the following: -

- (a) Necessary circuit breaker carriage with 3 position (isolate, test, service) draw out mechanism. The ACB shall be preferably double breaking type with line load reversibility and suitable for positive isolation, the breaking capacity of ACB shall be $I_{cs} = I_{cu}$.
- (b) Necessary isolating plugs and sockets.
- (c) Necessary mechanism interlock and automatic safe shutters gear with arrangement for pad locking.
- (d) Necessary independent motor cum manual spring mechanism with mechanical On/Off/trip indication as well as electrical On/Off & trip indication.
- (e) Necessary bus bars with bolted type neutral links.
- (f) ACB shall be provided with microprocessor based releases having built in over load, short circuit, shunt trip & earth fault protection. Microprocessor release shall be EMI (Electro Magnetic Induction)/ EMC (Electro Magnetic Compatible) certified.
- (g) With necessary 2 C/O auxiliary contacts terminal shrouds sliding type front operation kit the trip unit shall be interchangeable
- (h) Necessary set of CTs with ratios as specified.
- (i) Necessary identification, metering requirements as specified i/c. ON/ OFF indication lamps, selector switches, fuses, ammeter, voltmeter etc.
- (j) In case of 4 pole breaker neutral shall be fully rated with adjustable settings from 50% to 100% of I_n .
- (k) ACB terminals shall be suitable/ suitably brought out for direct aluminum termination as per IS 13947 Part-II.

Note: Wherever fixed type circuit breakers are required, it shall be clearly specified in Appendix II. Also refer Appendix V for further guidelines.

6.2 Switch Disconnecter Fuse Units /MCCB

6.2.1 MCCB

All MCCBs shall be current limiting type with features of load line reversibility and suitable for Horizontal/ Vertical mounting without any de rating. Beyond 300 Amps capacity MCCBs shall have positive isolation and preferably double break / contact repulsion & double insulation features. The MCCBs shall invariably be used with terminal spreaders. The MCCBs less than 160 A rating shall have thermal based O/L,S/C,E/F & S/T release. The MCCBs more than 160 A rating shall have microprocessor based O/L,S/C,E/F & S/T release.

6.3 Metering

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Multi Data Meter (MDM) of type Circutor NRG 96 with RS485. It is a 4 quadrant class 0.5 class Multi data meter. The CVM-NRG 96 measures, calculates and displays the main electrical parameters in three phase, balanced or unbalanced industrial systems. Measurements are taken in true effective value using the three alternating voltage inputs and three current inputs to measure 5.A secondary's from external measurement Simple Voltage, Compound voltage, Current A, Frequency Hz, Active power kW , Reactive Power L kvarL , Reactive Power C- kvarC , Apparent Power kVA , Power Factor PF , Cos ϕ , Maximum Demand Pd , Neutral Current IN , Voltage THD % : THD – V , Current THD % : THD – A , kWh (consumption and generation) Wh , kvarh. (consumption and generation) W·h , kvarh.C (consumption and generation) W·h , kVAh (consumption and generation) Wh , Harmonic decomposition (V and A).

The CVM-NRG 96 allows the display of all electrical parameters shown above, using the back-lit LCD display, showing 4 instant electrical parameters, maximum or minimum on each page jump.

6.4 CONTACTORS

Contactors shall be of the air break type, they shall be of the uninterrupted rating and contacts shall either be silver contacts or de-rated to allow for this duty. The contactors shall be category AC3 and have a no-load operating cycle of 1 million operations.

All contactors shall be of the block type and contacts shall be of the self cleaning type and easily renewable.

The design shall be such as to prevent welding in. All operating coils of contactors shall be able to operate on the control system voltage of the main low voltage switchgear.

Each contactor shall be so screened from adjacent units and current carrying parts that it is possible to carry out maintenance work in complete safety, while other equipment in the panel remains alive on load.

Means of isolation shall be provided to isolate all primary and secondary circuits to contactors, but means shall be provided to temporarily re-instate interlocks or other circuit interconnections with equipment which is required in service whilst the contactor is isolated.

