MINISTRY OF HEALTH & WELLNESS
GOVT. OF MAURITIUS

Tender

For

Construction of Area Health Centre at Cap Malheureux, Mauritius

VOLUME-IV

Technical Specification

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Technical Specifications (Civil Works)
Construction of Area Health Centre at Cap Malheureux, Mauritius

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SECTION 1 – GENERAL

1.1 SITE VISIT

The tenderer is advised to visit and inspect the proposed site for which he is tendering prior to submission of his tender. The successful tenderer shall be deemed to have so satisfied himself as to the nature and extent of the works and no claim for extra expense or for extension of time under the contract will be allowed on the grounds that insufficient information was given in the Tender Documents and or that the contractor was not conversant with the conditions prevailing at the site or that during the course of the work the contractor encountered unexpected difficulty which could have been avoided by inspection of the site.

1.2 MATERIALS AND WORKMANSHIP

The quality of materials, goods and standard of workmanship shall be of the best quality of their respective kinds and to the Architect’s entire satisfaction and shall comply in all respect to the latest relevant British Standard Code of Practice and or Mauritius Standards referred to herein as BS COP and MS respectively unless otherwise stated.

Preambles and descriptions of materials, goods and workmanship given in any one section or trade shall apply throughout all other sections or trades of this Specification unless otherwise described.

The Contractor’s attention is drawn to his responsibilities as to defects after completion as defined in Articles 1792 and 2270 of the Civil Code.

1.3 DISCREPANCIES

The Contractor shall notify the Project Manager / Architect in respect of Materials and Workmanship specified herein, where any of the above conflict with each other or any other specified requirements.

1.4 SUBMISSION OF DOCUMENTS

The Contractor shall when so requested submit all at his own expense to Project Manager / Architect copies of relevant British Standards, Codes of Practice, Mauritian Standards, other equivalent standards for inspection; Compliance certificate in conformity with the specification from manufacturers; manufacturer’s specification and recommendation for the use of materials specified.
1.5 **ORDER OF MATERIALS**

The Contractor shall place orders for all materials, equipments, fittings, etc. within fifteen days after being awarded the contract unless otherwise specified. The Contractor shall keep the Project Manager / Architect informed of orders placed and of their expected delivery for use in connection with the works.

Delays in obtaining materials, equipment, fittings, etc. or non availability of same is at the entire risk of the Contractor and will not be considered for extension of time.

1.6 **SUPPLY OF SAMPLES**

The Contractor shall allow for furnishing any sample of materials, workmanship or building components in conformity with specifications and with technical literature that may be required by the Architect for approval or selection including panels of rendering, block walls, painting, stone cladding, stone masonry wall, granite tiles, granite cladding, composite cladding, panels, all materials related to mechanical and electrical works and interior fit out works, miniature of openings with ironmongeries, taps, sanitary appliances etc. The approved samples shall be retained on site in temporary room suitably protected and labelled for comparison with materials used in the works and shall be removed when no longer required at the Contractor’s expense.

The Architect will reject any materials, workmanship or components which in his opinion is not up to the same standard of any previously approved sample and such material workmanship or component previously approved.

1.7 **REPORTS AND RECORDS**

The Contractor shall record daily the number of workpeople employed on the works in each trade together with details of delivery of materials on site and movement of plant and equipment to and from site as applicable.

He shall also keep daily records of weather conditions, and works executed and tests carried out.

The Contractor shall supply free of charge progress photos, in 20 nos. + 3 nos. CDS of such records to the Architect with copy to all Consultants and 2 copies for the Employer at fortnightly intervals from the commencement to the completion of the works. Similar records shall be kept by the Contractor for all sub-contractors employed on the project. All these documents shall be
part of Contractor Progress Report which will be submitted on fortnightly basis to Architect, with copy of to all parties as before specified.

1.8 **PLANT AND EQUIPMENT**

The Contractor shall provide and install all necessary plants, concrete mixers, vibrators, dumpers, excavators, bulldozers, rollers, pumps, cranes, hoist, ladders, scaffolding, staging, tackle, tarpaulins, tools, vehicles and other plant (mechanical and otherwise) and allow for altering, adapting, and maintaining them as necessary for the efficient and expeditious execution of the works and at or before completion clear same from building and site and make all good, to the entire satisfaction of the Architect.

The Contractor shall provide the requisite plant and equipment, scaffolding and facilities to Subcontractors and Suppliers, whether domestic or nominated until all their works are completed to the entire satisfaction of the Architect.

1.9 **GENERAL COSTS**

The Contractor shall allow for all costs incurred in respect of workpeople and site staff :-

- Workmen’s Compensation Insurance
- National Pensions Fund Contributions
- Sick Leave, Annual and Public Holidays
- Shut down or account of cyclone warnings, weather conditions, inclement weather, etc.
- Travelling time expenses, fares and transport costs.
- Incentive and Bonus Payments
- Severance and Subsistence Allowance
  Protective and Safety clothing and equipment.
  Any other costs necessary under the application of the Building Industry Remuneration Order and the Labour Act.

The Contractor must make himself acquainted with current ordinances and Government regulations regarding the movement of housing, security and control of labour, labour camps,
transport, etc. and make allowance for all costs incurred therewith or arising from the employment of workpeople and site staff.

1.10 **WORKING RULES & REGULATIONS**

The Contractor shall conform to all Regulations, By Laws and other requirements of the Local and Central Administration. He shall give all notices and pay all fees legally demandable by such Administration. If anything shown on the drawings or mentioned herein conflicts with such regulations, the Contractor shall inform the Architect and obtain his instructions before proceeding.

1.11 **HOARDING, BARRICADES AND SCREENS, GANTRIES**

The Contractor is informed the site is located in a built up areas with adequate movement of persons and vehicles, including office buildings, business hotels. The Contractor shall take all necessary precaution to have a tidy and clean environment, with adequate high charlon protection in double layer, minimum 5.50 m high secured fixed to resist prevailing wind of about 125 Km/hr and to Contractor’s design all along the site. This charlon protection shall act as screen to avoid propagation of dust to neighbours. Notwithstanding the above the Contractor shall comply with Occupational and Health Safety Act 2005 and other regulations to the entire satisfaction of the Architect.

The Contractor shall also provide and erect temporary hoarding, gantries, barricades and screens with gates, access doors and fastenings, as required for the proper execution of the works, for the protection of the workmen, public and occupants of the adjoining premises and for meeting the requirements of any local or other authority.

The whole of the site shall be properly fenced with temporary hoardings and shall be removed and cleared away from site on completion of works, all to Architect’s satisfaction.

1.12 **SHORING**

The Contractor shall provide for upholding sides of all exposed excavated surfaces with timbering shoring or other methods approved by the Architect.

The construction and efficiency of the shoring for the purpose for which it is erected shall be the entire responsibility of the Contractor. Should any subsidence or any other damage occur due to the inefficiency of the shoring or any other support provided, the damage shall be made good by the Contractor at his own expense.
1.13 **MAINTAIN AND PROTECT PUBLIC PROPERTY ETC**

The Contractor shall maintain and protect public and private carriageways, footing, kerbs, pipes, duct, sewers, service mains, underground and overhead cables, etc. and keep public roads free from mud, grit and even broomed the affected roads 3 times daily, especially when earthwork are being carried out and as well as keep the site environment clean and tidy throughout the execution of the works, and make good or pay for the reinstatement of any damage caused either directly or indirectly by the execution of the works even if done by Sub-contractors to the Authorities satisfaction at the Contractor’s expense, and to Architect’s satisfaction.

1.14 **WATCHING**

The Contractor, from commencement to completion of he works both day and night including Sunday and Public holidays, shall allow for all necessary watching for the security of the works. The Contractor’s attention is drawn that the present project is a fully fit out work, which warrants adequate securities and substantial watchmen, especially when high valuable final fix and high standard finishes shall be in progress and during deep cleaning. Contractor shall ensure there is no loss of any valuables/or final fix items from the work.

1.15 **POLICE REQUIREMENTS**

The Contractor shall allow for ascertaining and complying with police requirements and for all costs in connection therewith.

1.16 **ANNOYANCE TO NEIGHBOURS, ETC.**

The Contractor shall allow all costs in connection for executing any work which in the Architect’s opinion is likely to cause annoyance or inconvenience to neighbours in the vicinity, at such times during normal working hours as the Architect may direct.

1.17 **OVERTIME**

If the Contractor deems it necessary to execute work outside normal hours in order to complete the works by the prescribed date or for any other purpose, he shall obtain the consent of the Architect before doing so.
1.18 **ACCESS FOR INSPECTION AND MEASUREMENT OF WORKS**

The Contractor shall provide at all times during the execution of the works and the Defects Liability Period proper means of access, with ladders, gangways, etc. and necessary attendance to move and adapt same as directed for the inspection or measurement of the works by the Project Manager, Architect / Quantity Surveyor or his representatives.

1.19 **TEMPORARY LIGHTING**

The Contractor shall provide all necessary artificial lighting and power for the execution and security of the works and for the protection, with all meters, temporary wiring and fittings, etc. pay all charges and alter, adapt and maintain the temporary works as necessary, and remove and make good at completion. The Contractor shall pay all charges and cost of the power, water consumption, for the testing and commissioning and for deep cleaning, up to the issue of Taking over Certificate. The Tenderer shall allow all cost and charges in this respect in the tender price.

1.20 **TEMPORARY BUILDINGS ETC.**

All temporary buildings, etc. shall be situated in approved positions. The Contractor shall provide the following:

- Proper sheds, etc, for the storage and protection of materials, goods, tools etc, and for the execution of work which may be prepared on site.

- Proper sheds and messrooms for the workpeople.
  All necessary sanitary accommodation for the workpeople and site staff and shall deodorize the ground after removal.

- All other amenities, etc, in accordance with the Building Industry Ordinance and Construction Regulations.

- Offices for the Contractor’s staff.

1.21 **NOTICE BOARD**

The Contractor shall allow for supply and erection of a suitable name board displaying:

- Title of project
- Name of Employer
1.22 **ACCURACY OF WORK**

The whole of the Works shall be constructed to achieve levels of accuracy within the permissible deviations recommended in BS 5606 : 1978 “Accuracy in building and BRS Digest 114 – “Accuracy in setting out” unless specified otherwise. Contractor shall submit method statement for setting out of the buildings and the like for Architect’s approval.

The Contractor shall ensure that all materials, elements and components of the building fit together as designed. Work which fails to meet the specified levels of accuracy must not be rectified without approval. The Contractor shall submit proposals for such rectifications and meet all costs arising, including effects on other work. However, should approval not be given thereby necessitating removal and replacement of the work, the Contractor shall do so at his own expense.

1.23 **SETTING OUT**

The Contractor shall set out the Works using methods and measuring instruments described in BS 5606 : 1978 “Accuracy in building and BRS Digest 114 – “Accuracy in setting out” and shall inform the Architect when overall setting out is complete and before commencing construction.

The Contractor shall allow for providing all necessary instruments and assistance for checking the setting out and levels.

The Contractor shall check all dimensions and levels both on drawings and site, particularly the correlation between components and work in place and shall not order materials or any components or carry out the work until any discrepancies if any have been resolved with the Architect.

Details of all grid lines, setting out stations, bench marks and profiles shall be recorded on the site setting out drawing and retained on site throughout the contract and handed over to the Architect on completion. The cost thereof is deemed to be included in he Contractor’s rates.
1.24 **PREPARATION AND KEYING OF BASES AND BACKGROUNDS**

The Contractor shall ascertain the nature of the surface, after which the backgrounds shall be prepared and keyed where necessary in accordance with:

- the recommendations in any applicable British Standard and Code of Practice documents.
- the specification and recommendation of the Manufacturer of the materials to be laid thereon or applied or fixed thereto best building practices so as to be suitable to receive and, where keyed, to ensure adhesion of the materials to be laid thereon or applied and fixed thereto.

1.25 **ADHESIVES AND FIXINGS GENERALLY**

Where and to the extent that the types of adhesives and fixings and/or types, sizes and spacings of fixings are not fully specified they shall be suitable for the intended purpose having regard to the nature of and compatibility with the materials being fixed and fixed to; the size and weight of the fixture and the conditions under which it can reasonably be expected to be used; the specifications and recommendation of the Manufacturer of the adhesive or fixing, the material being fixed, the material being fixed to.

Adhesives and fixings shall conform to the latest requirements in any British Standard or Codes of Practice document or Mauritian Standards and be used in accordance with:

- the specification and recommendation of the Manufacturer.
- the recommendations in any applicable British Standard or Code of Practice documents or Mauritian Standards.
- best building practice so as to retain the fixture securely in position.

1.26 **PRICING**

All rates inserted in the Bills of Quantities shall cover all costs, charges and profit that may be considered necessary for the carrying out and observance of the provisions of General Specification unless otherwise specified. In the event any item of work in the bills of quantities are not priced the cost of these items shall be considered included in other items of the work. Contractor shall execute all works as per the construction drawings and specifications.

Notwithstanding the above, the Contract price shall be a lump sum Contract and work shall be executed and fully completed in accordance with the tender drawings, which shall thereafter
become construction drawings and in conformity with the specifications. There will be no remeasurement of the works, except for formal variations issued by the Architect.

1.27 **DISCREPANCIES**

During the progress of the works, the Contractor shall satisfy himself as to the correctness of all drawings and measurements. If the Contractor finds any discrepancy in the drawings or between the drawings and the specifications, he shall immediately refer the same to the Architect who shall decide which shall be followed. Figured dimensions shall be taken in preference to the scale mentioned on or attached to any drawings.

1.28 **WORKING DETAILS**

Two copies of all drawings and of the Specification shall be furnished by the Architect, free of cost to the Contractor for his own use. The Architect shall furnish to the Contractor within a reasonable time after the receipt by him of a written request for the same, any details which in the opinion of the Architect are necessary for the execution of any part of the work, such request to be made only within a reasonable time before it is necessary to execute such work in order to fulfill the Contract. One copy of the drawings, details and Specifications shall be kept on the Works until the completion thereof and the Architect or his representatives shall at all reasonable times have access to the same. All copies of the drawings, details and specifications shall be returned to the Architect by the Contractor on he completion of the Contract.

1.29 **DATUM**

The levels of the works are related to the Employer’s survey plan. All temporary bench marks required by the Contractor for the execution of the works shall be provided by the Contractor at his own expense.

1.30 **PROGRAMME AND PLAN OF OPERATIONS**

The whole of the works to be constructed by the Contractor under this Contract shall be completed within the time stated in the tender documents.

The Contractor shall, before commencing work on site, submit to the Project Manager/ Architect, for his approval, a full detailed programme showing the order of procedure and method by which he proposes to carry out the construction and completion of the works and with a Milestones date of start and date of completion of the elemental sections from the start and handing over of the works. This applies for all buildings. The Contractor shall also submit particulars of the
organisation and staff proposed to direct and administer the performance of the Contract. The Project Manager / Architect may ask the Contractor to amend the programme as and when required to suit the completion date in event the milestone dates of completion are not achieved.

The Contractor shall therefore submit the recoupment programme, with their proposed resources to catch up the delays.

The works shall be carried forward to completion with the greatest possible expedition, to the satisfaction of the Project Manager / Architect, in accordance with the programme.

Notwithstanding the above the Tenderer shall submit a broad programme of work along with the tender, taking into consideration all major elements, M&E work, site works, in line with the completion period.

On award of the Contract, the Contractor shall develop the programme of work as described above.

1.31 **UNITS**

All quantities in the Bills of Quantities, Specifications and the Drawings are given in the “System International D’Unités” (SI Units) prepared in accordance with Principles of Measurement International for Works of Construction (June 1979) issued by the Royal Institution of Chartered Surveyors (UK).

1.32 **TEMPORARY WORKS**

The Tenderer shall submit along with the tender layout plan showing the proposed location and general arrangement of his offices, workshops, stores, quarters, access roads and other temporary works required for the proper and expeditions execution of the permanent works. The Architect shall review same and convey his approval before the works on site commence.

The Contractor shall allow for paying all rates and other charges which may be made by local or other authorities in connection with temporary buildings erected for the purpose of the Contractor.

The Contractor shall not be allowed to make use of any building whether partly completed and or in progress.
1.33 **PRIVATE ACCESS**

The Contractor shall obtain his own information with regard to access to all parts of the site of the works if he wishes to make use of routes through private property then he must make all arrangements with the owners. The Condition of the surfaces of the private roads, paths or yards used or crossed by him by sub-contractors or by nominated suppliers for the purpose of the contract shall be kept clear of mud and in reasonable repair during its progress and on completion he shall put the roads, paths or yards in proper repair at least equal to the original condition of the roads, paths or yards used or crossed by him and to the satisfaction of the Architect, all at his own cost. In general, the Contractor is to regular the character of his transport to ensure that no undue damage is caused to any roads, tracks or properties within the area of the works, public or otherwise.

1.34 **CONTROL OF WORKMEN**

The Contractor shall keep all persons (including those employed by sub-contractors) under control and within the boundaries of the area allocated to him.

1.35 **CARE OF WORKS**

The Contractor will be held responsible for the care of the existing premises and the works generally until their completion, including all work executed and materials, goods and plant (including those of sub-contractors and suppliers) deposited on the site, together with all risks arising from the weather, carelessness of workpeople, damage or loss by fire, theft, cyclone or any other cause; and he shall make good at his own expense all such damage or loss.

The whole of the temporary works, plant, equipment and appliances used on the works will be the liability of the Contractor in regard to construction, sufficiency, safety, maintenance and removal on completion of the Contract and approval by the Architect shall in no way relieve the Contractor of this liability.

1.36 **PROTECTION FROM WATER AND SEWERAGE**

The Contractor shall keep the whole of the works free from water and sewerage and accept all risks of flooding in view of the high water table or from any cause whatsoever. The Contractor shall provide and maintain the necessary pumping plant to deal with all water and sewerage which may flow into trenches or excavations and shall allow in his prices for such plant, pumping, shoring, temporary drains, sumps, etc and shall clear away and make good at his own cost and to the satisfaction of the Architect any damage caused.
1.37 **EXISTING SERVICES**

The Contractor shall make such provisions as may be required by the authorities concerned for the support and protection of any water, main, sewer, telephone cable, power cable or other services met with on the site. The Contractor shall allow minimum of 4 nos. trial pits size 1.50 x 2.00 x 2.20 m deep to be excavated on the reserve of the site along the public road and expose the underground services for Architect’s overview and subsequently backfilling to Engineer’s satisfaction.

The location shall be determined on award of the Contract. Tenderer shall allow these costs in tender price.

1.38 **DAMAGE TO ESSENTIAL PUBLIC SERVICES**

In the event of the Contractor damaging water, sewerage, electricity or telephone services, whether these have been marked or not, the Contractor shall immediately inform the authority concerned and advise the Architect without delay and the cost of making good damage shall be at the expense of the Contractor.

1.39 **EXPLOSIVES AND BLASTING**

The use of explosives for blasting for any purpose whatsoever shall not be permitted on this Contract.

1.40 **SITE OFFICE FOR THE ARCHITECT**

The Contractor shall erect, maintain for the duration of the Contract and remove on completion, one furnished and well ventilated office on site and shall provide full time attendance for general cleaning duties.

1.41 **COVER UP AND PROTECT**

The Contractor shall cover up and protect the works from the weather and suspend all operations during weather conditions, which, in the Architect’s opinion, would be detrimental to the works.
1.42 CLEARING AWAY AND DEEP CLEANING

The Contractor shall take down and clear away all plant and temporary work, including sheds, messrooms, sanitary conveniences, offices etc, unless otherwise described and make good.

The Contractor shall remove all existing rubbish and debris and surplus materials from the site as they accumulate and at completion and clean all surfaces, internally and externally, remove stains and touch up paint work and polished work, and leave the works clean and to the satisfaction of the Architect at completion. In view of the project is a fully fit out work, tenderer shall allow for deep cleaning by Specialist Subcontractors, all to entire satisfaction of the Architect.

SECTION 2- DEMOLITION / ALTERATION / RENOVATION (IF REQUIRED)

2.1 Notwithstanding the provisions of Clause B.5.1 of the principles of measurement (International) for works of construction, June 1979, all materials described as “set aside for re-use and or salvaged materials” shall become the property of the Employer unless otherwise specified. The Contractor shall allow for cleaning, transporting and storing on site unless otherwise specified as directed by the Architect. All other demolition materials shall be understood to become the property of the Contractor and shall be cleared away and disposed off site.

2.2 Demolition works comprise of demolition of items, removal with care of components, units as specified, cutting of existing structures, making good to disturbed existing structures, finishes, including shoring and supporting to same, all to Architect’s satisfaction.

SECTION 3- EXCAVATION AND EARTHWORK

3.1 INSPECTION OF SITE

The contractor is deemed to have visited the site and to have ascertained the nature of the soil, type of rock, bedrock and the like to be excavated and shall be responsible for making his own judgement as to the nature of the ground and subsoil. Tenderer shall examine the Geotechnical investigation report included in Engineer’s specifications and allow cost and charges which may affect the substructure work.

No extra cost and extension of time shall be entertained. The Contractor must however use his own judgement as to whether conditions revealed by geotechnical investigation are consistent over the whole site.
3.2 **ORIGINAL GROUND LEVELS**

The levels shown on the various drawings relate to Ordinance Datum unless otherwise stated.

The Contractor shall be responsible for setting up and maintaining a site datum level accurately ascertained from this work.

Should the Contractor not be satisfied with the accuracy of the levels indicated on the drawings, he must give written notice thereof to the Architect before any work is commenced, otherwise no claim in respect of inaccuracy of levels will be entertained.

3.3 **STARTING LEVELS**

The term “Formation level” shall be deemed to be the surface of the ground after reduced level excavation stripped level or after filling to make up levels.

Any excavation through deposited earth from previous excavation will be entirely at the Contractor’s own expense.

The term “Original Ground Level” shall mean the existing ground level, as per the contour of the surveyed plan provided by the Architect / Employer.

3.4 **LIABILITY FOR EXCAVATIONS**

Notwithstanding any authorisations, approvals or directions given by the Architect with regard to excavations or any matter connected therewith, the Contractor shall be responsible for taking the necessary safety precautions and for any damage arising from the operations.

Excavations shall be carefully planned and executed to ensure that boundary walls, adjacent property and trees are adequately supported at all times and their safety shall be the Contractor’s responsibility. No tree roots shall be left uncovered during excavation.

3.5 **TOP SOIL**
Top soil retained on site for reuse shall be kept in separated spoil heaps and protected from contamination by subsoil, cement, broken concrete, aggregates and the like or by petrol and other substance likely to impair the growing qualities. Topsoil shall not remain unused for more than 12 months unless the topsoil is over turn to prevent it becoming stale. Weed growth on topsoil heaps shall be controlled by chemical means to prevent soil becoming polluted by weed seeds. All top soil all to be spread as directed by the Architect.

3.6 **DEALING WITH WATER**

The Contractor’s attention is drawn to the depths below ground level of the foundations and the consequent possibility of having to deal with water. Unless otherwise specified the contractor will be required by pumping or other means to keep the excavations dry during construction. Care must be taken, especially if ground dewatering equipment is used, that covering of the ground water table in the vicinity of the excavations or extraction of fine particles of soil from surrounding ground causes no damage to adjoining property.

3.7 **SHORING OF EXISTING STRUCTURE**

The Contractor’s attention is drawn to the requirements for shoring parts of the structure of the existing building during construction and the consequent need to carry out the excavation in stages. He is not allowed to excavate within the proximity of the existing structure without the drawings and/or instructions by the Engineer to do so.

3.8 **UNDERPINING (WHERE APPLICABLE)**

Underpinning of the existing buildings on sides of the new structure shall be carried out as per details on the drawings and further instruction on site by the Engineer. No excavation for the new base etc., will start before completion of underpinning. Excavation shall be to the widths and depths shown on the drawings or as instructed by the Engineer. Any excess excavation shall be made up with concrete grade 15, as directed by Engineer.

3.9 **PLANKING AND STRUTTING**

Where necessary sides of excavations are to be secured by planking and strutting to Engineer’s approval at no extra cost.

3.10 **EXCAVATION DIMENSIONS**
The excavations are to be executed to the widths and depths of the concrete or other foundations required shown on the drawings or to greater depths if instructed by the Engineer to obtain satisfactory foundations.

If the contractor excavates to any widths or depths greater than those shown on the Drawings, or as instructed by the Engineer he shall be at his own expense fill in such widths or depths beyond that instructed or shown with concrete Grade 15 to the satisfaction of the Engineer.

No extra cost or extension of time shall be entertained in whatsoever conditions for carrying out the substructure work to the entire satisfaction of the Engineer. Tenderer must allow all cost and charges in this respect in the tender price.

3.11 **ROCK**

“Rock” means any hard material, bed rock, rock strata which in the opinion of the Engineer can be removed only by use of compressors, wedges, special plants or explosives and the Engineer’s opinion shall be final. Decomposed rock, tuff or other material which can be removed by pick, traxcavator or other mechanical plant will not be classified as rock may, if approved by the Engineer, be used as hardcore filling but broken to gauge as approved by the Engineer.

3.12 **BLASTING**

No blasting will be permitted.

3.13 **TRIMMING EXCAVATION IN SOIL**

The lower 100 mm of soft material in the bottom of excavation shall not be removed until immediately before placing concrete.

3.14 **TRIMMING EXCAVATION IN ROCK**

The faces and bottom of excavations in rock shall be cleaned of all loose material to the satisfaction of the Engineer by brushing or washing with waterjets before placing concrete. Any extra concrete required to make up level and or instructed by the Engineer as a result of this unevenness of the faces and bottoms of such excavation shall be deemed to be included in the rates for the items of excavations and or concrete related thereto.
3.15 **COLLAPSE**

Should any ground fall in due to the omission or insufficiency of earthwork support or due to any cause whatsoever, it must be dug out and removed or disposed as directed and the excess excavation should be filled up with concrete grade 15 to Engineer’s approval, all at the expense of the Contractor.

3.16 **NOTICE**

The contractor is to give not less than 24 hours notice to the Engineer when excavations are complete and no concrete shall be cast until the excavation have been inspected and approved in writing.

3.17 **MATERIALS FOUND IN EXCAVATIONS**

No material found in the excavations is to be used in the works without the written permission of the Engineer.

3.18 **FILLING**

Filling under floors or paving shall consist of approved local field stones and spalls graded to max 150 mm size placed in layers not exceeding 225 mm thick. Each layer shall be watered and well rolled and compacted by a ten tonne roller or as approved by Engineer.

Hardcore filling is measured nett and to compacted thickness. No allowance has been made for decrease in bulk after compaction.

Top layer of the hardcore shall be levelled or graded to falls as required with crusher run and well watered and rolled to receive concrete as described.

Handpacking of hardcore to form vertical or battered faces, sinings and compactive of bottom of excavation, formation level shall be deemed to be included in the rate of filling, unless otherwise specified.

Backfilling around foundations shall be with selected excavated material free from deleterious material laid in layers not exceeding 200 mm thick, well compacted and consolidated.
3.19 **AREAS OF CAVES IN FOUNDATIONS (IF APPLICABLE)**

In the event of caves found in the foundation, the Engineer shall instruct the Contractor to carry out site investigation by rotary core drilling at selected places in the excavations to locate the areas of the caves and filling the same with concrete grade 15 by a specialist subcontractor to the Engineer's satisfaction.

3.20 **DIMENSIONS AND LEVELS**

The Contractor is to submit to the Quantity Surveyor with all necessary levels, formation levels, levels or top of blinding layer, as approved by the Engineer, with copy to the Architect.

3.21 **EARTHWORK SUPPORT**

Earthwork support, as an item has been provided in the Bills of Quantities for the Contractor to price earthwork support which shall be deemed to include the provision of everything necessary for adequately maintaining the sides of all excavations and for keeping excavations clear of all fallen materials, rubbish or debris and boards or coverings as required.

3.22 **RATES FOR EXCAVATIONS**

The rates for all excavation including the excavation for drains and service ducts shall include:

Excavating in any type of soil, including rock, bedrock, rock strata and including excavating below ground water levels or below water level.

Excavating in ground interspersed with boulders, rubble filling or waste material and grubbing up, cutting back and sealing off old service mains, pipes cables, timber and drains or other obstructions.

Excavating next to existing roads, footpaths, existing buildings, existing services and around existing services etc. The cost of any necessary measures to be taken in such instances shall be borne by the Contractor.

For the disposal of the excavated material to a suitable tip to be provided by the Contractor and or multiple handling of the excavated material.

For excavating and trimming the final 100 mm down to formation level by hand immediately prior to concreting.
For trimming sides, levelling and ramming bottoms and forming steppings unless otherwise described.

For trimming faces and bottom of excavation in rock, including cleaning as described.

For removing all ants, pests, termite nests or other parasites over area of site and backfilling

For all necessary barricades and watching and warning, lighting and protection.

Any additional excavation that may be required beyond the net width of the structure for working space, timbering or other temporary work, formwork to sides of foundations and any subsequent backfilling.

**SECTION 4 – CONCRETEWORK**

4.1 **ENGINEER’S SPECIFICATION**

The whole of the concrete work shall be specified in the Engineer’s specification included in the Tender Documents. The Engineer’s specification shall take precedence over this standard specification in so far as they relate to structural matters. The Contractor is to allow in his rates for all items therein. In the event of the Contractor leaving any item unpriced, he will be deemed to have considered that his rates are adequate to enable him to perform the services and obligations as described in the Engineer’s Specification without extra charge.

4.2 **CODE OF PRACTICE**

All workmanship, material, tests and performance in connection with the reinforced concrete work shall be in strict compliance with the latest edition of British Standard Code Practice CP 110. “The Structural use of Reinforced concrete in Buildings” where not inconsistent with the preambles.

4.3 **CEMENT**

Cement for use in the works shall unless otherwise specified, be Ordinary Portland Cement to BS 12. It shall be fresh and free from lumps or partly set particles. Cement, which in the opinion of the Engineer is sub-standard, shall be rejected and removed from site.

Cement shall be stored in watertight shed the floor of which shall be raised clear of the ground. Consignments shall be used in the order in which they are delivered.

4.4 **WATER**
Water used for mixing concrete shall be from an approved source, clean fresh, free from acid, oil, pollution but which will not impair the strength or durability of the concrete. Water for construction shall be generally available from Central Water Authority.

In the event the drought, the Contractor shall provide water from other source, subject to Engineer’s approval.

4.5 **AGGREGATES**

Aggregates shall conform to the requirements of BS 882 and samples of all aggregates shall be submitted to the Engineer for the approval before work commences. Fine aggregates shall consist of one part of washed coral sand and two parts of coarse rock sand or such other proportions as the Engineer may authorised. The sand shall be clean, strong, durable and free from salt, earth loam, dust, organic matter or other deleterious substances. It shall be graded with the limits specified by BS 882. Fine aggregated shall be washed and / or sieved if required by the Engineer at no extra cost.

Coarse aggregates shall be crushed blue basalt stone obtained from an approved source. The aggregates shall be roughly cubical in shape, clean, hard, non porous, free from dust, laminated or flaky pieces and any impurities in materials which may adversely affect the strength or durability of the concrete. It shall be graded in accordance with BS 882 for its respective nominal size.

If coarse aggregates conforming to the above grading are not reasonably obtainable, the Contractor shall supply two or more sizes of otherwise satisfactory aggregates and if approved the aggregates shall be stored on site separately for each size and mixed in proportions to be directed by the Engineer at no extra cost.

