ANNEXURE “E”

FIRE FIGHTING & FIRE PROTECTION SYSTEM

GENERAL TECHNICAL SPECIFICATIONS

1. General

Work under this contract shall be executed as shown on the drawings and given in the specifications; and required at site whether specifically shown or not.

Not-with standing the sub division of the documents into these separate section and volumes every part of each shall be deemed to be supplementary to and complementary of every other part and shall be read with and into the contract so far as it may be practicable to do so.

1.3 Where it is mentioned in the specification that the contractor shall perform certain work or provide certain facilities, it is understood that the contractor shall do so at his cost. The material, design and workmanship shall satisfy the regulations of the TAC, the job specifications contained herein and codes referred to where the job specification and TAC requirements stipulate in addition to these contained in the standard codes and specification, these additional requirements shall also be satisfied.

2. Scope of work

Work under this contract consist of furnishing labour, materials, equipment and appliances necessary and required to completely do all works relating to the fire protection system as describe here–in–after and shown and the drawings, consisting of:

i) Supply, installation, testing and commissioning of:
   a) Fire hydrant Down comer system including fire Terrace pumps and ancillary equipments.
   b) Hand appliances.

ii) Preparation of plans based on the shop dwgs./actual work at site and getting approval/NOC by the Local Fire Authority.

iii) Getting tested by and approval of the installation by the Local Fire Authority during the fabrication/construction stage as well as after completion.

iv) Supply of necessary spare parts during the commissioning stage.

v) Supply of any other item or services not specifically mentioned anywhere but required by the Local Fire Authority or essential for the operation.

3. Interpretation

In interpretation of specification, the following order of decreasing importance shall be followed:

a) Schedule of quantities
b) General Technical specifications
c) List of approved make of materials

d) General rules and conditions / Special Conditions

Matters not covered by the specifications given in this contract as a whole shall be covered by relevant and latest Indian Standard Codes. If such codes on a particular subject have not been framed, the decision of the engineer – in – charge/ Project Manager shall be final and binding.

4. Responsibilities of Contractors

Contractor shall be responsible for procuring, supplying, and providing all labour, tools, plant and equipment, etc., required for completing the work in all respects and as per the scope of the contract.

All expenses towards mobilization at site and demobilization including bringing in equipment, work force and materials, dismantling the equipment, clearing the site, etc. shall be deemed to be included in the rates quoted by the contractor against various items of schedule rates and no separate payment on such expenses shall be entertained.

The contractor shall acquaint himself with access availability, facilities such as railway siding, local labour, etc., to provide suitable allowance in his quotation. The contractor may have to build temporary access to roads to aid him own work which may also be taken care of while quoting for the work.

The procurement and supply in sequence and at the appropriate time of all materials and consumables shall be entirely the contractor’s responsibility, and his rates for execution of work will be inclusive of supply of all these items.

5.0 Specifications

5.1 Work shall be carried out strictly in accordance with the specifications attached to the tender.

5.2 Works not covered in the specifications shall be carried out as per relevant Indian Standard Code of practice specifications of materials.

6.0 Execution of work

6.1 The work shall be carried out in conformity with the contract drawings and within the requirements of architectural, HVAC, plumbing, electrical, structural and other specialised services, drawings.

6.2 The Contractor shall liaison with all traders and agencies working on the site. He shall ensure / liaison with civil contractor for hangers, sleeves structural openings and other requirements well in advance prevent hold up of the construction schedule.

6.3 On award of work, the contractor shall submit a schedule of construction in the form of Pert Chart or Bar Chart for approval of consultant / engineer – in – charge, all dates and time schedule, agreed upon shall be strictly adhered to.

6.4 The work shall be executed strictly as per the time schedule given in the tender document.
6.5 A joint program of execution of work will be prepared by the Contractor based on priority requirement of the project. This program will take in to account the time of completion mentioned in 6.4 above and the time allowed for the priority works by the owner.

6.6 Monthly/weekly construction program will be drawn up by the Owner jointly with the Contractor. Based on availability of work fronts and joint construction program as per 6.5 above. The contractor shall scrupulously adhere to these targets /programs by deploying adequate personnel and construction tools and tackles and he shall also supply himself all materials of his scope of supply in good time to achieve the urgent /program. In all matters concerning the extent of targets set out in the weekly and monthly targets programs and the degree of achievement, the decision of the Owner will be final and binding on the Contractor.

7. Drawings

7.1 Contractor drawings are diagrammatic but shall be followed as actual construction Permits. Any deviations made shall be in conformity with the architectural and other services drawings. Shop / working drawings shall be submitted by the Contractor in accordance with para 17 of this section.

7.2 Architectural drawings shall take precedence over contract or other services drawings as to all dimensions.

7.3 Contractor shall verify all dimensions at site and bring the notice of the owner any or all discrepancy or deviations notices. The decision of the owner in the regard shall be final.

7.4 Large size details and manufacturer’s dimensions for materials to be incorporated shall take precedence over small scale drawings.

7.5 Any drawings supplied with the tender shall be returned in good condition along with the tender.

7.6 All drawings issued by the consultants for the work are the property of the consultants and shall not be lent, reproduced or used on any other works than intended, without the written permission of the consultants.

8. Tender Information

8.1 The Contractor shall obtain all information relating to the preparation of the tender entirely on his own responsibility and expense.

8.2 The contractor shall visit the site and familiarize himself with the actual site conditions, access, availability of materials and other related problems for the speedy execution of the work.

8.3 The contractor shall examine all specifications, tender conditions and drawings before tendering for the work.

8.4 Information, levels and dimensions given in the tender drawings are supposed to be correct but the contractor shall make independent inquiries and verify the same. No claims for extras shall be admissible in case of any deviations for incorrectness of the information, levels or dimensions.
8.5 The contractor shall obtain all information relation to the local regulations, bye-laws, application of any and all laws relating to him work or profession. No additional claims shall be admissible on this account.

9.0 Materials

9.1 All materials used on this work shall be new, conforming to the specifications.

9.2 Materials shall conform to the latest TAC Regulations/Indian Standards Specifications as amended up to date and carry certification mark, where required.

