

BOQ COMPLIANCES			
S.no	Description	Unit	Qty
5	Fire Pump and Accessories All Fire Pumps (including jockey pumps) shall be UL Listed with UL Listed Control Panel with all required accessories including pressure sensing lines and fire pump house design shall be validated by contractor to comply with requirements of NFPA20. The name plate on each and every pump motor should include technical specifications such as current rating, power, RPM, flowrate, Head, IP rating etc., dimensions and color code to be specified		
5.1	FIRE (HYDRANT and SPRINKLER)PUMP : Supply, installation, testing and commissioning of Electrical motor driven main pump of horizontal mounted, single/multi stage, split case/end suction and capable to deliver 2850 LPM, 80M HEAD The pump shall be coupled to TEFC motor of 150 HP or equivalent with speed of 2900RPM and complete set shall mounted on common base frame. The quoted rate shall includes providing and fixing of coupling, coupling guard, cushy foot mount, Anchor Fastener, UL Listed Panel, Anti vortex plate, <u>eccentric and concentric reducer</u> , Air Relief Valve, Circulation Relief Valve, Suction & Discharge Pressure Gauge etc., complete as per technical specification (all pumps are UL Listed). All control wiring from pump to panel including pressure sensing line and other associated accessories to make system functional shall be considered here only as per drawing and specification.	Set	2
	Suitable cement concrete foundation with plaster, (design and drawing to be provided by the Contractor while the foundation will be done by others) complete with Antivibration arrangement of cushy foot mounting. (Minimum 6 No-in each pump)		
5.2	FIRE WATER CURTAIN PUMP : Supply, installation, testing and commissioning of Electrical motor driven main pump of horizontal mounted, single/multi stage, split case/end suction and capable to deliver 5670 LPM, 50M HEAD The pump shall be coupled to TEFC motor of 200 HP or equivalent with speed of 2900RPM and complete set shall mounted on common base frame. The quoted rate shall includes providing and fixing of coupling, coupling guard, cushy foot mount, Anchor Fastener, UL Listed Panel, Anti vortex plate, <u>eccentric and concentric reducer</u> , Air Relief Valve, Circulation Relief Valve, Suction & Discharge Pressure Gauge etc., complete as per technical specification (all pumps are UL Listed). All control wiring from pump to panel including pressure sensing line and other associated accessories to make system functional shall be considered here only as per drawing and specification.	Set	1
	Suitable cement concrete foundation with plaster complete with Antivibration arrangement of cushy foot mounting. (Minimum 6 No-in each pump)		
5.5	JOCKEY PUMP FOR HYDRANT & SPRINKLER SYSTEM . Supply, installation, testing and commissioning of electrical motor driven Jockey pump of vertical centrifugal end suction back pull out type with gland packing and capable to deliver 180LPM, 80M HEAD . The pump shall be coupled to TEFC motor of 25 HP or equivalent with speed of 2900RPM and complete set shall mounted on common base frame. The quoted rate shall includes providing and fixing of coupling, coupling guard etc., complete as per technical specification and drawing.		
	Vertical Multistage centrifugal pump, suitable for operation on 415 volts $\pm$ 6%, 3 phase, 50 HZ A.C supply. The installation shall be complete with Flexible coupling and ss braded coupling guard, complete as required. Jockey pump shall be of stainless steel construction. The pump head and base shall be CI construction and impellers, diffusers, shaft sleeve, seal bush and pump shaft shall be in SS 304 material. The pump shall be provided with gland packing seal and capable for delivering 180 LPM at outlet head of 80 mts. The system shall be complete with necessary suction & discharge pressure gauge with gun metal shut off cock on delivery side (The pump should meet the condition and shall be gotten approved by the Local fire Authority). (For Sprinkler and Hydrant System)	Set	2
	Squirrel cage induction motor TEFC type for operation on 415 V, 3 phase 50 HZ AC supply for the above pump with a synchronous speed of 2900 R.P.M. with flexible coupling and coupling guard etc. as required.		
	Common base plate for pump and motor from M.S. channel as required size.		
	Suitable cement concrete foundation with plaster complete with Antivibration arrangement of cushy foot mounting. (Minimum 4 No-in each pump)		
5.6	JOCKEY PUMP FOR WATER CURTAIN SYSTEM : Supply, installation, testing and commissioning of electrical motor driven Jockey pump of vertical centrifugal end suction back pull out type with gland packing and capable to deliver 280LPM, 50M HEAD . The pump shall be coupled to TEFC motor of 25 HP or equivalent with speed of 2900RPM and complete set shall mounted on common base frame. The quoted rate shall includes providing and fixing of coupling, coupling guard etc., complete as per technical specification and drawing.		
	Vertical Multistage centrifugal pump, suitable for operation on 415 volts $\pm$ 6%, 3 phase, 50 HZ A.C supply. The installation shall be complete with Flexible coupling and ss braded coupling guard, complete as required. Jockey pump shall be of stainless steel construction. The pump head and base shall be CI construction and impellers, diffusers, shaft sleeve, seal bush and pump shaft shall be in SS 304 material. The pump shall be provided with gland packing seal and capable for delivering 180 LPM at outlet head of 80 mts. The system shall be complete with necessary suction & discharge pressure gauge with gun metal shut off cock on delivery side (The pump should meet the condition and shall be gotten approved by the Local fire Authority). (For Sprinkler and Hydrant System)	Set	1
	Squirrel cage induction motor TEFC type for operation on 415 V, 3 phase 50 HZ AC supply for the above pump with a synchronous speed of 2900 R.P.M. with flexible coupling and coupling guard etc. as required.		
	Common base plate for (a) and (b) from M.S. channel as required size.		
	Suitable cement concrete foundation with plaster complete with Antivibration arrangement of cushy foot mounting. (Minimum 4 No-in each pump)		
5.10	Supply, installation, testing and commissioning of recharged air vessel (size 450 mm dia and 2000 mm height) for pressurization of hydrant, sprinkler & water curtain system complete with 25mm dia drain valve, 100 mm dial pressure gauge, 25 mm dia air release valve with isolation valve on the top, minimum 50 mm dia inlet duly painted from inside and outside with two coats of synthetic enamel paint over a coat of primer complete as required as per technical specification and drawing. Contractor to design legs of air vessel using Hot dip galvanised 150X100mm C Channel with base plate of 250X250mm such that the ARV on top is above the crown of Main delivery header of fire pumps. (Vessel should be suitable for 1.5 times of the rated working pressure). Note: - Cost of accessories shall be included in this item head only.	Nos.	3

Complied with
Cushy Foot mount
& Anti vortex Plate
reducer in
Contractor Scope

Complied with
Cushy Foot mount
& Anti Vortex Plate
& reducer in
Contractor Scope.

Complied.

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Complied.

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S.no	Description	Unit	Qty
5.3	FIRE (HYDRANT and SPRINKLER)PUMP : Supply, installation, testing and <u>commissioning of diesel Engine pump</u> of horizontal mounted, single/multi stage, split case/end suction centrifugal back pull out type with <u>gland packing and capable to deliver 2850LPM, 80M</u> . The pump shall coupled to 100 HP or equivalent of Diesel engine radiator water cooled type with speed of 1800RPM and complete set shall be mounted on common base frame. Batteries and battery leads with stand, gauge glass, Fuel piping with valves. The quoted rate shall includes radiator water cooling piping (if required) coupling guard, <u>cushy foot mount</u> , anchor fastener, Air Relief Valve, Pressure Relief Valve, Suction & Discharge Pressure Gauge, Waste Cone with sight glass, UL Listed Panel and other standard accessories etc., complete as per technical specification and drawing (all pumps are UL Listed). All control wiring from pump to panel including pressure sensing line and other associated accessories to make system functional shall be considered here only.	Set.	2
	Note: The diesel engine driver shall be UL listed fire pump and service and shall meet or exceed all the requirements of NFPA-20 and as per technical specifications, all requirements of subcontract works and pump room drawing. The engine shall be equipped with following standard features but not limited to: Governor to regulate engine speed with in 10%, Over speed shut down device with manual reset, battery contactors, alternator or generator for battery recharging, cooling system, Engine oil heater, Battery rack and cables, Flexible exhaust connector, instrument panel, Dual set batteries, fuel tank and Exhaust silencer, eccentric and concentric reducer (if required), discharge tee, automatic air vent, casing relief valve, capacity plate etc as required.		
	Suitable cement concrete foundation with plaster complete with Antivibration arrangement of cushy foot mounting. (Minimum 6 No-in each pump)		
5.4	Supply, installation, testing and commissioning of <u>diesel Engine pump for Water Curtain System</u> of horizontal mounted, single/multi stage, split case/end suction centrifugal back pull out type with gland packing and capable to deliver <u>5670LPM, 50M</u> . The pump shall coupled to 200 HP or equivalent of Diesel engine radiator water cooled type with speed of 1800RPM and complete set shall be mounted on common base frame. Batteries and battery leads with stand, gauge glass, Fuel piping with valves. The quoted rate shall includes radiator water cooling piping (if required) coupling guard, cushy foot mount, anchor fastener, Air Relief Valve, Pressure Relief Valve, Suction & Discharge Pressure Gauge, Waste Cone with sight glass, UL Listed Panel and other standard accessories etc., complete as per technical specification and drawing (all pumps are UL Listed). All control wiring from pump to panel including pressure sensing line and other associated accessories to make system functional shall be considered here only.	Set.	1
	Note: The diesel engine driver shall be UL listed fire pump and service and shall meet or exceed all the requirements of NFPA-20 and as per technical specifications, all requirements of subcontract works and pump room drawing. The engine shall be equipped with following standard features but not limited to: Governor to regulate engine speed with in 10%, Over speed shut down device with manual reset, battery contactors, alternator or generator for battery recharging, cooling system, Engine oil heater, Battery rack and cables, Flexible exhaust connector, instrument panel, Dual set batteries, fuel tank and Exhaust silencer, anti vortex plate, eccentric and concentric reducer (if required), discharge tee, automatic air vent, casing relief valve, capacity plate etc as required.		
	Suitable cement concrete foundation with plaster complete with Antivibration arrangement of cushy foot mounting. (Minimum 6 No-in each pump)		
5.7	Supply, installation, testing and commissioning of 450 liters fuel tank (fabricated from 3mm MS sheet, painted with two coats of synthetic enamel paint over a coat of primer). The tank shall be fitted with Magnetic oil level indicator, MH with cover, drain valve, air vent and over flow including structural supports (painted with approved shade) as per technical specification and drawing (For Hydrant & Sprinkler System)	Nos.	2
5.8	Supply, installation, testing and commissioning of 750 liters fuel tank (fabricated from 3mm MS sheet, painted with two coats of synthetic enamel paint over a coat of primer). The tank shall be fitted with Magnetic oil level indicator, MH with cover, drain valve, air vent and over flow including structural supports (painted with approved shade) as per technical specification and drawing (For Water Curtain System)	Nos.	1