Aggregates shall be stockpiled on paved areas or boarded platform in separate units to, prevent intermixing. On no account shall aggregates be stockpiled on the ground.

4.6 **CONCRETE PROPORTIONS AND MIXING**

Unless otherwise directed or specified, concrete aggregates shall be measured by volume in accurately made and approved gauge boxes to the proportions specified and / or shown on the drawings.
Cement shall be measured by weight. One or more complete bags of 50 kg shall be used for a single batch of concrete. The cement and aggregates shall be mixed for at least two minutes after the water has been added. Only sufficient water to produce dense concrete of adequate workability shall be added.

Unless otherwise specified coarse aggregates for the above mixes shall be graded from 10 mm to 20 mm. However, 10 mm to 35 mm-graded aggregates may be used in mix grade 15 &10 subject to the approval of the Engineer. Slump of the concrete shall not exceed 60 mm.

4.7 **CONCRETE PLACING AND CURING**

Concrete shall be placed in its final position in the moulds or forms within 20 minutes of mixing and shall not be subsequently disturbed. Concreting shall be carried on continuously up to predetermined construction joints as directed by the Engineer. It shall be placed in layers and worked around the reinforcement to fill all corners of the formwork.

All reinforced concrete shall be compacted by an approved type of vibrator, but shall not be over vibrated to bring cement and fine aggregate to the surface.

As soon as possible after the initial set has taken place all exposed concrete shall be covered as directed by Engineer and kept constantly wet for at least seven days.

4.8 **CONCRETE TESTS AND STRENGTHS**

Unless otherwise instructed the Contractor shall provide at his own cost for the making and testing of concrete test cubes in accordance with BS 1881, in standard steel moulds. The cubes shall be forwarded to an approved testing authority at 7 or 28 days. The contractor shall keep a record of all cubes made with details of cube markings and test results. A copy of this record shall be submitted to the Engineer when each test result is received.

The concrete strengths as determined by the test tubes shall give the following minimum strengths for each grade specified.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Nominal Mix</th>
<th>Minimum 7-day strength</th>
<th>Minimum 28 Day strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>1:1:2</td>
<td>24 N / mm²</td>
<td>35 N / mm²</td>
</tr>
<tr>
<td>30</td>
<td>1:1.8:2.8</td>
<td>22</td>
<td>30</td>
</tr>
<tr>
<td>25</td>
<td>1:2.4:3.8</td>
<td>17</td>
<td>25</td>
</tr>
<tr>
<td>20</td>
<td>1:2.7:4.2</td>
<td>14</td>
<td>20</td>
</tr>
<tr>
<td>15</td>
<td>1:4:6</td>
<td>10</td>
<td>15</td>
</tr>
</tbody>
</table>
The strengths above are the minimum acceptable crushing strengths at 7 and 28 days. The average crushing shall be at least 10% above the minimum strength.

4.9 CONSTRUCTION, EXPANSION AND CONTRACTION JOINTS

Construction joints in concrete shall be made only at positions predetermined and agreed with the Engineer. Concrete shall be placed continuously until completion of the work between construction joints. Such joints shall be truly vertical or horizontal as the case may be, except that in inclined members the joints shall be right angles to the axis of the member. Vertical and inclined joints shall be formed by using temporary stop boards. The provision of such boards shall be deemed to be included in the Contract Sum and joints shall not be measured as shuttering. A record of all construction joints shall be maintained by the Contractor and a record copy to the Engineer. Floor slab and beams shall be cast in one operation.

Construction joints shall be formed at distance not greater than 12 metres. No concrete shall be poured at this formed joints be the lapse of 48 hours. The spacing between construction joints ground floor on hardcore shall be not greater than 6 metres. Ground floor slabs shall be cast before walling above.

Expansion and contraction joints shall be formed in the positions to the details shown on the drawings.

4.10 DEFECTS IN CONCRETE

Any honeycombing, cavities or other defects in concrete shall on account be patched or repaired but shall be brought to the attention of the Engineer who will give instruction for the action to be taken. All remedial works shall be at the Contractor’s expense.

4.11 FORMWORK

All formwork and shuttering shall be of sound timber or other applicable material and of adequate sizes, strength and construction to with the loading from the placing and consolidation of concrete without distortion, springing or other movement. All joints shall be sufficiently tight to prevent leakage of cement grout and to avoid the formation of fins or other blemishes.

The following minimum intervals of time shall be allowed between placing concrete and removal of shuttering:
### Beam sides walls and columns
- Days: 2

### Slabs with props left in place
- Days: 7

### Removal of props to slabs
- Days: 14

### Beam soffits with props left in
- Days: 10

### Removal of props to slabs
- Days: 14

### Cantilever beam and slabs with props
left in
- Days: 14

### Removal of props to cantilever beams
and slab
- Days: 21

The contractor shall be responsible for any injury to the work any consequent damage by or arising from premature removal of shuttering centering or supports.

#### 4.12 CONCRETE COVER TO REINFORCEMENT

Unless otherwise directed or shown on the drawings, concrete cover to reinforcement bars in any face shall be: The greater of the diameter of the bar or the following dimensions:

- **Foundations against earth**: 75mm
- **Foundations against blinding**: 50mm
- **Columns and ground beams (links)**: 30mm
- **Beams (links) and walls**: 20mm
- **Slab**: 15mm

The specified concrete cover shall be maintained by the use of 50 x 50 concrete spacer blocks made with 1:11/2" cement and sand mortar, which are cast length of 18 SWG annealed wire for tying to the reinforcement bars. Such spacer blocks shall be so spaced as to ensure a constant cover to the reinforcement bars, but in no case shall the spacing exceed 1.00 m in any direction.

For hollow pot slabs spacer blocks shall be of the correct size to give the specified width of rib.

#### 4.13 STEEL REINFORCEMENT

The steel reinforcement shall comply with the latest requirements of the following British Standards:

- **Round Mild, Medium Tensile and High Tensile Steel Bars** ............... to MS 10
- **Hot rolled deformed bars for the reinforcement of concrete** ............... to MS 10
Cold twisted steel bars ................................................................. to MS 10
Fabric reinforcement ................................................................. to BS 4483

It shall be in metric sizes as detailed on the drawings. It shall be in lengths not exceeding 12
metres. No claim on account of non availability of reinforcement in specified lengths will be
entertained; price of reinforcement in schedule of rate shall include for cutting, bending and all
wastes.

All reinforcement shall be free from oil, grease, dirt, paint and loose rust scales, etc., and the
Contractor must allow for cleaning wire brushing, etc. as necessary to achieve this. All steel bars
must be cut and bent cold in accordance with BS 1478 and to the dimensions shown on the
drawings.

Steel reinforcement shall be accurately placed in position as shown on the drawings and shall
secured against displacement during concreting by using 16 SWG annealed binding wire or
suitable clips at all inter – sections. Concrete or metal supports, spacers or metal hangers shall
be used to ensure that the correct position of the steel bars and specified cover is maintained.

The contractor shall give a minimum of two days notice to the Engineer of his intention to
concrete any portion of the works to enable an inspection of the reinforcement and shuttering to
be made. The carrying out of any such inspection will in no way relieve the Contractor of his
responsibility for fixing the reinforcement in accordance with the drawings or the provisions
indicated therein and to ensure the specified cover. Any failure in the concretework where the
reinforcement is found to be not in accordance with the drawings or the provisions indicated
therein and to ensure the specified cover.

Any failure in the concrete work where the reinforcement is found to be not in accordance with
the drawings or not in the correct position will be the sole responsibility of the Contractor. Such
liability will include for any consequential delays in completion of the works or any claims arising
whatsoever and for the repair of the structure as directed by the Engineer.

4.14 FABRIC REINFORCEMENT

Fabric reinforcement shall be electrically cross-welded steel wire and reinforcement to BS 1221
or 4483 and of the size and weight specified.

The fabric shall be free from scale, rust, grease or other substance likely to reduce the bond
between the steel and the concrete and shall be laid with minimum laps of two spacing in both
directions and bound with No 18 SWG annealed iron wire. The Contractor is to include in his price for providing such laps.

4.15 **POSITION OF ELECTRICAL CONDUIT**

Unless otherwise instructed by the Engineer all electrical conduits to be positioned within the reinforced concrete shall be fixed inside the steel cages of beams and columns and between the top bottom steel layers in slabs and similar members. Conduit runs over 25 mm diameter shall be approved by the Engineer before the conduit if fixed.

4.16 **TOLERANCES**

The surface of the concrete shall be finished to a wood float finish to the levels, falls and crossfalls, as directed or shown on the drawings and shall be subject to the following tolerances:

- The level shall be within \(+\) or \(-\) 6 mm of the levels directed.
- The falls shall be within 10% of the falls directed.
- The smoothness shall be such that departures from a 3.0 m straight edge laid in any direction shall not exceed 3 mm.

Minor irregularities shall be made good by the use of a steel float but in no circumstances shall mortar be used to make good the surface.

4.17 **PRECAST CONCRETE**

Precast concrete shall be cast in properly made strong moulds true to the shapes required. Formork described as “fairface” the moulds shall be lined with hardboard, sheet metal or other approved material. The concrete shall be thoroughly vibrated into the moulds and shall not be removed from them until seven days of placing the concrete, but the sides may be removed after two days providing the concrete is not damaged by so doing.

The precast work shall not be cast under cover and shall remain under the same for seven days after removal of the moulds. During the whole of this period the concrete shall be protected by the hessian or other approved material kept wet. It shall then be removed from the cover and stacked in the open for at least seven days. All angles and prominent parts are to be suitably protected from damage during the execution of the works.
4.18 **FILLER BLOCKS (for hollow for slabs)**

Precast concrete hollow filler blocks shall be to the shapes and sizes as shown on the drawings and shall comply with Bs 2028 and of strength or gross area of 3.5 N / mm². The ends of the block facing beams shall be filled in for 25 mm depth.

4.19 **WATERPROOF CONCRETE**

Where “waterproof concrete” is required, unless otherwise specified, Waterproofing Compound of approved make to be added to the mixing water strictly in accordance with the Manufacturer's instructions and unless otherwise directed.

4.20 **WATERBAR**

Waterbar shall be PVC waterbar or equivalent of approved manufacture and shall be provided in the positions indicated on the drawings.

Joints shall be heat welded in accordance with the Manufacturer's instructions. Where the waterbar is to be fixed vertically, approved metal clips shall be provided to suspend the waterbar from the reinforcement. Formwork supporting waterbar or used to form a starter containing waterbar shall be carefully constructed and to the exact details shown on the drawings.

No concreting will be permitted to portions where upstand starters form an integral part until the formwork to the starter has been fixed and approved by the Engineer.

4.21 **CHASES AND HOLES**

Form of all chases, holes, etc. in concrete work as required by other trades and make good thereafter.

4.22 **CONCRETE SURFACE FINISH TO FLOORS**

Where a tamped finish for concrete surfaces is specified, the surface shall be a levelled and floated uniform plain or ridged finish which shall not be disturbed in any way after the initial set and during the period of curing; surplus concrete being struck off immediately after compaction. Any additional cement mortar required shall be allowed therein to obtain the uniform plain or ridged finish.
Where a wood float finish is specified floating shall be done after the initial set of the concrete has taken place and the surface has hardened sufficiently. The concrete shall be worked no more than is necessary to produce a uniform surface free from marks. Any additional cement mortar required shall be provided as before described.

Where hard smooth steel-trowelled finish is specified trowelling shall not commence until the moisture film has disappeared and the concrete has hardened sufficiently to prevent excess laitance from being worked into the surface. The surfaces shall be trowelled under firm pressure and left free from trowel marks. Any additional cement mortar required shall be provided as before described.

Where the surface is to be power floated smooth it shall be carried out by mechanical means and skilled operatives. On completion the surface shall be checked to ensure that the final finish is within 5 mm of required levels and shall be smooth and dense and free from marks and similar imperfections. The finished surface shall be adequately protected against damage by subsequent trades as agreed with the Architect. Any additional cement mortar shall be provided as before described.

If specified floor hardener shall be provided at the rate of 7 kg/ m² or as recommended by the Manufacturer subject to Architect’s approval.

4.23 FORMWORK FINISH

Formwork may be of steel or timber and will be specified for use in accordance with the following classifications:

Type A- Formwork intended for use in forming concrete faces with special surface features which will not be covered by any other finishes and shall be such as to impart to the resultant concrete face as for Type B formwork. Board marked feature shall be achieved with the use of wrottimber boards to the pattern as shown on the drawings.

Type B- Formwork intended for use in forming concrete faces which will not be covered other than by painting, if at all shall be such as to impart to the resultant concrete face a finish equal to that which would result from the use of plywood faced shutter boards or special steel forms which are new when concreting commences and thoroughly cleaned after each use. The Architect may require that parts of the concrete be rubbed down with a carborundum stone to finish clean and smooth without trace of shuttering marks or any
disfigurements. The term “Type B Formwork Finish” shall deem to mean “Fair Face Formwork” unless otherwise specified.

Where this class of formwork specified to be used to form the soffits of slabs or the faces of walls, the arrangement of panels shall be symmetrical, set out from edges or centre lines. Odd dimension fill-in panels shall be cut to size and symmetrically place in approved positions. All joints between shutter panels shall be straight and tight to approval.

**Type C**

Formwork intended for use in forming concrete faces which will be plastered or covered with tiles, or other similar finishes shall be such as to impart to the resultant concrete face a finish equal to that which would be obtained by the use of sawn timber or ordinary steel plates. The term “Type C Formwork Finish” shall deem to mean “Sawn Formwork” unless otherwise specified.

**Face Groove or rebate formers**

Where shown or noted on the drawings, forming grooves or rebates, approved plastic and or wrot timber or similar material shall be inserted in or between formwork elements to soffits or faces in such a manner as to form grooves, rebates in the concrete to obtain a class B finish formwork. The grooves or rebates shall be straight, to true lines and arranged in approved patterns.

### 4.24 MEASUREMENT AND PRICING FOR CONCRETE

All costs incurred by the Contractor for complying with the provisions concerning the preparation and use of graded mixes shall be allowed herein.

All rates for concrete shall include for mixing and depositing at the various levels required throughout the building, and shall also include for forming or hacking a satisfactory key for all faces receiving asphalt and plaster work.

Rates for concrete work shall include for all labour and material for forming all construction and day joints and kickers.

Prices for concrete are to include for all necessary curing.

Concrete in small projections, hoods, nubs, fins and the like unless otherwise described is included in the relevant concrete item to which they are attached.
Concrete poured against faces of excavation and beds laid on earth and or stone are measured to nett volumes. The Contractor shall allow in his prices for any formwork or extra concrete he may consider necessary for such times.

Notwithstanding the provisions of Clause C4, 1.4 of the principles of measurement (International) for works of construction, Formwork to sides of foundations is not measured and shall be allowed for by the Contractor in his rates for concrete if he so desires.

4.25 MEASUREMENT AND PRICING OF FORMWORK

The term “formwork” is to be taken to include centering, casing, shuttering and the like. Rates for all formwork shall include for fitting together in the required forms, hoisting, struting, shoring, staging, bracing and wedging, plumbing and fixing to true surface and angles, all straight and raking, cutting, splayed edges, notchings, holes for electric conduits, service pipes, etc., cutting and fitting around projecting pipes and continuity bars and the like, narrow widths and small quantities nails, bolts, clamps, wedges, including waste in cutting, overlaps and passings, and properly fixing at intersections, cleaning out before concreting, maintaining in position for the period directed, easing, striking and removing.

The formwork is measured to the actual net area in contact with the finished face of concrete.

The Contractor shall allow in his rates for formwork for forming all grooves or rebate, projections as shown or noted on the drawings and as required at all formwork joints.

The cost of the formwork required to form construction joints and the like, which may be necessary to uphold the concrete during the operation and setting is deemed to be included in the rate for concrete.

Notwithstanding the provisions of Clause C4.1 item 3 of the Principles of Measurement (International) for works of construction formwork to sloping upper surfaces of concrete shall be measured only where the slope is in excess of 45 degrees from horizontal. In all other cases, the Contractor must allow in the prices for the concrete for any formwork he considers may be necessary.

4.26 MEASUREMENT AND PRICING FOR REINFORCEMENT

Reinforcement is measured by computing its theoretical mass from the nominal size and lengths stated on bar bending schedule in line with the structural drawings as approved by
the Engineer, no allowance being made for waste, rolling margin, support, stools spacers or tying wire or for cutting to lengths.

The Contractor shall also allow in his rates for wire or other material required for binding or supporting the reinforcement as well as that of bending, hooking and all other work in providing and fixing the reinforcement as shown on the drawings or as specified.

The Contractor shall allow in his rates for fabric reinforcement for the extra material at laps, for cutting the fabric to the sizes required, and for bends, binding wire, stools, distance blocks and waste.

Notwithstanding the provisions of Clause C 3.2 of the Principles of Measurement: (International) for works of construction, reinforcement bars of differing diameters are grouped together irrespective of location.

SECTION 5 – BLOCK WORK

5.1 HOLLOW BLOCKS

Concrete blocks shall comply with EN-15037-2:2009 for strength, drying, shrinkage, moisture content curing and mix.

Concrete blocks shall be generally Grade A type (3.5 N/mm²) unless otherwise specified.

Concrete blocks shall be obtained from an approved manufacture. Blocks of dissimilar dimensions will not be accepted, half length blocks shall be used where required to break bond.

5.2 MORTAR MIXES

Cement mortar to be used shall be composed of cement and sand (1:3) with an approved plasticiser as per manufacturer’s specification unless otherwise specified. All mortar shall be measured in specially prepared gauge boxes and thoroughly mechanically mixed with water added until all parts are completely incorporated and brought to a proper consistency. Small quantities of mortar may be mixed on platforms subject to Architect’s approval.

All mortar must be used within sixty minutes of mixing. No partially or wholly set mortar will be allowed to be used or to be re – mixed.
5.3 **SETTING AND JOINTING**

All blocks shall be lightly wetted immediately before being bedded and jointed to minimise absorption of water from the mortar. Top of walling where left off shall be well-wetted before recommencement of block lying.

Blocks are to be well buttered with mortar as previously specified. The blocks shall be laid, in stretcher bond with 10mm thick, joints full, flushed up and grouted solid joints. The joints shall not vary by more than 3 mm and shall achieve the specified height in specific number of courses shown on the drawing. The work shall be carried out with horizontal joints truly horizontal and level. The vertical joint shall be 10 mm thick with approx. 3 mm tolerance. No vertical joint in any course shall be within 110 mm of a similar joint in the course immediately above or below unless otherwise shown. Joints shall be raked out where surfaces of walling are to be plastered.

No extra claim of labour and or material whatsoever shall be entertained by the Employer due to non availability of specified sizes of the concrete blocks. The Contractor shall build to the specified height floor to floor by cutting the concrete block and or placing extra concrete height of the beams at his own expense. The adjustments of mortar joint shall not be permitted.

5.4 **LAYING OF BLOCKS**

All walls throughout the work shall be carried up evenly in courses, no part being allowed to be carried up more than 900mm higher at one time than the other part and in such cases the joining shall be made in long steps so as to prevent cracks arising and walls shall be leveled around at each floor.

All putlog holes shall be carefully, properly and completely filled up with concrete grade 25 on completion of walling work.

All walling shall be properly protected while mortar is setting. Wall shall be kept thoroughly wet for at least three days or for longer period of time as the Architect may direct. Walls exposed to the sun shall be protected with hessian, which shall be kept wet.

5.5 **REINFORCEMENT IN BLOCK WORK**

Provide for reinforcing block work vertically in hollow core of block and horizontally in mortar joints as specified and where indicated on the drawings.
Provide wall ties at tee and right angle junctions at every three courses as shown on Engineer's drawings or as specified.

Provide doors and window jamb with 1 Y10 mm reinforcement in 1 hole of block work, and filled with concrete grade 20, all as shown on Engineer's drawings or as specified.

5.6 **BEDDING AND POINTING**

Bedding and pointing of timber door and window frames shall be in cement mortar. Where frames are in metal they shall be fixed with metal lugs and void to metal frame shall be filled with cement mortar well compacted.

5.7 **FIXING BLOCKS AND LEAVING HOLES**

Provide and built into walls all necessary fixing blocks and leave cut away as necessary holes and chases for pipes conduits and the like and make good after fixing by other trades and specialists.

5.8 **BUILD IN LUGS AND THE LIKE**

Form of leave mortises in walls for and build in lugs and all necessary fixing for metal windows and doors, door frames and lining, sanitary fittings, rainwater pipes, clips and bearer of various types.

5.9 **PRICES FOR BLOCK WALLING**

The Contractor must allow in his rates for block walling for plumbing angles, rough cutting whether straight raking or splay and waste, cutting and or filling with concrete grade 20 under soffit of beams and slab split courses necessary for bond, bonding at angles, intersections junctions of walling of different thickness, cutting and fitting columns, cutting and pinning to beam, cutting and fitting around end of cills and lintels, cutting and pinning ends of structural timber, steel sections and the like and also shall include for wall ties at angles, junctions and tees as shown on drawing or as specified.

The rates of block work must also include for fixing all door, window like openings, forming reveals to same and for cutting and waste to walling in short lengths to mullions and jamb of openings. Edge of block walling acting as jamb to openings shall be filled up with concrete grade 20 and with 1 no. Y 8 mm diameter vertical reinforcement from floor bed to lintel, duly
anchored and lapped. This is also applicable to all windows, except for vent, height below 600 mm. Tenderer shall allow the cost of this item in the block walling, whether there is an item or not in the bills of quantities, unless otherwise specified.

The rates of block work must also include for hoisting and building off slab and beams at any level, all necessary scaffolding and for work built overhand and building in of items as described.

SECTION 6 – STONEWALLER

6.1 CEMENT AND SAND

Cement and sand for this trade shall be as specified for “concrete”.

6.2 MORTAR FOR MASONRY WORK

Mortar for bedding and jointing of stonework shall be composed of cement and sand (1:3) mix with an approved plasticiser as per manufacture’s specification unless otherwise specified.

6.3 STONEWORK AS SOLID WALLS

All stones for use in walling, cladding shall be of approved local fields stones of blue or other colour basalt stone carefully selected according to the type of walling required. Walls to be built to the thickness shown on the drawings and the stones shall be well bonded and all voids filled in the solid with mortar as described. Excessive gaps between adjacent stones shall be filled with smaller stones to match with all the stonework. Wall to be laid at random i.e uncoursed, unless otherwise specified.

Mortar joints shall be raked to a depth of 25 mm from face of stonework for an open joint finish as a dry stone wall appearance or finish flush pointed with cement mortar with matching colour pigments.

All stonewall faces, angles, features, returns reveals shall be dressed to true lines, and levels, accurately plumb and true in vertical plane.

For fully dressed stonewall and or cladding, the joints shall be fine joints or invisible joints to all exposed surfaces unless otherwise specified.
Stone wall made up with old stones, shall be executed as per specialist stone layer, generally with regular course but with unequal heights with stretcher bond, fair return and fair weathered top. The joint shall be minimum 3 to 4 mm wide, but bedded in cement and sand mortar and backfilling with concrete grade 25. Stone wall shall be generally 450 mm thick and stone cladding shall be generally 200 to 250 mm thick cladded against hard wall. Adequate galvanised metal ties shall be provided, say 1 no. per m², as per specialist especially for stone cladding. The stone work shall be washed and cleaned on completion. All edges of stones shall be manually trimmed without machine cut edges. All work shall be completed to Consultant’s satisfaction.

6.4 BONDING

All walls shall be constructed with all materials fully bonded and or tied together, and joints filled, to ensure compliance with design requirements for stability and strength.

Appropriate galvanised malleable ties, shall be provided to backing wall as per

6.5 SAMPLE STONWORK PANELS

Allow for constructing two sample stonework panels approximately 2 sq m each 450 thick for stone masonry wall, and 150 mm thick for cladding on block walling background and approved sample panels shall form the standard to be maintained throughout the contract.

6.6 COPINGS

Copings to top of stone walls shall be dressed on all exposed faces, unless specified.

6.7 PROTECTION

The stone wall shall be properly protected from mortar droppings, etc, and kept clean and neat as the work proceeds and the whole of the stonework shall be wirebrushed and cleaned down to the satisfaction of the Architect on completion. Should the contractor be unable to clean the wall from mortar droppings etc., to the satisfaction of the Architect, he will be required to re-execute the work to he extent which the Architect may deem necessary at no extra cost.

6.8 RATES AND MEASUREMENTS

The Contractor shall allow in his rates for walling for all plumbing angles, rough cutting whether straight, raking or splay and waste, split courses necessary for bond, bonding at angles, intersections and junctions of walling of different thickness, forming solid tops under
beams and soffits of slabs for forming joints as specified, forming any split course and cutting and fitting around ends of cills and lintels or other members, cutting and pining ends of structural timbers, steel sections, forming all door, window or other openings including forming reveals to same and for all cutting and waste to walling to short lengths to mullions or jambs of openings; for hoisting and building off beams ad slabs at any level, all necessary scaffolding and for work built overhand and building in of items a described.

Rates for stonewalling shall include for all dressing to external angles, features, reveals returns and for galvanised wall ties.

SECTION 7 – ROOF COVERINGS

7.1 ROOF WATERPROOFING

The whole of the roof waterproofing works shall be carried out by a specialist firm approved by the Architect / Project Manager. The roof waterproofing shall be generally laid on screeded surfaces with an approved double layer, the bottom layer being minimum 2.5mm thick and the top layer being minimum 2.5 mm thick of bituminous roof waterproofing membrane on sealer coat and hot laid with melted oxidised bitumen executed by specialist strictly in accordance with the manufacturer's instructions and shall carry an irrevocable ten year guarantee with the terms and conditions as approved by the Architect / Project Manager. The guarantee shall be deposited with the Architect / Project Manager on issue of the Practical Completion Certificate. The Guarantee shall emanate from the Main Contractor, duly endorsed by the Specialist Waterproofing Contractor. The Main Contractor shall be prime responsible party of the guarantee for remedying any defects noted during the warranty period. The waterproofing treatment shall be applied over all expansion joints, parapets, upstands, flashings and dressed into all rainwater heads. The specialist must provide method of treating the upturn of waterproofing at parapet wall, upstand, if any to the Architect prior to execution of the work, in order to avoid water penetration underneath of waterproofing so that the ten year warranty is maintained.

All surfaces to be waterproof shall be inspected by the Specialist who must satisfy himself that the surfaces are slope and are in a perfect state to take the waterproofing. All the surfaces shall be cleaned and prepared as required by the Contractor at his own expense. The specialist must submit a compliance certificate to the Main Contractor that roof water are properly draining to roof outlets and there is no water ponding on roof prior to applying the roof waterproofing treatment. The Main Contractor need to submit the compliance certificate duly signed by them to Architect for record purposes.
7.2 METAL ROOF COVERINGS

0.75 mm thick pre-painted both sides galvanised mild steel corrugated sheet coverings, side and end laps, to manufacture’s written recommendations with and including waterproof adhesive joints fixing to steel purlins (m/s) with rustproof coach screws, Malakoff metal and plastic washers and caps to fixing devices, sealing end and side laps with waterproof adhesive strips suitable to withstand cyclonic winds of 280 Km/hr including all necessary labours, cutting, painting to ends, touching up protecting all to manufacture’s specifications (10 years warranty to be given) separate payment will be done for Coverings to Sloping roofs; in single lengths (measured nett) as well Extra for ridge capping in 0.75 mm thick pre-painted both sides plain galvanized mild steel sheet 400mm girth; with and including waterproof adhesive bands type “Aluma flash” or other equal approved and profile foam closers along both sides of capping.

7.3 STRUCTURAL STEELWORK

Supply fabricate and erect steelwork to BS Standard or similar approved standard, in frame and fabricated structure including bolts, nuts and washers for structural framing including connections, welding, hot rolled sections, angles, plates, flats hollow sections and testing all hot dipped galvanised after manufacture to BS729 (minimum coating 630 gm/m²) and as described in the Engineer’s Specifications and approval. All exposed metal surface shall be painted with 2 pack each primer and 3 coats of applied paint, to Architect’s approval.

SECTION 8 – CARPENTRY AND JOINERY

8.1 STRUCTURAL TIMBER

All structural timber in the works shall be according to BS 4978 and shall be treated Kempas, balaokeruing, Gurjun, Mahogany or other approved type.

The timber shall be imported good, sound, well seasoned vacuum impregnated with tanalith salts Type C at the rate of 64 kgs per cubic metre of timber, free from all defects and shall be worked to the full sizes indicated on the drawings. All timber shall be grade A type wrot finish, well seasoned and treated having moisture content not exceeding 13%.

8.2 TIMBER FOR JOINERY

Timber for joinery shall be hard wood, type oak, kiat or equivalent unless otherwise specified conforming to BS 1186 for highest quality workmanship and finishes.
All casing and core timber and framing shall be in dark red meranti timber or equivalent, as specified and to Architect’s approval.

8.3 **TREATMENT OF TIMBER**

The ends and backs of all doors, frames and all timbers built in, resting or in direct contact with walling or concrete where not exposed to view, shall be coated with two coats of creosote, solignum or other approved preservative.

8.4 **REPLACEMENT OF DEFECTIVE TIMBER**

Should any of the timber warp, shrink, wind or develop any other defect the same shall be removed and new fixed in its place and at the Contractor’s sole expense together with all other work that may be effected.

8.5 **PREPARATION OF TIMBER**

The preparation of timber shall commence simultaneously with the beginning of the work generally and shall proceed continuously until the whole of the woodwork is prepared and stacked on the site and properly protected from the sun and weather.

8.6 **STRUCTURAL CONSTRUCTIONAL TIMBER**

All constructional timber shall be properly jointed and framed together and secured with hot dipped galvanised metal plates, gusset plates, angle cleats, shoes, bolts minimum coating 63 g/m², surfaces painted with 2 pack etch primer and 3 coats of oil paint to Architect’s approval.

Metal fixing shall be timber Contractor’s design, subject to Engineer’s approval. Structural timber work, metal fixing shall be designed to resist basic cyclonic wind speed of 280 Km/hr, unless otherwise specified.

8.7 **WORKMANSHIP**

All carpentry shall be executed with workmanship of the best quality. All carpenter’s work shall be left with sawn surface except where specified to be wrot.

All carpenter’s work shall be accurately set out and in strict accordance with the drawings and shall be framed together and securely fixed in the best possible manner with properly
made joints generally mortice and tenoned joints and mitres, packing pieces, hardwood dowelling fixing and the like. Provide all brads, nails, screws, etc. which shall be in sheradised, candium finish, galvanised, subject to Architect’s approval as necessary and as directed and approved. All timber shall be as long as possible and practicable, in order to eliminate joints.

Actual dimensions of scantlings for carpentry shall not vary from specified dimensions by more than 3mm in deficiency or excess.

8.8 **JOINERY WORK GENERALLY**

All joiner’s work generally to be cast and framed together as soon is practicable after the commencement of the building but shall not wedged or glued until the building is ready for fixing same.

All work to be properly tenoned, shouldered, wedged, pinned, braided etc. as directed by and to the satisfaction of the Architect and as properly glued up with best quality approved glue.

Oval or round brads or nails all in sheradised, candium or galvanised finish shall be used for fixing on face work heads properly punched in and the holes plugged up with matching timber grain.