9.3 All materials used on the project shall be approved by the owner.

9.4 Contractor may be required to purchase such materials of particular make or from a particular source if in the opinion of the owner the same is necessary and required for the proper and reasonable compliance of the specifications and in the interest of better quality of work.

10. Storage of materials

10.1 All materials shall be stored in a proper manner protected from natural element so as to avoid contamination and deterioration.

Contractor’s stores shall be open to inspection by the owner at all reasonable hours.

10.3 Location of stores and stores yards shall be approved by the owner prior to construction and occupation.

Contractors shall take adequate protection of the stores maintained by him, at his own Expense.

11. Materials by owners

11.1 Materials designated to be supplied by owners shall be supplied at locations given under the relevant clause of the agreement.

11.2 Any materials supplied by the owners shall be protected and stored as given in para 10 above.

11.3 Any damage during cartage, execution, installation or before formally handing over shall be made good by the contractor at his own expenses.

12. Inspection and testing of materials

12.1 Contractor shall be required to produce manufacturer’s test certificates for the particular Batch of materials supplied to him. The test carried out shall be as per the relevant India Standards.

12.2 For examination and testing of materials and works at the site contractor shall provide all Testing and gauging equipment necessary but not limited to the following:
a) Steel tapes
b) Painting / Coating thickness gauge
c) Plum bobs , spirit levels , hammers
d) Micrometers / Vernier calipers
e) Hydraulic test machine , pressure gauge ,flow meter
f) Clamp –on – ammeter , megger
g) ‘Holiday Test ’ , machine

12.3. Contractor shall submit calibration Test Certificate not older than 15 days for all such Equipments / instruments . Further if required by the owner , calibration test certificate of Any approved laboratory may have to be submitted by the Contractor .

12.4 All testing equipment should be located at the site .

12.5 The contractor shall carryout the various tests as enumerated in the technical specifications Of tender documents .

12.6 All tests whether on the field or outside concerning the execution of the work and supply of Materials by the contractor shall be carried out by the contractor at his own cost .

12.7 The work is subjected to inspection at all times by the Owner. The contractor shall carry out All instructions given during inspection and shall ensure that the work is being carried out according to the technical specifications of this tender .

12.8 The contractor shall provide for purpose of inspection access ladders , lighting and Necessary instruments at his own cost .

12.9 All results of inspection and test will be recorded in the inspection reports , performa of Which will be approved the owner .These reports shall form part of the completion documents .

12.10 Any work not conforming to the execution drawings , specifications or codes shall be rejected forth with and the contractor shall carryout as per the specification at his won cost .

13 . Metric

13.1 All dimensions and sizes of materials and equipments given in the tender documents are Commercial metric sizes .

13.2 Any weights of sizes given in the tender having changed due to metric conversion ,the Nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost . The decision of the owner shall be final and binding on the contractor .

14 . Reference points

14.1 Contractor shall provide permanent bench marks , flag tops and other reference points for The proper execution of work and the same shall be preserved till the end of the work .

14.2 All such reference points shall be in relation to the levels and locations given on the
Architectural and contract drawings.

15. **Reference drawings**

The contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site.

All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation.

16. **Site order book**

16.1 The contractor shall maintain a site order book at the site office.

16.2 All instructions relating to the job shall be recorded by the owner, along with contractor’s compliance.

16.3 Contractor is bound to carry out all such instructions given to him.

17. **Working / shop drawings**

17.1 The contractor shall submit to the owner, six copies of the working/ shop drawings.

17.2 Working drawings shall be approved by the consultant. Six sets of shop drawings shall be submitted for approval showing:

a) Any change in layout from the contract drawings.

b) Equipment layout, piping, wiring diagram and instrumentation.

c) Manufacturer’s or contractor’s fabrication drawings for any material or equipment.

18. **Information to be furnished by tenderer**

The following details are required to be furnished along with the tender:

18.1 Tenderer shall submit documentary evidence in support of jobs carried out/ under execution, turnover statements and profit and loss account for the last 3 years.

18.2 Technical information (Catalogues/ Leaflets) in duplicate about all equipment’s, materials which are to be supplied by the tender.

18.3 All letters/ information, specification and details shall be submitted in duplicate.

19. **Completion drawings**

19.1 On completion of works, contractor shall submit one complete set of original tracings and Two prints of “As Built” drawings to the owner. These drawings shall have the following information:

a) Run of all piping, with diameters on all floors and vertical stacks.
b) Run of all fire lines with diameters, location of control valves, access panels.
c) Location of all mechanical equipment with layout and piping connections.
d) Run of control wiring and circuit diagrams of motor control panels.

19.2 Contractor shall provide six sets of catalogues, maintenance manuals, performance data and list of spare parts together with the name and address of the manufacture for all electrical and mechanical equipment provided by him.

19.3 All “Warranty Cards” given by the manufacturers shall handed over to the owner.

20. Contractor’s Rates

Rates quoted in this tender shall be inclusive of cost of materials, labour, supervision, 
Erection, tools, plant scaffolding, services, connections, transport to site, taxes, octroi and levies, 
breakage, wastage an all such expenses as may be necessary and required to completely do all the 
items of work and put them in a working condition to the satisfaction of the owner.

Rates quoted are for all heights and depths required for this work and must be for complete 
Items inclusive of such accessories, fixtures and fixing arrangements, nuts, bolts, hangers as are a 
standard part of the particular item unless given separately in the schedules of quantities.

All rates quoted must be for complete items inclusive of accessories, fixtures and fixing 
Arrangements, nuts, bolts, hangers as are standard part of the particular item unless given 
separately in the schedule of quantities.

All rates quoted shall be inclusive of cutting holes and chases in walls and making good the 
Same with cement concrete. Contractor shall provide holes, sleeves, recesses in the concrete and 
masonry work as the work proceeds.

The schedule of rates is to be read with all the other sections of this tender document.

The owner reserves the right to interpolate the rates of such items of work fall in between 
Similar items of lower and higher magnitude.

All items of work, in the schedule of rates shall be carried out as per the specifications, 
Drawings and instructions of the owner, and the rates shall provide for supply of required materials, 
consumables, skilled and unskilled labour, supervision, tools and tackles, etc., as called for in the 
detailed specifications and conditions of the contract.