Complied.
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in scope
Complied.

Contractor scope
Complied with
Cushy Foot
mount, Fuel piping
& Cooling piping in
Contractor scope.
Reducer & tee
in Contractor
scope, Rest
Complied.
Contractor scope

Complied.

Complied



Part- 3: Fire Pumps

3.1 General

1. Provide Fire Pumps, diesel engine, controller in accordance with requirements of the Contract Documents. *Complied.*
2. Provide UL Listed fire pumps, diesel engine, controllers, and assemblies, approved and rated by type for the capacity and discharge head scheduled on the Drawings. Mount pump and driver on a rigid, drip-rim base, field grouted in accordance with the Hydraulic Institute standards. Transmit power from the driver by means of listed and approved flexible couplings, complete with approved guards. Dual driven pump units are not allowed. Jockey pumps and controllers shall be as per BIS standards and local fire authority approval. *Complied*
3. Fittings and Accessories. Include eccentric suction reducer, discharge tee, suction and discharge gages, automatic air vent, casing relief valve piped-to-drain, and capacity plate. *non-UL listed Complied. Contractor Scope.*

3.2 System Description

1. Independent fire pumps for hydrant and sprinkler system shall be provided. Each system comprising of separate Main electrical driven and jockey pumps. Standby diesel engine shall be common for both systems.
2. The hydrant electrical motor driven pump shall be 2850 LPM. The minimum pressure required at farthest and remotest hydrant valve is 3.5 bars and pump head shall be calculated accordingly. The head of the pump shall not be less than 8 Bars (80 Meters) as per calculations.
3. The sprinkler electric motor driven pump shall be of 2850 LPM. The head shall be calculated by General Contractor (GC) after considering flow and pressure requirement at the farthest and highest sprinkler point. The head of the pump shall not be less than 8 Bars (80 Meters) as per calculations. *Complied.*
4. The common diesel engine driven pump shall be 2850 LPM. The minimum pressure required at farthest and remotest hydrant valve is 3.5 bars and pump head shall be calculated accordingly. The head of the pump shall not be less than 8 Bars (80 Meters) as per calculations.
5. The jockey pump shall be of 180 LPM for both sprinkler & hydrant systems. The head shall be calculated by General Contractor (GC) after considering flow and pressure requirement at the farthest and highest sprinkler point and hydrant valve. The head of the pump shall not be less than 8 Bars (80 Meters) as per calculations.
6. The water curtain pump shall be of 5670 LPM. The minimum pressure required at farthest and remotest water curtain nozzle shall be 1.4 bar @ 55-80 LPM. The head shall be calculated by General Contractor (GC) after considering flow and pressure requirement at the farthest and

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highest sprinkler point. The head of the pump shall not be less than 5 Bars (50 Meters) as per calculations.

7. The diesel engine driven pump for water curtain system shall be 5670 LPM. The minimum pressure required at farthest and remotest water curtain nozzle is 1.4 bars and pump head shall be calculated accordingly. The head of the pump shall not be less than 5 Bars (50 Meters) as per calculations. *Complied.*
8. The jockey pump shall be of 180 LPM for water curtain system. The head shall be calculated by General Contractor (GC) after considering flow and pressure requirement at the farthest and highest sprinkler point and hydrant valve. The head of the pump shall not be less than 5 Bars (50 Meters) as per calculations. *Complied.*
9. Separate controller for each pump shall be provided as per standards. *Complied.*
10. The velocity of system shall not exceed 4.5 m/s. To achieve this pump suction shall be of straight length of at-least ten times the diameter of suction pipe. *noted.*
11. Vortex plate shall be installed inside the tank at the point of suction as per NFPA-20. *Contractor Scope.*
12. The Controller(s) shall have in-built pressure sensing switches. *Complied.*
13. The jockey pump shut down shall be automatic whereas the main pumps and diesel engine for both the system shall have manual shut down. *noted.*
14. OS & Y Gate Valve, non-rising spindle type shall be provided on main suction header from tank and on individual suction and delivery pipes as shown in the drawing. *noted*
15. Check valve shall be provided on each delivery side of pumps. *Contractor Scope.*
16. Fire Pump Test connection shall be provided by means of venturi type flow measuring station and provide piping to re-circulate the pump's discharge to water supply tank or to the pump's suction. *Contractor Scope.*
17. Check Valve of suitable size shall be provided on Delivery header to allow hydrant pumps flow towards sprinkler system. Under no condition sprinkler pumps flow is allowed towards hydrant system. *Contractor Scope.*

3.3 Submittals

1. Contract Drawings & Specifications which may be issued with tender are diagrammatic only and indicate arrangement of various systems and the extent of work covered in the contract. These Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these Drawings. *noted Pumpset drawing will be provided*



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2. Submit shop drawings of all Plant and materials including layouts for Pump room (Minimum scale of 1:50 with required sections), showing exact location of supports, flanges, bends, tee connections, reducers, detailed piping and type of supports, valves, fittings etc. and get the shop drawings finally approved from General Contractor (GC) or his authorized representative. *Contractor Scope will provide pumpset GAD*
3. Each item of Plant/material proposed shall be a standard catalogue product of an established Manufacturer strictly from the approved list of Manufacturers. *noted.*
4. Approval of shop drawings and other submittals shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supersede the contract requirements, nor does it in any way relieve the General Contractor (GC) of the responsibility or requirement to furnish material and perform work as required by the contract. *noted.*
5. Maximum headroom and space shall be maintained at all points. Where headroom appears inadequate, the General Contractor (GC) shall notify the Consultant / Client or his authorized representative before submitting the shop drawings. *noted Contractor Scope.*
6. Fire Pump Assembly Unit Contract Booklets: Furnish bound, tab indexed booklets containing dimensioned prints and schematic wiring diagrams for each pump set, including pump, driver, base and mounting details, controller, and all auxiliary devices and components; within ten days of award of contract. *Relevant documents for mfg Clearance will be provided*
7. Prior to fabrication of the Switchgears, Distribution boards, the General Contractor (GC) shall submit the shop/ General Contractor drawing, and design calculations, indicating type, size, short circuit rating of all the electrical components used, details & schedule of components & model Nos. type, rating etc., bus-bar size, internal wiring size, Distribution board dimension, colour, mounting detail etc. to Consultant / Client or his authorized representative. The General Contractor (GC) shall submit Manufacturer's catalogues of the electrical components installed in the distribution. *Main MCC Contractor Scope.*
8. Product Data: Submit for Consultant / Client action. Furnish data sheets indicating necessary installation dimensions, materials, accessories, start-up procedures, and performance information. Performance information shall include complete electrical data, certified pump curve, pressure ranges, identifying types and numbers, and listings and approvals for the specific service intended. Where pertinent, this data may be provided by Manufacturer's catalogue sheets marked to indicate the specific Plant, apparatus or device to be furnished. *All relevant data pertain to pumpset will be submitted.*
- a) Pumps and drivers.
- b) Starters and Controllers.
- c) Transfer switches.