6.5 MOTOR STARTER / ISOLATORS

Motor starter/isolators, where separately mounted shall be surface mounted assemblies enclosed in a rust-protected sheet steel enclosure with a semi-gloss stove finish and with a degree of ingress protection (IP rating) to IP 54 against dust and splashing liquid, unless otherwise stated.

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The units shall comprise main “ON/OFF” isolating switch, mushroom-head stop button and flush mounted start button, and run trip indicating lamps.

The starter assembly shall be of the direct-on-line/star-delta or auto-transformer type of the kW ratings as indicated on the Contract drawings and all starters shall comply with BS 4941 and shall be suitable for intermittent or frequent mechanical duty according to the requirements of the plant.

Terminal markings shall be in accordance with BS 822, 1969. Part 6. Control circuits shall be operated at a voltage not exceeding 240 volts.

6.5.1 DOL STARTER

This shall be of double break type and shall incorporate air break contactor with bi-metallic thermal electromagnetic overload relays with start & stop push button. The starter shall be capable of 10 operations per hour and shall conform to IS: 1822.

6.5.2 STAR / DELTA STARTER

This shall conform to IS: 1822-1967 or latest and shall be of fully automatic type with an adjustable timer incorporated for automatic change-over from star to delta. The starter shall incorporate the electromagnetic or thermal type bi-metallic overload release pneumatic electro time delay relay, the solenoid coil operated under voltage release and current operating single phasing preventer.

6.6 TESTS AT MANUFACTURERS WORK

All routine tests shall be carried out and test certificates produced to the clients.

6.7 INSTALLATION

The installation work shall cover assembly of various sections of the panels lining up, grouting the units etc. In the case of multiple panel switch boards after connecting up the bus bars etc., all joints shall be insulated with necessary insulation tape or approved insulation compound. A common earth bar as per section 7 of these specifications shall be run inside at the back of switch panel connecting all the sections for connection to frame earth system. All protection and other small wirings for indication etc. shall be completed before calibration and commissioning checks are commenced. All relays, meters etc. shall be mounted and connected with appropriate wiring.

6.8 TESTING AND COMMISSIONING

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Commissioning checks and tests shall include all wiring checks and checking up of connections. Relay adjustment/setting shall be done before commissioning in addition to routine Megger tests. Checks and tests shall include the following: -

- (a) Operation checks and lubrication of all moving parts.
- (b) Interlock function checks.
- (c) Continuity checks of wiring, fuses etc. as required.
- (d) Insulation test: When measured with 500 V Megger the insulation resistance shall not be less than 100 mega ohms.
- (e) Trip tests and protection gear test.

7.0 SPECIFICATION FOR MEDIUM VOLTAGE CABLES

7.1 SCOPE

This section covers supply, laying and jointing as required and testing and energizing all cable work.

7.2 SPECIFICATION OF CABLE

7.2.1 11KV grade XLPE insulated PVC sheathed armoured Aluminum/ Copper cable shall be 3 core earthed of sizes as specified. The cable shall conform to IS 7098.

7.2.2 1.1 KV grade 1C/3C/3.5C/4C XLPE insulated, and PVC inner & outer sheath, stranded aluminium / Copper conductor, flat steel strip/ wire armoured cables conforming to IS:7098/ Part I (with latest amendments).

7.2.3 All control wires shall be 650 V grade copper conductor PVC insulated, conforming to as per IS 1554 (1964 - Part - I). The minimum size of the control wires shall be 1.5 sq. mm.

7.3 CORE IDENTIFICATION:

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

- 1 Core : Red/Black/Yellow/Blue.
- 2 Core : Red and Black
- 3 Core : Red, Yellow and Blue
- 3 .5 / 4 Core : Red, Yellow, Blue & Black.

7.4 CABLES AND OTHER ITEMS:

- i) Specifications for XLPE Cables : IS 7098 (1988- Part – I)
- ii) Specification for PVC insulated (Heavy duty) electric cables for voltage up to 1100 Volts. : IS 1554 (1964 - Part - I)
- iii) Specifications for PVC insulated : IS 694 (1988 - Part - II)

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cables for voltage up to 1100V
with aluminium conductors.

iv) Glossary of terms for electrical cables and conductors. : IS 1885 (1971)

v) Code of practice for safety of buildings (General) Electrical installation. : IS 1646 - 1961

7.5 Storing, Laying, Jointing and Terminations

7.5.1 Storing

All the cables shall be supplied in drums. On receipt of cables at site, the cables shall be inspected and stored in drums with flanges of the cable drum in vertical position..