21. Testing

21.1 Piping system shall be tested as specified under the relevant clause of the TAC Regulations/ 
Specifications and shall be performed in the present of the owner/local fire inspector.

21.2 All materials and equipment found defective shall be replaced and the whole work again tested 
To meet the requirements of specifications, at the cost of the contractor.

21.3 Contractor shall perform all such tests may be necessary and required by the local authorities
To meet the municipal or other bye – laws in force at his own cost.

21.4 Contractor shall provide free of cost all labour, equipment and materials for the performance of the test.

22. Site clearance and clean – up

22.1 The contractor shall from time to time, clear away all debries and excess material accumulated at the site.

22.2 After all the fixtures, equipment and appliances have been installed and commissioned, Contractor shall clean up the same and remove all plaster, paint, stains, stickers and other foreign matter and discoloration leaving the system in a ready to use condition.

23. License and permits

23.1 Contractor must be an experienced firm, approved by the local fire brigade authority and the insurance association of India for execution of fire protection system.

23.2 Contractor shall obtain the approval of all works executed by him from the local fire brigade authority.

24. Electrical works

24.1 Electrical work done under this contract shall be executed by licensed wiremen under the supervision of licensed electrical supervision as per requirements of the Indian Electricity Act.

24.2 Contractor shall obtain the approval of all electrical installation done under this contract from the appropriate competent authority before the installation is commissioned.

25. Approval of Fire Installation

25.1 Contractor shall prepare detailed drawings for fire fighting systems and obtain prior approval of the same from the Local Fire Authority.

25.2 Contractor shall keep a constant liaison with the above authorities to keep them aware of the progress and standards of works followed, and for the inspections to be carried out during the fabrication / construction phase.

25.3 Contractor shall obtain all NOC/ Approvals / Completion Certificates with respect to the fire Fighting installations from the District Magistrate / Local Fire Officer.

26. Welding

26.1 The welding procedure, types of electrodes etc. shall be in accordance with the following IS Specifications.

<table>
<thead>
<tr>
<th>Welding Procedures</th>
<th>IS : 823</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welding Electrodes</td>
<td>IS : 814, but of approved makes only</td>
</tr>
</tbody>
</table>
26.2 Only welders filling the requirements of IS : 817 and approved by the Owner shall be
Employed by the contractor. 

27. Jointing of pipes

Pipes and fittings shall be joined with electrical resistance welding in approved manner.
Gasket, for use in between flanged joints, to be of CAF as per IS – 2712, thickness as
Specified in SOQ/BOQ.

28. Painting

28.1 All above grounded pipes, pipe fittings, hose cabinets structural steel work pipe supports etc.
Shall be painted as per specifications given below.

28.2 Painting shall be done only after completion of fabrication work and testing.

28.3 The instructions of paint manufacture shall be followed as far as possible otherwise the work
is to be done as directed by the Owner.

28.4 All cleaning materials, brushes, tools and tackles, painting, material etc. shall be arranged
By the contractor at site in sufficient quantity.

28.5 All rust, dust shall scales, welding slag or any other foreign materials shall be removed fully
So that a clean and dry surface is obtained prior to painting. Any other oily containment shall be
removed by use of a solvent prior to surface cleaning.

28.6 First coat of primer paint must be applied by brush on dry clean surface immediately or in any
Case within 3 hours of such cleaning.

28.7 Primer paint – one coat (minimum thickness 100 microns) self – priming epoxy mastic.

28.8 Finishing coats:

a) For production areas – 2 coats (thickness minimum 50 microns each) of epoxy paint, fire
Red shade as per IS : 5.

b) For other than production areas – 2 coats of synthetic enamel paint, fire red shade as per
IS:5.

29. Coating wrapping for underground pipes

29.1 All underground piping shall be protected by coating and wrapping as per the following
Procedure.

29.2 The materials and workmanship shall in general confirm to IS:10221 or as directed by the
Owner.
29.3 Cleaning – The pipes shall be thoroughly cleaned by dust, rust will scales, oil, grease etc. By stiff wire brush and scrappers. The surface shall be coated with the primer immediately after cleaning.

29.4 Priming – The primer shall be PYPKOTE / RUSTFIRE / CORPORATE under coat. The Manufacturers recommended procedure would be followed for applying the primer.

29.5 Paste Application – PYPKOTE – AW Paste / CORPORATE paste shall be applied to fill up uneven surfaces in order to ensure smoothness for subsequent wrapping with multi-layer tape.

29.6 Tape wrapping – the tape is to wrapped while the second coat of primer is still tacky. Winding is to be done with 50% overlap so that the total thickness of 2.0 mm tape would become 4.0 mm. It should be ensured while wrapping that air bubbles are trapped. The ends of tape shall be secured with nylon binding to ensure that the tape doesn’t get loosened while handling.

29.7 The total thickness including 2 coats of primer, 50% overlap of tape etc. should not be less than 4.5 mm or as per manufacturer recommendations.

29.8 The ‘Holiday Test ’is to be conducted for detecting any entrapped air or any other defect. The contractor is to arrange for the Holiday Test and to rectify the defects if found any.

30. Inspection and testing schedule

Abbreviations used:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC</td>
<td>Dimensional Checking</td>
</tr>
<tr>
<td>MTC</td>
<td>Material Test Certificate (Chemical Analysis and physical properties)</td>
</tr>
<tr>
<td>HTC</td>
<td>Hydraulic / Pressure Test Certificate (Chemical Analysis and physical Properties)</td>
</tr>
<tr>
<td>NDT</td>
<td>Non‐Destructive Test</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>Item</th>
<th>DC</th>
<th>MTC</th>
<th>HTC</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.</td>
<td>Pipe</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>Test pressure as per specification.</td>
</tr>
<tr>
<td>02.</td>
<td>Fittings</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>03.</td>
<td>Flange</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>Body Test at 1.5 times PN – with valve open seat test at pressure equal to PN (With Valve closed)</td>
</tr>
<tr>
<td>04.</td>
<td>Bolting</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>05.</td>
<td>Gasket</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>06.</td>
<td>Valves</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>07.</td>
<td>Fire Hydrants</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>Contractor to furnish manufacturer’s test certificate and TAC approval certificate</td>
</tr>
<tr>
<td>08.</td>
<td>Hose Pipes</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>09.</td>
<td>Branch Pipes</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Fire Pumps</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>Contractor to furnish manufacturer’s test certificate. Shope Test after commissioning to be carried out by the contractor.</td>
</tr>
</tbody>
</table>

Note: Welded joints shall be tested as per TAC rules
I) Specifications for Fire Hydrant / Down Comer System

1. Scope of work

Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install Down Comer fire hydrant system as required by the drawings and specified herein after or given in this schedule or quantities.