8.9 **FINISH TO**

All exposed faces of woodwork shall be wrot, which shall mean bring up the surface after planing with sand and paper to a smooth satin like finish.

8.10 **WORKMANSHIP**

All joinery work shall be executed with workmanship of the best quality in strict accordance with the detailed drawings.

All joiner’s work shall be accurately set out on boards to full information and guidance of artisans before commencing the respective work. All joints, ironmongery work and other work connected there fully delineated which said setting out will be required to be suit to the Architect and approved before such respective works are completed.
All mouldings shall be accurately and truly run and all work planed and finished to the approval of the Architect. All arises to be pencil rounded.

Should any of the joinery work shrink, warp wind or develop other defects before the end of the defects liability period, the same be removed and new fixed in its place, together with all other work which may be affected thereby at the Contractor’s cost and expense.

All plugs described as fixing in backing block walling, concrete members for joinery, etc., unless otherwise shall be formed by Raw plasticPhil plugscrew fix or other approved patent material. No wood plugs shall be used.

Any fixed joinery which in the opinion of the Architect is liable become bruised or damaged in any way shall be properly cased and tested by the Contractor until the completion of the works.

All timber casing and framing shall be of such strength and stability to resist the load of the topping of the furniture if in solid timber, granite top and the like notwithstanding the size specified on the drawings.

8.11 DOOR FRAMES AND LININGS

Door frames and linings shall be constructed to the sizes and details shown on the drawings. Joints between stile and head shall be mitred, morticed and tenoned.

Doorframes shall be fitted with three fixing galvanised irons to each side of the frame and one at the head. Frames for double doors shall have two fixings at the head.

Fixing irons shall consist of 300mm long g.m.s hoop not less than 3mm thick bent up at 75mm at one end and twice screwed to the frame and the other end built fishtailed into the walls and cast into lintels to the depth of 225mm (where lintels to the depth of 225mm deep, the straps shall be cut off to the full depth of the lintel).

6mm diameter galvanised metal dowels shall be fixed to each end of the frames and let into the floor concrete to a depth of at least 50mm.

Door linings shall be screwed to wooden fixing slips let into the walls and lintel the same number as for fixing irons to frames.

8.12 DOORS
Doors shall be generally 44 mm thick, whether solid panel timber door or flush doors, unless otherwise specified, provided and fixed to the sizes and details shown on the drawings. Doors shall be free from all blemishes and shall be rubbed down to a satin like finish. Framed, ledged and braced doors shall be made to the sizes shown on the drawings with appropriate mortice and tenoned joints and the screwing in construction shall be driven from the face side, the heads of screws shall be punched and the holes plugged up with matching timber grain.

Butts and hinges shall be to the sizes and type specified and be fixed with the full number of screws and on no account shall nails be used.

8.13 **PLYWOOD**

Shall be to the specified thickness and shall comply with BS 1455. Plywood shall be Grade 1 whether varnished or painted. Concealed side of plywood can be Grade 2.

8.14 **BLOCKBOARD**

Shall be to thickness shown on drawings and shall conform to BS 3444 and 3583.

8.15 **GLUES**

All glues to be used for joinery works shall be the best of their respective kind and shall conform to BS 745, 1444, 1203 and 1204.

8.16 **SCREWS**

All screws to be used for the joinery works shall be rustproof and shall conform in every respect to BS 1210.

8.17 **NAILS**

These shall be galvanised mild steel wire nails – all in accordance with BS 1202.

8.18 **MOISTURE CONTENT OF TIMBER**

The Contractor is to ensure that the moisture contents of the various items of joinery generally not exceeding 13% delivered to the site are appropriate to the conditions of use to which the components are to be put.
8.19 **SHRINKAGE**

The arrangement, jointing and fixing of all joinery works shall be such that shrinkage in any part and in any direction shall not impair to strength and appearance of the finished work and shall not cause damage to contiguous materials or structure.

8.20 **TOLERANCE**

Reasonable tolerance shall be provided at all connections between joinery works and the building carcass, whether of masonry or frame construction, so that any irregularities, settlements or other move shall be adequately compensated.

8.21 **FABRICATION**

The joiner shall perform all necessary mortising, tenoning, grooving, matching, tonguing, housing, rebating and all other works necessary for correct jointing. He shall also provide all metal plates, screw nails and other fixings that may be instructed by the Architect or may be necessary for the proper execution of the joinery works. The joining shall also carry out all works necessary for the proper construction of all framing, linings, etc. and for their support fixing in the building.

8.22 **JOINTS**

The joinery shall be constructed exactly as shown on the Architect details. Where joints are not specifically indicated they shall recognised forms of joints for each position. The joints shall made so as to comply with BS 1186, Part 2: 1971

Loose joints are to be used where provisions must be made for shrink or other movement acting other than in direction of the stress fixing or loading.
Glued joints are to be used where provision need not to be made for shrinkage or other movements in the connections and where sealed are required.

All glued joints shall be cross – tongued or otherwise reinforced.

All nails, sprigs, etc. are to be punched and puttied.

Glued joints surfaces in contact are to have a good swan or planed finish. All cutting edges of tools are to be sharp to avoid ‘burnishing’. The surface of plywood to be glued should be lightly dressed with sand or glass paper. The sad or glass paper must not be allowed to clog and cause ‘burnishing’.

Members in construction to be jointed by gluing are to be of similar conversion. All surfaces to be glued are to be kept clean, free from dirt, sawdust, oil and any other contamination.

Adequate pressure should be applies to glued joints to ensure intimate contact is maintained whilst the glue is setting.

Mixing, application and setting conditions should be in accordance with the glue maker’s instruction.

“Adhesives” for joints in non – loadbearing internal work and for joints in work where moisture content is always less than 16 per cent can be case in or organic glues.

For work under damp conditions (moisture content normally 20 per cent or more or conditions liable to fungal attack) : resin type adhesives are to be used.

8.23 **SCRIBING**

All skirting, architraves, plates and other joinery works shall be accurately scribed to fit the contour of any irregular surface against which they may be required to form a close butt connection.

8.24 **FLUSH DOORS**

The specifications shall be as per relevant BOQ Item.

8.25 **WORKING PROCEDURE**
Measurements for Joinery

The Contractor is to take all measurements for joinery works on site to the building and not from the architect’s drawings, except where the work is specified to be “built-in”.

Fixed-in Joinery

Where joinery works are specified to be “fixed-in” or inserted in the positions, they are to occupy after the surrounding or enclosing carcass has been constructed, it shall be the responsibility of the Contractor to ensure that the necessary fixings are incorporated in the carcass, alternatively, the Contractor shall construct such groundwork as are required to provide a suitable base and fixing for the joinery works. The spaces enclosed in the ground works and behind joinery works shall be filled in the solid with plaster. The contractor is to secure ‘fixed –in’ joinery works so that they are plumb and true to the shapes and dimensions shown on the working drawings and details. Vertically junctions shall be solidly bedded with mortar, wedged or otherwise secured, as may be specified or as is most appropriate in the circumstances but a clearance is to be maintained in all overhead junctions so that settlements in the building carcass may take place without stressing or otherwise loading the joinery works.

Joinery works shall not be fixed in position until after all floors, wall and ceiling surfaces have been formed or constructed, unless otherwise specified.

Joinery Assembled insitu

Where joinery works are specified to be “assembled in site” and all stresses of support and fixing are to be engaged in the building, it shall be the responsibility of the Contractor to ensure that the necessary fixings are incorporated in the carcass; alternatively, the Contractor shall construct such ground works as are required to provide a suitable base and fixing for the joinery works.

The spaces enclosed in the ground works and behind the joinery works shall be fitted – in solid with plaster or concrete.

Insitu joinery works shall not be executed until after all floor, wall and ceiling surfaces have been formed or constructed, unless otherwise specified.

Drawings
Work is not to commence until the Architect has approved the manufacture full-size setting out drawings. Suggestions, which the manufacturer may wish to make for modifying the construction and joints shown on the Architect’s drawings, will be, and considered when the shop drawings are examined.

**Inspection**

Facilities are to be given for the Architect to inspect all work in progress in shops and on the site.

**Time for delivery**

None of the joinery is to be delivered until it is required for fixing in the building. Joinery which does not require to be built in as the work proceeds is not to be brought to the site and fixed until the building is enclosed and dry out.

**Transport and Protection**

The joinery is to be kept under a waterproof cover during transit and it is to be similarly covered and kept clear of the ground on the site. It is to be handled and stacked carefully to avoid damage.

**Plugging and screwing**

Where items are described as plugged or plugged and screwed this shall mean plugging, plugging and screwing to concrete block walling, concrete walling, stone walling to the approval of the Architect.

### 8.26 IRONMONGERY

Butts and hinges shall be of sizes and types specified and fixed with the full number of screws and on no account shall nails be used.

All locks and ironmonger shall be fixed before the woodwork or metal work is painted. Handles shall be removed carefully stored and re-fixed after completion of painting. Locks shall be oiled and left in perfect working order. All locks to include two keys and or three keys and all keys shall be labelled with door references marked on plastic labels before handing to the Architect on completion.
8.27 **PRICES OF TIMBER WORK**

The Contractor is to include in his prices of all members for fitted ends, miters, housings, returned ends, etc. and for short-lengths not exceeding 30mm.

The prices for all joinery items are to include for pencilled rounding all arises and all labour for cross grain.

Where hardwood is described as screwed, prices are to include for pellating with a matching hardwood.

Allowance is to be made in the prices for angles, ramps, mitres, ends, etc. on timber worked on solid and shall include for all necessary non-ferrous metal screws, metal cramps, dowels and the like.

The prices for all timber described as select quality are to allow for keeping clean for light coloured finishes, polishing, etc.

**SECTION 9 – METALWORK**

9.1 **GENERALLY**

Metal Work shall be of mild steel complying with BS 4360, and shall be hot dipped galvanised to BS 729 Part I minimum 610 gm/m², unless otherwise specified. Locally welded joints, if approved, shall be treated with epoxy zinc rich primer to Architect’s satisfaction.

Bolts, nuts and screws shall be in compliance with BS 916 or BS 1494 as appropriate. Bolts, nuts and screws shall be of sizes as shown, with hexagonal heads and nuts and washers as required.

Rivets shall be countersink at all bearings joints and where required.

Stainless Steel shall comply to BS 1449 of BS 4127 and shall be generally of marine grade, type 316.

All metal work shall be delivered to the site clean and tidy, free from rust, putting or any corrosion.
9.2 **ROLLER SHUTTERS**

Aluminium roller shutter in approved reinforced powder coated aluminium shutter blades, white powder coated finish to BS EN 12206-1:2004; (60 microns minimum thickness, powder coating to be guaranteed for 10 years). The roller shutter shall be designed to resist cyclonic wind speed of over 280 km/hr and shall be complete with runners, gears, guides, lugs, cleats, locking device, boxing or casings with detachable handle and mechanical rod to operate roller shutter manually; fixing in position to concrete / block work with and necessary rawl bolts etc all to manufacturer’s recommendations.

9.3 **ALUMINIUM OPENINGS**

Aluminium Openings shall be to BS standards or equivalent and shall generally be powder coated finish minimum 65 microns to BS 6496 (powder coating to be guaranteed for ten years). Aluminium opening shall be strictly to manufacturer’s specification and to Architect’s approval and shall be made up with extruded aluminium profiles, and if approved by Engineer reinforced with galvanised infill to resist a basic wind speed of 280 km/hr. Glazing shall be generally with clear float glass minimum 6 mm thick, properly set in neoprene gaskets. Perimeter of openings shall be pointed with elastometric silicone mastic minimum 6 mm thick and 10 mm deep, all around internally and externally. All joints are to be mitred, and openings shall watertight and dust proof all as recommended by manufacturer. Doors shall be fitted with approved heavy duty mortice lock, handle powder coated finish unless otherwise specified, and 1 ½ pairs of heavy duty stainless steel to each door leaf hinges unless otherwise specified. Windows shall be in heavy duty friction hinges, with heavy duty powder coated fasteners. All ironmongeries shall be to BS Standards and to Architect’s approval. Contractor will be required to submit sample of openings, of a miniature type, complete with ironmongeries to Architect, supported with all technical literature from manufacturer for approval prior to placing order, unless otherwise specified.

The Contractor shall be responsible to cover all exposed aluminium opening surfaces with protective paper or the like during erection and after installation against damage, staining, abrasion and or other injuries. On completion the contractor shall remove all protective material and clean the surfaces to Architect’s satisfaction. No abrasive agents shall be used.

9.4 **FIXING AND ERECTION**

All openings including doors and windows shall be inspected for damage on arrival on site and any damage shall be made good as described.
All seatings and surrounds shall be checked for line, level and bolt setting before commencement of fixing. Errors which cannot be accommodated without distortion shall be brought to the attention of the Architect. Drifting or burning of holes will not be permitted.

9.5 **FREEDOM FROM SURFACE DEFECTS**

All welded fillet or butt joints shall be ground smooth and shall be free from porosity, cavities and entrapped slag before hot dipped galvanising.

Welds which are to be hot dipped galvanised shall be neatly formed and the surfaces shall be acceptably free from cracks in the welds or heat affected zone, from overlap, undercuts, porosity, entrapped slag and spatter in or associated with the welds. The welds shall seal completely the edges of all overlapping or contacting surfaces.

The profile of the weld shall be uniform of approximately equal leg length and free from overlap at the toes of the weld. Unless otherwise specified, the surfaces shall be either flat or slightly convex in the case of fillet welds and with a reinforcement of not more than 3 mm in the case of butt welds. The weld face shall be uniform in appearance throughout its length.

9.6 **TEMPORARY BRACING OF METAL WORK**

The Contractor shall be responsible for whatever temporary bracing is necessary. Upon completion of the works all temporary bracing, brackets, cleats and the like shall be removed and all surfaces made good or painted as specified.

**SECTION 10 – PLASTERING, SCREEDING, WALL AND CEILING FINISH**

10.1 **GENERAL**

The renderings are to be carried out so that the finished surfaces appear without visible joints or patches. The rendering of wall surfaces, reveals of openings and cills are to be carried out in one operation and each day’s work stopped at a suitable point where it can be picked up again on the following day without noticeable joints. The quality and mixing of the materials are to be constant throughout so that there is no variation in colour or texture. The finished coat to be brushed down and left clean to receive decoration. If any continuous face of a wall the rendering shall be carried out continuously and day to day breaks made to coincide with architectural breaks in order to avoid unsightly junctions.
10.2 **PREPARATION OF SURFACES FOR RENDERING**

All faces of concrete work shall be well hacked to form a good key and in the case of block or stone walls the joints shall be raked out.

Concrete floors and roofs receiving screeds shall be hacked to form a good key, well washed and wire-brushed perfectly, well wetted and painted with a cement and sand (1:1) grout immediately before commencing screeding work.

All surfaces for rendering shall be well wetted with a hose before rendering is applied.

10.3 **CEMENT**

Shall be as specified previously.

10.4 **SAND**

Shall be as specified previously for fine aggregates, but in addition shall be in accordance with BS 1199 and shall have three washings if coral sand is used.

10.5 **MIX FOR RENDERING**

The mix for rendering both internally and externally shall be composed of cement and sand (1:3) mix plus an approved mortar plasticiser used strictly in accordance with the manufacturers' written instructions.

10.6 **APPLICATION OF RENDERING**

External rendering shall be not less than 16 mm or more than 20 mm in thickness.

Internal rendering and rendering to soffit of slabs, concrete beams shall not be less than 13 mm or more than 16 mm in thickness unless otherwise specified.

Moulds, weathering, projections, sunk bands and other architectural features shall be executed in accordance with the drawing to a true line finish and are to include for any dubbing out.

Internal angles are to be coved to a radius of not more than 25 mm.
The surface of internal rendering shall be steel trowelled to a smooth, even and true finish.

The surfaces of external rendering shall be finished to a true even surface with a wood float and to a sponge textured finish.

Rendering shall be returned into reveal soffits of openings, margins and sunk bands and the like, with strong and true arises and all angles shall be true and straight with salient angles rounded.

All rendered surfaces shall be free from blemish. All cracks, blisters and other defects shall be cut out and made good and the whole left perfect on completion.

All rendered surfaces be kept damp and moist for at least two days on completion of he rendering work.

10.7 **TYROLEAN FINISH**

Tyrolean renderings shall consist of two coats, with a backing coat of 12 mm thick made up with cement and sand mortar as before up to an even and true surface followed by a tyrolean finishing coat of cement and sand for a suitable mix applied with a special spraying machine and built up in three coats to a total thickness of 8mm approx. to the approval of the Architect.

10.8 **ROOF SCREED**

Provide for laying a cement sand screed 1.3 mix plus plasticiser and to which may be added an approved quality waterproofing compound in accordance with manufacturer’s specification, if specified.

Minimum screed thickness if not specified shall be 13mm and the maximum to be as necessary to provide adequate falls to rainwater outlets and to ensure that no water ponds on the roof. All loose screed will be removed by the Contractor and a new screed laid on epoxy compound.

Screeds shall be laid to falls and cross falls and shall be dished towards rainwater outlets.

Where roofs are to be waterproofed, provide for inspection of roof by specialist waterproofer and obtain signed statements that roof falls are acceptable. No waterproofing work should be allowed to commence before being accepted in writing by the waterproofing specialist.
10.9 **QUARRY TILING**

Quarry tiling shall be to the quality, sizes and colour as selected by the Architect, laid to area indicated on the drawings. The tiles shall be set square jointed bedded and pointed in cement mortar (1 part of cement to 3 parts of sand).

Tiles shall be soaked in water 24 hours before laying and shall be thoroughly scrubbed to remove all traces of cement after laying and protected with sawdust or sacking and not used for at least 10 to 14 days.

The surfaces shall be polished on completion of the contract.

10.10 **WALL TILING**

Wall tiling shall be executed with ceramic glazed earthware tiles conforming to BS 1281 of approved Manufacture true to shape and free from blemishes unless otherwise specified.

The backing coat for wall tiling shall be finished perfectly true and not less than 10mm thick and not greater than 16mm thick in mortar of a mix of one part of cement to two parts of sand, the surface of which after 24 hours shall be combed or scratched and left for a further 24 hours. When still slightly green the surface shall be well wetted and the wall tiles after soaking in water for 30 minutes and left to drain shall be bedded on the backing coat with a similar mixture of cement and sand as for the backing coat. The tiles shall be laid perfectly level and finished proud of the surrounding rendered wall surfaces. Internal and external angles and round edged tiles are to be of the same manufacture, colour of thickness as the foregoing. All joints to run perfectly straight both horizontally and vertically. The joints between the tiles are to be pointed in neat matching colour tile adhesive.

10.11 **SAMPLE PANEL**

The Contractor shall prepare samples of plastering, tyrolean finish, bush-hammered finish as directed until the quality texture and finish required is obtained and approved by the Architect after which all plastering, tyrolean and bush-hammered finished executed in the work and shall conform to the respective approved samples.

10.12 **PRICES FOR SCREEDS, PLASTERS, TILING, ETC.**
Prices for paving or screeds are to include for preparation of the concrete base all necessary hacking, grouting with cement grout, any extra thickness consequent upon the concrete surfaces not being finished to true and level, laying in bays and all necessary formwork and temporary dividing strips, and curing the finished screed or paving for at least seven days.

Prices for tiling shall also include for all straight and raking cutting, fair edges and fair joint, prices for tile skirting shall further include for angles, ends, mitres and for short lengths not exceeding 300mm, mitre cut to tile edge or for aluminium tile trim at exposed edges, unless otherwise specified.

Prices for plastering are to include for preparation of the surface, hacking of concrete, raking out joints of block work, grouting, forming temporary rules, fair edges and arises, rounded external angles, V-joints, working to rebates making good to window or door frames, around pipes, holder bats, sanitary fittings, narrow widths and small quantities.

Prices for rendering on walls shall also include for any extra labour involved in working to breaking columns, beams, cill, etc., all of which have been included in the general term of walls.

SECTION 11 – GLAZING

11.1 QUALITY OF GLASS

All the glass to be of the best quality obtainable free from all defects and imperfections and shall be to the approval of the Architect.

11.2 WINDOWS AND DOORS

Glaze all windows and doors in suitably thick clear sheet glass unless specified otherwise.

11.3 TRANSLUCENT GLASS

Windows requiring obscure vision shall be glazed with translucent glass of an approved texture or pattern, the thickness to be not less than that mentioned above unless specified otherwise.
11.4 **PUTTY**

Putty for glazing to wood shall be made of pure whiting and raw linseed oil and to be used fresh. Putty of glazing to metal shall be steel sash putty of approved manufacture.

All putty shall be delivered on site in the original manufacturer’s sealed cans or drums and used direct therefore, with the addition only of pure linseed oil of necessary. No mineral or other oils shall be used in the putties except genuine linseed oil.

The rebates of metal window shall be painted one coat before puttying.

11.5 **GLAZING**

All glass to be cut accurately in one piece, to fit easily into their rebates and to be well puttied, back puttied and secured with springs in the case of fixing to wood or with metal clips in the case of metal. Care must be taken to ensure that the putty does not show beyond the sight lines of panes and that the putty is neatly cut off externally and neatly splayed off externally all mitres and angles left clean and sharp.

11.6 **GLAZING WORK AT COMPLETION**

All glass broken, cracked or scratched during the progress of the works to be reinstated at the sole cost of the Contractor and all glazing to be left clean and perfect at the completion of the Contract.

**SECTION 12 – PAINTING**

12.1 **GENERALLY**

All work shall be carried out in strict accordance with schedule of colours to be obtained from the Architect.

Samples of colours if requested by the Architect shall be painted on the walls 1.00m x 1.00m square and approval obtained from the Architect before proceeding with the work.

12.2 **MATERIALS, PAINT, VARNISHES, ETC.**

All oil paints, emulsion paints, varnish and other materials shall be of an approved manufacture and to Mauritius Bureau Standards or B.S Standard or as specified and shall be used strictly in accordance with the manufacturer’s instructions. The Contractor will only be allowed to use materials which are brought to the site in sealed cans, bearing the name
of the manufacturer and properly labelled as to quality. Exterior quality paints only shall be used, both internally and externally unless otherwise specified. All cans of paints must be kept well stirred before and during the work and mix with approved admixture as recommended by the Manufacturer. All coats of paint applied over each other shall be from the same manufacturer and the type recommended by the manufacturer.

Well before commencing the painting work the Contractor shall submit to the Architect for approval a list of all the brands of paint and finishing including the necessary primers and undercoats he intends to use and immediately upon being so approved orders shall be placed and total requirements obtained for the works.

Once approved no other brand of material shall be used without the express permission of the Architect.

12.3 PREPARATION OF SURFACES

All surfaces to be painted shall be thoroughly cleaned down and surfaces of wood to be sandpapered and to be twice knotted and stopped before applying the priming coat which shall be regarded as additional to the undercoat. All surfaces of ironwork to be thoroughly cleaned of all scale. And every particle of rust, dirt or grease removed by scrapers and white bushes or other approved method. Galvanised, sheradised or zinc sprayed metal to be painted shall be treated with mordant solution and application of two pack etch primer. Copper pipes specified to be painted shall be rubbed down and clean as recommended by manufacturer.

12.4 WOOD PRESERVATIVE

Treat all timber built in or in contact with walling and concrete with 2 coats of approved type of wood preservative.

12.5 GALVANISED METAL SURFACES

Clean down, treat with galvanised iron cleaner, apply two pack etch primer, one coat of Universal undercoat, two coats of hard gloss enamel paint.

12.6 IRONWORK

Clean down, removing every trace of rust and paint one coat red lead primer, one coat of undercoat and two coats of gloss finishing.
12.7 **RENDERED SURFACES**

Brush down to remove dirt and dust, prime with alkali resistant as specified by the suppliers of the emulsion paint to be used and three full coats of approved PVA emulsion paint MS 3 standard (external quality) internally and externally strictly in accordance with the manufacture instruction.

12.8 **WOOD SURFACES**

Prepare, knot and stop and sand down all timber surfaces, apply on coat of undercoat and two coats of oil paints on surfaces of timber.

Unless otherwise stated, teak veneered doors shall be prepared, sand down and varnished with three coats of varnish.

12.9 **LIME WASH**

Rub down thoroughly by brushing, scraping or sand papering, remove fill crack and imperfections with universal emulsion filler.

Whenever stated, lime wash shall be applied three full coats to concrete blocks surfaces. Lime wash shall be glued type and shall be applied in accordance with manufactures’ instruction.

12.10 **CLEANING ON COMPLETION**

All floors to be twice washed, all marks of paint to be sponged of windows cleaned, the works generally to be touched up after all the trades are finished and the whole of the building left clean and on the completion to the satisfaction of the Architect.

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**Section 13  Soft Landscaping**

**General Specifications before Plantation**

**Procurement and materials/products**
The scope of works of the Contractor shall consist of:

Excavation of tree pits for plantation of mature and semi mature palm trees

Relocation of existing trees & other plants
Making good of edges of pits after plantation

Soil preparation and treatment
Supply of vegetable soil
Use of existing top soil

Shaping of planters as per MAL drawings
Spreading and leveling of top soil
Grassing

Supply and planting of plant species as per list below and Landscape Architect’s drawing
Planting of plants supplied by client

*Implementation _ setting out*

The Contractor shall carry out all setting out works as per L. Architect’s drawings and specifications.

The Contractor shall get the setting out works approved before proceeding with the implementation.

**Methodology**

**Earthwork**

L. Contractor’s Obligations

The Contractor is expected to have thoroughly visited the site before submitting his offer and to fully understand his responsibilities, scope of works, and vegetation that needs to be preserved and protected (if any) during the whole of the implementation period.

*Excavation work for plantation and creation of mounds*
All major excavation works may be carried out mechanically whenever necessary and possible.

*Protection of earthworks*

All earthworks shall be properly protected against the risks of slips, falls, subsidence, flood damage and injury from all causes.

*Transport and earth movement*

Means of transport within the site

The Contractor shall include in his quotation all transport costs for all operations on site (movement of soil, labour,…)

*Topsoil storage*

Removal of surplus soil

All surplus soil after execution of work shall be removed from the site at the Contractor's expense.

*Soil preparation / soil treatment*

The Contractor shall satisfy himself that the levels of the ground shown on the drawings are correct and bring to the notice of the L. Architect any discrepancies before landscape operations are commenced.

Filled areas, surfaces of excavations, and reinstated surfaces of ground shall be trimmed to a correct profile and, where directed by the Landscape Architect, shall be covered with a layer of topsoil spread lightly and to uniform thickness. The soil shall be free from all builder’s debris, rubble, concrete, stones above 40mm ring and clear of weeds. The surface shall be scarified before spreading topsoil.

Topsoil set aside shall be clean dry excavated material free from rubble, debris, rubbish deleterious matter or other pollution and shall be spread and leveled to a thickness of 150mm for lawn areas and 300mm within planters.
The Contractor shall allow in his prices for loading up and carting away to tip all surplus excavated material arising from excavations or preparation of surfaces for landscaping.

**Plantation**

*Scope of works*

The plantation work consists of:

- Soil preparation and treatment
- Supply of plants (including transport & labour)

Setting of plant material in the planting pit to proper grade and alignment. If Fabric In-ground container material is used, remove fabric bag first.

For mature trees, the Contractor shall set plants upright, plum and faced to give the best appearance or relationship to each other or adjacent structure. No filling will be permitted around trunks or stems. He shall back fill the pit with existing soil or approved top soil or mix. Ring of soil around the edge of each planting pit shall be created to retain water.

Watering: The Contractor shall water plants thoroughly to pull soils against root ball and settle air pockets.

**Wrapping, guying, staking:**

Wrapping should be done only on an as need basis.

Staking/Guying

Stake/guy should only be used when trees are loose or weak stemmed.

The Contractor shall take necessary measures & precaution to hold and stabilize mature trees during cyclonic period.

**Maintenance of plants until handing over**

Pruning.

The Contractor shall remove or cut back broken, damaged and asymmetrical growth of new wood. Unless otherwise directed, he shall prune evergreens only to remove broken or damaged branches.
Warranty of three months

The Contractor shall warrant plant material to remain alive and be in a healthy, vigorous condition for a period of three months after acceptance, provided plants are given proper care during this period. The Contractor to call for final inspection of plants. He shall remove and immediately replace all plants, as determined by the Landscape Architect or Employer to be unsatisfactory during the initial planting installation. He shall replace once, in accordance with the drawings and specifications, all plants that are dead or, as determined by Landscape Architect or Employer, are in a severely unhealthy condition within warranty period.

Supply of plants and Plantation

Source of plants

The Contractor may choose to source out his plants from various nurseries upon approval of the Landscape Architect. Plants may be inspected and approved at the place of growth, for compliance with specification requirements for quality, size and variety.

Reception of Plants

(i). Digging out of Plants in nurseries

Digging out of plants shall be done with all necessary precautions so as not to damage the roots and by appropriate techniques.

Specimen trees or shrubs may be tagged at the source of supply at the expense of the Contractor. (ii). Delivery of plants

The delivery of plants on site shall be at the Contractor’s expense. He shall take all precautions customary in good nursery practice to prepare plants for transport. Workmanship, which fails to meet the highest standards, will be rejected. He shall spray deciduous plants in foliage with an approved Anti-Desiccant immediately before digging to prevent dehydration. Dig, pack, transport, and handle plants with care to ensure protection against injury.

Cover plants transported on open vehicles with a protective covering to prevent windburn.
(iii). Handling of Plants on site

The plants will be checked and controlled before plantation. The state / quality of the plants shall be verified on site and any rejected plants shall be immediately removed away.

*Plant Material*

Quantities -

Quantities indicated on the Drawings for unit price items are approximate and are provided for the convenience of the Contractor.

Condition

All plants species shall have a normal habit of growth and are healthy, vigorous and free from insect and/or disease infestation.

The minimum acceptable size of all trees after pruning shall conform to the measurement specified in the Landscape BOQ specifications.

All plant materials shall have a root ball of sufficient size to support the plant’s recovery from transporting. Any plant materials delivered with small or inadequate root balls shall be rejected.

The Contractor shall find no excuse for unavailability of plants if no mention was made during Tender Stage. In case of genuine problem, the Landscape Architect reserves the right to recommend an alternative.

The Contractor may suggest alternative plant species if agreed by the Landscape Architect.

In case if the Contractor plants plant species which are of inferior height to what was specified, the Landscape Architect reserves the right:

Either to refuse them and get them replaced or to accept keeping them but at discounted price.
Grassing

Grass Species & Planting Techniques

The grass species to be used shall be as per BOQ Item.

The installation of the grass shall be by propagation by cutting, including preparation of ground, leading, maintenance until after work reception (health plant, shearing, fertilisation, treatments

Preparation of ground

Loosen topsoil of lawn areas to minimum depth of 300mm if compacted. Remove stones over 25mm in any dimension, sticks, roots, rubbish, and extraneous matter.

Apply appropriate fertiliser.

Grade lawn areas to smooth, free-draining and even surface with a loose, uniformly fine texture

Maintenance

The contractor shall maintain all green areas over a period of 12 months after completion of works (during the defects liability period) as per maintenance specifications below:

Specifications for maintenance during contract period

Maintenance works under this section include but are not limited to the following: The landscape contractor shall:

Protect areas that are exposed to traffic by erecting barricades immediately after planting.

Irrigate areas as required to ensure active growth. Keep areas moist but not saturated. Regulate irrigation as necessary to avoid erosion and gulling.