7.5.2 Laying

Cable shall be laid in RC pipes/cable trays and on walls as specified. Installation shall include all supports and clamps as required. The complete work shall be in accordance to NEC General Specifications for Electrical Works up to date. As far as possible cables shall not be fixed on walls directly but laid on cable trays.

7.5.2.1 Cables In Hume pipes

Cables shall be laid in RC pipes of suitable diameter. The depth of the laying RC pipes shall not be less than 750 mm from the final ground level for LT cables and not less than 1.2 m from ground level for HT cables. Wherever cables are bent, the minimum bending radius shall not be less than 12 times the diameter of the cable. After the cable is laid and straightened, it shall be covered with sand cushion. Approved cable markers made of CI indicating the voltage, no. of cables and the direction of run of the cables shall be installed at regular intervals.

7.5.2.2 Cables in cable trays

The cables shall be laid on Pre Galvanized/Hot dip galvanized, assembled Ladder/perforated Type cable trays fabricated out of Single Sheet Steel Confirming to I.S. 1079 : 1973 / I.S. 513: 1994 including horizontal and vertical bends ,anchor fastner and C channel,G.I bolt, reducers, tees, cross members at 300 mm interval and other accessories as required.

7.5.2.2A CABLE TRAYS - CONSTRUCTION NOTES

I) LADDER TYPE

- A) Prefabricated factory assembled bolted rung type ladder type cable trays shall be made out of hot dip/Pre galvanized (Hot dip galvanized should be minimum of 40/50microns zinc coating) G.I Sheeted galvanized sheet steel & slotted rungs shall be complete with associated accessories such as coupler plates, tees, elbows etc., the trays shall be fabricated from Minimum 2 mm thick sheet steel for 600mm & below widths & 2.5/3 mm thick steel sheet for 600 mm & above widths. Cable

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tray covers shall be fabricated from 16 gauge perforated (1.60 mm thick) hot dip galvanized sheets (cover shall be provided if specified in the BOQ).

- B) The cable trays shall be supplied in standard lengths of 2500 mm and clear inside widths x height of trays shall be as follows:

Ladder type trays Sizes (mm): To be as per Drawing and BOQ specification.

- C) Cable trays, accessories and covers shall be hot tip galvanized/G.I.Type.
- D) Cable trays of width 450 mm & above shall be duly suspended from the ceiling with fabricated MS angle supports / pre fabricated (as per BOQ) at 600 mm interval as required. The support steel sections shall be applied one coat of red oxide primer and two coats of finish paint of approved color.

Cable trays of width less than 450 mm shall be duly suspended from the ceiling with fabricated Hi-tech rods at 600 mm interval as required.

- E) All finished cable trays and accessories shall be free from sharp edges, corners, burrs and unevenness.
- F) All welded joints should be proper coated with Zinc paint.

II) PERFORATED TYPE

- A) The perforated type cable trays shall be fabricated out of hot dip galvanized /Pre galvanized (Hot dip galvanized should be minimum of 40/50microns zinc coating)sheet steel, the associated accessories such as coupler plates, tees, elbows etc., shall be fabricated from 2.5mm thick for trays above 600mm, up to 300mm shall be with 2mm hot dip galvanized steel sheets. Cable tray covers shall be fabricated from 16 gauge perforated (1.60 mm thick) hot dip galvanized sheet steel (cover shall be provided if specified in the BOQ).
- B) The cable trays shall be supplied in standard lengths of 2500 mm and clear inside widths x height of trays shall be as follows:

Perforated type trays Sizes (mm) : To be as per Drawing and BOQ specification.