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

a) Mild steel mains including valves, hydrants and all other accessories.

b) Mild Steel pipe fire risers within the building.

c) Landing valves, canvas hose pipes, hose reels, hose cabinets, fire brigade connections, connection to pumps, appliances and pressure reducing devices.

d) Excavation, anchor blocks and valve chambers.

2.0 General Requirements

2.1 All materials shall be of the best quality conforming to the specifications and subject to the approval of the employer.

2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workman like manner.

2.3 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.

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

2.5 Valves and other appurtenances shall be so located that they are easily accessible for operations, repairs and maintenance.

3. Pipes and fittings

For internal work:

a) All pipes within the building in exposed locations and shafts including connections buried under floor shall be ERW mild steel tubes conforming to IS:1239 (Heavy Class) with screwed or welded joints as specified by the engineer in charge.

b) Fittings of 50 mm or below shall be forged steel with socket weld ends of approved makes. For 65 mm and above shall be W.I./M.S with butt weld ends.
4. Jointing

(See clause 27.0 of General Technical Specifications)

5. Excavation

Excavations for pipe line shall be in open trenches to levels and grades shown on the Drawings or as required at site. Pipe lines shall be buried to a minimum depth of 1 to 1.5 meter or as shown on the drawings.

Wherever required contractor shall support all trenches or adjoining structures with Adequate supports to prevent land slides.

On completion of testing and painting, trenches shall be refilled with excavated earth in 15 Cm layers and compacted.

Contractor shall dispose off all surplus earth within the SBCH site.

6. Anchor Blocks

Contractor shall provide suitable cement concrete anchor blocks as may be necessary for Overcoming pressure trusts in under ground / external pipes. Anchor blocks shall be of cement concrete 1:2:4 mix.

7. Valves

Butterfly valves 65 mm dia and above shall be cast iron double flanged with lever type. Butterfly valves shall confirm to and marked IS : 13095-1991 780 Class PN- 1.6 tested to 20 kg/sq.cm.

Valves on MS pipe 50 mm and below shall be heavy pattern gun –metal gate valves (with Cast iron wheel )/ Ball Valve with lever type tested to 20 kg /sq .cm pressure . Valves shall conform to and marked IS:778.

Check valves shall be cast iron double flanged conforming to IS 5312-1975 with cast iron Steel body and stainless steel internal trims.

8. Internal Hydrants

8.1 Contractor shall provide on each landing and other locations as shown on the drawings one Signal headed gunmetal landing valve with 63 m dia outlets and 80 mm inlet ( I.S 5290-1969) with individual shut off valves and cast iron wheels. Landing valves shall have flanged inlet and instantaneous type outlet as shown on the drawings/BOQ.

8.2 Instantaneous outlets for fire hydrants shall be of standard pattern approved and suitable for Fire brigade hoses. Contractor shall provide for each internal fire hydrant station two numbers of 63 mm dia 15 meter long reinforced rubber lined hose pipes with gunmetal male and female instantaneous type coupling machine wound with G.I wire (hose to IS 636 type A and couplings to I .S 903 with I.S certification), fire hose reel, gunmetal branch pipe with nozzle I.S 903 fireman's axe as shown on the drawings/BOQ.
8.3 Each hose box shall be, after thorough cleaning of surface, painted as per section 28 of General Technical Specifications. The words Fire House to be painted on the inner face of the glass.

9. **First Aid Hose Reels**

Contractor shall provide standard fire hose reels with 20 mm dia high pressure rubber hose of 36 meters length with gunmetal nozzle with 6 mm bore, and control valve, shut off nozzle connected wall mounted on circular hose reel of heavy duty mild steel construction and cast iron brackets. Hose reel shall conform to I.S 884 – 1969. The hose reel shall be connected directly to the MS pipe rise through an independent connection as shown on the drawings/BOQ.

10. **Pressure Gauges**

   a) All pressure gauges shall be of dial type with bourdon tube element of IS 316. The gauge shall be of reputed make. The dial size shall be 150 mm dia and scale division shall be in metric units marked clearly in black on a white dial. The range of pressure gauge shall be 0 to 10 kg / sq cm.
   
   b) All pressure gauges shall be complete with isolation cock, nipples, tail pipes etc.

11. **Pressure switches**

   a) The pressure switch shall be industrial type single pole double throw electric pressure switch designed for starting or stopping of equipment when the pressure in the system drops or exceeds the pre-set limits. It shall comprise of a single pole change–over switch, below element assembly and differential spindle.

   b) All the pressure switches shall have 1/4” B.S P (f) inlet connection and screwed cable entry for fixing cable gland.
c) The electric rating of the switch shall be as under:

<table>
<thead>
<tr>
<th>Type of Supply</th>
<th>Voltage</th>
<th>Non – Inductive</th>
<th>Inductive</th>
</tr>
</thead>
<tbody>
<tr>
<td>A . C</td>
<td>110-380</td>
<td>10 Amp</td>
<td>6 Amp</td>
</tr>
<tr>
<td>D . C</td>
<td>24-250</td>
<td>12 Watts</td>
<td>12 Watts</td>
</tr>
</tbody>
</table>

12. Fire Brigade Connection

13.1 The contractor shall provide as shown on drawing gunmetal Fourr way collecting head with 63 mm dia instantaneous type inlets with built in check valve of 100/150 mm dia. outlet connection to the fire main grid and for tank filling, collecting head shall conform to IS 904-1965.