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- d) Test headers, manifolds, test valves and metering apparatus.
- e) Cabinet enclosures.
- 9. Record Documents: Submit for Consultant / Client information documentation. Furnish inspection and test reports, witnessed by the Consultant / Client Representative and other authority having jurisdiction within five days of each inspection or test.
- a) Manufacturer's Certified Pump Shop Test Curve for Flow and Head.
- b) Graph of Calculated Speed versus Torque and Current Curves.
- c) General Contractor (GC)'s Certificate of Test and Materials for all pump suction piping.
- d) Field Acceptance Test reports for each pump and controller set.

Complied.

3.4 Products

Manufacturers

Basis of Design: When a Manufacturer's material, product, process or system is specified for an item of Work, it shall be considered the Basis of Design. Other materials, products, processes or systems from acceptable Manufacturers listed in the Specification will be considered, provided the General Contractor (GC) submits a detailed technical proposal to substantiate that quality and performance is equal to the Basis of Design. General Contractor (GC) shall furnish all information necessary to assist the Consultant / Client in determining whether the proposal is acceptable and has been thoroughly coordinated with structure, piping, ductwork, electrical connections, size considerations, operation or service requirements; the burden of proof rests solely upon the General Contractor (GC).

noted

Main Electrical Driven Pumps (Hydrant, Sprinkler and Water Curtain Systems)

- (1) Separate UL Listed horizontal split case pump, conforming to the standards of NFPA -20 latest editions shall be provided for sprinkler and hydrant systems.
- (2) The pump will provide a rated capacity of 2850 LPM for sprinkler and Hydrant system.
- (3) At 150% of rated discharge capacity, the pump shall develop at least 65% of its rated head and shall not exceed 140% of the rated head at zero capacity. Shut-off head shall be 140% of total head.
- (4) The pump shall be tested at the factory and a test curve shall be submitted showing the performance and horsepower requirements based on this test before final acceptance.
- (5) All motor driven pumps shall be supplied with bronze casing relief valve to protect the pumps

Complied.



- (6) The pump shall be a single stage, horizontally split case design, in cast iron bronze fitted construction with packing bearing directly on a bronze shaft sleeve. The casing shall be (close-grained cast iron ASTM A48 Class 35A for working pressures 12 bar, (ductile iron for working pressures up to 400 psi, and shall be of axially split design with suction and discharge flanges and mounting feet cast integral with the lower half casing. Tapped and plugged holes shall be provided for priming, vent drain and gauge connections. The pump internals shall be capable of being serviced by removing the upper half casing without disturbing the piping connections or packing area.
- (7) The impeller shall be of the enclosed suction type made of bronze ASTM B584-875/SAE 40 non-overloading in operating characteristics utilizing the motor service factor. It shall be hydraulically balanced and dynamically balanced together with the shaft. The direction of impeller shall be clockwise when viewed from the motor. The impeller shall be keyed to the shaft and positioned axially by the shaft sleeves, which are, in turn, locked in place by shaft nuts.
- (8) The shaft shall be made of SAE-1045 / ⁵⁵⁴¹⁰ 4140 Steel or better and of ample size to operate under load with a minimum of deflection. Shaft shall not be threaded anywhere inside the pump casing. The diameter of shaft shall be as per Manufacturer's recommendations.
- (9) The shaft sleeve shall be made of bronze ASTM B584-932 and shall be locked in place by threaded, bronze shaft sleeve nuts. An "O"-ring shall be furnished under the sleeve to prevent leakage.
- (10) Stuffing box housing/Bearing brackets shall be made of cast iron ASTM A48 Class 25A or Class 30A separate from the casing. Stuffing boxes shall not be split but machined of one concentric piece to ease sealing. Stuffing box/bearing brackets will be drilled and tapped for drain connection. The stuffing box shall consist of graphited acrylic yarn packing, and a split type gland to permit removal and access to packing. Ample space shall be provided for re-packing the stuffing box. Piping, valve and seal cages (if necessary) can be supplied to provide packing lubrication and shall be mounted on the upper half of the casing. Flush from an external source shall also be possible for lubrication and/or cooling.
- (11) Casing rings shall be made of bronze ASTM B584-932 and shall be installed with an anti-rotation device and designed to restrict leakage across the ring fit.
- (12) Bearings shall be grease lubricated ball type, single row inboard, double row outboard, selected to carry radial and thrust loads. The outboard bearing shall be retained by a bearing locknut and lock washer. (Snap rings are not acceptable). The bearings, (inboard and outboard) shall be replaceable without opening the pump casing.
- (13) Bearing housings are made of cast iron ASTM A48 Class 25A or Class 30A, bolted to the ends of the bearing bracket/stuffing box and

Complied



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shall be male female fitted for a full 360 degrees to assure positive alignment. The housings shall provide a fit for the inboard bearing that allows freedom for thermal expansion while the outboard bearing shall be clamped in place to take all thrust loads and keep the rotating element in its proper axial location. Openings for adding new grease and draining old grease shall be provided.

- (14) Base plate shall be steel with drip rim, sufficiently rigid to support the pump and the driver. Final alignment of pump and driver shall be made after grouting and installation and shall be approved by customer prior to operation.
- (15) Coupling shall be of the Manufacturer's choice and of the flexible type. Coupling hubs shall be secured to the driver and driven shafts by a set screw located over the key.
- (16) Coupling guard shall be cone type, all metal guard rated as per ANSI B15-1, Section 8 and OSHA 1910-219 compliant.
- (17) The driver shall be mounted with the pump on a base plate at the pump Manufacturer's plant and shipped as one unit.
- (18) Nameplates and other data plates shall be all corrosion resistant and suitably secured to the pump.
- (19) Pump Manufacturer shall be ISO9001 certified.

noted
Complied.

- (20) Accessories— Provide listed fire pump assemblies, approved and rated by type for the capacity and discharge head scheduled on the Drawings. Fire Pump shall be furnished with the following fittings as standard:

Suction Side

- (a) Entrance elbow and anti-vortex plate with dimensions at-least twice the diameter of suction pipe.
- (b) OS&Y gate valve of non-rising spindle.
- (c) Strainer.
- (d) Eccentric reducer, if required.
- (e) 4" dial size Pressure gauge with syphon cock.

Discharge Side:

- (a) The fittings shall be rated for 17 bars ANSI B16.1 pressure operation.
- (b) Concentric Reducer, if required.
- (c) 3/4" casing relief valve.

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- (d) $\frac{3}{4}$ " automatic air release valve.
- (e) 4" dial size pressure gauge with syphon cock.
- (f) Drain Valve.
- (g) Test header with necessary control valves and flow meter.
- (h) Supports.

Complied as
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Electric Motors

- (1) The electric motor for fire pump shall be a standard, Totally Enclosed Fan Cool, 1.15 service factor, squirrel cage induction motor with grease lubricated ball bearings. The locked rotor current shall not exceed the values specified in NFPA-20.
- (2) Motor should be size to cover 150% of the duty flow and should be non-overloading at the same time.
- (3) Characteristics:
 - (a) Shall be suitable for 415-volt, 3 phase, 50 hertz service.
 - (b) Suitable for $\pm 10\%$ electrical service fluctuation.
- (4) All motors for 50 Hz operation must be specially wound for 50 Hz applications.
- (5) Classifications: Class F insulation and continuous duty classification at minimum service factor of 1.15 based on a 500 C rise above a 400 C ambient temperature.
- (6) Type: Totally Enclosed Fan Cool for firefighting pumps.
- (7) The motor shall be rated for continuous duty and shall have a horsepower rating necessary to drive the pump at 150 per cent of its rated discharge with at least 65 per cent rated head.
- (8) All Components shall be of adequate mechanical strength and robustness and shall be constructed of metal unless otherwise approved.
- (9) Two independent earthing's points shall be provided on opposite sides of the motor for bolted connections.
- (10) 415 Volt power terminals shall be suitable for receiving 1.1 kV grade armoured power cables.
- (11) The cable boxes and terminations shall be designed to enable easy disconnection and replacement of cables.

noted.

Complied.



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

noted
Complied.

- (13) Provide other specific requirements required by governing energy conservation codes.

Jockey Pump and Motor

- (1) Pump: The pump shall be vertical multistage type and of detail as Specified. The capacity of the jockey pump shall be 180 LPM for Sprinkler, Hydrant and Water curtain System. The Pump should meet the condition and shall be gotten approved by Local Fire Authority.
- (2) Motor: Totally enclosed fan cool type, squirrel cage Induction motor for operation on 415V AC, $\pm 10\%$, 3 phase, 50Hz supply for the pump with flexible coupling and guard as required.

noted
Complied

Fire Pump Test Connection

- (1) Flow Measuring Station: UL Listed venturi type flow measuring station complete with a calibrated direct reading manometer gage (litres per minute), permanently mounted to the structure. Include valve trim. Provide piping for recirculation of pump discharge to water supply tank or to the pump suction.
- (2) The General Contractor (GC) shall supply and install float less type switch probes in sprinkler and hydrant system tank to give low level alarm, low water level cut-out and earthing probe. Each probe shall be of correct length for particular application and tank location. The electrode shall be of polished stainless steel 20mm OD. Electrode holder shall be connected and wired to the building earth system of the building. The earthing probe shall be installed inside a 200mm dia PVC pipe acting as wave barrier. The level switch set shall operate with a stepped down voltage at 24V maximum. Stepped down transformer shall be provided for each set of control probes and shall be installed inside centralized control cubical of pump room.

noted

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Control Cabinet Assembly (Electrical Panel)

For electric motor driven fire pumps of Sprinkler, Hydrant and Water Curtain system

- (1) Provide factory assembled, wired and tested unit assemblies in drip-proof, steel cabinets bearing labels indicating listed and approved service and device labels. All labelling shall be in both English and /or Hindi as required by authority having jurisdiction.
- (2) Provide separate panels for main hydrant, sprinkler and water curtain pumps.

noted
Complied.