- C) Cable trays, accessories and covers shall be hot dip galvanized/G.I. Type.
- Cable trays of width 450 mm & above shall be duly suspended from the ceiling with fabricated MS angle supports / pre-fabricated (as per BOQ) at 600 mm interval as required. The support steel sections shall be applied one coat of red oxide primer and two coats of finish paint of approved color.
- Cable trays of width less than 450 mm shall be duly suspended from the ceiling with fabricated Hi-tech rods at 600 mm interval as required.
- D) All finished cable trays and accessories shall be free from sharp edges, corners, burrs and unevenness.
- E) All welded joints should be proper coated with Zinc paint.

III) CABLE TRAYS - INSTALLATION NOTES

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Cable trays shall be installed generally at the elevations shown in respective cable tray layout drawings. If any major modifications in the drawings are envisaged in the field, these should be carried out after getting approval from Consultant. Before laying the trays, contractor shall submit the shop drawing & take the approval from Client/ Consultant.

- A) It shall be the responsibility of the electrical contractor to mark up all the field modifications on the latest issues of the drawings and return two copies of all such “ as constructed ” drawings to Client/ Consultant.
- B) The type and size of tray to be used shall be as mentioned in the individual layout drawings.
- C) The maximum size of cable tray when used in trenches shall be of 750 mm width.
- D) Cable trays shall be welded to the mounting/ carrier structures. Trays shall be supported with suitable M.S.angle/ hi-tech rod supports/threaded rod with proper intervals.
- E) Each continuous laid out length of cable tray shall be earthed at minimum two places by M.S. flats of minimum size 25x3 mm (unless otherwise noted) to the purchaser’s earthing system. The distance between earthing points shall not exceed 10 meters.
- F) The following shall be checked before laying the cables on trays.
 - a) Check for proper painting and identification nos. of the trays.
 - b) Check for continuity of cable trays over the entire route.
 - c) Check that all sharp corners, burrs and waste materials have been removed from the tray.
 - d) Obtain clearances from piping contractor/other agencies engineer that no piping will be taken in the way of cable trays.
 - e) Check for earth continuity & earth connection of cable trays.
 - f) Cable tray installation work shall comply with all currently applicable statutes regulations and safety codes in the locality where the installation is to be carried out.

7.5.3 JOINTING FOR 1.1 KV GRADE CABLE GLANDS

Jointing work shall be carried out only by licensed experienced cable jointer and shall be in accordance to NEC General Specifications for Electrical Works amended upto date.

Each terminations for the following 1.1 kV grade XLPE insulated armoured aluminium / copper conductor cable shall be carried out using brass compression

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glands and cable sockets, including supply of all materials like cable Single compression gland for cables of size less than 120 sq.mm & Double compression glands(120 sq.mm& above), Tinned copper lugs long barrel, neoprene bushes, and interconnections, earthing, complete as required and as directed by EIC. Hydraulic crimping tool shall be used for making the end terminations. Suitable identification tags with the feeder designation inscribed on an aluminium/G.I. sheet shall be tied to either ends of each cable.

7.5.3.1 Acceptable Termination Methods for cables

A) GENERAL REQUIREMENTS

The general requirements for terminations of Aluminium cables shall be:

- a) To remove oxide from the conductor and prevent the oxide re-forming.
- b) To prevent corrosion resulting from contact between dissimilar metals.
- c) To retain contact pressure under cyclic loading conditions.

For all Aluminium cables, the oxide shall be removed by thoroughly wire-brushing the bare end of the cable. After brushing, a liberal coating of approved oxide-inhibiting, moisture-excluding thermally stable grease shall be applied, and the cable shall be wire-brushed again through the grease. Cable strands shall not be separated before brushing.

Bare Aluminium lugs, ferrules and other connectors, unless factory-tinned or factory pre-filled with inhibiting grease, shall be wire-brushed and contact grease coated in the same way as cables.

Before making any joints or terminations in Aluminium cables, the Contractor shall submit the proposed method to the Client/ Consultants for approval. Notice shall be given before making any joints or terminations, to enable the Client/ Consultants to witness the work.

B) ACCEPTABLE JOINT/ TERMINATION METHODS

Aluminium to Aluminium connections shall be made by one of the following methods:

- Aluminium crimp lugs or tinned copper lugs.
- Fusion welding with Aluminium lugs.