13. Air Valves

13.1 The contractor shall provide 25 mm dia screwed inlet case iron single acting air valve on all high points in the system or as shown on drawings.

14. rain valve

14.1 The contractor shall provide 25 mm dia M.S pipe to IS : 1239 (heavy class) with brass gate Valve for draining any water in the system in low pockets as shown in drawings or as directed by the owner.

15. Valve chambers

15.1 Contractor shall provide suitable brick masonry chambers in cement mortar 1:5 (1 cement : 5 coarse sand) on cement concrete foundations 150 mm thick 1: 5 : 10 mix (1 cement : 5 fine sand 10 graded stone aggregate 40 mm nominal size) 15 mm thick cement plaster inside and outside finished with a floating coat of neat cement inside with cast iron surface box approved by fire brigade including excavation, back filling, complete.

15.2 Valve chamber shall be of the following size:

For depths 100 cm and beyond 120 x 120 cms

16. Pipe Protection

(See clause 28.0 & 29.0 on ‘Painting’ and ‘Coating / Wrapping’ under General Technical Specifications)

17. Pipe Supports

17.1 All Pipes shall be adequately supported from ceiling or walls by means of anchor fasteners By drilling holes with electrical drill in an approved manner as recommended by manufacturer of the fasteners.

17.2 All supports / clamps fabricated from MS Structural e.g. roads, channels, angles and flats
Shall be painted as described in specifications for “painting” under General Technical Specifications.

17.3 Where inserts are not provided the contractor shall provide anchor fasteners. Anchor Fasteners shall be fixed to walls and ceilings by drilling holes with electrical drill in an approved manner as recommended by the manufacturer of the fasteners.

18. Testing

18.1 All piping in the system shall be tested to a hydrostatic pressure of 11.0 kg / sq.m without Drop in pressure for at least 2 hours.

18.2 Rectify all leakage’s, make adjustments and reset as required and directed.

19. Hose Cabinets

19.1 Provide doors / hose cabinets for internal / external hydrants respectively fabricated from 16 Gauge M.S sheet with double glass front door and locking arrangement, with breakable glass key access arrangement, duly painted red as per specifications and fixed to wall / floor as per site conditions. The cabinet shall have a separate chamber to stove a key with breakable glass as per approved design. Hose cabinets shall be hinged double door partially glazed with locking arrangement, painted as per specifications with “Fire hose” written on it prominently. Samples of hose cabinet for indoor and outdoor works shall be got approved from Owner before production delivery at site.

19.2 For external hydrants the hose cabinets shall be fabricated from 16 gauge thick MS sheet With double shutter glass front door and locking arrangement with breakable glass key access arrangement. The cabinet shall have “Fire Hose” written on it prominently. Sample of hose cabinet shall be got approved from the Owner before installation at the site.

20. Measurement

Mild steel pipes shall be measured per liner meter of the finished length along the centre line and shall include all fittings (including flanges), welding, jointing, clamps for fixing to walls or hangers, anchor fastener and testing.

Butterfly valves, check valves and full way valves shall be measured by number and shall Include all items necessary and required for fixing and as given in the specifications / schedule of quantities.

Landing valves, hose cabinets, reinforced rubber lined fire hose pipes, first aid fire hose reels (with gunmetal full way valves) and gunmetal branch pipes shall be measured by numbers and shall include all items necessary and required for fixing as given in the specifications / schedule of quantities.

Suction and delivery headers shall be measured per linear meter or finished length and shall
Include all items as given in the schedule of quantities.

Painting / wrapping / coating of headers, pipes shall be included in the rate for pipes and no separate payment shall be made.

Brick masonry chambers shall be measured by number and shall include all items as given in the schedule of quantities specifications.

No additional payment shall be admissible for cutting holes or chases in walls or floors, making connections to pumps, equipment and appliances.
II) SPECIFICATIONS FOR PUMPS AND ANCILLARY EQUIPMENT

1. **Scope of work**

   Work under this section shall consist of furnishing all labour, materials, equipment and Appliances necessary and required to completely install electrically operated pumps for fire hydrant installations as required by the drawings and specified hereinafter or given in the schedule of quantities.

   Without restricting to the generality of the foregoing the pumps and the ancillary equipment and shall include the following:

   a) Electrically operated pumps with motors, base plate and accessories.
   b) Pumps suction and delivery headers, valves, air vessel and connections.
   c) Pressure gauges / pressures switch.
   d) Electrical switchboard, wiring, cabling, cables, tray, control panel and property connecting to earthing system of the factory.

2. **General Requirements**

   2.1 Pumps shall be installed true to level on suitable concrete foundations. Base plate shall be firmly fixed by foundation bolts properly grouted in the concrete foundations.

   2.2 Pumps and motors shall be truly aligned with suitable instruments.

   2.3 All pumps connections shall be standard flanged type with appropriate number of bolts.

   2.4 Manufacturers instructions regarding installation connections and commissioning shall be followed with respect to all pumps, switch gear and accessories.

3. **Fire Pumps**

   3.1 **Pump sets**

      a) Centrifugal, End suction, horizontal pump should be selected as per IS. Pump should have following specifications.

      **Materials of Construction.**

      **Parts**

      - Casing: Cast Iron
      - Impeller: Bronz IS: 318, Gr. LTBJ / JTB 2
      - Casing wearing: Cast iron
      - Shaft: Stainless steel
Shaft Sleeve          SS-410
Thrust Bearing        Antifriction of Titling pad type

b) Shut up head should not exceed 120% of rated head. Pump shall not develop less than 65% of rated head at 150% of rated capacity.

c) Pumps shall be provided with pressure gauge with isolation cock on the delivery side.

d) In case of motor driven pump the motor rating should be adequate to drive the pump at 150% of rated discharge.

e) The pump and its prime mover (Electric motor or Diesel Engine) shall comply with all the requirements of the Rules of Tariff Advisory Committee.

4. Wet Riser (Hydrant) System

|Down Comer hydrant system shall be pressurized through a set of pumps driven by electric motors. Desired pressure shall be created and maintained in the systems by means of Terrace pump sets.