- (3) Necessary cables from two different sources shall be provided up to transfer switch / panels others however the termination of cables at end point with proper lugs/thimbles shall be provided by fire protection General Contractor (GC).
- (4) Include an instantaneous recycle running period timer to keep the pumps operating for the following periods after each pump start-up, and to shut down the pumps if all conditions are normal. Establish pressure settings at the time of Final Acceptance.
- (5) Electric Fire Pumps: One minute for each 10 horsepower, or fraction thereof, with a minimum run time of 10 minutes for any pump.
- (6) Set floor mounted units on minimum 300 mm high concrete housekeeping pads.
- (7) DOL ~~Star-Delta~~ Closed Transition Transfer Switch Fire Pump Controllers: The star-delta closed transition transfer switch fire pump controllers shall be designed and built strictly in accordance with NFPA No. 20. It shall be a factory assembled, combination fire pump controller with integral built-in transfer switch. Upon request the Manufacturer shall furnish proof that the controller/transfer switch has proven itself in actual field usage for a minimum of three years in a high-rise pumping control application. The entire combination shall be listed for fire protection service by Underwriters Laboratories and approved by Factory Mutual for Fire Pump service.
- (8) The controllers shall be of the combined manual and automatic type designed for DOL ~~star-Delta~~ Closed Transition starting of the fire pump motor having the horsepower, voltage, phase and frequency rating shown on the plans and drawings. The controller components shall be housed in a NEMA Type 2 (IEC IP11) drip-proof enclosure. The fire pump controllers shall be equipped with the necessary logic for sequential started including a field adjustable delay timer with digital countdown display.
- (9) All controller components shall be front mounted, wired and front accessible for maintenance. The minimum withstand rating of the controllers shall not be less than 100,000 Amps RMS Symmetrical at the rated voltage.
- (10) The controller shall include a motor rated combination isolating disconnect switch/circuit breaker, mechanically interlocked and operated with a single, externally mounted handle. When moving the handle from OFF to ON, the interlocking mechanism shall sequence the isolating disconnect switch ON first, and then the circuit breaker. When the handle is moved from ON to OFF, the interlocking mechanism shall sequence the circuit breaker OFF

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first, and then the isolating disconnect switch. The circuit breaker trip curve adjustment shall be factory set, tested and sealed for the full load amps of the connected motor. The circuit breaker shall be field testable to verify actual pick up, locked rotor, and instantaneous trip points after field installation without disturbing incoming line and load conductors.

- (11) The fire pump controller shall feature an operator interface with user keypad. The interface shall monitor and display motor operating conditions, including all alarms, events, and pressure conditions. All alarms, events, and pressure conditions shall be displayed with a time and date stamp. The display shall be a 2-line, 20-character, vacuum fluorescent, dot matrix type designed to allow easy viewing from all angles and in all light conditions. The display and interface shall be NEMA rated for Type 4X protection and shall be fully accessible without opening the controller door. The display and user interface shall utilize multiple levels of password protection for system security. A minimum of 3 password levels shall be provided.
- (12) The fire pump controller operator interface shall display true RMS digital motor voltage and current measurements for all three phases simultaneously. Displays requiring push-button and selector switches to toggle between phases or current and voltage shall not be accepted. Voltage and current shall be measured by True RMS technology to provide the most accurate measurement for all sine waves, including non-sinusoidal waveforms. Average responding meters will not be accepted.
- (13) Include a Built in Alarm system with Supervisory Power on Lamp, and Audible Alarm with silence pushbutton for Pump Running, Power/Phase Failure and Phase Reversal. Alarm system shall be powered by a separate 230-volt, 50 hertz, single phase power source.
- (14) The digital display shall indicate text messages for the status and alarm conditions of Motor On, Minimum Run Time, Fail to Start, Under Voltage, Over Voltage, Over Frequency, Motor Overload, local start and Emergency Start. The Sequential Start Timer and Minimum Run Timer/ Off Delay Timer shall be displayed as numeric values reflecting the value of the remaining time.
- (15) LED indicators, visible with the door closed, shall indicate Power On, Pump Running, Common Alarm, Phase Failure, Phase Reversal, Low System Pressure, Interlock On, Emergency Isolating Switch Open, Transfer Switch Normal and Transfer Switch Emergency.
- (16) The digital display shall monitor the system and log the following data: Motor call/Starts, Last Trip Current, Last Breaker Trip, Minimum Voltages, Maximum Voltages, Last Phase Failure, Last Phase Reversal, Min/Max Pressure, Elapsed Motor Run Time,

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Maximum Run Currents, Last Motor Run Time and Min/Max Frequency.

(17) The controller shall record all operational and alarm events to system memory. All events shall be time and date stamped and include an index number. System memory shall store up to 3000 events and allow the user access to the event log via the user interface. The user may scroll through the stored messages in groups of 1, 10, or 100.

(18) The controller shall include drive to save all operational and alarm events. The drive shall store up to 1 years' worth of data (under normal operating conditions) in individual monthly files. Each event shall be time and date stamped. The controller shall also save settings and values to disk through the user interface.

(19) The Fire Pump Controllers shall be equipped with Module to connect with Fire alarm network (Refer Fire alarm specifications). The module allows users to remotely monitor the status of the fire pump controller, either connected to a single computer or over a network. Controller information shall be accessed via a web browser by simply typing in the IP address assigned to the Module installed in each controller.

(20) The controller shall be supplied with a solid-state pressure transducer with a range of 0-20 Bar. The pressure transducer and all components in contact with the system water shall be made of Type 316 stainless steel. The solid-state pressure switch shall be used for both display of the system pressure and control of the fire pump controller. Systems using analogue pressure devices or mercury switches for operational control will not be accepted. The Start, Stop and System Pressure shall be digitally displayed and adjustable through the user interface. The pressure transducer shall be mounted inside the controller to prevent accidental damage. The pressure transducer shall be directly pipe mounted to a bulkhead pipe coupling without any other supporting members.

(21) The controller shall be provided with two normally open and two normally closed dry contacts for each of the following alarm signals, Pump Running, Power Failure, Phase Reversal, and Transfer Switch Position.

(22) A digitally set On Delay (Sequential Start) timer shall be provided. Upon a call to start, the user interface shall display a message indicating the remaining time value of the On-Delay timer. The controller shall be field programmable for manual stop or automatic stop. If set for automatic stopping, the controller shall allow the user to select either a Minimum Run Timer or an Off-Delay Timer. Both timers shall be programmable through the user interface.

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- (23) A nonadjustable restart delay timer shall be provided to allow the residual voltage of the motor to decay prior to restarting the motor. At least 2 seconds, but no more than 3 seconds, shall elapse between stopping and restarting the pump motor.
- (24) A Lamp Test feature shall be included. The user interface shall also display the status of system inputs and outputs.
- (25) The controller shall not start the fire pump motor under a single-phase condition. If the motor is already running when a phase loss occurs, the controller shall continue to run the motor, but still display a Phase Failure alarm.
- (26) The power transfer switch shall be housed within the fire pump controller enclosure or in a NEMA Type 2 (IEC IP11) drip-proof enclosure attached directly to the fire pump controller. Where the power transfer switch is provided in an attached enclosure, the enclosures shall be fitted so that the assembly constitutes a single unit. Transfer switches utilizing mechanically or electrically interlocked circuit breakers to accomplish power transfer are not acceptable. The fire pump controller/power transfer switch shall be factory assembled, wired and tested as a unit prior to shipment.
- (27) The power transfer switch shall include a motor rated disconnect/isolating switch for interrupting the motor locked rotor current. The disconnect/ isolating switch shall be mechanically interlocked so that the enclosure door cannot be opened with the handle in the ON position except by a hidden tool operated defeater mechanism. The disconnect/isolating switch shall be pad lockable in the OFF position with up to three padlocks for installation and maintenance safety and may also be locked in the ON position. The enclosure door shall have a locking type of handle and three- point cam and roller type vault hardware.
- (28) An auxiliary contact shall be provided on the transfer switch to prevent starting of the emergency generator set when the transfer switch or the main fire pump controller is being serviced.
- (29) The transfer switch circuitry shall sense both the normal power source and the emergency power source. All voltage sensing, frequency sensing, and time delays shall be field adjustable to accommodate individual installation requirements. The transfer signal shall be delayed for one second, delaying the transfer and engine start signals so as to compensate for momentary, normal power outages. An automatic delay of three seconds shall be provided upon transfer to or from the emergency power source to allow the motor to slow sufficiently, preventing line disturbances that could trip either the generator set or fire pump circuit breakers.