Fertilize as needed in accordance with the manufacturer’s recommendations and five days prior to the Final inspection. Exercise caution and proper supervision and take necessary measures to avoid scorching of plants.

Keep planting areas free of weeds and undesirable grasses through daily weeding if required. Remove the entire root system of all weeds. Dispose of all weeds in appropriate trash containers. All nut grass shall be manually removed before flowering.
Inspect all plants, including lawn, for disease infestation or insect attack weekly. Treat affected plant materials immediately with appropriate fungicide or Insecticide until complete recovery.

Remove damaged or diseased growth from trees, shrubs and ground covers.

Immediately remove any dead or dying plants. Replacement shall be of same species and size as originally planted.

Stake, tighten, repair, reset guys to proper grades or upright position for any plants that not in their proper growing position.

Mow the lawn to 20 mm height whenever the average height exceeds 50 mm. Grass shall be cut according to the contours of the ground. The height of grass blade after cutting shall not stand higher than 35 mm above the ground level.
Cut lawn using cylindrical grass cutters. All clippings must be removed on the same day.

As it becomes evident that certain areas of the lawn and ground covers have not uniformly or properly established, the successful bidder shall replant the area immediately with the same plants and quantity as specified for the initial planting. The plant material must be maintained to ensure healthy and active growing condition for approval during the Final Inspection.

Prune all trees as directed by the ARCHITECT to establish desired form, habit and appearance.
Maintain records of maintenance procedures including manpower, description of tasks, fertilizers, irrigations etc…These records shall be submitted upon the request of the ARCHITECT or Client.
Set up a maintenance schedule with the Owner / Operator.
Routine Maintenance work: Schedule:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Schedule/Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watering</td>
<td>Check all planting areas and pits and water as often as necessary to ensure that planting medium does not dry out.</td>
</tr>
<tr>
<td>Weeding</td>
<td>Weekly</td>
</tr>
<tr>
<td>Edging</td>
<td>Fortnightly</td>
</tr>
<tr>
<td>Fertilizing</td>
<td></td>
</tr>
<tr>
<td>a. Trees / Palms</td>
<td>Once every three months</td>
</tr>
<tr>
<td>b. Shrubs / Groundcovers</td>
<td>Monthly</td>
</tr>
<tr>
<td>c. Turf</td>
<td>Once every three months</td>
</tr>
<tr>
<td>Composting Trees / Palms</td>
<td>Once every three months. Water thoroughly after the application</td>
</tr>
<tr>
<td>Mulching (wood chips)</td>
<td></td>
</tr>
<tr>
<td>a. Trees / Palms</td>
<td>Once every three months</td>
</tr>
<tr>
<td>b. Shrubs</td>
<td>Once every three months</td>
</tr>
<tr>
<td>Loosing of soil</td>
<td>Fortnightly</td>
</tr>
<tr>
<td>Control of pest by applying</td>
<td></td>
</tr>
<tr>
<td>Appropriate insecticides</td>
<td>Fortnightly</td>
</tr>
<tr>
<td>Control of disease by applying</td>
<td></td>
</tr>
<tr>
<td>Fungicides</td>
<td>Monthly, increasing the appropriate frequency to fortnightly during rainy season</td>
</tr>
<tr>
<td>Grass cutting</td>
<td>Fortnightly</td>
</tr>
<tr>
<td>Pruning and shaping Trees / Palms</td>
<td>Once every six months for small and low sagging branches and when requested by the Landscape Architect</td>
</tr>
<tr>
<td>Guying / Staking</td>
<td>As and when required</td>
</tr>
<tr>
<td>Trimming Shrubs / Groundcovers</td>
<td>Monthly or as when required</td>
</tr>
<tr>
<td>Mowing the Turf</td>
<td>Fortnightly</td>
</tr>
</tbody>
</table>
The Contractor is expected to:

- Water all plants manually and ensure that lawn gets properly watered automatically.
- Keep all planters clear from undesired weeds at all time
- Control plants by using stakes, trimming, removing dead leaves. Note: Trimming of plants to be carried out upon Landscape Architect’s approval.
- Keep all plants free from pests and other diseases by applying appropriate pesticides and fungicides when required. E.g: Apply Decis or Confidor or Dursban over plants every 15 days over a period of 3 months depending on state of plants.
- Use appropriate fertilizers to ensure proper development of plants. E.g: Apply 13/13/20/2 to all plants once a month.
- Replace dead or unhealthy plants.
- Mow lawn two to three times a month once established
- Tilt soil within planters once to twice a month
- Keep all planters and lawn well defined as per L. Architect’s drawings
- Keep site clear from soil, fallen leaves or any other organic matter.

Warranty

Warranty against theft and damage

The Contractor shall replace any lost plants during the implementation stage at his own expense. The warranty period shall be 12 months (during defects liability period).

The Contractor shall also take all necessary measures to protect all form of vegetation existing and planted during the whole of the implementation period.
TECHNICAL SPECIFICATIONS FOR

1.00 PLUMBING & SANITARY INSTALLATIONS

1.01 Special condition for PHE work: The plumbing work shall be carried out by specialized plumbing agency who has licensed plumber and experience of similar works. For supervising the plumbing work at least one engineer who has rich experience in executing plumbing work shall be engaged full time. Approval of specialized agency shall be obtained from HSCC.

1.02 The provision of adequate sanitary and safety facilities as per the norms of NBC 2016 and good engineering practice shall be compliance during construction for construction workers and staff.

1.03 The water use for construction shall be suitable for the same and should be used efficiently and checks and control valves shall be provided to avoid the wastage and leakage.

1.04 To reduce the water consumption of the building, the flushing system of water closet shall be of dual flushing cistern type and plumbing fixture shall be provided which require GRIHA compliance for low flow rate.

1.05 Lab service related to plumbing & fire fighting will be executed by specialized agency who has experience of carrying out similar work earlier. All the lab item shall be detailed out & redesign as per requirement of client, WHO, CDC norms, items given in BOQ are indicative but covered the cost as per the latest requirement of client, WHO, CDC and required approval of client before execution.

1.06 Wall Caps

Wall caps shall be provided on all walls, floors, columns etc. wherever supply and disposal pipes pass through them. These wall caps shall be chromium plated brass snugly fittings and shall be large enough to cover the puncture properly and shall conform to IS: 4291.

1.07 Pipes, Hangers, Brackets, etc.

Sturdy hangers, brackets and caddles of approved design shall be installed to support all pipe lengths, which are not embedded over their entire runs. The hangers and brackets shall be of adjustable heights and painted with red oxide primer, and two coats of enamel paint of approved make and shade. Clamps, coils and saddles shall be provided to hold pipes with suitable gaskets of approved quality. The brackets and hangers shall be designed to carry the weights of pipes safely. Wherever required pipes may run along ceiling level in suitable gradient and supported on structural clamps. Spacing for clamps for such pipes shall be as follows:

<table>
<thead>
<tr>
<th></th>
<th>Vertical</th>
<th>Horizontal</th>
</tr>
</thead>
<tbody>
<tr>
<td>G.I. Pipes</td>
<td>300 cms</td>
<td>240 cms</td>
</tr>
<tr>
<td>H.C.I. Pipes</td>
<td>180 cms</td>
<td>120 cms</td>
</tr>
</tbody>
</table>

1.08 Pipe sleeve

Adequate number of sleeves (pipe inserts) of Cast Iron or Mild Steel shall be provided where pipes cross through concrete, masonry and similar work. The pipe inserts shall be provided with removable timber plugs to keep foreign matter out till installation of the services pipe cross the sleeve. The diameter of sleeve should be one size higher than the proposed dia or as instructed by the Engineer.

1.09 Floor trap inlet

Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, contractor shall have a special type G.I. / M.S. inlet hopper without or with one, two or three inlet sockets to receive the waste pipe. Joint between waste and hopper inlet socket shall be
lead caulked/welded/threaded. Hopper shall be connected to a C.I. P or S trap with at least 50mm water seal. Floor trap inlet hoppers and traps shall be set in cement concrete 1:2:4 blocks without any extra cost.

1.10 C.P. gratings

Floor trap and urinal trap shall be provided with 110mm square or round C.P. /stainless steel grating, with rim of approved design and shape. Minimum thickness shall be 3 mm.

1.11 Hot Water Supply

The chase will be closed in cement mortar 1:2 (1 cement : 2 coarse sand). Pipes shall be clamped to the wall inside the chase.

1.12 Making Connections

Contractor shall connect the new sewer line to the existing manhole by cutting the walls, benching and restoring them to the original condition. A new channel shall be cut in the benching of the existing manholes for the new connection. Contractor shall remove all sewage and water if encountered in making the connection without additional cost.

1.13 SAMPLE AND SHOP DRAWINGS;

All plumbing items shall be provided as per approved sample/data sheet approved by the HSCC. Before placing the order, the contractor shall submit the shop drawings prepared based on tender drawings and BOQ alongwith samples for approval of HSCC. The shop drawings shall have all the details. The contractor has to obtain the approval of external plumbing drawings from DJB/MCD before start of work.

1.14 SANITARY FIXTURES

SCOPE OF WORK

a) The codes of the Uniform Plumbing Code of India shall be used as a general guide for good engineering practice, design and workmanship norms.

b) Work under this section shall consist of furnishing all Material and labour as necessary and required to completely install all Sanitary Fixtures, brass and chromium plated fittings and accessories as required by the drawings and specified hereinafter or given in the Indicative Items.

Grab Bar S, type-304, 18-gauge (1 mm) stainless steel tubing with satin-finish. 1-1/2”(25.4mm) outside diameter. Concealed Mounting Flanges — 18-8 S, type-304, stainless steel plate; end flanges with two holes for attachment to wall. Snap Flange Covers — 18-8 S, type-304, 22-gauge (0.8mm) drawn stainless steel with satin-finish. Each cover snaps over mounting flange to conceal mounting screws.

Swing Grab Bar 1 8-8 S, type-304, 18-gauge (1mm) stainless steel tubing with satin-finish. 1–1/4 (25mm) outside diameter. Ends are heliarc welded to flanges. Backplate - 18-8 S, type-304, 3/16” (5mm) thick, satin-finish stainless steel with four screw holes for attachment to wall.

Scrub Sink: For Hospital Block Compact floor mounted pedestal base surgical scrub sink tailor made to suit the site available compatible with all the regular and standard plumbing system, with inbuilt geyser designed for use in operation theatre fabricated from thickness 1.6 mm 304 type stainless steel seamless 304 welded,polished to satin finish including connecting to drainage and water points and making good cutting of walls and floor surface all complete.

Tailor made surgical scrub sink (2 bay) Approximate size 1.4 mX0.54mX0.84m with 1 user elbow operated mixture tap, soap dispensers, drain outlet ,thermostatic control of water temperature.

Bed Pan Sink: For Hospital Block S S 304 -18/16 SWG(thickness 1.5 mm) bed pan sink with CPVC P trap, size 850W x 600Dx300Hmm + SPL with 10 litres PVC. flushing cistern , 32 mm dia flush pipe cpvc , C.I./M.S. bracket with ss with complete with accessories, C.P. brass long body bib cock and health fucet fittings .
1.15 SOIL, WASTE & VENT PIPES, PVC PIPES

SCOPE OF WORK

a) Work under this section shall consist of furnishing all labour, materials, equipment’s and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes as required by the drawings, specified hereinafter and given in the Indicative Items.

b) Vertical and horizontal Soil, Waste and Vent Pipes, PVC PIPES, Rainwater Pipes and Fittings, Joints Clamps and connections to Fixtures.

Connection of pipes to Gully Traps & Manholes etc.

Clean Out Plug: Clean Out plug consist of CI bend & GI socket heavy class with Brass cap & key for opening male threaded cap etc. including lead caulked to CI pipes complete in all respects as per drawing/ sample approved by Engineer-in-Charge FCO (floor clean out plug shall be flushed with floor finish. Cleanout plugs shall be threaded and provided with key holes for opening. Cleanout plugs shall be fixed to the pipe by a male threaded adaptor.

WC Connector Socket: WC connector socket (for vitreous china & CI pipe) of EDPM good quality with polypropelene body 100x150/100x250 of approved quality and make complete in all respect.

HDPE PIPE: The labs effluent/waste water will be collected separately in HDPE pipe line with manhole and finally discharge into ETP. Laboratory Effluent waste pipe and fitting of high density polyethylene (HDPE), CLASS-PE 80 , pressure rating PN-6, conforming to IS:4427, electric fusion joints/flanged joints, fittings which includes bends, junctions, cowls, offsets, access pieces etc. Complete including jointing.

TESTING

The soil, waste piping system and rain water should be tested after installation as follows:

1. WATER TEST
The pipes shall be tested after installation & before the appliances are connected, preferably in sections so as to limit the static head of 4.5m. The pipe shall be filled with water for at least 10 minutes. After filling, pipes shall be struck with a hammer and inspected for blow holes and cracks. Then it will be necessary to seal all openings and leaks at joints immediately as observed during the test and all defective pipes shall be rejected and removed from the site. Pipes with minor sweating shall be accepted at the discretion of the Engineer-in-Charge.

2. SMOKE TEST
Alternatively, the Contractor may test all Soil, Waste and Rainwater stacks by smoke testing machine. The smoke test shall be carried out as under: Smoke shall be pumped into the stack after plugging all inlets and connections at the lowest points from a smoke testing machine which consists of a bellow & burner. The material usually burnt is greasy cotton waste which gives out a clear pungent smoke which is easily detected by sight as well as by smell, if there is leak at any points of the pipe. The top end shall however be left open. The stack shall then be observed for leakiness and all defective pipes and fittings removed or repaired as directed by the Engineer-In-Charge.

1.16 WATER SUPPLY SYSTEM

SCOPE OF WORK

1. Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified here in after and given in the Indicative Items.
2. Without restricting to the generality of the foregoing, the water supply system shall include the following:

(a) All water lines to different parts of building and making connection from source etc.

(b) Pipe protection and painting.

(c) Control valves, masonry chambers and other appurtenances.

(d) Connections to all toilets, kitchen equipments, storage tanks and appliances.

(e) Excavation and refilling of pipe trenches, wherever required.

(f) Trenches for taking pipe lines for these services.

'Y' type strainer

Y type strainers are most suitable for horizontal and vertical pipelines where the debris is difficult to be removed from the liquid. C.I. 'Y' type strainer flanged with SS 304 perforated screen including nuts, bolts and rubber insertions etc.

Bourden type Pressure gauges

Bourden type pressure gauges range 0 to 20 bar 10mm brass gauge cock brass pipe snubber etc complete. Bourden type pressure gauges are most common type in many areas and used to measures medium to high pressures. This instrument for measuring the condition of a fluid.

Hot Dipped Puddle flange: Hot Dipped Puddle flange Length -400mm Class C pipe, Puddle Plate 6mm Thk of Size (450x450) welded in the centre of the pipe One End Threaded.

TESTING

All pipes, fittings and valves shall be tested by hydrostatic pressure of min. 1.5 times, the working pressure and subject to minimum of 7 kg/cm² in any case and with the consent of Engineer-In-Charge

1.17 SEWERAGE / DRAINAGE SYSTEM

SCOPE OF WORK

1. Work under this section shall consist of furnishing all Labour, Materials, Equipment’s and Appliances necessary and required to completely finish Sewerage/Drainage system as required by the drawings and specified hereinafter or given in the Indicative Items.

2. Without restricting to the generality of the foregoing, the sewerage system shall include:

(a) Installation of all sewer lines / effluent lines
(b) Installation of all storm water drainage lines
(c) Construction of all catch basins, chambers, manholes & other related civil works
(d) Rain water harvesting system

Non Pressure NP-3 class (Medium duty) R.C.C. pipes : Non Pressure NP-3 class (Medium duty) R.C.C. pipes including collars/spigot jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand) including testing of joints etc. complete.

Oil Skimmer with Oil Trap for Mess Block Kitchen

Type : Belt Type,Belt Size:-100mm X 1200mm (Circumference) Driven: Dive Pulley/with bottom pulley with oil stopper, Tray-To Collect Oil, Capacity :15 Ltrs/Hr. Motor:0.5HP 3Phase, Oil Trap (SS 304) Size-600mmX1000mmX600mm Ht.
1.18 Submersible pump and electrical panel
Submersible pump and electrical panel suitable for 200 mm dia casing of bore with SS impeller, high tensile SS shaft, copper wound squirrel cage wet type induction motor 3000 rpm, 415 V, 50 Hz, 3 phase A.C. supply, conforming to ISS: 8034-1976, capacity 300-500 LPM at 80-120 m head along with a directly coupled submersible type squirrel cage electric induction 10 H.P (minimum). motor suitable for operation on 400 V, 3 phase, 50 c.p.s. A.C. supply, water lubricated bearings and provided with pivoted segment type thrust bearings to withstand non-vertical lead with minimum wear and tear and duly fitted with device to take up the expansion of water with heating of motor, including supply, testing and commissioning of electrical panel from the same manufacturer, complete with all accessories in all respects. The contractor to obtain approval for model and make of pump set & suitable Electrical panel after having yield report of fully developed tube well and submit actual bore strata chart. Including supplying laying and fixing water proof PVC insulated flat submersible cable 3x10 sqmm with end termination with its accessories. Complete in all respect as required. 1 No. 3 Phase, fully automatic star-delta starter, type - II of 15 HP with thermal overload relay, contactor, Timer, Push Buttons and Auto-manual selector switch etc complete as required.
2.00 WATER TREATMENT & PUMPS

2.01 SCOPE OF WORK

Work under this section consists of furnishing all labour, materials, equipment’s and appliances necessary and required to supply, install and commission pumping and water filtration as described hereinafter and given in the schedule of quantities and/or shown in the drawings. Tentative raw water characteristics are given in Appendix-1

2.02 GENERAL REQUIREMENTS

2.02.1 All materials shall be new and of the best quality conforming to specifications and subject to the approval of Engineer.

2.02.2 All equipment shall be of best available make manufactured by reputed firms.

2.02.3 All equipment shall be installed on suitable foundations, true to level and in a neat work-man-like manner.

2.02.4 Equipment shall be so installed as to provide sufficient clearance between the end walls and between equipment to equipment.

2.02.5 Piping within the pump houses shall be so done as to prevent any obstruction in the movement within the pump house.

2.02.6 Each pumping set shall be provided with a valve and a flap type non-return valve on the delivery side.

2.02.7 The contractor shall submit the following documents:

a. Process and hydraulic design calculations for all units.

b. Civil, Structural arrangement, design calculations if included in the scope of work.

c. Plant layout drawings

d. Process flow sheet

e. Design Philosophy

f. All technical brochures,

g. Operation and maintenance manuals and other details of the system offered.

h. Equipments listing & list of consumables.

2.02.8 The contractor shall supply shop drawings with supporting details for approval from Engineer before procurement of material. The contractor shall also obtain approval from local statutory authority/authorities as applicable at no extra cost.

Four 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.
12.00 MOTOR CONTROL CENTERS

12.01 Switchboard cubicles of approved type shall be fabricated from 2mm thick CRC sheet with dust and vermin proof construction. It shall be painted with powder coating of approved make and shade. It shall be fitted with suitable etched plastic identification plates for each motor. The cubicle shall comprise of the following (Switchgear as given in the schedule of quantities):

a) Incoming MPCB of required capacity
b) Isolation MPCB/MCCB, one for each motor
c) Fully automatic DOL/Star Delta starters suitable for motor DOL upto 7.5 H.P.; Star/Delta for 10 H.P. and above H.P. with push buttons one for each motor and On/Off indicating neon lamps.
d) Single phasing preventor of appropriate rating for each motor
e) Rotary duty selector switch
f) Panel type ampere meters one for each motor shall be with rotary selector switch to read line currents.
g) Panel type voltmeter on incoming main with rotary selector switch to read voltage between phase to neutral and phase to phase
h) Neon phase indicating lamps and indicating lamp for each motor and on incoming mains.
i) Rotary switch for manual or auto operation for each pump
j) Fully taped separate aluminium bus bar of required capacity for normal and emergency supply where specified.
k) Space for liquid level controllers and other equipment specified separately in the contract/given in the schedule of quantities
l) The panel shall be pre-wired with colour coded wiring. All interconnecting wiring from incoming main to switchgear, meters and accessories within the switchboard panel. Wiring shall have suitable copper or aluminium ferrules.

12.02 Switchboard cubicle shall be floor or wall mounted type as directed by the Engineer.

13.00 Automation for Water Treatment & Water Supply System

Raw water from Tube Wells would be received in the underground Fire Tank (T1) from there it overflows to the underground Raw Water Tank (T2).

There is no consumption of water from (T1) except in case of fire or during trail runs of the Fire Pumps and the above overflowing arrangement is provided to prevent stagnation of Water in Tank (T1).

The Tube Well Pump would be automatically switched on/off by Level Controller provided in Tank (T2.) The same Level Controller would give audio/visual alarm in case of reaching very high (HH) or very low (LL) level. (Chlorination to kill bacterial/virus is done in the Filtered Water with a Chlorine Dosing Pump in the line going to OH Tanks.)

Raw Water from Tank (T2) is pumped by Pumps P6 A/B to the Filter Water Tank, after passing through Filter. Raw Water from Tank (T2) is also pumped by Pumps P7 A/B to the Over Head Fire Water Tank (T5) from there it overflows to the Over Head Flushing Water Tank (T6 & T5). Filtered water pump P6 A/B would be automatically controlled by the Level controller provided in tank (T5) and Raw Water Lift Pump P7 A/B would be automatically controlled by the Level controller provided in tank (T6 & T5). These Level Controllers as in earlier cases would also give audio visual/alarm in case of very high or very low level.
Filter Water from Tank (T3) is also pumped by Pumps P9 A/B to the Over Domestic Water Tanks (T7 & T12). Filtered water pump P8 A/B would be automatically controlled by the Level controller provided in tank (T4) and Filter Water Lift Pump P9 A/B would be automatically controlled by the Level controller provided in tank (T7 & T12). These Level Controllers as in earlier cases would also give audio visual/alarm in case of very high or very low level.

Domestic Water from Over Head Domestic Water Tank (T7) shall be go into the R.O. Plant placed on the terrace of Building and from there the RO water would be distributed for Building.

Electric Control Panel containing DOL starters for all the pumps described above would be supplied by the Owner. The Automation System Vendor has to provide interface with the contractors of these Pump Motor Starters. There would be enough empty space in the bottom tier of this Electric Control Panel. However, Automation System Vendor has to provide full details of such relays controllers indication lights/ alarms etc. to the Owner for incorporating there in the Electric Control Panel.

14.00 TREATED WATER QUALITY

The output from Softener shall conform to commercial hardness. Similarly the resultant TDS from RO system shall be less than 100 PPM. Other output parameters from the system shall with in the Desirable limits specified in IS: 10500 standards.

APPENDIX - I

Tentative Raw Water Characteristics:

<table>
<thead>
<tr>
<th>S.NO</th>
<th>PARAMETER</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hardness</td>
<td>800 mg/l</td>
</tr>
<tr>
<td>2</td>
<td>Colour</td>
<td>Less than 5</td>
</tr>
<tr>
<td>3</td>
<td>Odour</td>
<td>Unobjectionable</td>
</tr>
<tr>
<td>4</td>
<td>Turbidity</td>
<td>4 NTU</td>
</tr>
<tr>
<td>5</td>
<td>PH</td>
<td>6.5 to 8.5</td>
</tr>
<tr>
<td>6</td>
<td>Total iron</td>
<td>0.1 mg/l</td>
</tr>
<tr>
<td>7</td>
<td>Chlorides</td>
<td>250 mg/l</td>
</tr>
<tr>
<td>8</td>
<td>Total Dissolved solids</td>
<td>1200 mg/l</td>
</tr>
<tr>
<td>9</td>
<td>Coliform organisms at 37o C (MPN)</td>
<td>221 per 100 ml</td>
</tr>
<tr>
<td>10</td>
<td>E-Coli</td>
<td>79/100 ml</td>
</tr>
</tbody>
</table>

Note: The parameters and characteristics of raw water given are tentative only. The contractor shall on his own collect and assess the nature of water available at the site and has to design the system according to that.

15.00 HYDROPNEUMATIC SYSTEM

15.01 SCOPE

This section of the contract involves the design, supply, installation, testing and commissioning of the complete Hydropneumatic pumping system and other pumping systems complete with all controls and electrical work for
domestic water supply. All submersible, drainage pumps for the project are also included in this contract. It also involves testing and commissioning of the pumping system with the domestic water and flushing water supply & distribution.

This specification described the particulars of the contract, designs and systems chosen, and mode of operation.

All installation work shall comply with the latest rules and regulations.

The work embraced by this specifications covers the design, submission to authorities, supply, delivery on site, installation, testing, commissioning and maintenance of the Hydropneumatic pumping system, other pumping system installation of the building in accordance with this specification and associated drawings.

The scope of work shall include the following (list is indicative and not exhaustive):

- Variable speed pumping units domestic water supply & distribution.
- Suitably sized food grade quality, non-toxic diaphragm type pressure vessels complete with necessary interconnections and controls.
- Control panel for pump control complete with variable speed drives, circuit breakers, fuses, pressure transmitters etc. complete with all interconnections to pumps and electrical supply panels.
- Pump control units complete with pre-programmed micro-processor chip.
- Pump monitoring units to monitor operation of pumps.
- Each Hydropneumatic Pumping unit shall be supplied as a complete set including variable speed pumps, pressure vessels suction and discharge common manifolds, non-return valves, isolating valves, pressure transmitters on the discharge side and level electrode at the suction tank. Each unit shall be provided with electronic microprocessors for unit control and all necessary electrical work for the unit.
- Submersible drainage pumps for plant room drainage complete with electrical panels and necessary accessories with automation for pump operation.
- The Hydropneumatic system supplier shall provide the pumping units in the designated pump rooms as complete units included all necessary piping within plant such that only discharge connections are required to be connected into the unit’s discharge manifolds just inside the plant room, by the Plumbing tendered. The Hydropneumatic system tendered shall guarantee specified pump performance at various pump speeds and Hydropneumatic pumps must be able to supply at least 2 bar pressure at the highest/farthest fitting.
- Electrical equipment and installation work including the PLC in Control panel.
- Provision of all hold down bolts, spigots struts and the like required to be built in during construction;
- Provision of all level switches, flow switches and other sensing devices for status indication.
- All interfacing work with other trades.
- Testing and commissioning and balancing of the Hydropneumatic & Pumping system;
- Provisions of operating instructions and maintenance manuals;
- Provision of spare parts;
- Training of the employer’s staff for proper operation of the entire systems;
- Liaison with Local Authorities to obtain all necessary certificates and approvals, including the completion of all submission drawings, forms and payment of any fees and charges. All the
costs for all the tests required by Local Authorities shall be included. To attend to any Authorities inspection regardless of whether this inspection is carried out after the defect liability period;

- Provisions of the necessary installation which include pumping works, pipework within the pumping unit up to suction and discharge manifolds, conduit and control wiring, etc. to form a workable system required;

- All other works and systems as specified in the Contract document and or shown on the drawings.

- All cutting, patching, framing up, furring in, chasing and making good associated with the building construction for the passage of pipes, conduits and the like including providing GI pipes sleeves of required size corresponding to pipe dia, wherever pipes crossing fire rated walls and floors and sealing with glass wool in between and fire sealent compound on either end. Details on shop drawings shall also be provided.

15.02 GENERAL

Equipment offered for supply and installation shall include the following:

All minor items and incidental work, equipment accessories and materials may not be specifically mentioned but are required for the proper completion of the installations in accordance with the true intent and meaning of this Specification.

Readily accessible, dust-proof lubricating facilities on all moving parts and equipment including provision for cleaning all lubricating lines and bearings and charging same with the correct lubricants after installation but prior to testing and commissioning.

Clearly visible and robust manufacturer's name-plates permanently fitted each and every item of equipment and showing the manufacturer's name, type and/or model number, serial number, and all essential operating data such as speed, capacity, voltage, current draw, etc.

The Tenderer also shall allow provision for the inspection of all plant and equipment by the manufacturer or his licensed representative, at least twice during the course of the installation.

15.03 PIPING

The pipes and fittings in the domestic Water Treatment plant room shall be CPVC /GI class ‘C’ (heavy class) conforming to IS: 1239 (Part-I) for pipes and IS:1879 (Part 1 to 10) for malleable cast iron galvanized fittings or specified in the BOQ.

16.00 PUMPS FOR HYDROPNEUMATIC & DRAINAGE SYSTEM

16.01 PUMPS

Pumps shall be vertical, centrifugal, multistage directly coupled to motor. Provision of pump with pump head & base of cast iron and other parts in SS 304 shall be made for pumps required in Hydropneumatic System. Impeller shall be hydraulically balanced and keyed to shaft. Pump shall be mounted on a concrete foundation, projecting at least 15 CM above finished floor level. The pumps base shall be set on a vibration elimination pad. The pump shall be lubricated in strict accordance with the manufacturer’s instructions and shall be factory aligned prior to shipment. All motors and bases shall be painted with approved finish shop coat of paint. The pump shall be selected for the lowest operating noise level and shall be complete with flexible connections, valves, and pressure gauges. The pumps shall include cost of foundation channel complete.
The Tenderer shall supply and install pumps of the type and performance as shown on the drawings. All duties of pumps given in the Tender Drawings shall be checked and where necessary corrected before ordering. All the parts of the pumps that are in contact with water e.g. shaft, impeller etc. shall be of stainless steel construction.

Pumps shall be so selected that the design duty point is within 5% of the maximum efficiency point. The pump casing so selected shall have ample space to take an impeller one size larger than that capable of performing the design duty.

Pumps of 2900 rpm with high efficiency and low noise motor can be selected and noise data submitted for approval. All pumps and motors shall be of minimum vibration and noise level during operation. Vibration isolators shall be provided for all pump sets.

Facilities shall be provided to prevent starting of pumps when the water tank is at low water level. An indicator for this low water level alarm shall be provided.

Facilities to select which pump to be duty pump and standby pump shall be provided and be interchangeable.

Pump curves for all pumps offered shall be submitted. All curve indicating excessive shut-off head will not be approved.

Each pump shall be provided with a gate valve at suction and discharge, approved check valve at discharge, approved strainer at suction, flexible connections at pump suction and discharge, eccentric reducer at suction, concentric reducer at discharge, pressure gauges at suction and discharge, circulation relief valve and automatic air relief valve.

Appropriate neoprene vibration isolation mountings shall be provided for each pump sets.

16.01.1 Vertical Pumps

Multi-stage pumps shall be of centrifugal type and arranged with shafts vertically installed. The impellers shall be of stainless steel mechanically balanced and keyed to shaft. Renewable guide rings are to be provided in the casting, keyed to prevent rotation.

Pumps shall be driven by elevated in-line TEFC squirrel cage motors via extended vertical shafted complete with universal couplings.

The shafts shall be stainless steel. Stainless steel sleeves shall be provided to protect the shaft in the water space and through the sealing glands. The sleeves shall be keyed to prevent rotation and secured against axial movement.

The bearings shall be of ball or roller type protected against ingress of water, dirt and other matter.

Vertical multistage pumps shall have universal flanges. Intermediate bearing, support bearing shall be provided in the pump.

The shaft seal shall be easily serviceable and shall allow for correct adjustment and loading of the seal. Pump motors above 7.5 kW shall be equipped with a spacer coupling which allows changing of shaft seals without removing the motor. The pump motors shall be of Class "F" insulation and IP55 rating and shall be provided with built-in thermistors for protection against over heating.