5. Electric Driven

Electrically driven pumps shall be provided with totally enclosed fan cooled induction Motors suitable for fire pumps with IP55 enclosure.

The motors should be rated not to draw more than 4.5 times the starting current.

Motors shall be at least equivalent to the horse power required to drive the pump at 150% of its rates discharge.

The motors shall be wound for class F-insulation and windings shall be vacum impregnated with heat and moisture resisting varnish, glass fiber insulated.

6. Base Plate

6.1 Pumps and motors shall be mounted on a common structural base plate and installed as per manufactures instructions.

7. Vibration eliminators

7.1 The contractor shall provide on all suction and delivery lines double flanged reinforced Neoprene flexible pipe connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the test connector shall be as per manufacturer details.

8. Cubicle type switch boards / L.T panel

Cubicle type switch boards and components shall conform to the requirements of the Latest revision including amendments of the following codes and standards.
IS : 8623  Specification for factory built assemblies of switchgear and control gear for Voltage up to and including 1000- V AC / 1200 V-DC.

IS : 4237  General requirements for switch gear and control gear for voltage not exceeding 1000-V.

IS : 2147  Degree of protection provided by enclosures for low voltages switch gear and Control gear.

IS : 1028  Switch gear and control –gear selection / installation and maintenance.

IS : 6005  Code of practice for phosphating of iron and steel.


IS : 1248  Direct acting indicating analogue electrical measuring instruments and testing Accessories.

IS : 2705 part I, II&III 1964  Current transformers for metering and protection with classification burden and Insulation.

The board shall be metal enclosed single front, indoor floor mounted free standing type or wall mounting type as mentioned in BOQ. The panel shall be designed for A degree of protection of IP-52. The panel height shall not exceed 2350 mm including horizontal main bus bar at top. 1750 mm from finish floor. 40 mm clear Space shall be left throughout the panel at bottom. The cold rolled sheet steel will be of 2 mm thick.

All cutouts and covers shall be provided with synthetic rubber gasket.(Preferably neoprene).

The panel shall be divided into distinct vertical sections each comprising of:

a) Complete enclosed bus bar compartment for running horizontal and vertical bus bars.

b) Complete enclosed switch gear compartment one for each circuit for housing air circuit breaker, MCCD etc.

c) Compartmentally for power and control cables of at least 300 mm width covering entire height provided.

d) The panel shall have 20% spare space duly wired for future use.

The font of each compartment shall be provided with hinged single lead door with locking facilities. Panel shall be provided with suitable lifting facilities. Isolators & MCCB / ACBs shall be of fixed / drawout type as described later.

Each feeder shall have compartmentalised construction cable entry shall be from top / bottom (3 mm thick gland plate shall be provided) as required.
The panel shall be provided with three phase buses and neutral bus bars of aluminium sections throughout the length of the panel and shall be adequately supported and braced to withstand the stresses due to the short circuit current of 50 KA rms. For 1 sec.

Maximum temperature rise of bus bars and bus bar connection while carrying rated current shall not exceed 40°C over an ambient temperature of 50 deg C.

The minimum clearance in air between phases and between phases and earth for the entire run of the bus bar connections shall be 25 mm minimum bus bars support insulators shall be made of non-hydroscopic non-combustible track resistant and high strength type porcelain or polyester fiber glass moulded material.

All bus bars shall be colour coaded as per IS: 375 and the current density shall be 1 amp / sq.mm.

G.I earth bus of 50 x 6 mm size shall be provided at the bottom of the panel throughout the length. Similarly, 40 x 6 mm G.I strip in each vertical section for earthing the individual equipment/accessories shall be provided and connected to main horizontal bus.

All fuses shall be of HRC cartridge plug in type and shall be of class 2 type (80 KA rms) breaking capacity. Fuses shall have visible operation indications. Neutral link shall be mounted on fuse carriers which shall be mounted on fuse bases.

Contractors shall be electromagnetic type with interrupted duty as per IS: 2959. The main contacts shall be of silver or silver alloy, provided with minimum 2 NO and 2 NC auxiliary contacts. The push button should be of shrouded type and each should be provided with 1 NO and 1 NC contact. Colour coding shall be as per IS: 6875 (Part – II).

8.2 ACB

The circuit breaker shall be of air break type in order to eliminate fire and explosion risk. And shall comply with the IS: 13947-1993 with a rupturing capacity of not less than 50 MVA at 415 volts or as specified elsewhere (The service short circuit breaking capacity shall be as specified and equal to the short circuit with stand value). The breaker shall be provided with microprocessor based releases for over load and short circuit protection.

The breaker shall consist of a horizontal drawout pattern triple pole, fully interlocked, independent manual spring operated mechanism. The mechanism should be such that the circuit breaker is at all times free to open immediately. The trip coil is energized. Current carrying parts should be silver plated and suitable arcing contacts shall be provided to protect the main contact are chutes for each pole shall be provided and shall be lifted out for the inspection of main and arcing contact.

Self aligning cluster type isolating contacts shall be provided on breaker for interlocking Protection metering and for any other purposes.

Breaker shall be provided with automatic safety shutters to screen the main live contact. When the breaker is withdrawn. The frame of the circuit breaker should be positively Earthed when the breaker is racked into the cubicle.
The following safety arrangements shall be provided the safety of the personnel to prevent Mal-operation.

(i) Interlock to prevent the truck from being withdrawn or replaced except in the fully isolated position.

(ii) Interlock to prevent earth connection from being made by the earthing device except breaker is open.

(iii) Interlock to prevent the breaker from being made alive without its rack in position.

8.3 **Moulded case circuit breaker (MCCB)**

MCCB shall conform to the latest IS : 13947-1993/IEC 947-1989. The service short circuit Breaking capacity (ICS at 415 VAC) should be 50 KA.

MCCB shall be current limiting and comprise of quick make – break switching mechanism. Preferably double break contact systems are extinguishing device and the tripping unit contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses. All MCCBs shall be capable of defined variable overload adjustment. All MCCBs rated 200 Amps and above shall have adjustable Magnetic short circuit pick up.