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- (30) The transfer switch shall have LED's for Transfer Switch Normal, Transfer Switch Emergency and Emergency Isolating Switch Off, switches for Test and Transfer Bypass, an audible alarm device, and a Silence Alarm pushbutton mounted on the flange of the enclosure. The power transfer switch shall be furnished with both normally open and normally closed auxiliary contacts for an engine start signal when normal power failure occurs. Auxiliary contacts shall also be provided and wired to terminals to indicate the transfer switch position. The transfer switch shall be electrically operated and mechanically held and may be operated by a manual transfer mechanism located on the switch. The power transfer switch shall be for normal utility power and engine generator set emergency power.

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Electrical Panels for Jockey Pumps

- (1) This section comprises of fabrication design, supply, erection, testing and commissioning of Indoor/outdoor Motor Control Centre (MCC), wiring and earthing of all FDP equipment, components and accessories. For type of breaker, short time rating and other specific details, please refer to the technical & specific requirement sheets enclosed. The equipment to be offered under this specification shall be of proven design. Further, the switchgear must have been type tested in the same configuration that has been offered.

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- (2) Necessary cables from two different sources shall be provided up to transfer switch / panels others however the termination of cables at end point with proper lugs/thimbles shall be provided by fire protection General Contractor (GC).

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- (3) In general, the Plant shall conform to all relevant latest BIS/IEC standards. In case of any contradiction between the BIS/IEC and this specification, the more stringent of the two shall apply.

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|------------------------------|--|
| (a) BIS 13947 (Part 4) | AC contactors up to 1000V |
| (b) BIS 13947 | AC Circuit Breakers |
| (c) BIS 2705 | Current Transformers |
| (d) BIS 3156 & 4146 | Potential Transformers |
| (e) BIS 13947 | Control switches |
| (f) BIS 1822 | Motor duty Switches |
| (g) BIS 12021
transformer | Specification for control |
| (h) BIS 8623
control gear | Factory built assembly of switchgear & |

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- (i) BIS 13947 (Part 1) Degree of protection for enclosure
- (j) BIS 3842 Specification for electrical relays for AC system
- (k) BIS 13707 Specification for HRC fuses
- (l) BIS 5082 Wrought Al. and Aluminium alloys, bars, rods, tube and sections for electrical purposes.
- (m) BIS 13947(Part 1) General requirement for switchgear & control gear for voltage not exceeding 1000V
- (n) BIS 3231 Electrical relays for power system protection
- (4) All the 415V AC, devices/Plant like bus support insulators, CT's, VTs, etc., mounted inside the switchgear shall be suitable for continuous operation and satisfactory performance under the following supply conditions:
- (a) Variation in supply voltage $\pm 10\%$
- (b) Variation in supply frequency $\pm 3\%$
- (c) Combined voltage and frequency variation 10%
- (5) The switchboard panel shall be designed, manufactured and tested in accordance with relevant Indian Standards. The panels shall be indoor, metal enclosed, free standing type. The type of construction of the switchgear panels shall be construction Form 3B as per IEC 439. All moulded case circuit breakers and air circuit breaker feeders shall be in fully compartmentalised design as specified in the specific requirement sheets. The sheet steel (CRCA) used for fabrication shall be of 2.0mm for non-load bearing members and 2.5mm for load bearing members. The panels shall be supplied with required base channels. The insulators shall be made of high epoxy resin moulding. The bus bars and cable chambers shall be housed in separate chambers.
- (6) The Motor control centre with incoming breaker rating greater than 200 A shall be supplied along with CO2 flooding system (trace tube technology).
- (7) The bus bar and cable chambers should be fitted with bolted covers with gaskets and should be shrouded to avoid direct access to live parts immediately after opening respective covers. The bus bars and jumper connections shall be insulated to full maximum operating voltage. The cubicle shall be designed for

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IP4X protection for indoor and IP55 for outdoor duty. The vermin proofing shall be such that the vermin cannot enter from one compartment to another/bus bar chambers. Neoprene gaskets shall be used for all doors, covers and openings.

- (8) The bus bars and connectors shall be made of high conductivity Copper. The bus bars shall be amply sized to carry the rated continuous current under the specified ambient temperature without exceeding the total temperature of 85 °C. Unless otherwise stated, the entire bus bar shall be rated for the continuous rated current of the incomer. When sectionalised with a bus coupler, both the bus bars shall be of the same rating.
- (9) The entire switchboard along with all components shall be designed for the ambient site condition. The minimum area of cross section of the neutral shall be half that of the phase bus bar, unless otherwise specified. The busbar shall be interleaved for current carrying capacity greater than 1600A.
- (10) The bus bars and their connections shall be capable of withstanding, without damage, the thermal and mechanical effects of through fault currents equivalent to the short time rating of the switchgear. It shall be possible to extend the switchboard on both sides. The bus bars shall be sleeved and with respected phase colour. The sleeves shall be rated for an insulation level of 1100V.
- (11) Each compartment shall have hinged doors with gaskets and shall not form part of withdrawal chassis of breaker chamber. Suitable door interlock with switch / breaker shall be provided with provision for emergency defeat feature.
- (12) Suitable lifting hooks shall be provided. These hooks when removed shall not leave any opening on the enclosure.
- (13) Switchgear shall be designed for a top/bottom cable entry and the bus bars preferably shall be located at top, unless otherwise specified.
- (14) All switchgears compartments shall be totally enclosed with necessary barriers & adjustable horizontal frame with rail arrangement. It shall be possible to change the module size by repositioning compartment supports.
- (15) All switch drives other than rotary switches shall be lockable in "OFF" position.
- (16) All MCCs, Starter panels, Electrical panels shall be provided with 25% extra spare feeders/starters fully pre-wired complete with starter/VFD. In case of starter panels which have 1 or 2 outgoing feeders, 1 No spare feeder complete with starter/VFD of larger size shall be provided.

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- (17) If Loads/Motors being controlled by MCCs/ Panels are farther than distances recommended by IE rules or if panel is invisible from motor, then a local Isolator or start/stop Push button station with locking arrangement shall be provided near the motor.
- (18) **Safety Shutter Devices:** Shutters shall be provided at bus bar chamber cut-out for closing the same when the withdrawal chassis of the modules are drawn out. The bus bar shutters shall be automatically operated by the movement of the carriage.
- (19) **Insulation:** Insulators of moulded or resin bonded material shall have a durable, non-hygroscopic surface finish having a high anti-tracking index. Insulators, barriers made out of hylam, synthetic resin bonded paper, and treated wood will not be accepted. Insulators shall be mounted on the switchgear structure such that there is no likelihood of their being mechanically over-stressed, during normal tightening of the mounting and bus bars, connections etc.
- (20) **Moulded Circuit Breaker:** The MCCBs shall conform to the latest applicable standards.

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MCCBs in AC circuits shall be of four pole construction arranged for simultaneous four pole manual closing and opening. Operating mechanism shall be quick-make, quick-break and trip free type. The ON, OFF and TRIP positions of the MCCB shall be clearly indicated and visible to the operator. Operating handle for operating MCCBs from door of board shall be provided.

All feeders of rating 400A and up to 630A above shall be draw out type.

All MCCBs shall be provided with microprocessor-based trip unit for protection against overload, short circuit and earth faults. The releases shall be communicable to other systems on an open communication protocol. The Communication Port shall be provided in front/back.

MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit ratings.

MCCBs shall incorporate time delay devices to ensure that it will tolerate harmless transient overload unless this is well in excess of 25% of its rated value for a sustained period.

The circuit breaker shall be provided with 2 NO + 2 NC (specifically for purchaser's use) of auxiliary potential free contacts required for indication, control, interlocking and other purposes. All contacts shall be wired to a terminal block.

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The breaking capacity of MCCB's shall be as per the design requirements. The breaking capacities specified shall be for ICU=ICS i.e. type-2. Co-ordination as per IEC-60947-2, 1989/IS 13947-2, 1993.

- (21) Miniature Circuit Breaker: Miniature Circuit Breaker shall comply with BIS-8828-1996/IEC898-1995. Miniature circuit breakers shall be quick make and break type for 230/415 VAC 50 Hz application with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10 KA at 415 VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting be type (Class-3). MCBs shall be classified (B,C,D ref BIS standard) as per their Tripping Characteristic curves defined by the Manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the BIS/IEC and the Manufacturer shall publish the values. The housing shall be heat resistant and having a high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP and TPN miniature circuit breakers shall have a common trip bar.

- (22) Earth Leakage Circuit Breaker (ELCB): Earth Leakage Circuit Breaker (ELCB) shall work on the principle of core balance transformer. The incoming shall pass through the toroidal core transformer. As long as the currents in the phase and neutral shall be the same, no electro motive force shall be generated in the secondary winding of the transformer. In the event of a leakage to earth, an unbalance shall be created which shall cause a current to be generated in the secondary winding. This current shall be fed to a highly sensitive miniature relay, which shall trip the circuit if the earth leakage current exceeds a predetermined critical value. ELCB/RCCB shall be current operated independent of the line voltage, current sensitivity of a minimum of 30 mA and a maximum of 300 mA at 240/415 volts AC and shall have a minimum of 20,000 electrical operations.