Tinned copper lugs shall be terminated using the compression method. For compression connections on stranded cables, a hexagonal die shall be used. On solid conductor cables, indent type dies shall be used, with at least two indentations per cable connection. Lugs shall be selected to suit the size and shape of the conductor. Compression dies shall be selected to suit the particular lug or ferrule. Aluminium crimp lugs shall be filled with oxide inhibiting contact grease.

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Joints by the fusion welding method shall be made by jointers experienced in this method. Particular care shall be taken to protect the cable insulation from heat by fixing substantial heat sinks to the cable near the joint. After completion of the weld the joint shall be wire brushed and all sharp projections filed smooth.

Aluminium to copper connections shall be made by one of the following methods:

- Bi-metal connectors, or
- Tinned copper lugs or
- Electro-tinned cast Aluminium lugs.

Bi-metal connections shall consist of lugs or pin type connectors having a cast copper palm or pin, friction-welded to an Aluminium barrel section which is subsequently factory filled with oxide-inhibiting grease. The Aluminium cable shall be inserted in the barrel section and fixed using the compression method as detailed above. The copper pin or palm section shall be fixed to copper or brass connectors or bus-bars in the conventional manner. Tinned copper lugs shall be terminated using the compression method.

Where electro-tinned Aluminium lugs are used, they shall be fixed to the cable using the compression method. The palm of the lug shall be bolted to the copper bus-bar or terminal using a bolt and nut, with one large diameter flat washer and two "Belleville" spring cup washers.

All nuts shall be adequately torque tightened to manufacturer's recommended levels. Identification tags for feeder designation shall be by using cable tags tied to either end of each cable.

All cable glands & cable armour shall be earthed properly with earthing clamps & braided copper wires.

All cable glands shall be of double compression type for higher size, single compression for low size cables & lugs shall be Aluminium for Aluminium cables & copper for copper cables.

7.6 TESTING

Cables shall be tested at factory as per the requirements of IS 7098 Part I. The tests shall incorporate routine tests, type tests and acceptance tests. Copy of such test certificates shall be furnished to the Developer prior to dispatch.

7.7 POWER DISTRIBUTION SYSTEM LOSSES

The power cabling shall be adequately sized as to maintain the distribution losses not to exceed 1% of the total power usage. Record of design calculation for the losses shall be maintained. The cables be designed as per the voltage drop regulations (<3%) at peak load, and the losses be calculated on the basis of the assessed load during the day, week and year and should not be limited to the peak load

8.0 SPECIFICATION FOR EARTHING

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8.1 SCOPE

This section covers the general requirements of the earthing system for Utility block, STP & PHE pump rook & security blocks installation. G.I. plate earthing with G.I. strip for body earthing and copper plate earthing for Equipment Neutral Earthing.

8.2 SYSTEMS

Earthing system shall comprise earth electrodes in accordance with clause of NECI Specifications for Electrical Works. For every additional transformer 2 more separate and distinct earth electrodes shall be provided for neutral earthing. The body earthing for transformers, HV & MV panels shall be done to a common earth bus connected to two separate and distinct earth electrodes.

Note: For each transformer, the total number of earth electrodes shall be 4 (2 for neutral and 2 for body earthing).

8.3 ELECTRODES

The earth electrodes shall be as per NEC General Specifications for Electrical Works.

8.3a GI plate earthing

GI Earth plate 600 x 600 x 3.15mm GI plate confirming to IS 3043 with latest amendments & as per standards.

Two Nos. of 50 x 06mm GI Earth strip run in parallel from Earth Plate up to Earth Test Link/Bus of size 50 x 06mm provided on top. One No. GI Watering Pipe 40mm dia x 3mt long, along with GI Funnel & wire mesh

The mixture of charcoal & salt should be provided at 150mm all around the peripheral area of Earth Plate. The brick chamber along with the RCC/IL approved hinged type cover of 450mm x 450mm should be provided to cover the earth pit.

The job is including excavation, civil work & the excess soil will have to remove from the site location. The resistance of earth pit should be less than 1.0ohm. (These Earth Pits shall be provided for Body of H.T. Panel, D.G., LT panels & transformers, etc.)

8.3b Cu Plate earthing

Copper Earth Plate 600 x 600 x 6mm electrolytic Copper plate confirming to IS 3043 with latest amendments & as per standards.