16.02 VARIABLE SPEED HYDROPNEUMATIC PUMPING SYSTEM

Variable speed Hydropneumatic pumping units shall be provided for supply of domestic water, flushing water supply for the project. The units shall be selected so as to provide at minimum of 2 bar pressure at the highest/farthest fitting in each plumbing system, the unit serves. The hydropneumatic pumping units shall have the following features;

16.02.1 System Description
The system shall be supplied as complete sets including suction and discharge common manifolds, non-return valves, isolating valves, pressure transmitter on the discharge side and electrode at the suction tank.

The system operation will be such that the initial small water demand shall be met by the charged diaphragm pressure vessel. Should the water demand continue the system pressure will dip to a preset pump cut-in point when the lead pump starts to operate at reduced speed through the variable speed drive. However, should the system pressure be still below the preset value, the controller continuously increases pump speed to meet the system demand. When the lead pump is not able to meet the system pressure at full speed, the second pump also starts to operate.

At peak demand all the pumps operate. Similarly, if there is a drop in water demand the duty pump speed starts to reduce, then standby pumps cuts-off, followed by stopping of the duty pump.

The closed diaphragm pressure vessel shall be of polyethylene material with a pressure gauge and isolating valve. The interior shall be of non-toxic lining suitable for use with potable water. The vessel shall be manufactured to conform to ASME pressure vessel code/standards.

The system shall be under the control of an electronic microprocessor unit (EMU).

A pressure transmitter shall detect the pressure at the delivery manifold and feedback to the microprocessor control panel via control circuit.

The system shall incorporate a frequency converter or frequency converter motors on the pumps and the pressure transmitter shall register the actual pressure on the discharge side.

The variable speed drive pumping system shall maintain a constant pressure regardless of the system demand. If there is a drop in pressure outside the preset point, the Variable Speed Drive (VSD) pump shall start to run until the pressure increases to the preset limit, or it will continue to increase the pump speeds to the upper limit of the frequency. If the water system demand still cannot be met, the second pump shall be called in to run, the VSD will then alter the pump speed to meet the preset pressure point. If the set point is still unable to be met, the third pump is then activated to run (in case of 3 pumps units).

This shall be achieved by continuously varying the motor speed of the duty pump according to the demand up to a maximum designed capacity.

Under decreasing hydraulic demand the reverse sequence to the above description shall apply.

The EMU shall ensure alternation of all the duty and standby pumps for even running hours for all the pumps.

The frequency converter shall be linked to the motor of the duty pump for continuous speed adjustment and ultimately the water delivery shall be maintained at constant pressure at the preset value.

16.02.2 Local Motor Control Panel

The motor control panel shall be equipped with all the necessary electrical components including a microprocessor control unit and a frequency drive. The control panel and the microprocessor shall cover the followings functions:

- Flexibility and simplicity in allowing the necessary re-adjustment of the pumping system preset delivery pressure to operate the pumps within the specified maximum and minimum delivery ranges.

- Built-in frictional loss compensation factor which will automatically increase the delivery pressure setting, in collaboration with the increase in flow demand. This shall be able to
minimise the system pressure differences and provide a more constant pressure along the supply line and also to save the energy consumption of the motor when running at low speed.

- Automatic changeover of the pumps to be controlled by the microprocessor which dictates the duty and standby pumps to run at variable speed.

- Built-in clock functions with weekly programming and with switch on system to operate at at least 10 different pre-set pressure points as required.

- When the system has not been operated for more than 24 hours, it shall automatically start the pumps for a few seconds/day to ensure the pumps readiness at all times. The standby pumps shall be activated upon failure of duty pump(s). In event of control failure, the pumps shall be able to be start/stopped manually at the local panel by means of pressure switches.

- The microprocessor control panel shall be able to cut-off the pumping system when excess pressure is registered in the discharge common manifold.

- The system shall have the capability of receiving input signal concerning reduced water level in suction tanks and shall have control mechanisms to prevent the pumps from running dry.

- Automatically starting the pumps when the water level is back to normal.

- In case of pump failure due to motor overload, the standby pump is switched on automatically. Alarm signal is displayed on the LCD Display unit and alarm lights are activated.

- Functions to limit the no. of start/stop of pumps per hour.

- The system control panel shall incorporate at least the following components:
  a. LCD Display
  b. Pumps selections for up to 4 pumps so that system controller can control up to 6 pumps
  c. Pump status button to display duty pump speed and system capacity
  d. Zone status button to display operating parameters for different pumping units
  e. Setting button to input preset pressure, system start/stop time etc.
  f. ±1 button to key in numeric data such as pressure set point, etc.
  g. Enter button for confirmation of input into the system
  h. Alarm button to show location of fault - self diagnostic function display
  i. Hour Run measurement for each supplied pumpset
  j. Buttons for scrolling to select the actual display reading for system configuration, i.e. up and down scroll concept.
  k. Necessary devices for programming, supervising and monitoring operation data/system, status shall be incorporating into the control panel.

16.02.3 Operations

Local control panel shall perform as follows:
Auto mode

The desired delivery pressure within the range specified shall be set at the duty local control panel. The pressure transmitter shall detect the delivery pressure continuously within 1 second and feedback to the microprocessor which will control the variable speed drive frequency converter for speed control of the duty pump. When demand increases, the subsequent pumps in the system will be activated to boost up the pressure. Ultimately the duty pump set shall be operated fully automatically to maintain the delivery pressure constantly at the desired set value.

Manual Mode

The on/off function of the pumps shall be manually adjusted at the microprocessor located at the local control panel.

Frequency Control By-pass Mode

All the pump sets shall be started/stopped automatically with the pump output at fixed maximum rotational speed. All the control and protection functions shall remain active. The cut in/cut out pressure shall be internally calculated by the microprocessor for each pump.

16.02.4 System Features

The required performance features of each Hydro pneumatic pumping unit shall be as follows:

a. System Configuration

b. Variable speed pumps with pressure vessels.

c. Control panel consisting of the following components:

- Pump Functional Unit (PFU) - control unit c/w pre-programmed microprocessor chip. This unit shall control all pumping unit operations through electronic controller.

- Pumping Monitoring Unit (PMU) - monitor the operation of the pumpsets. This unit shall allow for monitoring and setting of all control parameter.

- Variable Speed Drive

- Circuit Breakers

- Fusses

- Pressure Transmitter

Set Point

Ten separate pressure “set points” shall be able to be programmed into the PMU, and switching between set points is timed by a real time clock when a lower pressure is acceptable during certain periods, for instance after hours or weekends, the set point shall be lowered to minimise power consumption.

An external input shall also be used to switch between set points, or manually adjust a set point at any time.

Friction Loss Compensation

It shall be possible to allow for the friction loss component of the system, calculated at full flow and set as a percentage of the set point which will reduce the working pressure of the
pump set depending on the actual no. of pumps in operation. A linear approximation of system resistance curve can therefore be allowed for, and pressure will automatically increase as system flow and subsequent frictional losses increase. As such power consumption shall reduce which is required for the pumping system.

**Displays**

Through the PMU keypad all variable parameters shall be adjustable, current status of settings and measured values shall be able to display on the 2 line x 24 character liquid crystal display.

Individual menus shall be available for monitoring individual pumps, zones, settings, alarms and ON/OFF functions.

**Pump Status**

- Running hours of each pump
- Actual pump status (running, not available, standby, allocated to zone, fault)
- Maximum head of pump at zero flow.

**Zone Status**

This menu shall be the main operating menu where at the setting and operating parameters can be viewed,

- Current operating set point
- Measured values in the system
- Operating capacity in terms of total output
- Mode of operation for the zone
- Clock programs (relating to set point pressures)
- Standby pumps
- Pump change over time
- Zone configuration
- Pressure transducer scaling
- Friction loss compensation
- Pump priority
- Inlet pressure measuring (if required)
- System response times
- Allowable number of starts per hour for the pumps
- Minimum limit (loss of water, burst mains protection)

**Setting Menu (Set)**

In this menu all parameters for the operation of the pump set shall be able to be adjusted as required.

- a. Set points (up to 10)
- b. On/Off function (used to prevent unnecessary cycling at low demands)
- c. Displayed pressure units (Bar, PSI, mBar, kPa)
- d. Real time clock programming for any time of the day, week, or weekend
- e. Zone configuration
- f. Friction loss compensation

**Alarm**

The alarm menu shall display all faults that occur during operation, logging the time and date of when the fault occurred and when it was corrected, or whether it is still an actual fault, up to 10 faults can be maintained as history in the controller. The following type of faults shall be diagnosed by the controller.
a. Mains failure
b. Frequency converter fault
c. Analogue input (pressure transducer) fault
d. High discharge pressure fault
e. Low discharge pressure fault
f. Motor thermal overload fault

**Variable Frequency Drive**

Variable frequency drive shall be of a reputable make acceptable to Project Manager and shall be complete with RFI filter and harmonic dampers.

**Enclosure**

An IP 54 powder coated steel enclosure shall house all the electrical components.

The enclosure can be supplied loose for remote mounting, or mounted on a common base with the pumps, it shall be adequately ventilated for use in conditions up to a maximum ambient temperature of 45 degrees Celsius.

**Electrical Componentry**

All circuit breakers, thermal overloads and contactors shall be of reputable make acceptable to the architect. Electrical supply to the pump controller shall be protected using an isolating circuit breaker.

**Method of Starting**

The panel shall be built to start the pumps in suitable starting modes, i.e. D.O.L., Star/Delta, or using Soft Starters.

**Quality and Testing**

Manufacture of the pumps, plus design and assembly of the complete packaged Hydropneumatic pumping system shall be factory assembled and the pump station shall be fully tested hydraulically and electrically prior to dispatch to site. Test reports etc. shall be submitted for review before dispatch.

**16.02.5 Pump Pressure Vessel**

Diaphragm type pressure vessels shall be provided as shown on the drawings. They shall be incorporated into the system so that during normal operation the pump shall not need to be start within 30 seconds of it switching off in order to prevent the pump hunting.

The pressure vessel shall be of adequate capacity to accommodate a considerable fluctuation in water demand by the system with minimum start/stop cycles of the pumps. The vessel shall be constructed of steel plate built to ASME Standards for Unfired Pressure Vessel. A rubber diaphragm shall be provided in the vessel for separating the water and pre-charge nitrogen. The pre-charge pressure shall be adjustable and charging port with non-return device shall be provided. The adjustable cut-in and cut-off pressure unit for the pumps shall be built-in at the vessel to suit the system.

**16.02.6 FLOATLESS TYPE LEVEL SWITCH IN WATER TANKS**

The Tenderer shall supply and install floatless type switch probes in the water tanks as indicated below and shown on the drawings.

- Raw Water Tanks at Pump Room
  - High level alarm (over-flow);
  - Low level alarm;
- Low level cut-out for raw water pumps;
- Earthing probe.

**Cooling Tower Make-up**
- High level alarm (over-flow);
- Low level alarm;
- Low level cut-out for supply pumps;
- Earthing probe.

**Potable Water Tank**
- High level alarm (over-flow);
- Low level alarm;
- Low water level cut-out for the domestic hydropneumatics pumps;
- Earthing probe.

Each probe shall be of the correct length for the particular application and tank location. Electrodes shall be of polished stainless steel 20 mm OD. Electrode holders shall be weatherproof in all respect.

The earthing probes shall be connected and wired to the building earth systems of the building.

Each set of electrodes shall be installed inside a 230 mm diameter PVC pipe acting as a wave barrier.

The level switch set shall operate with a stepped down voltage at 24V maximum. Stepped down transformers shall be provided for each set of control probes and shall be installed inside centralised control cubicles inside pump room.

Mechanical steel stuffing boxes shall be used.

**Control of Duty / Standby Pumps**

Operation of the duty and standby pumps shall be carried out by the following method:

a. Automatically by means of pressure sensor (i.e. pressure switches);

b. Manually by means of a local start/stop push buttons on pump local motor control panel and emergency stop switch.

The pressure switch shall be installed next to the manual release valve. When the pressure drops to the pre-determined level, a signal will be sent to the pump local motor control panel to start the pump.

Automatic controls shall be operated by electronic, floatless type level switches.

**Pump Indicator**

The following audible and visible indication shall be provided at the pump local control panels as applicable:

a. Red "overflow level" indicator with buzzer for the associated water tanks;

b. Amber "extra high water level" indicator for the associated water tank;

c. Amber "high water level" indicator;

d. Amber "low water level" indicator;

e. Red "pump trip" indicator for each pump;

f. Green "pump on" indicator for each pump;

g. "Pump electrical supply healthy" indicator for each pump;
h. Amber "remote/local" status indicator.

17.00 SEWAGE TREATMENT PLANT

Sewage generated from the project will be treated in proposed sewage treatment plant at the project site within the premises based on MBBR technology.

Design Consideration/Process detail of Sewage Treatment Plant Sewerage System
An external sewage network shall collect the sewage from all units, and flow by gravity to the proposed sewage treatment plant.

Following are the benefits of providing the Sewage Treatment Plant in the present circumstances:

- Reduced net daily water requirements, source for Horticultural purposes by utilization of the treated waste water.
- Reduced dependence on the public utilities for water supply and sewerage systems.
- Sludge generated from the Sewage Treatment Plant shall be rich in organic content and an excellent fertilizer for horticultural purposes.

a. Wastewater Details

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>a)</td>
<td>Daily load</td>
</tr>
<tr>
<td>b)</td>
<td>Duration of flow to STP</td>
</tr>
<tr>
<td>c)</td>
<td>Temperature</td>
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<tr>
<td>d)</td>
<td>pH</td>
</tr>
<tr>
<td>e)</td>
<td>Colour</td>
</tr>
<tr>
<td>f)</td>
<td>T.S.S. (mg/l)</td>
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<tr>
<td>g)</td>
<td>BOD₅ (mg/l)</td>
</tr>
<tr>
<td>h)</td>
<td>COD (mg/l)</td>
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b. Final discharge characteristics

<p>| | |</p>
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<th></th>
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<tbody>
<tr>
<td>a)</td>
<td>pH</td>
</tr>
<tr>
<td>b)</td>
<td>Oil &amp; Grease</td>
</tr>
<tr>
<td>c)</td>
<td>BOD₅ (mg/l)</td>
</tr>
<tr>
<td>d)</td>
<td>COD (mg/l)</td>
</tr>
<tr>
<td>e)</td>
<td>Total Suspended Solids</td>
</tr>
</tbody>
</table>

a. Treatment Technology
The sewage will be first passed through a Bar Screen Chamber where any extraneous matter would get trapped. The influent would overflow by gravity to the Oil & Grease Chamber which is provided for safety so that the oil may not inhibit the biological growth in the MBBR reactors.

The sewage would then collected in an Equalization Tank where the variations in flow and characteristics are dampened, which otherwise can lead to operational problems and moreover it allows a constant flow rate downstream. Here the sewage is kept in mixed condition by means of coarse air bubble diffusion.

The Bio Reactor is based on the Fluidized Random Aerobic Reactor which combines the advantage of an Activated Sludge Plant with the Random distribution systems such as Bio filter with capacities that could be as low as 1/10th of ASP and fractional power consumption, such a reactor is ideal for the efficient removal of BOD and organics from the wastewater.

The tanks are packed with RIGID PP-UV-sterilized Gas Fluted Media with liquid random distribution wherein air diffusers are placed to uniformly release air across the tanks.

**Working Principle:**
The MBBR works on the same principle as the submerged fixed film process with only one exception – the media is not fixed and floats around in the aeration tank. The main advantage of this system over the submerged fixed film process is that it prevents choking of the media. This also avoids sludge recirculation. Compared to conventional technologies the MBBR is compact, energy efficient and user friendly. It also allows flexibility in design of the reactor tank.

**Sewage Quality:**
The Sewage discharged from the Bio reactor system will contain sloughed biological solids, but would be relatively free of soluble organic chemicals. The quantity of biological solids in the sewage will depend substantially on the quantity of suspended solids and the concentration of soluble BOD entering system. It is therefore necessary to provide means of separating the biological mass from the sewage. Package unit contains tube settlers for sedimentation and 60 Gross fluted Rigid PVC fill media for the FAB units to treat the wastewater for discharge into the receiving waters and/or the sanitary sewers as per the local regulations. The media thickness changes with the design parameters/depth of the unit and can vary from 0.25 to 0.40 mm thickness.

1. **Tube Settler/ Lamella Clarifier**: Here we are providing the Tube Settler along with the PVC media which will enhance the contact period and thereby the improved performance. The Tube settler will have a determined lope in the bottom to collect the suspended solids from the waste water. The sludge will be suited to the Sludge Drying Beds.

2. **Pressure Sand Filter**: Here the treated water coming from the TSS will be treated for the suspended impurity removal.

3. **Activated Carbon Filter**: Here the water coming from the ACF will be treated for colour removal, suspended impurity removal and the treated water shall be sent to the sewer.
4. Filter Press: A filter comprises a set of vertical, juxtaposed recessed plates, presses against each other by hydraulic jacks at one end of the set. The pressure applied to the joint face of each filtering plate must withstand the chamber internal pressure developed by the sludge pumping system. This vertical plate layout forms watertight filtration chambers allowing easy mechanization for the discharge of cakes. Filter clothes finely or tightly meshed are applied to the two grooved surfaces in this plat.

Primary Treatment: This is the first step of inlet waste mainly consist of removal of coarse particles, oil and grace and mixing co-agents in the water for removal of suspended solids through sedimentations. After this treatment scheme, the BOD, TSS, COD, and O&G level comes down to 20% of initial levels.

Secondary Treatment: This is second step of waste water treatment. It mainly consist aerobic process of the Primary treated water, bacterial growth, EM dosing addition of oxygen and chemical which help in bacterial growth and lastly settlement of the biological waste as sludge. Normally it is found that the reduction level in TSS, BOD, O & G and COD after an efficient secondary treatment will be as under-

Tertiary Treatment: This is the final stage of treatment where the Sewage after secondary treatment first is mixed with Sodium Hypo Chloride and then Sewage will be passed through (PSF) dual media filter and (ACF) activated carbon filter where sand, anthracite and activated carbon will be used as filtration media. Once the above limits achieved thereafter the final outlet water will also confirms the Bio Assay test of 90% of fish survive.

Disinfection System: We will use a Unique Technology for Treated Water Disinfection (i.e) UV WATER STERILISERS & Oxylite (Mixed Generation System). Oxylite is an all natural ,non toxic ,non –irritant ,environmentally and ecologically safe sanitizing and disinfecting solution. It is produced from the electrochemical reaction of water , salt and electricity . Oxylite is the mixture of mixed oxidants. Oxylite is broad-spectrum , fast acting , non toxic , eco friendly disinfectant for universal application . It can kill all types micro-organism (i.e bacteria, Viruses, Fungi & Spores, within a short contact time. Oxyliteis super-oxidized water generated by electrolysis of a dilute NaCl solution passing through an electrolytic cell. This process creates large volumes of a gentle but extremely potent antimicrobial solution capable of rapid reduction of bacteria, viruses, spores, cysts, scale and biofilm.

18.00 Effluent Treatment Plant (ETP): The effluent collected from labs and liquid waste (other than domestic sewer) will be treated at ETP, design based on physico chemical continuous process with provision of barscreen, equilization tank, chemical dosing tank and system. Reaction tank with agitator, PLC to control the ETP operation on auto mode, digital pH meter, tube settler, Filter press, sludge tank and flow meter, filter, interconnecting pipe, pump valve, oxylite as disinfection system complete system to meet the functional requirement as well as Pollution Control norms. ETP will be common for Hospital and other institutional buildings.
01.0 FIRE FIGHTING SYSTEM

GENERAL

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

01.02 Not-with standing the sub-division of the documents into separate sections 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 in to the contract so far as it may be practicable to do so.

01.03 Where it is mentioned in the specifications that the contractor shall perform certain work or provide certain facilities, it is understood that the contractor shall do so without any extra cost to the Employer/HSCC.

01.04 The material, design and workmanship shall satisfy the local fire regulations. The job specifications contained herein and codes referred to where the job specifications stipulate in addition to these contained in the standard codes and specifications, these additional requirements shall also be satisfied.

01.05 Portable fire extinguisher shall be provided in the building as per BOQ which should not contain halogen to minimize the use of ozone depleting substance as per GRIHA.

2.00 SCOPE OF WORK

2.01 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 described here-in-after and shown and the drawings, consisting of:
i) Supply, installation, testing and commissioning of:

Fire hydrant system including fire pumps and ancillary equipment’s described later in the Volume.

Fire sprinkler system, as described later in the volume.

Portable Fire Extinguishers

i) Preparation of plans and getting pre-installation approval by the Local Fire Authority.

Getting tested by and approval of the installation by the Local Fire Authority during the fabrication/construction stage as well as after completion. It will be the responsibility of the Contractor to get all approval and completion certificate from the Local Fire Department without which the work will not be taken over by the owner. Fee payable to the local bodies for such activities shall be borne by the Owner on production of receipts for money paid and the all other expenses barring the fee will be borne by the Contractor.

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

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

3.00 INTERPRETATION

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

a. Statutory Rules & Regulation

b. Schedule of quantities

c. Additional specifications

d. List of approved make of materials

e. General rules and conditions

4.00 SPECIFICATIONS

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

4.02 Works not covered in the specifications shall be carried out as per relevant latest PWD specifications-E-BSR/ Indian standard Code of practice specifications of materials.

5.00 EXECUTION OF WORK

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

6.00 TENDER DRAWINGS

6.01 For guidance of the bidder, drawings as listed are enclosed with these tender documents. These drawings are broadly indicative of the work to be carried out. The Contractor on award of work will furnish shop drawings based on the working drawings issued to him, as required in advance for approval of Engineer and get the same approved by Local Fire Authority/other statutory
bodies. No claim whatsoever shall be admissible on account of changes that may be introduced by the Engineer / Local Fire Authority.

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

6.03 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.

6.04 The contractor shall obtain all information relating to the local regulations, bylaws, and application of any and all laws relating to him work or profession. No additional claims shall be admissible on this account.

7.00 SHOP DRAWINGS

7.01 The Contractor shall prepare and furnish all shop drawings in quadruplicate at no extra cost for approval by the Engineer before commencing fabrication/ manufacture of the equipment. Such shop drawings shall be based on the Architectural & Fire fighting drawings and requirements laid down in the specifications and as per site conditions. The manufacture of equipment shall be commenced only after the shop drawings are approved in writing by the Engineer. Such drawings shall be co-ordinated with all disciplines of work.

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

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

7.04 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.

7.05 Working drawings shall be approved by the consultant. Four 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.

8.00 COMPLETION DRAWINGS

On completion of the work and before issuance of certificate of virtual completion, the Contractor shall submit to the Engineer. General layout drawings, drawn at approved scale indicating layout of pump house piping and its accessories “As installed”. These drawings shall in particular give the following:

a. General layout of pump house.

b. Panels and other equipment location and sizes etc.

c. Complete Schematic as installed.

d. Location of Hydrants, Earth pipes, route of earthling conductors etc.

e. Route of all cables and pipes run along with detail sizes and mode of installation.
9.00 DOCUMENTS

The Contractor shall submit to the Engineer, the following documents on completion of the work and before issuance of virtual completion.

i. Warranty for equipment installed.

ii. Test certificates.

iii. History sheets of the equipments.

iv. Catalogues.

v. Operation and Maintenance manuals.

vi. List of recommended spares and consumables.

vii. Reconciliation statement.

viii. All approvals and sanctions.

10.00 MATERIALS

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

10.02 Materials shall conform to the technical specification and/or the PWD Specifications E-BSR/Indian Standards Specifications as amended up to date and carry certification mark, wherever so required.

10.03 Only approved make of material shall be used. The contractor shall get the samples of all the items approved from the Engineer before commencing the supply.

11.00 TESTING OF MATERIALS

11.01 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 PWD Specifications E-BSR/Indian Standards.

11.02 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 HSCC shall be final and binding on the contractor.

11.03 The Engineer shall have full power to get any material of work to be tested by an independent agency at Contractor’s expense in order to prove the soundness and adequacy.

12.00 INSPECTION AND TESTING

12.01 All equipment shall be inspected and tested as per an agreed quality Assurance Plan before the same is packed and dispatched from the Contractor’s Works. The Contractor shall carry out tests as specified/directed by Engineer.
12.02 Contractor shall perform all such tests as may be necessary to meet requirements of Local Authorities, Municipal or other statutory laws/ bye-laws in force. No extra shall be paid for these.

12.03 The Engineer may, at his sole discretion, carry out inspection at different stages during manufacturing and final testing after manufacturing.

12.04 Approvals or passing of any inspection by the engineer or his authorized representative shall not, however, prejudice the right of the Engineer to reject the plan if it does not comply with the specification when erected or give complete satisfaction in service.

12.05 All materials and equipment found defective shall be replaced and the whole work again tested to meet the requirements of the specifications, at the cost of the contractor. Contractor has to obtain a performance certificate/approval for the complete layout of piping/equipment erected.

13.00 WELDING

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

Welding Procedures IS: 823
Welding Electrodes IS: 814, but of approved makes only
Testing of Welders IS: 817

13.02 Only Welders fulfilling the requirements of IS: 817 and approved by the HSCC shall be employed by the Contractor.

14.00 JOINING MATERIAL (GASKET)

Gasket, for use in between flanged joints, to be of CAF as per IS:2712, thickness as specified in S.O.Q.

15.00 PAINTING

15.01 All above ground pipes, pipe fittings, hose cabinets structural steel work pipe supports etc. shall be painted as per specifications given below.

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

15.03 The instructions of paint manufacturer shall be followed as far as possible otherwise the work is to be done as directed by the HSCC.

15.04 All cleaning materials, brushes, tools and tackles, painting, material etc. shall be arranged by the Contractor at site in sufficient quantity.

15.05 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.

15.06 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.

15.07 Primer paints - one coat (minimum thickness 100 microns) self-priming epoxy mastic.

15.08 Finishing coats:

a) For Pump Rooms - 2 coats (thickness minimum 50 microns each) of epoxy paint, fire red shade as per IS.
b) For other than Pump Rooms - 2 coats of synthetic enamel paint, fire red shade as per IS

16.00 COATING WRAPPING FOR UNDERGROUND PIPES

16.01 All underground piping shall be protected by coating and wrapping as per the following procedure.

16.02 The materials and workmanship shall in general conform to IS: 10221, 1982 or as directed by the HSCC.

16.03 Cleaning - The pipes shall be thoroughly cleaned by dust, rust will scales, oil, grease etc. by stiff wire brush and scappers. The surface shall be coated with the primer immediately after cleaning.

16.04 Priming – Suitable primer shall be applied as an undercoat. The manufacturers recommended procedure would be followed for applying the primer.

16.05 Paste Application - Paste shall be applied to fill up uneven surfaces in order to ensure smoothness for subsequent wrapping with multi-layer tape.

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

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

16.08 The ‘Holiday Test’ is to be conducted as per IS: 10221 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.

17.00 TRAINING OF DEPARTMENT PERSONNEL

17.01 The Contractor shall train the Owner’s personnel to become proficient in operating the equipment installed. Training shall be done before the expiry of the defect’s liability period.

17.02 The period of training shall be adequate and mutually agreed upon by the Engineer and Contractor.

17.03 The Owner’s personnel shall also be trained for routine maintenance work and lubrication, overhauling, adjustments, testing, minor repairs and replacement.

17.04 Nothing extra shall be paid to the Contractor for training Owner’s personnel.

18.00 PERFORMANCE GUARANTEE

At the close of the work and before issue of final certificate of virtual completion by the Engineer, the Contractor shall furnish a written guarantee indemnifying the Owner against defective materials and workmanship for a period of one year after completion and handing over. The Contractor shall hold himself fully responsible for reinstallation or replace free of cost to the Owner.

a. Any defective material or equipment supplied by the Contractor.

b. Any material or equipment supplied by the Owner which is proved to be damaged or destroyed as a result of defective workmanship by the Contractor.

19.00 SPECIFICATIONS FOR PUMPS AND ANCILLARY EQUIPMENT

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

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

   Electrically/diesel operated pumps with motors/diesel engine, base plate and accessories.

   Pump suction and delivery headers, valves, air vessel and connections.

   a.) Alarm system, Pressure gauges/Pressure switch.

   b.) Electrical switchboards, wiring, cabling, cable tray, control panel and properly connecting to earthing system of the Factory.

   c.) Foundations, vibration eliminator pads and foundation bolts.

20.00 GENERAL REQUIREMENTS

20.01 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.

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

20.03 All pump connections shall be standard flanged type with appropriate number of bolts.

20.04 Manufacturer instructions regarding installation connections and commissioning shall be followed with respect to all pumps, switchgear and accessories.

21.00 QUALITY CONTROL

21.01 These shall comply with the IS Codes as specified.

23.0 HYDRAULIC DETAILS

24.00 STORAGE

These shall be stored as delivered in original packings.

SPECIFICATIONS FOR FIRE HYDRANT SYSTEM/ DOWNCOMER SYSTEM/ WETRISER DOWNCOMER SYSTEM

25.00 SCOPE OF WORK

25.01 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install Downcomer/wet riser fire hydrant system as required by the drawings and specified hereinafter or given in this schedule of quantities.

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

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

   Mild steel pipe fire downcomer/risers within the building.

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

   Excavation, anchor blocks and valve chambers.
26.00 GENERAL REQUIREMENTS

26.01 All materials shall be of the best quality conforming to the specifications and subject to the approval of the employer. The wet riser system shall remain pressurized at all times during operation, and as such the piping work shall be carried out to withstand the same.

26.02 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

26.03 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.

26.04 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.

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

27.00 PIPES AND FITTINGS

FOR INTERNAL WORK:

27.01 All pipes & fittings, jointing within the building shall be as per PWD E-BSR 2013.

28.00 EXCAVATION

28.01 Excavations for pipeline shall be in open trenches to levels and grades shown on the drawings or as required at site. Pipelines shall be buried to a minimum depth of 1 to 1.5 meter or as shown on the drawings.

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

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

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

29.00 ANCHOR BLOCKS

29.01 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.

30.00 VALVES

30.01 Butterfly valves above 65mm shall be of cast iron body and bronze/gunmetal seat. They shall conform to type PN 1.0 of IS: 13095.

30.02 Non return valves shall be of cast iron body and bronze / gunmetal seat. They shall be swing conform to Class 1 of IS: 5312 and have flanged ends. They shall be swing check type in horizontal runs and lift check type in vertical runs of piping. They shall not be spring loaded type.

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

Valves on pipes 65mm and below shall be heavy pattern gunmetal valves with cast iron wheel seat tested to 20kg/sqcm pressure. Valves shall conform to IS:778.

31.00 FIRE HYDRANTS (as per PWD E-BSR)
31.01 EXTERNAL HYDRANTS

Contractor shall provide external hydrants. The hydrants shall be controlled by a cast iron sluice valve. Hydrants shall have instantaneous type 63-mm dia outlets. The hydrants shall be of gunmetal and flange inlet and single outlet conforming to ISI marked, conforming to IS 5290 (type A) with G.I. duck foot bend and flanged riser of required height to bring the hydrant to correct level above ground

31.02 Contractor shall provide for each external fire hydrant two nos. of 63 mm dia 15 meter long synthetic fibre non perculating hose pipe with SS male and female instantaneous type couplings machine wound with copper wire hose to I.S. 636 type A and couplings to IS 903 with IS certification), gunmetal branch pipe with 16 mm nozzle to I.S. 903-1984.