The trip command shall over ride all other commands. MCCB shall employ maintenance free double break contact system to minimize the let thru’ energies and capable of achieving discrimination upto the full short circuit capacity of downstream MCCB. The manufacturer shall provide both the discrimination tables and let thru’ energy curves. The MCCB shall not be restricted to line/load connections.

The handle position shall give positive indication of ‘ON’, ‘OFF’ or ‘Tripped’ thus qualifying to disconnection as per the IS/IEC indicating the true position of all the contacts. In case of 4 pole MCCB the neutral shall be defined and capable of offering protection.

The general purpose control switch shall be provided for ON / OFF Auto / Manual. The switch shall be provided with engraving plates on the front with the complete inscription.

The switch shall be normally a fixed control box type heavy duty unit.

Indicating lamps shall be of the panel mounting, LED type and shall have execution plates marked with its function wherever necessary. The colour of the lamp cover shall be red for ‘ON’ and green for ‘OFF’.

Indicating meter shall be digital type.
8.4 Motor and starters for fire pumps

The starters shall be of DOL type. The motors should have double sq. cage or other provision to limit the starting current to 4 times the full load current.

8.5 Name Plates and Lables

(1) Panel and all modules shall be provided with prominent engraved identification plates. The module identification designation. For single front switch boards, similar panel and board identification labels shall be provided at the rear also.

(ii) All name plates shall be of non-rusting metal or 3 ply lamicold, with white engraved lettering on black background. Inscription and lettering sizes shall be subject to Owner’s approval.

(iii) Suitable stenciled paint marks shall be provided inside the panel / module identification of all equipments in addition to the plastic sticker labels, if provided. These labels shall be partitioned so as to be clearly visible and shall have the Device number, as mentioned in the module wiring design.

8.6 Painting of all steel work

The steel used for fabrication of electrical / mechanical equipment should be stove enameled as per the detailed specifications given below:

a) Degreasing: All the steel components, to be painted, should be effectively cleaned by alkaline degreasing.

b) Picking: Oxide scale rust formation are to be removed in a hot bath of sulphuric acid. Pitting of the surface is to be prevented by the use of pickling in habitors.

c) Cold Rinsing: The parts are then to be washed with cold water to remove all traces of acidic solution.

d) Phosphating: In order to attain durable paint coating the metal surface is to be given phosphating treatment by development a phosphate layer on the surface. Preferably hot grenadine solution is to be used in the phosphating plant.

e) Pessivating: This process is to be carried out by using deodalite solution.

f) Drying: The treated parts should then be dried in a hot chamber in dust free atmosphere to ensure that they are absolutely clear and dry before the paint is applied.

g) Primer coating: The treated and dried parts are to be sprayed with high corrosion resistance primer.

h) Stove Drying: The primer coating is to be backed in an electrically heated, air circulated area type storing oven.
i) Finishing coat: The finishing paint coat is to be applied by spraying two coats of 15 micron thickness powder coated paint of approved shade.

8.7 Wiring

Control and protective wiring shall be done with copper conductor PVC insulated 110 volts grade multi-stranded flexible wire of 2.5 sq. mm 2 cross section. The colour coding shall be as per latest edition of IS : 375.

Each wire shall be identified by Plastic ferrule. All wire termination shall be made with type connection. Wire shall not be taped or spied between terminal points.

Terminal blocks shall preferably by grouped according to circuit function and each terminal block group shall have at least 20% spare capacity.

Not more than 1 (one) wire shall be connected to any terminal block.

8.8 Current Transformer

Current transformers shall be of ration, burden (shall be worked out by panel supplier), class/accuracy specified in Single Line diagram. Current transformers shall conform to latest edition to relevant standards. Current transformers shall be epoxy resin cast with bar primary or ring type.

The design and construction shall be sufficiently robust to withstand thermal and dynamic stresses due to the maximum short circuit current of the circuit.

The current transformer shall preferably be capable of being left open circuited on the secondary side with primary carrying rated full load current, without overheating or damage. Short time current rating and rated withstand time shall be same as corresponding C.B.

C.T core laminations shall be of high grade silicon steel.

Secondary terminals of CT shall be brought out to a terminal block which will be easily accessible for testing and external connections. Facility shall be provided for short-circuiting and earthing of CT secondary leads through a removable and accessible link with provision for attaching test link.

Rating plate details and terminal markings shall be according to the latest edition of relevant Indian Standard Specification.

Generally separate current transformers (core) shall be used for metering and protection.

12. Cables

12.1 Contractor shall provide all power and control cables from the motor control center to various Motors and control devices, of ratings as per IS: 3961.
12.2 All power and wiring cables shall be FRLS armoured. Cables and wires shall comply with requirements of IS: 5831, 694, 8130, 7098 (I) & 1554 as the case may be.

12.3 All cables shall have stranded conductors. The cables shall be supplied in drums as far as possible and bear the manufacturer’s identification mark.

12.4 All cable joints shall be made in an approved manner as per accepted practice.

13. Earthing

13.1 The earthing pit would be provided by the owner. Fire fighting contractors shall have to provide earthing strips (G.I 25 x 3 mm) or earthing wires (G.I. 8 SWG) as may be required for proper earthing of the equipments supplied by him. Thickness of galvanization to be 75 microns (minimum). Each electrical equipment is to be earthed at 2 points.

14. Commissioning

14.1 Commissioning of the systems shall commence only after:

a) All pipes, accessories, pumping set, fire alarms, etc have been completely installed and Tested.

b) The electrical connection has been made and direction of motors rotation checked.

c) Related works by other agencies has been completed in all respects.

d) Water supply is available in adequate quantity in the underground tank.

e) Basement drainage pumps are fully commissioned.

f) On completion of all related work given in para above, start pumping sets and develop desired pressure in both the systems.

g) Open one hydrant and test if pumps starts at desired drop in pressure and the alarm operates. If required make adjustments and reset.


15.1 On completion of the entire work and successful commissioning, contractor shall handover Four copies of maintenance manuals of all equipment installed by him.

15.2 Maintenance manuals shall include information relating to make, model number, year of Manufacture for all electrical and mechanical equipment with names of local suppliers or manufacturers agents.