Two Nos. of 50 x 6mm copper strip run in parallel from Earth Plate up to Earth Test Link/Bus of size 50 x 6mm provided on top.

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One No. GI Watering Pipe 40mm dia x 3mt long, along with GI Funnel & wire mesh. The mixture of charcoal & salt should be provided at 150mm all around the peripheral area of Earth Plate. The brick chamber along with the RCC/IL approved hinged type cover of 450mm x 450mm should be provided to cover the earth pit.

The job is including excavation, civil work & the excess soil will have to remove from the site location. The resistance of earth pit should be less than 1.0ohm. (These Earth Pits shall be provided for Neutral of Transformer & D.G)

8.3c Earth strips

Supply and laying following sizes of GI/Copper wire/strips including supply of fixing clamps and accessories when laid inside the building and inclusive of excavation & refilling of earth when laid outside the building and interconnections with earth pit and equipment, terminations/ interconnections in an approved manner as per IS:3043 (with latest amendments) inclusive of supply of all hardwares complete as required. GI conductor joints shall be bolted and joints shall be protected with bitumen paint. Copper conductor joint shall be brazed or rivetted .The equipment connection shall be bolted using galvanized hardware or bolted by using passivated hardware.

8.4 LOCATION OF EARTH ELECTRODES

Normally an earth electrode shall not be situated less than 1.5 m from any building. Care shall be taken that the excavation of earth electrode may not affect the column footings or foundation of the building. In such cases electrodes may be farther away from the building. The location of the electrode earth will be a place where the soil has reasonable chance of remaining moist. As far as possible, entrances, pavements and road ways, are to be definitely avoided for locating the earth electrode.

8.5 WATERING ARRANGEMENT

Method of watering arrangement shall comply with NEC general specifications.

8.6 SIZE OF EARTH LEAD

The recommended sizes of copper earth bus lead shall be in accordance with clause of NEC General Specifications for Electrical Works amended up to date. The minimum size of earth lead shall be 25 mm x 5 mm copper or equivalent GI strip.

8.7 INSTALLATION

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All joints shall be riveted and sweated. Joints in the earth bar shall be bolted and the joints faces tinned. Where the diameter of the bolt for connecting earth bar to apparatus exceeds one quarter of the width of the earth bar, the connection to the bolt shall be made with a wider piece of flange of copper jointed to earth bar. These shall be tinned at the point of connection to equipment and special care taken to ensure a permanent low resistance contact to iron or steel. All steel bolts, nuts, washers etc. shall be cadmium plated, main earth bars shall be spaced sufficiently on the surface to which they are fixed such as walls or the side trenches to allow for ease of connections. Copper earthing shall not be fixed by ferrous fittings. The earthing shall suitably be protected from mechanical injury by galvanized pipe wherever it passes through wall and floor. The portion within ground shall be buried at least 60 cm deep. The earthing lead shall be securely bolted and soldered to plate or pipe as the case may be. In the case of plate earthing the lead shall be connected by means of a cable socket with two bolts and nuts. All washers shall be of the same materials as the plate or pipe. All iron bolts, nuts and washers shall be galvanized.

8.8 TESTING

After installation, the tests as specified in NEC General Specifications for Electrical Work shall be carried out and results recorded.

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G. TECHNICAL DATA

I. ELECTRICAL MOTOR DRIVEN BOOSTER PUMPS

1. Type :
2. Make :
3. Flow rate in LPM :
4. Delivery head in Mtrs :
5. Materials of impeller :
6. Rate speed in RPM :
7. Suction and delivery sizes in mm. :
8. Type of Drive recommended motor rating :
9. Recommended motor rating :
10. Material of casting shaft. :
11. Efficiency of the pump at rated capacity and head :

II. G.I.PPIPE :

1. Make :
2. Standard (IS/BS) :

V. LANDING VALVE :

1. Make :
2. Type :
3. Standard (IS/BS) :

III. BUTTERFLY VALVE

1. Make :
2. Material of seat :
3. Material of body :

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- IV. HOSE PIPES :
- 1. Make :
- 2. Material of body :
- 3. Whether as per IS :