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The moving contacts of the phases shall be mounted on a common bridge, actuated by a rugged toggle mechanism. Hence, the closing /opening of all the three phases shall occur simultaneously. This also shall ensure simultaneous opening of all the contacts under automatic tripping conditions.

The moving contacts of the phases shall be mounted on a common bridge, actuated by a rugged toggle mechanism. Hence, the closing /opening of all the three phases shall occur simultaneously. This also shall ensure simultaneous opening of all the contacts under automatic tripping conditions.

Neutral Advance Feature: The neutral moving contact shall be so mounted on the common bridge that, at the time of closing, the neutral shall make contact first before the phases, and



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at the time of opening, the neutral shall break last after allowing the phases to open first. This is an important safety feature which is also required by regulations.

Testing Provision: A test device shall be incorporated to check the integrity of the earth leakage detection system and the tripping mechanism. When the unit is connected to service, pressing the test knob shall trip the ELCB and the operating handle shall move to the "OFF" position.

- (23) **Current Transformers:** The current transformers shall have synthetic cast resin insulation and be of the single-phase type, with number of cores as per the specific requirements.

The primary & secondary connections shall be clearly labelled.

All current transformers shall have insulation level and short time rating as per main switchgear. All current transformers shall be dimensioned to carry continuously a current of 120% of the rated current. The ratios shall be as per the specific requirements.

- (24) **Voltage / Potential transformer:** The voltage transformers shall be insulated for full voltage rating.

PT shall be capable of withstanding thermal and mechanical stresses resulting from short circuit and momentary current rating of breaker/switches.

- (25) **Relays & Accessories:** All relays shall be of switchboard pattern, back connected, draw out type suitable for flush mounting and fitted with dust tight cases and provided with flag indicators and hand reset devices. The relays shall conform to IS. A set of test block and test lead for necessary secondary injection tests shall be included. All relays in draw out cases shall have suitable spring-loaded contacts for inserting test block.

Relays shall be provided with hand reset type contacts. The flag indication shall be suitable for external hand resetting and mechanically interlocked to prevent falling when relays are subjected to vibration. The rating of the auxiliary contacts shall not be less than 10 A at 240 V AC and 5 A for 110V DC.

All protective relays shall be provided with adequate number of self-reset contacts and hand reset flag indicators.

Motor duty contactors shall be three pole air break electro-magnetic type suitable for making and breaking locked rotor current of the motor. The connection of the contactor shall be direct-on-line type. Reversible motor contactors shall be mechanically and electrically interlocked with each other. The contact material shall have anti-weld properties. 3 main

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contacts 2NO and 2NC auxiliary contacts shall be provided as a standard future. The aux. Contact shall be rated for min. 5A at 240V AC and 1.5A at 110V DC. Over-load relays for the contactors shall be three element, compensated time lag, hand reset and bimetallic thermal type with adjustable setting range. The relay shall have at least 1NO + 1NC change over contacts. The thermal overload relay shall have reset facility without opening the door. Required no. of aux. Relays/contactors shall be considered to suit the specific schematic requirement.

Meters: All incoming feeders shall have Multifunction meter similar to Schneider PM850 or approved equal. MFM shall be suitable for measuring unbalanced loads on a 3 - phase, 4 wire systems and shall operate on 415V 3 ϕ , 4 wires supply.

All outgoing feeder shall have ammeter with selector switch & CT's with suitable rating.

- (26) Indicating Lamps / Push Buttons: These shall be switchboard type, low power consumption, LED type lamps complete with necessary accessories. Lamps shall be provided with screwed translucent covers to diffuse light. The lamp covers shall preferably be unbreakable, moulded, heat resistant material and shall be provided with chromium plated bezels. Push Buttons shall be heavy duty, push to actuate type with colored button and inscription marked with its function. Each push button shall have minimum 2 NO + 2 NC contacts or as required, rated 10 A at operating voltage. Push button shall be shrouded type except for emergency trip button (if provided) which shall be mushroom type for easy identification. Push button color shall be as follows:

Stop/off	-	Red
Start/ON	-	Green
Reset	-	Yellow
Test	-	Black

- (27) Control Switches / Selector Switches: Control and meter selection switches shall have integral name plate and for all other devices, the same shall be located below the respective devices. Instrument and devices mounted on the face of the panels shall also be identified on the rear with the same number.

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

The handle of control switches used for circuit breaker operation shall turn clockwise for closing and anticlockwise for tripping and shall be spring return to neutral from close/trip with lost motion device.

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The control switches, operating handles, meters, relays etc. shall be mounted at the front of the switchgear panels. The instruments shall not be mounted less than one meter or more than two meters from the floor level. Operating handles shall not be mounted at a height more than 1.75 meters. Breaker Control switches wherever provided shall be so designed that when released by the operator it shall automatically return to a neutral position. They shall be fitted in sequence with lock to avoid inadvertent operation and shall be arranged such that after passing the "closed" position the control switch cannot be moved into the "Closed" position again without passing the "open" position. Each panel shall have indicating lamps for "ON", "OFF", "TRIP", "TRIP CIRCUIT HEALTHY" and "SPRING CHARGED".

(28) Auxiliary Supply: AC Supply: 240V, 1 phase, 50 Hz

Control Bus shall be provided in the MCC with supply voltage at 240V AC/1 phase/50 Hz. AC supply required for control/protection/ indication/ tripping /metering devices shall be taken from the above bus bars through protective fuses.

Suitable fuses and links shall be provided for individual circuits for protection and also for isolation from bus without disturbing the other circuits.

Panel space heaters with thermostats, ventilation fans, mesh/filter protected louvers for dust prevention shall be provided in all the panels.

(29) Control Wiring: Stud type terminals with identification ferrules shall be used. Local dependent marking as well as remote end dependent marking may be indicated in the ferruling at terminal blocks. Interlocking type ferrules shall be used. All wires carried within the switchgear enclosure shall be LSZH insulated and neatly arranged so as to be readily accessible and to be easily replaceable. Wherever necessary the wires should be run in cable troughs and the wiring should be routed so that the same remains away from areas where electrical flame or flash over may occur. No conduit or cables shall be carried through the bus bar chamber.

The voltage transformer wiring shall be done by LSZH insulated, 1100V grade multi stranded flexible copper conductor of size 1.5 Sq.mm and all the current transformer and DC control wiring shall be of the same type of cable as specified above with conductor size of 2.5 Sq.mm. The color coding shall be as per IS 11353 & 5578.

AC and DC wiring are to be distinguishable function wise. AC and DC terminals are to be separated by shrouded terminal separators. All spare contacts of switches / relays shall be wired up to the terminal blocks. 20% extra spare terminals shall

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be provided. All terminals shall be suitable for terminating 2 wires from bottom and top side of the terminal block. However not more than one wire shall be terminated from either side on any terminal. All CT wiring shall be terminated on shorting and disconnecting type terminals.

- (30) **Name plate:** Suitable anodized Aluminium name plate of 1.2 mm thick shall be provided on all the switchboards and individual compartments.
- (31) **Earthing:** An earth bus of requisite section shall be provided. It shall extend throughout and solidly connect all panels in a line with proper terminals, at the end to connect to the station earthing system. The terminal arrangement at the ends shall be suitable for connection to Earth flat and shall be complete with bimetallic washers etc.
- (32) **Cable Chamber:** The position of the cable chamber shall be such that the cables can be safely taken and carried through one-meter trench at the bottom of the switchgear line up and the jointing carried out in a convenient and satisfactory manner. The cable termination arrangement for multiple cables shall permit connection and disconnection of individual cables without disturbing the other cables. Each panel shall have a separate cable alley. Cable alleys shall consist of cable supporting arrangement so that the load of the cable does not act on the terminals. Special warning labels shall be provided on removable covers (or) doors giving access to cable terminals and bus-bars.
- (33) **Painting:** All metal surfaces shall be thoroughly cleaned and degreased to remove mill scale, rust, grease and dirt. Fabricated structure shall be pickled and then rinsed to remove any trace of acid. The under surface shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. The under surface shall be made free from all imperfections before undertaking finishing coat. After preparation of the under surface, the switchgear panel shall be spray painted with two coats of final paint. Color shade of final paint shall be RAL 7032 (epoxy based). The finished panel shall be dried in staving oven in dust free atmosphere. Panel finish shall be free from imperfections like pin holes, orange peels, run off paint etc. The General Contractor shall furnish painting procedure details along with the drawing's submission. All unpainted steel parts shall be cadmium plated or suitably treated to prevent rust corrosion. If these parts are on moving element, then these shall be greased

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General

- (1) Looking at numbers of External hydrants, 2 no's common standby DG set shall be provided for sprinkler and hydrant systems and 1 no's for water curtain system.
- (2) Engines shall be acceptable for horsepower ratings listed by the testing laboratory for standard Society of Automotive Engineers (SAE) conditions.
- (3) The diesel engine shall be of multi cylinder type four/six stroke cycle with mechanical (airless) injection, cold starting type.
- (4) Main pipe pressure relief valve shall be UL Listed main relief valve sized for the close valve pressure. The main relief valve shall be connected to the waste cone with sight glass to provide visible observation of the operation of the relief valve.
- (5) The engine shall be designed with regard to ease of maintenance, repair, cleaning and inspection.
- (6) All parts susceptible to temperature changes shall have tolerance for expansion and contraction without resulting in leakage, misalignment of parts or injury to parts.
- (7) It shall also be capable of driving the pump at 150% of the rated discharge at 65% of rated head.
- (8) The engine shall be capable of continuous non-stop operation for 8 hours and major overhaul shall not be required before 3000 hours of operation.
- (9) The engine shall have 10% overload capacity for one hour in any period of 12 hours continuous run. The engine shall accept full load within 15 seconds from the receipt of signal to start.
- (10) The sequence for emergency manual operation, arranged in a step-by-step manner, shall be posted on the fire pump engine. It shall be the engine Manufacturer's responsibility to list any specific instructions pertaining to the operation of this Plant during the emergency operation.