16. Measurements

16.1 Pumping sets, air vessel, switchboard cubicle, pressure switch, fire alarm shall be
Measured by number and shall include all items necessary and required and given in the specifications.

16.2 Earthing shall be measured as a lump sum item

16.3 Earthing tape will be linear measurement.

16.4 Cabling shall be measured per linear meter from switchboard to each motor and shall include all items necessary and required and given in the specifications.
III) COMMISSIONING OF FIRE FIGHTING SYSTEM

1. **Scope of work**

1.1 Work under this section shall consist of pre – commissioning , commissioning testing and providing guarantees for all equipment, appliances and accessories supplied and installed by the contractor under this contract.

2. **General Requirements**

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

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

2.3 All inspection and testing for gauging the efficacy of all equipments would be as per the TAC regulations.

3. **Pre- commissioning**

3.1 On completion of the installation of all pumps , piping , valves , pipe connections , electrical wiring motor control panels and water level controlling devices the contractor shall proceed as follows :

**A . Testing of MCC**

Tests to be carried out for motor control centers shall be :

(a) Insulation resistance test with 500 volt merger , before and after high voltage test , on all power and control wiring.

(b) High voltage test at 2000 volts AC for one minute on all power and control wiring.

(c) Low voltage continuity test ( 6 volts ) on power wiring of feeder , between bus bars and outgoing terminals with switches and contractors in.

(d) Low voltage continuity test ( 6 volts ) on all control wiring.

(e) Operation test for all feeders with only control supply made ‘ On ’ to ensure correctness of control wiring , operation of the various equipment used such as push buttons , protective devices indicating lamps and relays , etc . All contactors shall be checked for presence of humming and chattering.

(f) Earth continuity test with voltage not exceeding 6 volts between various non – current metallic of equipment , steel work . etc . and the earth bus provided in the MCC.

(g) Operation of all instruments and meters provided on the MCC.

**B. Fire protection system**
(a) Check all hydrant valves and close if any valves is open. Check that all suction and delivery connections are properly made.

(b) Test run and check rotation of each motor and correct the same if required.

A. Pipe work

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

(b) Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specifications if any leakage is found. Rectify the same and reset the pipes.

4. Commissioning and testing

A. Fire Hydrant System

(a) Pressurize the fire hydrant system by running the Terrace fire pump and after attaining the required pressure shutoff the pump.

(b) When the fire pumps have been checked for satisfactory working on automatic controls, open fire hydrant simultaneously and allow the hose pipe to discharge water. The electrically driven pump should run continuously for eight hours so that its performance can be checked.

(c) Check each landing valve, male and female couplings and branch pipes for compatibility with each other. Any fitting, which is found to be incompatible and does not fit into the other properly, shall be replaced by the contractor. Landing valves shall also be checked by opening and closing under pressure.

B. Handing over

(a) All commissioning and testing shall be done by the contractor to the complete satisfaction of the engineer – in – charge / consultants, and the job handed over to the client.

(b) Contractor shall also hand over to the client all maintenance and operation manuals and all items as per the terms of the contract.
LIST OF APPROVED MAKES OF MATERIALS FOR FIRE PROTECTION WORKS

Note: The tenderer shall quote his rates on the basis of price of brand/make stipulated in the item of works as described in BOQ specification and furnished in technical data. The tenderer shall consider the first make of material from the list of Approved make while quoting tender. The owner reserves the right to select any of the branch indicated in the “List of approved makes/Agencies”.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Material</th>
<th>Brand Name</th>
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<tbody>
<tr>
<td>1.</td>
<td>Black steel (M.S)pipes/ G.I pipes</td>
<td>Jindal Hissar, Jindal, Tata</td>
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<td>2.</td>
<td>G.I. fittings (Malleable C.I)</td>
<td>Zoloto, Unik, R</td>
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<td>3.</td>
<td>Gate Valves/Globe valves/Ball Valves</td>
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<td>4.</td>
<td>Cl butterfly valves, Check valves, Y strainer</td>
<td>SKS, CiM, Audco, Kirloskar</td>
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<td>5.</td>
<td>Alarm Valve</td>
<td>HD, Gem, Reliable</td>
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<tr>
<td>6.</td>
<td>Sprinkler Head</td>
<td>Spraysafe, ASCOA, Safex</td>
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<td>7.</td>
<td>Fire Hydrants</td>
<td>Superex</td>
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<td>Fire Hose reel</td>
<td>Minimax, Newage</td>
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<td></td>
<td>GM Collecting Head</td>
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<td></td>
<td>Fire hose couplings</td>
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<td></td>
<td>Branch pipe and nozzles</td>
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<td>8.</td>
<td>Canvas Hose (RRL)</td>
<td>Jayashree, Indian Rayon</td>
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<td>9.</td>
<td>Fire Extinguishers</td>
<td>Superex, Minimax, Firex</td>
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<td>Rubber hose pipe</td>
<td>Dunlop or eq.appd. make</td>
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<td>Pumps</td>
<td>Kirloskar, KSB, Mather &amp; Platt</td>
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<td>12.</td>
<td>Motors</td>
<td>Kirloskar, Crompton greeves, Siemens</td>
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<td>13.</td>
<td>Diesel Engine</td>
<td>Kirloskar, or eq.appd.make</td>
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<td>14.</td>
<td>Electrical Switch gear</td>
<td>L&amp;T, English electric, Siemens</td>
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<td>15.</td>
<td>Cables</td>
<td>CCI, Universal, ICC, Gloster</td>
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<td>16.</td>
<td>Wiring</td>
<td>National, Grandlay, Skytone, Ecko</td>
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<td>17.</td>
<td>AMP Meter &amp; Volt meter</td>
<td>AEI, Havells.</td>
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<td>18.</td>
<td>Moulded circuit breaker</td>
<td>English Electric, L&amp;T.</td>
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<td>19.</td>
<td>a) Battery</td>
<td>Exide, Standard, Arukwa, Amco</td>
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<td>b) Battery Charger</td>
<td>Volstate or eq. Appd. Make</td>
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<td>Level Indicator</td>
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<td>Level Controller</td>
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<td>24.</td>
<td>Water flow meter</td>
<td>Kent or eq. Appd. Make</td>
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