32.00 INTERNAL HYDRANTS/ DOWNCOMER SYSTEM

32.01 Contractor shall provide on each landing and other locations as shown on the drawings one single headed gunmetal landing valve with 63 mm 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.

32.02 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 four numbers of 63 mm dia 7.5 meter long synthetic non perculating hose pipes with gunmetal male and female instantaneous type coupling machine wound with G.I. wire (Hose to I.S. 636 type B and couplings to I.S. 903 with I.S. certification), fire hose reel, gunmetal branch pipe with nozzle I.S. 903 fireman’s axe.

32.03 Each hose box shall be, after thorough cleaning of surface, painted as per Section 28 of General Technical Specifications. The words FIRE HOSE to be painted on the inner face of the glass.

33.00 FIRST AID HOSE REELS

33.01 Contractor shall provide standard fire hose reels with 20 mm dia high pressure rubber hose of 36 meters length with gunmetal nozzle with 5mm bore, and control valve, shut of nozzle connected wall mounted on circular hose reel of heavy duty mild steel construction and cast iron brackets. Hose reel shall conform to IS: 884-1969. The hose reel shall be connected directly to the M.S pipe riser through an independent connection.

34.00 PRESSURE GAUGES

34.01 All pressure gauges shall be of dial type with bourdon tube element of SS 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 12 kg/sq.cm.

34.02 All pressure gauges shall be complete with isolation cock, nipples, tail pipes etc.

35.00 PRESSURE SWITCHES

35.01 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 changeover switch, below element assembly and differential sprinkle.

35.02 All the pressure switches shall have 1/4" B.S.P (f) inlet connection and screwed cable entry for fixing cable gland.

36.00 FIRE BRIGADE CONNECTION
36.01 The contractor shall provide as shown on drawing gunmetal four ways collecting head with 63mm dia instantaneous type inlets with built in check valve and 100/150 mm dia. Outlet connection to the fire main grid and for tank filling, collecting head shall conform to IS: 904-1964.

37.00 AIR VALVES

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

38.00 DRAIN VALVE

80/50mm dia GI / black steel pipe conforming to IS:1239 heavy class with 50mm gunmetal full way valve for draining and water in the system in low pockets.

Pressure gauge of suitable range shall be installed on the discharge side of each pump vacuum gauge shall be provided on suction side for pumps with negative suction. The dia size shall be 250mm. The gauges shall have brass cocks.

Orifice plates shall be of 6mm thick stainless steel to reduce pressure on individual hydrants to operating pressure of 3.5kg/sq.cm. Design of the same shall be given by the Contractor as per location and pressure condition of each hydrant.

39.00 VALVE CHAMBERS

39.01 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.

39.02 Valve chamber shall be of the following size:

For depths 130 cm and beyond 120x120 cms
Weight of C.I. frame and cover shall be 38 kg.

40.00 PIPE PROTECTION

See Clause 15.0 & 16.0 on ‘Painting’ and ‘Coating/.wrapping’ under General Technical Specifications).

41.00 PIPE SUPPORTS

41.01 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.

41.02 All supports/clamps fabricated from M.S. structural e.g. roads, channels, angles and flats shall be painted as described in specifications for “Painting” under General Technical Specifications.

41.03 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.

<table>
<thead>
<tr>
<th>Pipe Support Spacing</th>
<th>Horizontal</th>
<th>Vertical</th>
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</thead>
<tbody>
<tr>
<td>Pipe upto 50 mm</td>
<td>2 Mtr</td>
<td>3 Mtr</td>
</tr>
<tr>
<td>Pipe 65 - 100 mm</td>
<td>1.75 Mtr</td>
<td>3 Mtr</td>
</tr>
<tr>
<td>Pipe above 100mm</td>
<td>1.50 Mtr</td>
<td>3 Mtr</td>
</tr>
</tbody>
</table>

42.00 AIR VESSEL AND AIR RELEASE VALVE
Air vessel on top of each wet riser piping shall be installed before execution for approval fabricated out of at least 8mm thick steel to withstand the pressure, with dished ends and supporting legs. This shall be of 300 mm dia and 1m high. This shall be completed with necessary flange connection to the wet riser piping and air release valve with necessary piping to meet the functional requirement of the system. The air vessel shall be of continuous welded construction and galvanized to IS: 4736-1968. This shall be tested for twice the working pressure.

43.00 TESTING

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

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

44.00 HOSE CABINETS (as per PWD E-BSR)

44.01 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 given on page 12 para 28.8 fixed to wall/floor as per site conditions. The cabinet shall have a separate chamber to store a key with breakable glass as per approved design. Hose cabinets shall be hinged double door partially glazed with locking arrangement, painted as per Section 28 of General Technical Specifications with ‘FIRE HOSE’ written on it prominently. Samples of hose cabinet for indoor and outdoor works shall be got approved from HSCC before production/delivery at site.

44.02 For external hydrants the hose cabinets shall be fabricated from 16 gauge thick M.S. 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 HSCC before installation at the site.

45.00 MEASUREMENT

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

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

45.03 Landing valves hose cabinets, synthetic non-perccuting 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.

45.04 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.

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

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

45.07 No additional payment shall be admissible for cutting holes or chases in walls or floors, making connections to pumps, equipment and appliances.

SPECIFICATIONS FOR SPRINKLER SYSTEM (as per PWD E-BSR)

46.00 SCOPE OF WORK

46.01 Work under this section shall consist or furnishing all labour, materials, equipment and appliances necessary and required to completely install the sprinkler system as required by the drawings and specified herein after or given in the schedule of quantities.
a) Sprinkler mains, branch and external piping complete with valves, alarm, hangers and appurtenances and painting.

b) Sprinkler heads with spare sprinklers

c) Connections to risers, pumps and appliances

47.02 GENERAL REQUIREMENTS

47.01 All materials shall be of the best quality conforming to specifications and subject to the approval of the engineer.

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

47.03 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.

47.04 Pipes shall be supported from walls and ceiling by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceilings and walls.

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

47.06 Sprinkler heads shall be approved by the underwriters Laboratories (U.L.) or Fire officers Committee (FOC). The finish shall be as specified in the schedule of quantities. The contractor shall give required tools for removing and fixing of different types of sprinklers free of cost as directed by the HSCC.

48.00 SPRINKLER HEADS (as per PWD E-BSR)

a) Sprinkler heads shall be of quartzoid bulb type with bulb, valve assembly yoke and the deflector. The sprinklers shall be of approved make and type.

b) Types:

i) Conventional Pattern:

The sprinklers shall be designed to produce a spherical type of discharge with a portion of water being thrown upwards to the ceiling. The sprinklers shall be suitable for erection in upright position or pendant position.

ii) Spray Pattern:

The spray type sprinkler shall produce a hemispherical discharge below the plane of the deflector.

iii) Ceiling (flush) Pattern:

These shall be designed for use with concealed pipe work. These shall be installed pendant with plate or base flush to the ceiling with below the ceiling.

c) Constructions:

i) Bulb: - Bulb shall be made of corrosion free material strong enough to with stand any water pressure likely to occur in the system. The bulb shall shatter when the temperature of the surrounding air reaches a predetermined level.
ii) Valve Assembly: Water passage of the sprinkler shall be closed by a valve assembly of flexible construction. The valve assembly shall be held in position by the quartzoid bulb. The assembly be stable and shall withstand pressure surges or external vibration without displacement.

iii) Yoke: The yoke shall be made of high quality gun metal. The arms of yoke shall be so designed as to avoid interference with discharge of water from the deflector. The sprinkler body shall be coated with an approved anti-corrosive treatment if the same is tossed in corrosive conditions.

iv) Deflector: The deflector shall be suitable for either upright or pendent erection. The deflector shall be designed to give an even distribution of water over the area protected by each sprinkler.

d) Colour Code:

The following colour code shall be adopted for classification of sprinkler according to nominal temperature ratings:

e) Size of Sprinklers Orifices:

The following sizes of sprinklers shall be selected for various classes or hazards:

<table>
<thead>
<tr>
<th>Class</th>
<th>Orifice Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extra light hazard</td>
<td>10/15 mm nominal bore</td>
</tr>
<tr>
<td>Ordinary light hazard</td>
<td>15 mm nominal bore</td>
</tr>
<tr>
<td>Extra high hazard</td>
<td>15/20 mm nominal bore</td>
</tr>
</tbody>
</table>

f) Stock of replacement sprinkler:

The following spare sprinklers shall be supplied along with the system:

<table>
<thead>
<tr>
<th>System</th>
<th>Spares (Sprinklers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extra high hazard systems</td>
<td>6</td>
</tr>
<tr>
<td>Ordinary hazard systems</td>
<td>24</td>
</tr>
<tr>
<td>Extra high hazard systems</td>
<td>36</td>
</tr>
</tbody>
</table>

g) Temperature Rating:

For normal conditions in temperature climates rating of 68/74 deg. C shall be used. However the temperature rating shall be as close as possible to, but not less than 30 deg. C above the highest anticipated temperature conditions.

49.00 Installation Control Valve: Installation control valves shall comprise of the following:

a. One man stop valve of full way pattern with gunmetal pointer to indicate where open/shut.

b. One automatic alarm valve, fitted with handle and cover.

c. One hydraulic alarm motor and gong for sounding a continuous alarm upon out-break of fire.

d. One combined waste and testing valve including 5mtr of tubing and fittings.

e. Alarm stop valve

f. Strainer

g. Drain plug

h. Padlock & strap

i. Wall box for installation of valve

50.00 Pressure Gauges: Burden type pressure gauges conforming to IS/BS specifications shall provide at the following locations.
a. Just above alarm valve.

b. Just below alarm valve, on the installation stop valve.

c. One pressure gauge on delivery side of each pump.

d. Required number of pressure gauges on pressure tank.

**51.00 INSTALLATION OF PIPING**

**51.01 Below ground piping:** Under the ground piping shall be installed in masonry trenches with a cover or reinforced concrete. The pipe work shall be supported at regular intervals of 2.5m with masonry or RCC supports. Wherever pipes pass through roads/pavements suitable size hue pipes shall be provided for protection of piping. Underground pipes shall be protected against corrosion with two coats of bituminous painting and wrapped with tarpaulin or similar covering. If the piping is to be buried in ground with back filling of earth, a coat of epoxy painting shall be given.

**51.02 Above ground piping:**

a. All above ground piping shall be installed on suitable to pipe hangers/supports as required. The hangers shall be made of MS angles, channels etc. and painted to the required finish (with suitable synthetic enamel Paint). The spacing of piping supports shall be as follows:

   i) 20mm to 32mm dia 2 mtr
   ii) 40mm to 65mm dia 2 mtr
   iii) 65mm to 100mm dia 1.75 mtr
   iv) above 150mm dia 1.50 mtr

b. Piping shall be so installed that the system can be thoroughly drained. All the pipes shall be arranged to drain to the installation drain valve. In case of basement and other areas where the pipe work, is below the installation drain valve/auxiliary valves of the following sizes shall be provided.

   i) 20mm dia valve for pipes up to 50mm dia
   ii) 25mm dia valve for 65mm dia pipes
   iii) 32mm dia valves for pipes larger than 65mm dia

c. Piping shall be screwed type up to 50mm dia. Welding of joints will be allowed for pipes of 50mm of larger diameters.

d. The piping shall be pressure tested by the hydrostatic method up to a pressure of 1.5 times the working pressure the piping shall be slowly charged with water so that all the air is expelled from the piping by providing a 25mm inlet with a stop cock. The piping shall be allowed to stand full of water for a period of 2 hours and then the piping shall be put under pressure by means of manually operated test pump or by a power driven test pump. The pressure gauges used for testing shall be accurate and shall preferably be calibrated before the testing is carried out. All the leakages and defects in joints revealed during the testing shall be rectified to the entire satisfaction of the Consultant. The system may be tested in sections as the work of erection of piping proceeds. The piping shall withstand 1.5 times the working pressure for at least 2 hours.

**52.00 FLOW SWITCH**

**52.01** Provide one electrically operated flow switch of appropriate dia, at the head of each circuit. Flow switches should be capable of the required flow in the circuit. The electrical cabling for the flow switches and control panel shall be provided by the contractor.

**53.00 PUMP SETS**
Same as wet riser & Hydrant system specification.

54.00  ANNUNCIATION SPRINKLER PANEL

The equipment for control panel should be compact neatly wired and enclosed in a suitable 14 gauge M.S. sheet/16 CRCA sheet Metal Box which is suitably treated against corrosion. The control panel should be painted with overbanked enamel paint. The panel shall consist of:

a) Panel should be made in a modules of 10 zones e.g. Each module will have audible and visual indications and will monitor the circuit conditions.

A.C. Power Supply
Fault and Fire indication lamp.
Alarm acknowledgment push buttons.

b) The circuits provided in the control panel for each zone shall indicate the following conditions:

i) Open Circuit in zone wiring
ii) Short Circuit in zone wiring
iii) Normal conditions
iv) Power failure
v) Low battery

c) The Automatic annunciation panel shall suitable for operation on 24V DC and shall be provided with power supply unit suitable to operate on A.C. mains of 230V with a variation of 10%. The system shall be so designed that in case of failure of A.C. main supply it shall automatically change over to battery supply.

d) Suitable protection may be provided against charging of the battery over and above the specified values.

55.00  BATTERY UNIT

i) The system shall be powered by lead acid storage stationery complete with automatic dual rate charger boost and trick operating from 220V, 50 Hz, single phase, mains supply. The battery capacity should be adequate for operation of the system connected to it for at least 24 hours in the non-alarm state followed by 30 minutes operation of all sounders and other connected equipments after a power (mains) failure.

ii) The automatic charger should operate at the boost charge when the battery terminal voltage is less than about 2.1V 20 per cell, and operate at a trickle charge rate of 100 to 200 HA, when the battery terminal voltage exceeds about 2.25 per cell.

iii) The power unit should have the following:

a) Voltmeter 0-30 V
b) Ammeter of suitable range
c) Indicator lights for mains
d) Indicator lights for DC output

iv) The preferred nominal DC voltage shall be 24 V and shall preferably be isolated. (IF an isolated supply is provided a line earthing indicator should also be provided).

v) The DC system and the detection and sounder circuits shall be protected against their attaining a voltage to earth exceeding 50V.
vi) The connection to the 220V, 50Hz, single phase system shall be through a three pin plug socket especially provided for the connection to the annunciation panel. This connection should in addition utilized for earthing all non-current carrying metal parts of the sprinkler system, except those that are either doubly insulated or mounted at a height exceeding 2.2 meters.

vii) The battery unit shall be housed in a steel cabinet with suitable mounting at least 2.5mm thick suitably painted with two coats of Post Office Red, Enamel necessary vent holes should be provided for proper ventilation.

viii) One battery unit complete with battery charger shall be provided for each control panel.

56.00 TESTING

56.01 All pipes in the system shall be tested to a hydrostatic pressure of 11.0 kg/sq.cm without drop in pressure for at least 2 hours. Rectify all leakages, make adjustments and retest as required.

57.00 MEASUREMENT

57.01 Black steel pipes shall be measured per linear meter of the finished length and shall include all fittings including flanges, welding, jointing clamps for fixing to walls or hangers and testing.

57.02 Butterfly valves, check valves and full way valve and flow indicating switches shall be measured by numbers and shall include all items necessary and required for fixing as given in specifications.

57.03 Cabinet and the spare sprinkler heads, with spanner etc. shall be measured as per actual item given in the schedule of quantities.

57.04 Sprinkler heads shall be measured by numbers.

57.05 No additional payment shall be admissible for cutting holes, or chases in the wall or floors, making connections to pumps, equipment and appliances.

57.06 Painting and coating/wrapping of pipes shall be included in the rates for pipes and no extra payment shall be made.

COMMISSIONING OF FIRE FIGHTING SYSTEM

58.00 SCOPE OF WORK

58.01 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.

59.00 GENERAL REQUIREMENTS

59.01 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.

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

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

A survey of the site of the work shall be made by the Contractor before preparation of the detailed drawings for submission to the department for approval. The installation shall be carried out strictly in accordance with the approved drawing.

59.04 The scope of installation work shall include the following, where or not expressly mentioned in the schedule of work.

i. Cement concrete (1:2:4mix) foundation for all pump sets.
ii. Vibration isolation arrangement for all pump sets.

iii. Filling up the hole in flooring with cement concrete, after laying the wet riser pipes.

iv. Necessary supports and clamps for wet riser pump room.

v. Necessary supports and clamps for wet riser plumbing the building.

vi. Supporting bracket/frame work for the fuel oil tank of the engine.

vii. Excavation of the earth, consolidation and refilling after laying of wet riser piping in ground.

viii. Provision of necessary brick base or intermediate support as required in approved manner in case of soils which are no strong enough to support the pipes, thereby likely to case different settlement.

ix. Necessary anchor block of ample dimensions in 1:2:4 cement concrete at all bends, tee connections, foot of the wet riser, and other places as required to stand the pressure thrust in pipes.

x. Necessary masonry work/steel work for supporting hose cabinets near external (yard) hydrants.

xi. Valve chambers of approved design with external (yard) hydrant.

xii. Ground level hydrants of approved design, where specifies.

xiii. Cutting and making good the damages for the installation work of the riser system

xiv. Strainers and foot valves for pumps with negative suction and strainers for pumps with positive suction.

xv. All the required control piping, exhaust piping (5m long) from engine, oil piping for fuel oil and lubricating oil for the engine, drain piping from the pumps to the drain pint in the pump room, overflow piping from priming tank to the sump. The piping work shall include all necessary fittings, valve and accessories for effective functional requirements.

xvi. Inter-connecting cable work with controls, control panel, batteries etc. including battery leads.

xvii. Orifice plates at individual hydrants, as required.

Where provision of GI/MS pipe shall below ground become inescapable, it shall be protected from soil corrosion by 2 coats of coal tar hot enamel paint and 2 wraps of reinforced fiber glass tissue or bituminized horizon.

Each CI pipe/GI pipe shall be subjected to hydraulic pressure test before installation, in presence of the Engineer or his authorized representative.

External (yard) hydrants shall be located at least 2m away from the face of the buildings but not more than 15m and be accessible.

Where external hydrants below ground level are specifically indicated in tender specifications, there shall be enclosed in masonry or cast iron structure of size 75cm2 and 8cm above ground level. The hydrant shall be with in 8cm from the top of the enclosure.

Necessary facility for draining the rise pipe shall be provided at ground floor level with 40mm size sluice valve.

Internal hydrants at each floor shall be located at about 1m above floor level.

Valve chambers shall be of 1sqm meter in size, with cover.

All hoses shall be numbered and a record submitted with completion plane. The number and length shall be easily recognizable on each hose pipe.
External hose boxes shall be installed such that the hose is not exposed to sun rays.

"Siamese" quadraplet instantaneous fire brigade connections comprising of two gunmetal instantaneous male inlet coupling 63mm dia with plug and cap, chain bends, tees etc for inlet to the static tank.

Puddle Flanged
Puddle Flanged including 60 to 90 cm long Gi pipe piece welded / threaded with MS plates 450x450x6mm thick with both end screwed / flanged

60.00 PRECOMMISSIONING

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:

61.00 TESTING OF M.C.C

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

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

61.02 High voltage test at 2000 volts A.C. for one minute on all power and control wiring.

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

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

61.05 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 contractors shall be checked for the presence of humming and chattering.

61.06 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 M.C.C.

61.07 Operation of all instruments and meters provided on the M.C.C.

62.00 FIRE PROTECTION SYSTEM

62.01 Check all hydrant valves and close if any valve is open. Check that all suction and delivery connections are properly made.

62.02 Test run and check rotations of each motor and correct the same if required.

63.00 PIPE WORK

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

63.02 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.

64.00 COMMISSIONING AND TESTING

64.01 FIRE HYDRANT SYSTEM

64.01.1 Pressurize the fire hydrant system by running the main fire pump and after attaining the required pressure shutoff the pump.
64.01.2 Open by-pass valve and allow the pressure to drop in the system. Check that the jockey pump cuts-in and cuts-out at the pre-set pressure. If necessary adjust the pressure switch for the jockey pump. Close by-pass valve.

64.01.3 Open by-pass valve and allow the water to flow into the fire water tank in order to avoid wastage of water. The main fire pump should cut-in at the preset pressure and should not cut-out automatically on reaching the normal line pressure. The main fire pump should stop only by manual push button. However, the jockey pump should cut out as soon as the main pump starts.

64.01.4 Switch off the main fire pump and test check the diesel engine driven pump in the same manner as the electrically driven pump.

64.01.5 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 into the fire tank to avoid wastage. The electrically driven pump should run continuously for eight hours so that its performance can be checked.

64.01.6 Diesel engine driven pump should also be checked in the same manner as given in para above by running for 8 hours.

64.01.7 After laying and jointing, the entire piping shall be tested to hydrostatic test pressure. The pipes shall be slowly charged with water so that the air is expelled from the pipes. The pipes shall be allowed to stand full of water for a period of not less than 24 hours and then tested under pressure. The test pressure shall be 10kg/cm². The test pressure shall be applied by means of manually operated test pump or by a power driven test pump to be provided by the Contractor. In either case precautions shall be taken to ensure that the required test pressure is not exceeded.

64.01.8 The open end of the piping shall be temporarily closed for testing.

64.01.9 Test shall be conducted on each pump set after completion of the installation with respect of delivery head, flow and B.H.P. The test shall be carried out by the Contractor at his own cost.

64.01.10 All leaks and defects in different joints noticed during the testing and before commissioning shall satisfaction of Engineer.

64.01.11 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.

64.01.12 Testing of fittings/equipments shall be carried out either at site or at works in the presence of a representative of the Engineer. Test certificates shall also be furnished by the Contractor.

64.01.13 The automatic operation of the system for the various functional requirements and alarms as laid down in his specification shall be satisfactory carried out on as described above.

64.02 HANDED OVER

64.02.1 All commissioning and testing shall be done by the contractor to the complete satisfaction of the engineer/consultants, and the job handed over to the client.

Contractor shall also hand over to the client all maintenance and operation manuals and all items as per the terms of the contract.

SPECIFICATIONS FOR ELECTRICAL PANEL PROTECTION SYSTEM

Electrical Panel Protection System: Supply & Installation Clean Agent MODULAR type 5 kg capacity Ceiling Mount fire extinguisher (For Electrical Panel, UPS, Server, Battery Rooms etc.) pressurized with Dry Nitrogen gas at 8 bar, Anti-corrosive Treatment Powder Coated Cylinder, Body Hydrotested at pressure 35 kgf/cm², Standard Bulb temperature 68°C, UL Listed HFC-236fa agent, Operating...
temperature -30°C to +60°C - For Electrical, UPS, Server, Battery Rooms etc Clean Agent MODULAR type 5 kg capacity Ceiling Mount fire extinguisher pressurized with Dry Nitrogen gas at 8 bar, Anti-corrosive Treatment Powder Coated Cylinder, Body Hydrotested at pressure 35 kgf/cm², Standard Bulb temperature 68°C, UL Listed HFC-236fa agent, Operating temperature -30°C to +60°C.

65.00 HAND APPLIANCES (as per PWD-E-BSR)

65.01 SCOPE OF WORK

65.01.1 Work under the section shall consist of furnishing all labour, material, appliances and equipments necessary and required to install fire extinguishing hand appliances.

65.01.2 Without restricting to the generality of the foregoing the work shall consist of the following:

Installation of fully charged and tested fire extinguishing hand appliances CO2, Foam, ABC type, CO2 type as required by these specifications and drawings.

Sand Bucket with Stand (6 Bucket) as per site conditions

66.02 GENERAL REQUIREMENTS

66.02.1 Fire extinguishers shall conform to the following Indian Standard Specifications and shall be with ISI approved stamp as revised and amended upto date:

   a) Water gas type IS 15683
   b) Mechanical Foam IS 15683
   c) ABC Type IS 15683
   d) CO2 Type IS 15683

66.02.2 Fire extinguishers shall be installed as per Indian Standard "Code of practice for selection, installation and maintenance of portable first aid appliances “I.S. IS 15683”.

66.02.3 Hand appliances shall be installed in readily accessible locations with the appliance brackets fixed to wall by suitable anchor fasteners.

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

66.02.5 All appliances shall be fixed in a true workman like manner truly vertical and at correct locations.

66.02.6 The contractor has to obtain approval of Fire Department for all fire fighting installations.

LIST OF APPROVED MAKES: PLUMBING WORKS

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Material</th>
<th>Relevant IS Code</th>
<th>MANUFACTURERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vitreous China Sanitary ware</td>
<td>-</td>
<td>Jaquar/Parryware/Hindware/Cera/Rocca/American Standard / Kohlar/QUEO/As Approved by Engineer</td>
</tr>
<tr>
<td>2</td>
<td>Stainless Steel Sink</td>
<td></td>
<td>Cera/ Nirali/Plato/GADOTT</td>
</tr>
<tr>
<td>3</td>
<td>Plastic Seat Cover</td>
<td></td>
<td>Jaquar/Parryware/Hindware/Cera, Rocca/American Standard / Kohlar/QUEO/As Approved by Engineer</td>
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<tr>
<td>No.</td>
<td>Item Description</td>
<td>Supplier/Model</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td>Geyser</td>
<td>Usha Lexus/ Jaquar/ Hindware / As Approved by Engineer</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>C.P.-Fittings Mixer/Pillar taps, Washers, Angle Valve, Bibcock, waste,</td>
<td>Jaquar/ Parryware/ Hindware/ Cera, Rocca/ Grohe / Kohlar/ QUEO</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>C.P. brass accessories</td>
<td>Jaquar/ Parryware/ Hindware/ Cera, Rocca/ Grohe / Kohlar/ QUEO / As Approved by Engineer</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Centrifugally / Sand cast iron pipes &amp; Fittings</td>
<td>Neco/ SKF / HEPCO</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>G.I. Pipes</td>
<td>Jindal-Hissar, Tata, Prakash-Surya</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>G.I. Fittings</td>
<td>Unik, K.S., Zoito, Sant, Plato</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Gunmetal Valves</td>
<td>Zoito, Leader, Castle, Sant</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Brass stop &amp; Bib Cock/ Pressure Release valve</td>
<td>Jaquar/ Parryware/ Hindware/ Cera, Rocca/ American Standard / Kohlar/ QUEO / As Approved by Engineer</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Brass stop &amp; Bib Cock/ Pressure Release valve</td>
<td>Jaquar/ Parryware/ Hindware/ Cera, Rocca/ American Standard / Kohlar/ QUEO / As Approved by Engineer</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Ball valve with floats</td>
<td>Zoito, Leader, Sant</td>
<td></td>
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<tr>
<td>14</td>
<td>Stoneware pipes &amp; Gully Traps</td>
<td>IS Marked pipes, as approved by Engineer</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>R.C.C. pipes</td>
<td>IS Marked pipes, as approved by Engineer</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>C.I. Manhole Covers</td>
<td>Neco, HEPCO, SKF</td>
<td></td>
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<tr>
<td>17</td>
<td>Water Tank</td>
<td>Sintex, Polycon, Uniplast</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Mirror</td>
<td>Modiguard, Asahi, Saint Gobain</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Hand drier</td>
<td>Kopal, Euronics, Plato</td>
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<td>20</td>
<td>Insulation of Hot water pipes</td>
<td>Vidoflex Insulation, Superon, Thermaflex, Kaiflexkaimen</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>PVC Rain Water Pipes.</td>
<td>Finolex, TRUFLOW, Supreme</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>D.I. pipes</td>
<td>Tata, Electrosteel, Jindal</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>DI Fittings</td>
<td>Sant, Tata, Electrosteel, Jindal</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Sluice valve / NRV</td>
<td>Zoito, L&amp;T, Castle, Sant, Plato, Leader</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Water supply pumps</td>
<td>Crompton (CG), GRUNDFOS, KSB, Mather &amp; Platt, Kirloskar, Xylem</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>DI Manhole Cover</td>
<td>SKF / NCEO / HEPCO / Sant</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Submersible pumps</td>
<td>GRUNDFOS / KSB / Mather &amp; Platt / Kirloskar / As approved by Engineer</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>PVC/UPVC pipes &amp; fittings</td>
<td>Finolex, TRUFLO, Supreme</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Chlorinator</td>
<td>Siemens, Watcon</td>
<td></td>
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<tr>
<td>30</td>
<td>HDPE Solution tank</td>
<td>WATCON, Water Supply Specialist P (ltd), Plullocon Technology</td>
<td></td>
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<tr>
<td>31</td>
<td>Infrared Sensor operated Faucets/ Urinals</td>
<td>Jaquar/ Parryware/ Hindware/ Cera</td>
<td></td>
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<tr>
<td>32</td>
<td>Gratings, Strainers, Cleanouts etc</td>
<td>Neer Brand (Sage Metals), Plato</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Level controller</td>
<td>21st Century / Advance Auto / Shridhan international / Minilec / radar / Femac / Swisslet</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Drainage Pumps</td>
<td>Grundfos, KSB, Mather &amp; Platt, Kirloskar</td>
<td></td>
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</tbody>
</table>

Construction of Area Health Clinic Cap Matheureux Mauritius / Technical Specification / Vendor List
<table>
<thead>
<tr>
<th></th>
<th>System integrator for Water / Sewage/ Effluent Treatment Plant</th>
<th>Pollucon Technologies, Geo Miller, Grey water solution / As approved by Engineer</th>
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<td>36</td>
<td>Decorative bath room fittings</td>
<td>Jaquar/Parryware/Hindware/Cera</td>
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<tr>
<td>37</td>
<td>R.O System</td>
<td>Ion-Exchange, Pentair, Pollucon Technologies,</td>
</tr>
<tr>
<td>38</td>
<td>PE-AL-PE</td>
<td>Kitec, Jindal, PRINCE, TRUFLO</td>
</tr>
<tr>
<td>39</td>
<td>HDPE pipes and fittings</td>
<td>IS:14333 (1996) Finoex, TRUFLO, Supreme</td>
</tr>
<tr>
<td>40</td>
<td>CPVC pipe, fittings, and Solvent</td>
<td>Finoex, TRUFLO, Supreme</td>
</tr>
<tr>
<td>41</td>
<td>Solar Panel, for Water Heater</td>
<td>Inter Solar / As approved by Engineer</td>
</tr>
<tr>
<td>42</td>
<td>Copper Pipe</td>
<td>Raj Co., Maxflow, Viega</td>
</tr>
<tr>
<td>43</td>
<td>Copper Fittings</td>
<td>Raj Co., Maxflow, Viega</td>
</tr>
<tr>
<td>44</td>
<td>Lab drainage</td>
<td>Viega, Duraline,</td>
</tr>
<tr>
<td>45</td>
<td>Lab Fittings</td>
<td>Viega, Duraline,</td>
</tr>
<tr>
<td>46</td>
<td>SS pipe (EN-10312) &amp; press type fitting</td>
<td>Vieta, Jindal</td>
</tr>
<tr>
<td>47</td>
<td>Hub less centrifugally cast (spun) iron pipes epoxy coated inside &amp; outside</td>
<td>IS:15905 Neco, SKF, HEPCO</td>
</tr>
<tr>
<td>48</td>
<td>Oxlyte (Mixed Oxidant )</td>
<td>Oxibee Solutions, Pollucon Technologies/ As approved by EngineerEngineer</td>
</tr>
</tbody>
</table>