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Engine Accessories

- (1) Fly wheel dynamically balanced.
- (2) Direct coupling for pump and coupling guard.
- (3) Corrosion Resistor.
- (4) Air cleaner.

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- (5) Fuel service tank support and fuel oil filter with necessary pipe work.
- (6) Exhaust silencer with necessary pipe work.
- (7) Governor.
- (8) Instrument panel housing all the gauges, including Tachometer, hour meter and starting switch with key (for manual starting).

Starting

- (1) **Engine Starting System:** A high torque D.C motor charged by battery shall initiate automatic start of diesel engine. The battery shall hold adequate retainable charge to provide the starting of the diesel engine. Starting power will be supplied from storage batteries. The battery capacity shall be adequate for ten consecutive starts without recharging with a cold engine under full compression. Battery shall be lead acid type of 12 V, 180 Ah capacities with self-starter switch.
- (2) Lead-acid batteries shall be furnished in a dry charge condition with electrolyte liquid in a separate container. Electrolyte shall be added at the time the engine is put in service and the battery is given a conditioning charge.
- (3) The engine shall be capable of both automatic and manual start. Generally, the engine shall start automatically, but in case of the auto-start system failure the engine shall be capable of manual start. The main battery contactors supplying current to the starting motor shall be capable of manual mechanical operation to energize the starting motor in the event of control circuit failure.
- (4) **Battery Recharging:** Two means for recharging storage batteries shall be provided. One shall be the generator or alternator furnished with the engine. The other shall be an automatically controlled charger taking power from an alternating current power source.
- (5) **Battery Chargers:** The requirements for battery chargers shall be as follows:
 - (a) Chargers shall be specifically listed for fire pump service.
 - (b) The rectifier shall be a semiconductor type.
 - (c) The charger for a lead-acid battery shall be a type that automatically reduces the charging rate to less than 500 mA when the battery reaches a full charge condition.
 - (d) The battery charger at its rated voltage shall be capable of delivering energy into a fully discharged battery in such a manner that it will not damage the battery. It shall restore

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to the battery 100 percent of the battery's reserve capacity or ampere-hour rating within 24 hours.

- (e) An ammeter with an accuracy of 5 percent of the normal charging rate shall be furnished to indicate the operation of the charger.
- (f) The charger shall be designed such that it will not be damaged or blow fuses during the cranking cycle of the engine when operated by an automatic or manual controller.
- (g) The charger shall automatically charge at the maximum rate whenever required by the state of charge of the battery.
- (h) The battery charger shall be arranged to indicate loss of current output on the load side of the direct current (dc) over current protective device where not connected through a control panel.
- (6) Battery Location: Storage batteries shall be rack-supported above the floor, secured against displacement, and located where they will not be subject to excessive temperature, vibration, mechanical injury, or flooding with water. They shall be readily accessible for servicing. Battery cables shall be sized in accordance with the engine Manufacturer's recommendations considering the cable length required for the specific battery location.
- (7) The scope shall cover all cabling, terminals, initial charging etc.
- (8) Engine shall be able to start without any preliminary heating of combustion chamber; manual cranking mechanism shall also be provided. All controls/mechanisms, which have to be operated in the starting process, shall be within easy reach of the operator.
- (9) Battery Maintenance: Storage batteries shall be kept charged at all times. They shall be tested frequently to determine the condition of the battery cells and the amount of charge in the battery. Only distilled water shall be used in battery cells. The plates shall be kept submerged at all times. The automatic feature of a battery charger shall not be a substitute for proper maintenance of battery and charger. Periodic inspection of both shall be made. This inspection shall determine that the charger is operating correctly, the water level in the battery is correct, and the battery is holding its proper charge.

Instrumentation:

- (1) Governor: Engines shall be provided with a governor capable of regulating engine speed within a range of 10 percent between shutoff and maximum load condition of the pump. The governor



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shall be field adjustable and set and secured to maintain rated pump speed at maximum pump load.

- (2) **Over speed Shutdown Device:** Engines shall be provided with an over speed shutdown device. It shall be arranged to shut down the engine at a speed approximately 20 percent above rated engine speed and to be manually reset. A means shall be provided to indicate an over speed trouble signal to the automatic engine controller such that the controller cannot be reset until the over speed shutdown device is manually reset to normal operating position.
- (3) **Tachometer:** A tachometer shall be provided to indicate revolutions per minute of the engine. The tachometer shall be the totalizing type, or an hour meter shall be provided to record total time of engine operation.
- (4) **Oil Pressure Gauge:** Engines shall be provided with an oil pressure gauge to indicate lubricating oil pressure.
- (5) **Temperature Gauge:** Engines shall be provided with a temperature gauge to indicate engine coolant temperature at all times.

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Controller (Electrical Panel)

- (1) The controllers shall be specifically listed for diesel engine-driven fire pump service.
- (2) The controllers shall be completely assembled, wired, and tested by the Manufacturer before shipment from the factory.
- (3) The controllers shall be marked "Diesel Engine Fire Pump Controller" and shall show plainly the name of the Manufacturer, the identifying designation, and the complete electrical rating.
- (4) **Location:** Controllers shall be located as close as to engine in coordination with authority having jurisdiction. Current-carrying parts of controllers shall not be less than 12 in. (305 mm) above the floor level.
- (5) **Construction:** control panel shall be metal enclosed sheet steel cubical indoor type, dead front, floor mounting/wall mounting type. The panel shall be totally enclosed, completely dust and vermin proof, Gaskets between all adjacent units and beneath and all covers shall be provided to render the joints dust proof. All doors and covers shall be lockable. All mild steel sheets used in the construction of panels shall be minimum 2mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all slag ground off and welding pits wiped smooth with plumber metal.

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- (6) **Connections and Wiring:** Field Wiring: All wiring between the controller and the diesel engine shall be stranded and sized to carry the charging or control currents as required by the controller Manufacturer. Such wiring shall be protected against mechanical injury. Controller Manufacturer's specifications for distance and wire size shall be followed.
- (7) **Wiring Elements:** Wiring elements of the controller shall be designed on a continuous-duty basis.
- (8) **Electrical Diagrams and Instructions:** A field connection diagram shall be provided and permanently attached to the inside of the enclosure.
- (9) Complete instructions covering the operation of the controller shall be provided and conspicuously mounted on the controller.
- (10) The Panel shall have an auto/manual/test/off selector switch for engine.
- (11) Visible indicator alarms in form of pilot lamp shall be provided in the controller which shall be visible from all possible angles. It shall be accessible for replacement.
- (12) No audible alarm silencing switch, other than the controller main switch, shall be permitted for the alarms.
- (13) Separate visible indicators and a common audible alarm capable of being heard while the engine is running and operable in all positions of the main switch except off shall be provided to indicate trouble caused by the following conditions.
- (a) High engine jacket coolant temperature.
 - (b) Failure of engine to start automatically.
 - (c) Shutdown from over speed.
 - (d) **Battery failure:** Controller shall be provided with a separate visible indicator for each battery.
 - (e) **Battery charger failure.** Each controller shall be provided with a separate visible indicator for battery charger failure.
 - (f) Starting failure.
 - (g) **Voltmeter:** A voltmeter with an accuracy of ± 5 percent shall be provided for each battery bank to indicate the voltage during cranking.
 - (h) Inlet and outlet water temperature gauge (dial type) with key.