Note:

- Equivalent make of any item may be added with price adjustment with the approval of Engineer.
- Wherever makes have not been specified for certain items, the same shall be as per BIS and as per approval of Engineer.
### LIST OF APPROVED MAKES : FIRE FIGHTING WORKS

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Material</th>
<th>Relevant ISI Code</th>
<th>MANUFACTURERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G.I./M.S. Heavy class pipe</td>
<td>1239/3589</td>
<td>Jindal-Hissar, Tata,</td>
</tr>
<tr>
<td>2</td>
<td>Gate Air Valve</td>
<td></td>
<td>Zoloto, Castle, Sant</td>
</tr>
<tr>
<td>3</td>
<td>Butterfly valves</td>
<td>13095</td>
<td>Sant, Zoloto, Castle</td>
</tr>
<tr>
<td>4</td>
<td>Portable Fire Extinguisher</td>
<td>2171</td>
<td>Minimax, Ceasefire, KANEX</td>
</tr>
<tr>
<td>5</td>
<td>First aid Fire hose reels</td>
<td>884</td>
<td>Ceasefire, Newage, Minimax</td>
</tr>
<tr>
<td>6</td>
<td>Fire hose pipes</td>
<td>636</td>
<td>Newage, Minimax, Ceasefire,</td>
</tr>
<tr>
<td>7</td>
<td>Fire Hydrant valves</td>
<td>5290</td>
<td>Minimax, Newage, Ceasefire, Sant</td>
</tr>
<tr>
<td>8</td>
<td>Sprinkler Heads</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Sprinkler Side wall extended through</td>
<td>IS</td>
<td>Tyco, Viking, HD, Grinnel,</td>
</tr>
<tr>
<td></td>
<td>Sluice and non return/ check valve foot valve</td>
<td></td>
<td>Eversafe, Zoloto, castle, Sant,</td>
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<tr>
<td>10</td>
<td>Thermoplastic fire hose pipe</td>
<td>1258</td>
<td>Minimax, Newage, Ceasefire,</td>
</tr>
<tr>
<td>11</td>
<td>Rubber hose 12/20mm dia</td>
<td></td>
<td>Dunlop, Good year,</td>
</tr>
<tr>
<td>12</td>
<td>Reinforced rubber lined/canvas</td>
<td></td>
<td>Newage, Jayshree, Safeguard,</td>
</tr>
<tr>
<td>13</td>
<td>Standby battery lead acid</td>
<td></td>
<td>Exide, Amco</td>
</tr>
<tr>
<td>14</td>
<td>Horizontal centrifugal/Fire pumps</td>
<td></td>
<td>Mather&amp; platt(WILO), GRUNDFOS,</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Kirloskar, Xylem</td>
</tr>
<tr>
<td>15</td>
<td>Diesel engine</td>
<td></td>
<td>Cummins, Ashok Leyland,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Caterpillar, Kirloskar</td>
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<tr>
<td>16</td>
<td>Electric motors</td>
<td></td>
<td>GEC, Siemens, ABB, Crompton,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Kirloskar</td>
</tr>
<tr>
<td>17</td>
<td>Electrical switch gear &amp; starters</td>
<td></td>
<td>HPL and As per Electrical Works</td>
</tr>
<tr>
<td>18</td>
<td>Cables</td>
<td></td>
<td>As per Electrical Works</td>
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<tr>
<td>19</td>
<td>Flow meter</td>
<td></td>
<td>Sant / As approved by Engineer</td>
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<tr>
<td>20</td>
<td>Suction strainer</td>
<td></td>
<td>Leader, ZOLOTO, AUDCO, Castle</td>
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<tr>
<td>21</td>
<td>Vibration eliminator connectors</td>
<td></td>
<td>Resistoflex, Kanwal, D.wren</td>
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<tr>
<td>22</td>
<td>Single phase preventor</td>
<td></td>
<td>L &amp; T, GEC, SIEMENS, ABB,</td>
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<tr>
<td>23</td>
<td>G.I. Fittings</td>
<td>1239 Part l</td>
<td>Unik, K.S., Zoloto,</td>
</tr>
<tr>
<td></td>
<td>Item Description</td>
<td>Supplier(s)</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Yard Hydrant Stand Post, 4-way suction</td>
<td>Minimax, Newage, Ceasefire</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>DI pipes</td>
<td>Jindal, TATA, Electro steel,</td>
<td></td>
</tr>
<tr>
<td>25a</td>
<td>DI Fittings</td>
<td>Jindal, TATA, Electro steel, Sant</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Pipe coat material (Pipe protection)</td>
<td>Pypkote Integrated water proofing co., coaltek Rustech products (P) Ltd., Makphall</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Fire Man's Axe</td>
<td>Safeguard/safex/Newage/Gunnebo, Getech</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Pressure guage</td>
<td>IS:C3624 (cl-l) H.GURU/Fiebig/BRC/</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Flow switch</td>
<td>Potter/Safex system sensor/Rapid flow/</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Pressure switch</td>
<td>Indfoss/switzer/As approved by Engineer</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Pannale for water supply / fire/STP/ETP</td>
<td>RISHA / As approved by Engineer</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Fire suppression system</td>
<td>SVS Buildwel (p) Ltd / Kanex / As approval of Engineer,</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Sprinkler Flexible Drops</td>
<td>VICTAULIC/SMITH COOPER / ANVIL</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Grooved Coupling &amp; Fitting</td>
<td>VICTAULIC/SMITH COOPER / ANVIL</td>
<td></td>
</tr>
</tbody>
</table>

Note: Final choice of make specified or not specified above shall remain with the Engineer in charge equivalent makes can also be added or deleted, subject to price adjustment if any
GENERAL SCOPE OF WORK

The scope of work shall cover internal and external electrical works for CONSTRUCTION OF AREA HEALTH CENTER, MAURITIUS electrical equipments as per BOQ. Also, supply, installation, testing and commissioning of electrical works of the project including the following main items/systems:

i. Floor LV Panels.
ii. MCB Distribution Boards.
iii. Internal electrification through concealed conduit and provide light points, fan points, socket outlets etc. including supplying, installation, testing and commissioning of light fixtures, fans etc.
iv. Conduiting and wiring for telephone points including Main Telephone Distribution Boards (Tag Blocks), telephone outlets etc. complete with telephone cabling from tag blocks to telephone outlets including, telephone instruments etc.
v. Conduiting and wiring for cable TV.
vi. Conduiting for computer networking.
 vii. Fire Alarm Manual Call Points Hooter etc. including conduiting/wiring & cabling complete
viii. LT Cabling.
ix. Earthing, safety equipments and misc items required for electrical installation complete in all respect.
 x. Lightning protection system consisting of lightning arrester, finial, horizontal and vertical strips, test joints, earth electrodes etc.
xi. Surge Protection.
xii. Testing and commissioning of all electrical installations.
xiii. Any other items/works required for the completion of electrical work.
xiv. Enhancement/Sanctioning Electrical Load from Central Electricity Board Mauritius.
xv. Submission of GA drawings of electrical equipments and getting approvals from Client/HSCC/Owner before manufacturing/fabrication.
xvi. Obtaining approvals from Chief Electrical Inspectors, Local Electricity Supply Authority, Telecom Department, and any other statutory authorities /Local Bye Laws for the complete scope.
xvii. Contractor shall submit equipment drawing from manufacturer along with the layout etc. and working drawings for approval from HSCC Electrical Engineer before manufacture / commencement of work at site.
xviii. Contractor has to submit the working drawing of internal & external electrification based on our tender drawings for the approval of HSCC Electrical Engineer before commencement of work.
xix. Contractor has to take the approval of DB schedule/drawing of each DB from HSCC.
xx. If, details of any electrical item/system are left out, then kindly refer the BS (British standards)/Mauritius Standards Bureau of Mauritius specifications/ IS Standards & approval from Engineer.
1.0 EMISSION AND SAFETY STANDARDS

All equipment shall meet the latest versions of the following:

1.1 Regulatory Compliance:

• CE Markings per directives 2004/108/EC and 2006/95/EC

1.2 Emission:

  • EN 55022 (Class A limits)
  • EN55022: 2006 w/Amendment 1: 2007Class B
  • EN61000-3-2;& EN 61000-3-3

1.3 Electromagnetic Compatibility

  • IEC/EN 61000-4-2/3/4/5/6

1.4 Immunity

  • EN55024: (IEC 61000-4)
  • EN6060112

1.5 Safety:

  • UL 60950-1 Information Technology Equipment-Safety-Part 1:
    General Requirements

1.6 Restriction of Hazardous Substance (RoHS).

  • All material and/or components to be in compliance with the EU Directive 2002/95/EC

1.7 Telecom

  • Industry Standards: IEEE 802.3 Ethernet, IEEE 802.3af and 802.3at
  • Industry Standards: TIA 810 and TIA 920

2. POWER SUPPLY

Electrical supply shall be from the local Central Electricity Board - 3 Phase + Neutral, Earth, 400/230VAC, 50Hz, + 10%, - 6%

3. EARTHING SYSTEM : TT
4. NOTES:

4.1 All equipment shall be fully tropicalized and conditioned to operate under the ambient conditions prevailing in Mauritius.

4.2 All equipment shall be provided with (i) proprietary audio, video, data, signal, power, etc. cords and cables complete with all terminations (ii) proprietary power supplies as required for a complete installation. This shall hold good irrespective of whether these are mentioned or not in the bill of quantities.

4.3 All power distribution units, power cords & cables shall to be provided with 3 pin, 13 amps socket outlets and/or plugs to BS1363.
2.0 MAIN LOW VOLTAGE & FLOOR PANELS

2.1 MAIN LOW VOLTAGE PANEL

Panels will be fabricated as per BS /Mauritius standards/ IS Standards. It shall be designed and constructed electrically as per BOQ. All compartments of the MLVP shall be self-standing, modular, of standard dimensions, metallic, of Form 4A and be from reputable manufacturers. Particular attention must be given to its water tightness and resistance against corrosion. Degree of protection shall be to IP55 minimum. It shall be fitted with a hinged metal door under lock and key. A perforated copper earth bar shall be provided throughout the width of the panel and the envelope/compartments carefully earthed through an earth continuity conductor.

It shall be supplied complete with incoming mccb, outgoing mcbs, and busbars, mounting rails, terminal blocks, perforated / plain plates, phase indicators, fuses, cable glands, engraved labels and other accessories. Separate cable, control and communication compartments shall be provided within the same envelope. It shall be labeled properly using engraved labels to be approved by the HSCC Engineer before order. Hazard signs shall also be provided on the doors of all electrical distribution boards. Approved as-built schematic drawings shall be provided within document holder inside the electrical panel. Ventilators as required will be installed with washable filter complete with a pair of plastic louvres each 325x325mm (all to at least IP54) shall be installed in the main LV panel.

Detailed drawings of the main low voltage panel shall be approved by the HSCC Engineer before importation and assembly.

2.2 GENERAL

Main/Sub Distribution Panels shall be indoor type, metal clad, floor mounted, free standing, totally enclosed, extensible type, air insulated, cubicle type for use on 415 Volts, 3 phase, 50 cycles system.

- Major civil work such as foundations, trenches, etc will be paid as per civil works.
- Minor civil work like cutting and making good all damages caused during installation and restoring the same to their original finish will be inclusive in the price.

3. AUTOMATIC SOURCE CHANGE OVER SYSTEMS

These must be with intelligent withdrawable (chassis type) motorized circuit breakers fitted with electrical interlocks, mechanical interlocks and trip unit type 4.

Three series of auxiliary changeover contacts c/w draw out terminal blocks shall be provided for the chassis to indicate the "connected" position CE, the “disconnected” position CD and the “test” position CT. Each circuit breaker shall be equipped with a remote-operation system made up of MCH gear motor with a springs-charged limit switch contact CH, MX or MN opening release, XF closing release, PF “ready to close” contact, CDM mechanical operation counter. Each circuit breaker shall additionally be fitted with device ON/OFF indication OF & fault-trip indication SDE.

The dedicated automatic controller shall be with replacement source start-up, shut-down and load shedding controls. The following shall also be included:
Accessories: Cable-lug adapters, Interphase barriers, Spreaders, Safety shutters, etc.
On the device: Transparent cover to independently block access to the pushbuttons used to open and close
the device using a padlock, etc.
On the Chassis: Connected”, “disconnected” and “test” position locking, door interlock catch, racking
handle,racking interlock, Automatic spring discharge before breaker removal, Mismatch protection,
grounding kit, key locks, etc.

4. **EARTHING**

Earthing will be as per relevant BS standards. Earth rods shall be UL listed copper
bonded steel core ground rods 2.5mL x 17mm dia. with at least 250 microns
copper thickness.

Earthing stations shall consist of 3nos. earth rods Interlinked, in a triangular
disposition interspaced at 2xDepth, using bare copper cable 185mm². All
connections/joints shall be made using Cadwelplus or other equivalent system such
that the resistance of the joint shall not be more than the resistance of the same length
of continuous bar. In general, joints shall be kept to a minimum.

Bare or PVC insulated round semi-rigid/rigid copper wire/conductor of size
as indicated on drawings and/or in the Bill of Quantities shall link the earth
stations to the earth bars.

The maximum earthing resistance to be achieved for each earth station shall
be 1.0-2.0 Ohms. The Contractor shall allow in his price for all additional
works, earth rods, copper plates or materials including non-soluble earth
enhancing compounds required to achieve the desired earth
resistances.

All components must be proprietary and from a single Supplier with
proprietary exothermic Cadwelplus connections and using earth enhancing compound

All test links (if required) shall be inside a 400mmx400mm concrete earth
inspection/test pit with proprietary heavy duty cover engraved with the
lettering "EARTH INSPECTION PIT"

5. **TEST CERTIFICATES**

The successful bidder shall carry out the routine tests and/or submit the documents – all, at
least, as listed below - to the local Central Electricity Board before commissioning the MV
switchgears' panels:
6. INSTALLATION OF METALLIC BARRIER

A metallic demarcation barrier (heavy duty) shall be installed between CEB circuit breaker panel and the Client outgoing panel. These demarcation barriers shall be installed throughout the whole width and height of the room, including from duct to floor, so as to prevent all possible means of access between the two sides. The fixation points shall only be accessible from CEB side of the room.

Major civil work such as foundations, trenches, etc will be paid as per civil works.

Minor civil work like cutting and making good all damages caused during installation and restoring the same to their original finish will be inclusive in the price.

7. WORKING DRAWINGS

The bidder shall submit general arrangement and detailed working drawings of all equipment being supplied and installed on site. The Bidder will also supply the working drawings of internal electrifications and external electrifications based on our tender drawings on the latest architectural plan. These drawings shall show all required dimensions and clearances.

The successful bidder shall supply to the HSCC Engineer three copies of all drawings, for comments and approval.

8. Electrical Installations

1. INTRODUCTION

This section shall relate to the description of the installations and the specifications of materials and equipment to be used on the project.

2. STANDARDS

All parts of the installation shall conform in all respects to MS 63: 1995 - Code of Practice published by the Mauritius Standards Bureau of Mauritius for the electrical installation of buildings & the relevant British Standards/ IS Standards. This document shall serve as a reference throughout to determine acceptability of materials, techniques and workmanship.
Where the installation of a particular material or equipment is described by the manufacturer, the Bidder shall submit these information to the HSCC Engineer before the start of the works. The Bidder shall also ascertain that the procedures laid down are properly followed.

Where an item or subject within the contract has not been covered either under the MS63:1995 Regulations or in the specifications contained within the section, the relevant British Standards Codes of Practice shall be referred to.

3. DRAWINGS

Drawings, as listed at the end of this document, are supplied for tender purposes only. Based on the tender drawing the bidder will prepare the working drawings incorporating the latest requirements of the Client, if any and after getting approval from HSCC bidder will take-up the work. Bidder will also will prepare equipment layout drawings of substation etc. based on relevant BS/ Mauritius standards/ IS Standards and will take-up the work after getting approval from statutory authority of Mauritius if any or HSCC as the case may be.

4. ELECTRICAL NETWORK

Two nos. new transformers each rated at 2500 kVA and One canopied DG sets each 1000KVA with AMF panel shall be installed to feed the building. A separate metering cubicle shall be provided at the MV block to house the CEB H.V meter.

Various outgoing switchgears as indicated on the above drawing shall feed the different distribution boards. Connections between the main low voltage panel and the electrical distribution boards shall be through armoured/non armoured cables as indicated on the drawings. Loads connected to the various distribution boards shall be as indicated in the bill of quantities.

5. EARTHING

Earth rods shall be UL listed steel tipped copper bonded steel core ground rods 2.5mL x 17mm dia. with at least 250 microns copper thickness.

Earthing stations shall consist of 3nos. earth rods Interlinked, in a triangular disposition interspaced at 2xDepth, using bare copper cable 185mm². All connections/joints shall be made using Cadwelplus or other equivalent system such that the resistance of the joint shall not be more than the resistance of the same length of continuous bar. In general, joints shall be kept to a minimum.

Bare or PVC insulated round rigid/semi rigid copper wire/conductor of size as indicated on drawings and/or in the Bill of Quantities shall link the earth stations to the earth bars.

The maximum earthing resistance to be achieved for each earth station shall be 1.0-2.0 Ohms.
Bonding of the earthing system to the building structural steel bars is recommended and shall be carried out using proprietary rebar clamps. However, the above desired resistance value shall be measured and achieved before such bonding is carried out. Bonding to firefighting pipes shall be with special proprietary clamps/studs, etc.

The Contractor shall allow in his price for all additional works, earth rods, copper plates or materials including non-soluble earth enhancing compounds required to achieve the desired earth resistances.

All components must be proprietary and from a single Supplier with proprietary exothermic Cadweldplus connections and using earth enhancing compound.

All test links shall be inside a 400mmx400mm concrete earth inspection/test pit with proprietary heavy duty cover permanently engraved with the lettering "LIGHTNING (or other) EARTH INSPECTION PIT"

### 6. EARTH REFERENCE BAR (ERB)

(a) The ERB shall be installed in a dedicated enclosure with a cover that requires a tool to open it and marked ‘Earth Reference Bar’ or ‘ERB’. It shall be provided with (i) easily removable links in order to fulfill test procedures (ii) a coloured labeling system for ease of identification of all the system earths connected to the ERB.

(b) The mains supply protective conductor entering the location shall be terminated at the ERB. The ERB shall be close to the mains supply isolator. It shall be installed in an accessible position, not higher than 1.8m and not lower than 1m measured from the floor.

(c) The ERB shall contain copper connection bars insulated from the building earth. The connection bars shall be connected to the incoming earth conductor by means of a flexible removable links to facilitate the use of a current measuring probe. Additional smaller connection bars shall be provided to accommodate protective earth and equipotential bonding conductors from the socket outlets.

(d) Each equipotential bonding conductor shall be separately terminated and connected to the relevant connection bar. Circuit protection and potential equalization conductors shall have crimped connections. All circuit protective conductors shall be identified, and a list of connections made, a copy of which shall be available in the ERB cabinet.

(e) All installed equipment shall be earthed to the ERB if there are any conductive surfaces that are accessible to either patient or staff. All non-powered equipment with metal surfaces shall be similarly bonded to the ERB.

(f) The unit shall be designed to be flush mounted (landscape oriented) into a wall and of dimensions max.550mm wide x 380mm tall x 93mm deep. Material: Stainless Steel

Main Bar cross section: 100mm²

Bar A : Main Earth from distribution board-1no.x 10mm

Bar B : Supplementary Equipotential Bonding-17nos.x 6mm Bar C : Permanently Installed Medical Devices -17nos.x 6mm Bar D : Clean Earth Sockets and Equipment -16nos.x 6mm.
Bar E: Lighting and non-Medical Equipment 13A Sockets -16nos.x 6mm

It shall be similar to model from Starkstrom or Brandon.

7. LIGHTNING PROTECTION (to BS6651)

Air Termination

The air termination shall be UL Listed and be of the early streamer emission type to provide full coverage of the building.

Air Termination Support

The support mast shall consist of a minimum of 2m of insulating re-enforced fibreglass cylindrical mast complete with mast base, an aluminium mast of appropriate height and a mast support adaptor. The mast shall be securely fixed on the roof of the building with proprietary guying kits to enable the air termination and mast system to withstand cyclonic winds of up to 300 km/hr.

Down conductor

The down conductor shall be electrical grade copper tape 25 x 3mm fixed with proprietary bare copper clips at every 0.5mt intervals. The down conductor shall be supplied in one length as no jointing shall be allowed.

Performance recording equipment

Each protection system shall be supplied with a lightning event counter. The lightning event counter shall have an electronic register that activates one count for every discharge where the peak current exceeds 1500A. The test wave shape shall be the 8/20us standard as defined by ANSI C62.41

The lightning event counter shall be robust, easy to install and housed in an IP67 rated enclosure. The counter shall operate from the energy of the lightning discharge and not rely on external or battery power to operate.

A lightning event counter shall be provided on each down conductor and latter shall be terminated to the earth station through a test joint.

The lightning event counter shall be installed to the manufacturer’s instructions in a readily accessible manner so that readings can be taken at regular intervals. It shall be positioned such that its operating temperature is within the range -10°C to +50°C.

All metallic roofs and structures shall be properly bonded to the lightning protection earth. All the above components must be from a single supplier specialising in the field.

8. SURGE PROTECTION

Technical Specifications of Surge Protection Devices (SPD) for 230 / 415V AC 50 Hz power supply
Applicable Standards

IEC 62305 : Protection against Lightning

Part 1: Basic Principles
Part 2: Risk Assessment
Part 3: Protection of structures
Part 4: Electrical & Electronic equipments within structures

Note: IEC 61024 & IEC 61312 are old standards and are replaced by IEC 62305.

IEC 61643-1: Surge Protective Devices Connected to Low-Voltage Power Systems:
Performance requirements and testing methods.

IEC 61643-12: Surge Protective Devices Connected to Low-Voltage Power Systems:
Selection and application principles

Type of Network – 3 phases, 4 wires.

Mains Incoming Panel

Protection at the main incomer of the power supply system – i.e. at the Main Distribution Board (after the incoming breaker)

Class B/Class I (according to IEC 61643)

3 numbers of lightning arrester for the connection between Phase and Neutral and one number of lightning arrester between Neutral and Earth with the following ratings: (1 no for each phase)
<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Parameters</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Type</td>
<td>Encapsulated/Non-exhausting Spark Gap</td>
</tr>
<tr>
<td>2.</td>
<td>Nominal Voltage, Un</td>
<td>230V, 50/60 Hz</td>
</tr>
<tr>
<td>3.</td>
<td>Over Voltage withstanding capacity</td>
<td>400V</td>
</tr>
<tr>
<td>4.</td>
<td>Lightning Impulse Current</td>
<td>50 KA(10/350 μsec)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>125 KA(10/350 μsec)</td>
</tr>
<tr>
<td>5.</td>
<td>Voltage Protection Level, Up</td>
<td>&lt; 1.3 KV</td>
</tr>
<tr>
<td>6.</td>
<td>Response Time</td>
<td>&lt; 100 nano seconds</td>
</tr>
<tr>
<td>7.</td>
<td>Operating temperature range</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>8.</td>
<td>Mounting on</td>
<td>Din Rail</td>
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<tr>
<td>9.</td>
<td>Degree of Protection</td>
<td>IP 20</td>
</tr>
<tr>
<td>10.</td>
<td>Max. Back-up fuse</td>
<td>500 A gL/gG</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NA</td>
</tr>
</tbody>
</table>

Sub Distribution Board (SDB)/LT Panel

Second Stage Protection at the Sub distribution board or in LT panel of the power supply system

Class B+C/Class I+II (according to IEC 61643)

1 numbers of pluggable type surge arrester with potential free contact, thermal disconnector & provision for inbuilt common remote indication for defective arresters to connect between Line and Neutral and one number arrester Spark Gap type to connect between Neutral and Earth of following ratings including base element & pluggable arresters.
<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Parameters</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Line to Neutral</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neutral to Earth</td>
</tr>
<tr>
<td>1.</td>
<td>Type</td>
<td>Single MOV with built in thermal fuse</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spark Gap Encapsulated / Non-exhausting</td>
</tr>
<tr>
<td>2.</td>
<td>Nominal Voltage, Un</td>
<td>230V, 50/60 Hz</td>
</tr>
<tr>
<td>3.</td>
<td>Maximum Continuous Operating Voltage, Uc</td>
<td>&gt; 320 Volt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>255 Volt</td>
</tr>
<tr>
<td>4.</td>
<td>Nominal Discharge Current In</td>
<td>30 KA(8/20 µsec)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50 KA(8/20 µsec)</td>
</tr>
<tr>
<td>5.</td>
<td>Maximum Discharge Current Imax</td>
<td>50 KA (8/20 µsec)</td>
</tr>
<tr>
<td>6.</td>
<td>Lightning Impulse Current</td>
<td>7 KA(10/350 µsec)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25 KA(10/350 µsec)</td>
</tr>
<tr>
<td>7.</td>
<td>Voltage Protection Level at 1 KA</td>
<td>&lt; 750 volts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;1200 Volt</td>
</tr>
<tr>
<td>8.</td>
<td>Response Time</td>
<td>&lt; 25 nano seconds</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt; 100 nano seconds</td>
</tr>
<tr>
<td>9.</td>
<td>Operating temperature range</td>
<td>-40°C to +80°C</td>
</tr>
<tr>
<td>10.</td>
<td>Mounting on</td>
<td>Din Rail</td>
</tr>
<tr>
<td>11.</td>
<td>Degree of Protection</td>
<td>IP 20</td>
</tr>
<tr>
<td>12.</td>
<td>Max. Back-up fuse</td>
<td>160 A gL/gG</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NA</td>
</tr>
</tbody>
</table>

Visual Indication of the flag in the surge arrester (Line to Neutral)

Healthy condition : Green Colour

Faulty condition : Red Colour

Equipment Level (UPS, MCB DB’s CNC machine/Drives, etc)

Protection for Sensitive Equipments at the input of the end equipments like UPS, CNC machine, VFD’s or at Important MCB DB’s feeding power to Computer / Server etc
Class C/Class II (according to IEC 61643)

3 numbers of pluggable type surge arrester with potential free contact, thermal disconnector & provision for inbuilt common remote indication for defective arresters to connect between Line and Neutral and one number arrester Spark Gap type to connect between Neutral and Earth of following ratings including base element & pluggable arresters.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Parameters</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Line to Neutral</td>
</tr>
<tr>
<td>1.</td>
<td>Type</td>
<td>Single MOV with built in thermal fuse</td>
</tr>
<tr>
<td>2.</td>
<td>Nominal Voltage, Un</td>
<td>230V, 50/60 Hz</td>
</tr>
<tr>
<td>3.</td>
<td>Maximum Continuous Operating Voltage, Uc</td>
<td>&gt; 320 Volt</td>
</tr>
<tr>
<td>4.</td>
<td>Nominal Discharge Current In</td>
<td>20 KA(8/20 μsec)</td>
</tr>
<tr>
<td>5.</td>
<td>Maximum Discharge Current I max</td>
<td>40 KA</td>
</tr>
<tr>
<td>6.</td>
<td>Voltage Protection Level at 1 KA</td>
<td>&lt; 1000 Volts</td>
</tr>
<tr>
<td>7.</td>
<td>Response Time</td>
<td>&lt; 25 nano seconds</td>
</tr>
<tr>
<td>8.</td>
<td>Operating temperature range</td>
<td>-40°C to +80°C</td>
</tr>
<tr>
<td>9.</td>
<td>Mounting on</td>
<td>Din Rail</td>
</tr>
<tr>
<td>10.</td>
<td>Degree of Protection</td>
<td>IP 20</td>
</tr>
<tr>
<td>11.</td>
<td>Back-up fuse</td>
<td>125 A gL/gG</td>
</tr>
</tbody>
</table>
Visual Indication of the flag in the surge arrester (Line to Neutral)

Healthy condition : Green Colour

Faulty condition : Red Colour

Connection diagram for SPD for 3 phase 4 wire

F1, F2, F3 - Incoming ACB/MCCB/SFU
F4, F5, F6 - Back up fuse for Surge Arrester
R, Y, B and N - RYB and N Bus bar or looping after the incomer
PE - Earth Bus bar in the panel

SPD 1, 2, 3 - Surge Arrester to connect between Line and Neutral
SPD 4 - SPD to connect between Neutral and Earth.
Technical Specification for Surge Protection Devices (SPD) for security system.

(CCTV Protection)

Applicable Standards

IEC 62305: Protection against lightning
IEC 62305-1; Protection against lightning: General principles
IEC 62305-2; Protection against lightning: Risk management
IEC 62305-3; Protection against lightning: Physical damage to structures and life hazard
IEC 62305-4; Protection against lightning: Electrical and electronic systems within structures


1) Surge Protection devices at the power side 230 V AC (Single phase).

Surge protection device at the power line entrance shall be of Class II or Type 2 type, capable of diverting a part of lightning current (10/350 micro second) between neutral to earth and surge current generated due to induction effect of Lightning Electro Magnetic Impulses (LEMP) (8/20 micro seconds) and switching surges (8/20 micro seconds) generated inside the structure. The SPDs shall be with mechanical flag indication and pluggable type. The details of the specification is given below.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Large Block MOV between L-N and Spark Gap between N-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Operating voltage</td>
<td>230V</td>
</tr>
<tr>
<td>Maximum Continuous operating voltage (MCOV)</td>
<td>320 V</td>
</tr>
<tr>
<td>Requirement Class as per IEC 61643-1</td>
<td>Class C or Class 2</td>
</tr>
<tr>
<td>Mode of protection as per IEC 60364- 5-53</td>
<td>L – N and N- PE</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Lightning Protection zone</td>
<td>1-2</td>
</tr>
<tr>
<td>Nominal Discharge Current (8/20 µs )/phase In</td>
<td>20KA</td>
</tr>
<tr>
<td>Maximum Discharge Current (8/20 µs )/phase In</td>
<td>40KA</td>
</tr>
<tr>
<td>Impulse current between Neutral to Earth (10/350 µs )</td>
<td>25KA</td>
</tr>
<tr>
<td>Voltage Protection Level</td>
<td>&lt;800V</td>
</tr>
<tr>
<td>Response time</td>
<td>&lt;25 ns</td>
</tr>
<tr>
<td>Protection level</td>
<td>IP 20</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-40°C to + 80°C</td>
</tr>
</tbody>
</table>

### 2) Surge Protection device for Coaxial cable (75 Ohm,BNC Connector)

The surge protection devices shall be with two stage protection circuit suitable for the protection of video signals and cameras. The housing of the surge protection devices shall be of Aluminum to avoid the EMI effects. The surge protection device should ensure the equipotential bonding between PE/Shield and the data cables to reduce over voltages to a safe protection level.

<table>
<thead>
<tr>
<th>Technology</th>
<th>GD Tube and Tranzorb diodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Umax AC</td>
<td>4.2V</td>
</tr>
<tr>
<td>U max DC</td>
<td>6.2 V</td>
</tr>
<tr>
<td>Requirement Class as per IEC 61643-1</td>
<td>Class D or Class 3</td>
</tr>
<tr>
<td>Lightning Protection zone</td>
<td>1-3</td>
</tr>
<tr>
<td>Nominal Discharge Current (8/20 µs )</td>
<td>10KA</td>
</tr>
</tbody>
</table>
Transmission frequency | <200 MHz
---|---
Insertion loss | 0.2 at 10 MHz
Voltage Protection Level in (sym) | <12 V
Plug in system | BNC m/F
Temperature Range | -40°C to + 80°C

### 3) RS 485 lines to control camera movement of PTZ camera

The surge protection device for the RS 485 control lines shall be with high lightning current deflection capacity with 6KA(10/350 micro sec) and two stage protection also with integrated end coupling inductivities in the longitudinal branch.