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Fuel System

- (1) Fuel Supply and Arrangement. Before fuel system is installed, plans shall be prepared and submitted to the authority having jurisdiction for agreement on suitability of the system for conditions prevailing.
- (2) Fuel Type: The diesel engine shall be suitable to run on High-Speed Diesel Oil (HSD).
- (3) Fuel Tank, piping and connections:
 - (a) The fuel tank shall be of double skin welded steel construction, 3 mm thick. The tank shall be complete with necessary wall mounted supports, level indicator (protected against mechanical injury) inlet, outlet, overflow connections and drain plug and piping to the engine fuel tank. The outlet shall be so located as to avoid entry of any sediment into the fuel line to the engine.
 - (b) Fuel supply tank(s) shall have a capacity at least equal to 1 gal per horsepower, plus 5 percent volume for expansion and 5 percent volume for sump. However single tank capacity shall not exceed 990 litres. Separate multiple tanks for each system shall be provided, if required capacity exceeds 990 litres.
 - (c) Diesel fuel supply tanks shall be located above ground in accordance with municipal or other ordinances and in accordance with requirements of the authority having jurisdiction and shall not be buried. The engine fuel supply (suction) connection shall be located on the tank so that 5 percent of the tank volume provides a sump volume not usable by the engine. The fuel supply shall be located on a side of the tank at the level of the 5 percent sump volume.

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The inlet to the fuel supply line shall be located so that its opening is no lower than the level of the engine fuel transfer pump. The engine Manufacturer's fuel pump static head pressure limits shall not be exceeded when the level of fuel in the tank is at a maximum. The fuel return line shall be installed according to the engine Manufacturer's recommendation.

- (d) Flame-resistant flexible hoses listed for this service shall be provided at the engine for connection to fuel system piping. There shall be no shutoff valve in the fuel return line to the tank.
 - (e) A guard or protecting pipe shall be provided for all exposed fuel lines.
 - (f) The fuel supply tank and fuel shall be reserved exclusively for the fire pump diesel engine.
 - (g) There shall be a separate fuel line and separate fuel supply tank for each engine.
 - (h) 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 bracket. The fuel filter shall be suitably located to permit easy servicing.
- (4) 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 supply.
- (5) Lubricating Oil System: Forced feed Lubricating Oil system shall be employed for positive lubrication. Necessary Lubricating oil filters shall be provided, located suitably for convenient servicing.

Cooling System

- (1) The engine cooling system shall be included as part of the engine assembly and shall be of heat exchanger type that includes circulating pump driven by the engine, a heat exchanger, and an engine jacket temperature regulating device.
- (2) Coolant and Fill Openings: An opening shall be provided in the circuit for filling the system, checking coolant level, and adding make-up coolant when required. The coolant shall comply with the recommendation of the engine Manufacturer.
- (3) The cooling water supply shall be from the discharge of the pump taken off prior to the pump discharge check valve. Threaded rigid piping shall be used for this connection. The pipe connection in the direction of flow shall include an indicating manual shutoff valve, an approved flushing-type strainer in

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addition to the one that can be a part of the pressure regulator, a pressure regulator, an automatic valve, and manual shutoff valve. A pressure gauge shall be installed in the cooling water supply system on the engine side of the last manual valve.

- (4) Pressure Regulator: The sizing of pressure regulator shall be as per recommendations of Manufacturer but under any condition it shall be of such size and type that it is capable of and adjusted for passing approximately 120 percent of the cooling water required when the engine is operating at maximum brake horsepower and when the regulator is supplied with water at the pressure of the pump when it is pumping at 150 percent of its rated capacity. The cooling water flow required shall be set based on the maximum ambient cooling water.
- (5) Automatic Valve: Provision of automatic valve shall be made on supply line to permit flow of cooling water to the engine when it is running.
- (6) Bypass connection: A bypass line with manual valves, a flush-type strainer, and a pressure regulator shall be installed around the manual shutoff valve, strainer, pressure regulator, and automatic valve.
- (7) Waste Outlet: An outlet shall be provided for the wastewater line from the heat exchanger, and the discharge line shall not be less than one size larger than the inlet line. The outlet line shall be as short as possible, shall provide discharge into a visible open waste cone, and shall have no valves in it.

Exhaust System

- (1) Independent Exhaust: Each pump engine shall have an independent industrial type exhaust system.
- (2) Exhaust Discharge Location: Shall be coordinated with authority having jurisdiction and shall be piped to a safe point outside the pump room and arranged to exclude water. Exhaust gases shall not be discharged where they will affect persons or endanger buildings.
- (3) Exhaust Piping: A seamless or welded corrugated (not interlocked) flexible connection shall be made between the engine exhaust outlet and exhaust pipe. The exhaust pipe shall not be any smaller than the engine exhaust outlet and shall be as short as possible. The exhaust pipe shall be covered with high-temperature insulation or otherwise guarded to protect personnel from injury. The exhaust pipe and muffler, if used, shall be suitable for the use intended, and the exhaust back pressure shall not exceed the engine Manufacturer's recommendations.

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- (4) The exhaust system shall be complete with silencer suitable for outdoor installation, and silencer piping including bends and accessories needed for a run of 15mtrs from the engine manifold. } noted.

Accessories

- (1) The engine shall be mounted on a base plate of fabricated steel construction. Adequate access shall be provided to the big end and main bearing, camshaft and governor drives, water jackets etc.
- (2) The engine shall be provided with inlet filter and silencer, outlet muffler, expansion joints, dampers etc. as necessary for efficient operation. Intake air shall be taken from inside the building in which the engine is located, but the exhaust shall be discharged into the air at location as desired by the General Contractor (GC).
- (3) The General Contractor (GC) shall provide all accessories, fittings and fixtures necessary and required for a complete operating engine set. } Contractor Scope.

Weekly Programme Timer

To ensure dependable operation of the engine and its controller, the controller Plant shall be arranged to automatically start and run the engine for at least 30 minutes once a week. Means shall be permitted within the controller to manually terminate the weekly test provided a minimum of 30 minutes has expired. A solenoid valve drain on the pressure control line shall be the initiating means or as suggested by Manufacturer.

Air Vessel

The air vessel shall be provided to compensate for slight loss of pressure in the system and to provide an air cushion for counter acting pressure surges, whenever the pumping set come in to operation. The Air vessel shall conform to BIS: 3844. It shall be normally half full of water, when the system is normal. It shall be fabricated with 8mm thick MS plate with 10 mm thick dished ends at both sides with suitable legs. It shall be provided with 80mm dia flanged connection from pump, 25mm dia drain with valve, 25 mm dia air release valve with isolation valve on top, water level gauge. The air vessel shall be tested to a pressure of two times the operating pressure for continuous 12 hours. } Contractor Scope.

Vibration & Balancing

The rotating elements shall be so designed to ensure least vibration during start and throughout the operation of the Plant. All rotating components shall be statically and dynamically balanced at workshop. } noted will be done



Foundation

RCC foundation for pumps shall be constructed by General Contractor (GC)s as per approved drawing. General Contractor (GC) must submit the detailed foundation drawing showing dimensions, load and other required factors for designing of foundation, material used and requirements of Manufacturer, for approval and construction.

Anti-Vibration Mounting

Anti-Vibration Mounting: Suitable vibration mounting duly approved by Services General Contractor (GC) shall be employed for mounting the unit so as to minimize transmission of vibration to the structure. The isolation efficiency achievable shall be clearly indicated.

Cabling / Wiring

- (1) The incoming cables from two different sources shall be provided for main panel of hydrant, sprinkler and water curtain system by General Contractor (GC).
- (2) Cabling/wiring from panel to pumps, pumps to pressure switches shall be in scope of General Contractor (GC).
- (3) All power cabling shall be carried out with 650/1100-volt grade PVC insulated PVC sheathed, armoured, aluminium conductor cables laid on the cable tray/racks/pipes. Cables shall be sized for starting current and by applying proper de-rating factor. All control wiring shall be carried out by using 650/1100 volts PVC insulated copper conductor wires in wire ways or in conduit.

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Rubber Mat

Rubber mat shall be provided in front to cover the full length of all panels. Where back space is provided for working from the rear of the panel, rubber mat shall also be provided to cover the full length of panel.

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3.5

Source Quality Control

- (1) Factory tests of the fire pump assemblies and controller (Electric Panel) will be witnessed by the Consultant / Client or his authorized representative. Include all costs associated with the fire pump assembly tests in accordance with the Contract Documents.
- (2) Fire Pump Assembly Tests: Certified factory test data shall be provided to verify that the following tests have been performed.
 - (a) Complete visual inspection.
 - (b) A complete operational test.
 - (c) A plumbing leakage test done at the maximum system pressure.
 - (d) A pressure switch accuracy test.

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- (e) A 5000-volt dielectric voltage withstand test.
- (f) A 125% thermal power path test.
- (g) A 300% no trip test conducted through the entire power path.
- (h) A 600% locked rotor test conducted through the entire power path.

} noted.

(3) Controller Assembly tests:

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

} Will
Submit
Test
Certificate
from
Controller
OEM

3.6

Execution

Verification of Conditions: Examine the areas to receive the Work and the conditions under which the Work would be performed. Identify conditions detrimental to the proper and timely completion.

3.7

Identification

Identification shall be in English and/or Hindi accordance with requirements of the local authority having jurisdiction, including, but not necessarily limited to the following.

- (1) Control valves and test valves.
- (2) Fire suppression pumps.
- (3) Fire suppression pump control panels.
- (4) Fire suppression pumps operating instructions for the fire officer's operation of the pumps including last resort direct on-line operation in the event of starter failure.

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