<table>
<thead>
<tr>
<th>Technology</th>
<th>MOV, GD tube and Tranzorb diode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Voltage</td>
<td>5V</td>
</tr>
<tr>
<td>Requirement Class as per IEC 61643-1</td>
<td>Class D or Class 3</td>
</tr>
<tr>
<td>Lightning Protection zone</td>
<td>0-3</td>
</tr>
<tr>
<td>Pulsed Current (10/350 µs ) Iimp</td>
<td>6 KA</td>
</tr>
<tr>
<td>Nominal Discharge Current (8/20 µs )/phase In</td>
<td>10KA</td>
</tr>
<tr>
<td>Voltage Protection Level(sym)</td>
<td>&lt;18V</td>
</tr>
<tr>
<td>Response time</td>
<td>&lt;1 ns</td>
</tr>
<tr>
<td>Protection level</td>
<td>IP 20</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-40°C to + 80°C</td>
</tr>
</tbody>
</table>
4) **Ethernet Protection (CAT 6)**

The surge protection device for CAT6 application shall confirm to the channel performance as per ISO/IEC 11801 Amend. 2 of the CLASS EA and CAT 6A as per TIA/ANSI. The SPD shall be able to put directly on dinrail for local equi potential bonding. The housing of the surge protection devices shall be of Aluminum to avoid the EMI effects.

<table>
<thead>
<tr>
<th>Technology</th>
<th>GD Tube and Tranzorb diodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Umax AC</td>
<td>41 V</td>
</tr>
<tr>
<td>U max DC</td>
<td>58 V</td>
</tr>
<tr>
<td>Channel performance Ansi/EA</td>
<td>Class 6A</td>
</tr>
<tr>
<td>Lightning Protection zone</td>
<td>1-3</td>
</tr>
<tr>
<td>Surge current rating</td>
<td>7 KA</td>
</tr>
<tr>
<td>Voltage Protection Level in (wire/wire)</td>
<td>&lt;120 V</td>
</tr>
<tr>
<td>Plug in system</td>
<td>RJ 45</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-40°C to + 80°C</td>
</tr>
</tbody>
</table>

9. **AUTOMATIC POWER FACTOR CORRECTION DETUNED CAPACITOR BANK**

9.1 **General**

The automatic power factor correction capacitor bank shall be a self-contained, automatically controlled self-protecting capacitor bank. The capacitor equipment shall allow automatic switching in KVAR increments (required to meet the application) with an electronic regulator for automatic battery connection and cosφ control.

The finished product shall be engineered, assembled, tested, and shipped by the manufacturer. Equipment provided in any other manner is not acceptable.

In general, equipment shall be used on three phase 4-wire, TT wire systems at 50 Hz.
Equipment is designed for reliable, continuous operation in ambient temperatures of –5 C to + 40 C, up to 1000 meters above sea level, non-condensing 95% relative humidity.

The finished power factor correction equipment shall be UL listed to 508A and cUL.

9.2 System Ratings as Per BOQ

9.3 Automatic Switched Capacitor Bank

The switched capacitor bank shall be three-phase, individual step fuse-protected, and contactor controlled. Each capacitor shall include capacitor discharge resistors.

9.4 Incoming Power Connections

The incoming power connection options shall include a circuit breaker sized no less than 150% of assembly KVAR rating at rated voltage.

The circuit breaker interrupt rating shall be no less than the available fault current available at point of connection.

The circuit breaker shall be provided with mechanical lugs or lug pads to accommodate the incoming cable connections.

9.5 Fuses

Current Limiting fuses shall be class J type rated at 200KA symmetrical amperes, utilized for protection of major faults on all three phases of each switched step and each fixed step.

Fuses shall be rated to protect the contactor, capacitor, and interconnecting wiring.

Each capacitor bank fuse shall be provided with a blown fuse indicator consisting of an indicating lamp which shall be illuminated when a capacitor bank fuse has blown. The indicating lamp shall be visible from the front of the enclosure when the door is closed. A nameplate identifying the associated capacitor bank fuse shall also be included with each lamp.

Fuse mounting arrangement shall be in such a manner to provide convenience for inspection and servicing.

9.6 Contactors

Contactors shall be three-pole, electro-mechanical type provided with silver-coated contacts and rated for capacitor duty to withstand the in-rush currents imposed by dynamic switching of the low inductive, low loss capacitors.

Each contactor shall include a means of suppression, capable of withstanding the full inrush capacitor switching current.

Each contactor shall include a pre-charge resistor to reduce the effects of capacitor switching transients.
9.7 Reactors

Filter reactors (where applicable) shall be provided as protection for power factor correction equipment capacitors installed in a harmonically loaded environment.

In general, reactors shall be detuned for the 4th harmonic order and rated thus: tuning order - 3.8, tuning frequency @ 50Hz - 190 Hz, relative impedance -7%, to reduce harmonic amplification.

Reactors shall be iron core construction and in accordance with UL-508, IEC 76 and IEC 289. They shall be vacuum and pressure impregnated using either epoxy or varnish.

Reactors shall utilize a 180 degree C (Class H) insulation system and operate at a maximum temperature rise of 115 degrees C, in a 50 degree C ambient.

Fringing flux losses and extraneous magnetic fields shall be minimized by utilizing polygap construction to maximize the number of air gaps and minimize the length of any individual air gap. They shall include a thermal switch.

Reactors shall be electrically and thermally tested in accordance with the magnitudes of fundamental and harmonic frequency currents for which they were designed. A test report of the actual reactor performance shall be furnished by the manufacturer.

Inductance tolerance of each reactor phase (coil) shall be -2% to +3% of the nominal inductance rating.

9.8 Capacitors

Power Capacitors, shall comply with applicable industry standards IEEE Std. 18, NEMA CP-1, CSA 22.2, IEC 831, and UL 810.

Capacitors shall MPP Type Heavy duty.

Capacitors shall be constructed with self-healing metalized polypropylene film with resin encapsulation and shall be designed with segmented film for maximum safety and protection against over voltage transients. Each capacitor housing shall be aluminum.

Capacitors shall be designed for proper overcurrent, overvoltage, low watt loss (no more than 0.5 watts per KVAR) and long life capabilities. Capacitors shall be rated for 525V.

Capacitors shall be able to carry continuous current of at least 1.5 times the nominal current corresponding to its KVAR rating, at full ambient temperature and altitude without the need to de-rate the capacitor cells voltage rating.

Capacitors shall be suitable for continuous operation in ambient temperature from -40°C to +60°C without de-rating.

Capacitors shall include an integral discharge resistor to reduce the residual voltage to 50V or less within sixty seconds after the capacitor is disconnected from the power source.

Capacitors shall not have any PCB’s and be delta connected.
Capacitance tolerance shall be +/-5%.

Capacitors shall have a rated life expectancy of 20 years continuous operation at its full rated specification.

9.10 Power Factor Controller

The power factor controller shall by a full featured controller utilizing a color touch screen to program, display, and monitor critical capacitor bank parameters and system data. The power factor controller shall have the following characteristics:

9.11 Automatic or manual commissioning

The controller shall be capable of providing a fully automatic commissioning setup to minimize errors and to provide efficient startup assistance.

Power and Harmonic Measurements

Power

• KW, KVAR, KVA, Voltage, Current, frequency, Power Factor and Night Power Factor
• All measurements shall be averaged over a one second period

Harmonics

• Total harmonic distortion on voltage
• Individual voltage and current harmonics from the 2nd through the 49th harmonic
• Individual voltage and current harmonics shall be able to be displayed in a table format or a bar graph

Protection

The power factor controller shall be fully programmable to set the following protections:

• Minimum voltage level, maximum voltage level, maximum current level, maximum voltage distortion level.
• Temperature protection when optional temperature probes are used
• One external input is allowed to disconnect the capacitor bank based on a desired external protection scheme.
• Warning signal for minimum voltage level, maximum voltage level, maximum current level, maximum voltage distortion level.

Diagnosis
The following bank monitoring features shall be available from the power factor controller:

- **Diagnosis** - Lists the total number of operations of each capacitor output relay since the power factor controller has been manufactured

- **Test Function** - Allows testing of the alarm relay, fan relay and each capacitor output relay

- **Alarm Logging** - Lists the last five alarm messages with a real time stamp

- **Real Time Clock** - A real time clock shall be included in the power factor controller including the date and time. It shall be backed up by a battery in case of power loss

### 9.12 Event Logging

The power factor controller shall be able to log the amount of time a measured value has exceeded a minimum and maximum threshold.

The following parameters may be set with a minimum and maximum threshold for the event log feature:

- Voltage, Current, and Frequency
- KW, KVAR, KVA
- Missing Reactive Power
- Voltage and Current Total Harmonic Distortion
- Temperature

### 9.13 Communications

The power factor controller shall be able to communicate via MODBUS RS485 with the communication adapter supplied and installed.

**Technical Data**

- The controller shall be capable of operating between -10°C to 70°C
- All programmable parameters shall be saved in non-volatile memory
- The controller shall be insensitive to harmonics during its operation
- The controller shall be capable of accepting either a 1A or 5A input from the current transformer
- The power factor controller output relays shall be rated 5A maximum

### 9.14 Busing
Main bus shall be electrical grade cooper, fully rated and integral to the equipment. At a minimum, a 65KA brace rating shall be used, to withstand specified short circuit ratings, while providing adequate clearance. Appropriate proprietary hardware shall be utilized at connection points. A grounding connection point shall also be included.

9.15 Equipment Construction

Manufacture of the power factor correction equipment shall follow the most recent applicable ANSI, IEEE and NEMA standards and guidelines. The enclosure shall be wall mounted and/or free-standing depending on KVAR rating.

The enclosure assembly shall be a rigid frame structure using a minimum 16-gauge formed sheet steel outer surface. Enclosure shall be a modular bolted design and allow for ease of expansion in the field. Top, bottom or side connection entry shall be provided.

Doors shall be hinged and equipped with a positive latch-close system and include a lockable feature. The entire assembly shall provide adequate personnel safety and component security. Removable lifting eyes located at the top of the equipment, shall be provided for transport and to facilitate ease of installation.

The complete assembly shall be painted using electrostatically applied powder coated paint, providing for enhanced durability and extended protection. Standard color shall be RAL 7034 (light grey) or color as specified. NEMA 1, 12, 3R and other ratings shall be available.

Thermostat operated fans shall be provided for forced air cooling, convection cooling is not acceptable.

All internal power wiring shall have thermoplastic insulation rated for a minimum of 90°C at 600 volts. All wiring connections shall be mechanically fixed with a nut or screw.

On/Off switch for control power and dry contacts for remote/external disconnect means shall be provided. Internal circuit breaker shall include shunt trip and assembly shall include door interlock system.

Enclosure shall be equipped with grounding lugs and removable lifting eyes (when necessary) to facilitate handling.

The equipment shall be suitable to meet applicable seismic requirements.

9.16 Testing and Documentation

The power factor assembly shall be assembled, wired and functionally tested at the factory in accordance with applicable standards.

The power factor correction equipment shall be production tested for proper operation, prior to shipment. This shall include, at a minimum: wire connections, torque connections, mechanical functional operation, controller operation, visual inspection.

Nameplates, labels and other documentation providing safety, general operation instruction and manufacturer data shall be included with the equipment. Such markings shall be visually accessible and conveniently located, both internally and externally on the equipment.
A manual for the purpose of operation, maintenance, and service instruction shall be included with the finished equipment. A general bill-of-material list, external and internal outline mechanical and electrical drawings, in a CAD format, shall be included with the equipment.

10. SWITCHGEARS

All switchgears shall also be from reputable manufacturers and be strictly to either BS norms/IS Standards. Switchgear used must be such that neutral lines are always interrupted at the same time as phase lines - i.e. switchgear will always be 4 poles or 2 poles.

The circuit breakers and auxiliaries shall comply with the following International and/or European recommendations:

- IEC/EN 60947-1 for general rules
- IEC/EN 60947-2 for circuit breakers
- IEC 60947-3 for switch-disconnectors
- IEC 60947-4 for contactors and motor starters
- IEC 60947-5.1 for control circuit devices and switching elements; automatic control components
- IEC 60068-2-1/2/30/52 for climatic withstands.
- IEC/EN 61000-4 for electromagnetic compatibility
- European environment directive EC/2002/95 for the restriction of hazardous substances (RoHS).

All switchgears shall be provided with cable-lug adapters, interphase barriers, spreaders, terminal extensions, terminal shields & escutcheons, safety shutters, connectors, etc. as required. Outgoing switchgears in all UPS panels must be of the high immunity type.

Intelligent switchgears shall be provided with pre-wired connectivity (cables, cords, terminations, etc.) and plug-and-play interface modules for easy integration with communication networking. It shall be possible to equip the intelligent switchgears with any or a combination of the following:

Breaker Status & Control Module for the following:

Indications of Breaker Status: O/F- ON/OFF, SD - trip indication, SDE -Fault-trip indication (overload, short-circuit, ground fault).

Maintenance indicators: Mechanical operation counter, electrical operation counter, history of status indications. It is possible to assign an alarm to the operation counters.

Controls: The module can be used to carry out communicating remote control operations: (open, close and reset) in different modes (manual, auto).
I/O Application module to monitor and control: cradle management, circuit breaker operation, light and load control, custom application.

Motor mechanism module for remote closing and opening control

Note: ULP is a fast communication link dedicated to circuit breaker monitoring and control

Thermal Magnetic Trip Units

Thermal protection Ir: Adjustable in amps from 0.7 to 1 times the rating of the trip unit; Non-adjustable time delay defined to ensure protection of the cables. tr at 1.5 x In = 120-400s; tr at 6 x Ir = 15s

Magnetic protection Im: fixed pick-up for 16 to 160 A ratings and adjustable from 5 to 10xIn for 200 and 250 A ratings; fixed pick-up for 16 to 63 A ratings; fixed time delay.

Electronic Trip Units

All electronic trip units shall be with a Limited Torque Screw (LTS) installation system. The protection functions shall be independent of the measurement functions to ensure a high level of reliability. Electronic trip units and/or display unit shall be provided with external 24 V DC power supply, as/where required.

L - Long-time protection

S0 - Short-time protection with fixed time delay

S - Short-time protection

I - Instantaneous protection

Electronic Trip Units Type 1 (LS0I) with no metering functions

Adjustment and reading:

Pick-up set in amps with fine adjustment using dials, Non-adjustable time delay

Front indications: Ready LED, Overload pre-alarm LED, Overload LED Test connector

Self-test LEDs (on the measurement system and the tripping release) Electronic Trip Units Type 2 (LSI) with current metering functions

Adjustment and reading: Pick-up set in amps, Fine adjustment via keypad, Adjustable time delays, Front indications, Test connector, Self-test LEDs

Current measurements: Phase and neutral currents I1/I2/I3/IN, Average current of the 3 phases Iavg, Highest current of the three phases Imax, Maximeter/minimeter for I measurements

Operating Indications, alarms and histories: Indication of fault types, Alarms for high/low thresholds linked to I
measurements, Trip, alarm & operating histories, Time-stamped tables for settings and maximeters

Maintenance indicators: Operation, trip & alarm counters, Operating hours counter, Contact wear, Load profile and thermal image

Communication: Modbus with add-on module, Ethernet with add-on module

Electronic trip units Type 3 (LSI) with both current and energy metering functions

Adjustment and reading: Pick-up set in amps, Fine adjustment via keypad, Adjustable time delays, Front indications, Test connector, Self-test LEDs

Current measurements: Phase and neutral currents I1/I2/I3/IN, Average current of the 3 phases Iavg, Highest current of the three phases Imax, Maximeter/minimeter for I measurements, Current unbalance between phases

Voltage measurements: Phase-to-phase (U), phase-to-neutral (V) voltages, Average voltages Uavg/Vavg, Ph- Ph (U) & Ph-N (V) voltage unbalance

Frequency measurements: Frequency (f)

Power-quality indicators: Total harmonic distortion (THD) for current and voltage

Power measurements; Active, reactive and apparent power - total and per phase, Power factor and cos ϕ

Maximeters/minimeters: For all I, U, f, P, E measurements

Demand current & power measurements: Demand values - total and per phase, Maximum demand

Energy metering: Active, reactive and apparent energy, total and per phase

Operating Indications, alarms and histories: Indication of fault types, Alarms for high/low thresholds linked to I, U, f, P, E measurements, Trip, alarm & operating histories, Time-stamped tables for settings & I, U, f, P, E maximeters

Maintenance indicators: Operation, trip & alarm counters, Operating hours counter, Contact wear, Load profile and thermal image

Communication: Modbus with add-on module, Ethernet with add-on module

Electronic trip units Type 4 (LSI) with current, energy metering and power quality functions

Besides the functions offered by Type 3, this one shall also offer the following additional functions:

- Frequency of the power system and phase sequence
- Power factor per phase and cosØ – total & per phase
• Setting of load shedding and reconnection parameters (according to the power or the current flowing through the circuit breaker) either by a supervisor via the COM option (BCM ULP) or using the keypad via a 6-contacts programmable interface

• Power quality indication of (i) total harmonic distortion (THD) of phase to phase & phase to neutral voltage (ii) total harmonic distortion (THD) of phase currents (iii) current, voltage and power fundamentals (iv) current and voltage harmonics up to the 31st order

• To be with COM Ethernet gateway

Intelligent Ethernet (Switchboard) display unit

The switch board display unit shall be a Color TFT LCD (at least to IP54) with an LED backlit anti-glare graphic screen. It shall be able to collect/display data from up to 8 devices via an Ethernet network

24VDC Power Supply (for communication bus & interfaces)

• UL listed Class2 power supply
• Power supply type: Regulated switch type
• Rated power: 72 W
• Input voltage: 100–230VAC for single phase
• PFC filter: With to IEC 61000-3-2
• Output voltage: 24 V DC
• Power supply out current: 3 A

It shall be supplied and installed complete with 3hours battery backup module and power supply terminal blocks.

24VDC Power Supply (for trip control units and prog. contact module)

• Input Voltage: 200/240, 50/60 Hz (+10 % -15 %)
• Output voltage: 24 V DC ±5 %, 1 A.
• Ripple < 1 %.
• Dielectric withstand: 3.5 kV rms between input/output, for 1 minute.
• Overvoltage category: as per IEC 60947-1 cat. 4.

It shall be supplied and installed complete with 4hours battery backup module and power supply terminal blocks.

Maintenance/Test Kit for MCCBs
It shall include the following: (i) Configuration and maintenance module (ii) power supply (110...220 V AC / 50-60 Hz 24 V DC - 1 A) (iii) special cable for connection to the trip-unit test connector (iv) standard USB cable(v) standard RJ45 cable (vi) user manual (vii) Bluetooth link (to PC).

Switch-disconnectors

Switch-disconnectors shall be installed as main incomer in all MDBs. These shall be suitable for isolation (make and break its rated current) as defined by standard IEC 60947-3 and comply with utilization categories AC22A or AC23A. They shall be installed complete with an MN emergency release. They shall be pad lockable in the OFF position and be capable of installation with a rotary handle.

The Contractor must submit calculations, based on manufacturer’s proprietary software, in confirmation that the breaking capacities and tripping curves of the switchgears proposed do match with the requirements of the installations.

11.0 INTERNAL ELECTRIFICATION OF BUILDING

11.1 GENERAL

The electrical Installation work shall be carried out in accordance with relevant BS Standard/Mauritius standards Code of Practice for Electrical Wiring Installation/ IS Standards . It shall also be in conformity with the current Electricity rules and regulations and requirements of the Local Electricity Supply Authority and Fire Insurance regulations, so far as these become applicable to the installation.

Wherever these specifications calls for a higher standard of material and or workmanship than those required by any of the above mentions regulations and specification then the specification here under shall take precedence over the said regulations and standards.

11.2 DISTRIBUTION BOARDS.

As a general practice only MCB type double door DB (IP54 )shall be used or as specified in BOQ. DB shall have following features:

i) Recess/ surface type with integral loose wire box.

ii) Phase/neutral/ earth terminal blocks for termination of incoming & outgoing wires.

iii) DIN channel for mounting MCBs.

iv) Arrangement for mounting incomer MCB/RCCB/RCBO/MCCB as required.

v) Copper bus bar.

vi) Earthing terminals.

vii) Wiring from MCBs to terminal block.
viii) Interconnection between terminal block/ incoming switch/ bus bar/ neutral/ terminal block/ earth terminal connector with specified size of FRLS pre insulated copper conductor cable duly fitted with copper lugs/ thimbles.

ix) Termination block should be suitable for termination of conductor/ cable of required size but minimum rated cross section of the terminal blocks should be 6 sq. mm.

x) Terminal block shall be made of flame retardant polymide material.

xi) Coloured terminal blocks and FRLS wires for easy identification of phases, Neutral and Earth.

xii) DB shall be provided with a detachable cassette for safe removal of MCBs, RCCBs. Terminal connectors from the DB without loosening the internal cable connections of phase and neutral circuits.

xiii) The DB shall have peel able poly layer on the cover for protection from cement, plaster, paints etc during the construction period.

xiv) Detachable plate with knock out holes shall be provided at the top/ bottom of board. Complete board shall be factory fabricated and pre-wired in factory, ready for installation at site. The box and cover shall be fabricated from 1.6 mm sheet steel, properly pretreated, phosphotized with powder coated finish.

xv) DB shall be of double door construction provided with hinged cover in the front.

Distribution Board shall be standard type. Distribution boards shall contain miniature circuit breakers of rating specified in BOQ/DB Schedule.

Miniature circuit breakers shall be quick make and quick break type with trip free mechanism. MCB shall have thermal and magnetic short circuit protection. All miniature circuit breakers shall be of minimum 9 KA rated rupturing capacity unless otherwise specified.

Neutral busbars shall be provided with the same number of terminals, as there are single ways on the board, in addition to the terminals for incoming mains. An earth bar of similar size as the neutral bar shall also be provided. All live parts shall be screened from the front. Ample clearance shall be provided between all live metal and the earth case and adequate space for all incoming and outgoing cables. A circuit identification card in clear plastic cover shall be provided for each distribution board.

MCB's shall be provided on the phase of each circuit. The individual banks of MCB's shall be detachable. There shall be ample space behind the banks of MCB's to accommodate all the wiring. All the distribution boards shall be completely factory wired, ready for connections. All the terminals shall have adequate current rating and size to suit individual feeder requirements. Each circuit shall be clearly numbered from left to right to correspond with wiring diagram. All the switches and circuits shall be distinctly marked with a small description of the service installed.
Earth Leakage Circuit Breaker shall be current operated type and of 30mA sensitivity unless otherwise specified. It shall also provide over-current and short circuit protection i.e. it shall be MCB-cum-RCCB (Residual Current Circuit Breaker). In case ELCB doesn’t have inbuilt short circuit protection, same rating MCB have to be provided for short circuit protection along with ELCB. Cost of this MCB is deemed to be included in the cost of ELCB. ELCB shall be housed within the Distribution Board.

Distribution Boards shall be ready for connections and shall be inspected in the factory by HSCC Electrical Engineer before dispatch.

Before procurement of Distribution Boards, MCB’s, ELCB’s (incomer and outgoings) etc., the contractor has to take approval of the DB Schedule/Drawings of each DB from the HSCC Electrical Engineer. The whole unit i.e. Distribution Board, MCB’s, ELCB’s etc. shall come from the manufactures premises/workshop. After inspection and clearance from the HSCC Electrical Engineer the same may be dispatched to site for installation. However if a single component (such as ELCB or MCB or DB) is required for any reason such as replacement, increase in no. of circuits in the DB, change in the load of existing circuit, change in the total load on a particular DB etc., the same may be ordered separately but after the approval of HSCC Electrical Engineer.

11.3 Conduits

Conduits to be embedded into concrete or chased into blockwalls shall be plastic, flexible and be specially manufactured for the purpose. Suitable accessories shall be used for the implementation of the conduit network. The Tenderer shall ensure that all necessary precautions are taken for protection of the conduits from breakage or blockage.

Coloured conduits shall be used for different circuits i.e. blue for lighting, brown for sockets and green for “low current” circuits. Turbogliss conduits are acceptable for this purpose. Where conduits are surface mounted above a false ceiling or laid within dry wall partitions etc. only non-fire propagating ones shall be allowed.

Unless otherwise stated, conduit sizes shall be as follows:-
• For lighting circuits - ICTL 25
• For socket circuits - ICTL 25
• For air conditioning circuits - ICTL 32
Conduits not meeting the appropriate EN Norms and above colour coding shall not be acceptable.

11.4 LOAD BALANCING

Balancing of circuits in three-phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

11.5. ELECTRICAL ACCESSORIES

Metal Outlet Boxes & Covers, Switches Cover Plate, Socket & Other Accessories etc as per BS Std/IS Standards. Final point user accessories shall be as defined in the bid documents and be supplied complete with all proprietary back boxes. These shall conform to BS3676 and/or BS1363.
The Bidder shall provide for appropriate proprietary flush/surface back boxes, clip-on support frames, front plates and associated accessories for mounting of these either flush to walls or in partitions or in PVC trunking.

All front plates to be. All flush mounting metal back boxes shall be hot dipped galvanized at least 1.6mm thick with screw type earth terminal. All recessed back boxes to be equivalent to Batibox. Minimum ampere rating for light switches shall be 10A. All socket outlets must be of 2P+E, 13 Amps, British standard type to BS1363 Part 2. All outlets for normal distribution shall be of moulded white finish unless otherwise indicated. All socket outlets for UPS distribution shall be of moulded red finish, be supplied complete with proprietary plug - one no. for each outlet and be all of the same model/reference. All isolated socket outlets must be blue in colour. Socket-outlets and switches shall not be installed within a 200 mm radius from the centre of a medical gas terminal unit.

All switches must be labelled with the distribution board ref., circuit no. and lights being controlled. All sockets must be labelled with the distribution board ref., circuit no., UPS or non-UPS, etc. Samples of all fittings and accessories shall be submitted to the HSCC Engineer for approval prior to order.

**Industrial type interlocked switch sockets**

These shall be of polyamide 6 and self-extinguishing. They shall be of IP44 & IK09 and conform to IEC 60309-1/2. The shall be provided with surface mounting box (installed recessed) and offering two possible mounting positions (5° or 25°) without changing the box.

**Faceplate:** Blue Urea  
**Back Molding:** Mineral Filled Nylon  
**Shutter Slide:** 33% Glass Filled Nylon 66  
**Screw/Terminal:** Brass  
**Terminal Retainer:** Nylon 66  
**L/N/E Bars:** Phosphor Bronze  
**Dim:** 146Lx86Wx19mmD  
**Connections:** Phase Conductors and Socket Pin Earth - Up to 2x 6.0mm2  
**Equipotential Earth:** Up to 3x 2.5mm2  
**Mounting Back Box:** Flush, min. 25mm deep  
**Standards:** BS 7671 IEE Wiring regulations, HTM06-01, BS 5733, BS 1363-2, MEIGaN v2.0, BSEN 60601-1-1:2006 Medical electrical equipment

**15.6 WIRING CABLES**

All PVC insulated copper conductor wires shall conform to relevant BS Codes/ IS Standards. All wires/cables shall be stranded type irrespective of its size. Cable conductor size and material shall be specified in BOQ.

All wiring shall generally be single core copper conductor cables rated at 450/750V and manufactured to BS6004. These shall be PVC or LSF insulated, as indicated.

Colour coding for single core cables shall be as follows:  
- Brown/black/grey for the corresponding phase  
- Blue for neutral  
- Green/yellow for earth  

Cables sizes for all circuits shall be as specified on the relevant one-line diagram. All back boxes shall be provided with a dedicated earth stud and earthed with SPVC wire.
12.00 TELEPHONE SYSTEM

12.01 Telephone point wiring as per BS Std/ Mauritius std/ IS Standards.

(a) The point wiring shall be carried out with two pair telephone wire/cable, unarmoured, PVC insulated, 0.61 mm dia annealed tinned copper conductor in suitable size conduit (one pair always remaining spare for one point)

Minimum Diameter of Conduit for Internal/External Telephone Wiring - 20mm.

If more than one telephone point has to be provided at one point, multicore, unarmoured telephone cable shall be used (pairs required are equal to 2 No.of points) in suitable size of conduit.

(b) The point shall commence from the main telephone tag box/sub tag box and would terminate at outlet box of point. Connection at both ends included in point wiring.

(c) Fixing of conduit, conduit accessories draw out boxes and outlet box etc. in concealed/surface conduit works as that of wiring for light fixtures shall be applicable for telephone wiring conduit system also.

(d) Joint in telephone wiring (between main tag box/sub tag box and outlet box of point) shall not be allowed and the contractor should bear the wastages of wire if resulted due to this special requirement of telephone system.

(e) External/Internal telephone and intercom wiring can be drawn in the same conduit, provided after drawing wires, 50% of conduit cross sectional area is free. However, independent PVC insulated telephone wire of suitable pairs shall be used for external, internal and intercom.

(f) To identify each pair of multipair telephone wire/cable, PVC indication numbers shall be put on both ends of pair just before termination.

13.02 Telephone Tag Boxes

These shall be of MS sheet 2 mm thick with connector suitable for telephone connection (as approved by ITI). It shall have hinged MS sheet cover.
13.0 EPABX SYSTEM

13.1.1 Scope:

This specification covers the design, manufacture, testing and supply of digital Electronic Private Automatic Branch Exchange (EPABX), Telephone Sets, MDF, Back-up Power supply system, Voice Mail System etc.

13.1.2 Code and Standards:

The telephone system and the components shall conform to the latest edition of the "The International Telegraph and Telephone Consultative Committee (CCITT)" and other Indian and International standards as applicable.

13.1.3 Site Condition:

All the equipments shall be designed and tropicalised to withstand the site conditions as specified in the schedule of quantities.

13.1.4 Technical Requirements

Calling line identification display on all extension (external line as well as intercom)

In built SMDR (Minimum 1500 calls)

In built USB port for programming on system / CPU

Memory backup based on SD card with at least 5 years duration

At least 2 in built ports for external music source connectivity

Power voltage Ac 100v-240v

In built interface for connecting optional External battery bank-36v(12vx3)

13.1.5 AUTO ATTENDENT-04 CHANNEL

In skin, of same brand as EPABX. Expandable to 08/12 channels

UPS Suitable for above configuration or optional External Battery bank-36 v(12x3)

System should be-

100% non –blocking Digital Hybrid IP PBX employing PCM/TDM principles

Based on universal Slot Architecture

Capacity of supporting connection of additional Digital phone from another digital phone without need for any other adaptor or hardware
Supporting optional CLI on analogue P&T line
Supporting optional multiple 4 channel DISA cards
Supporting ISDN BRI (4line & 8 line) and PLI
Supporting optional IP Gateway/ Extension card
Supporting optional CTI card
Supporting Floating extension
Supporting major networking protocols such as FXO, FXS , E &M ( 8 channel), E1 & QSIG ( PRI/ BRI)
Supporting Background music on Key Telephone
Supporting Background music on Key Telephone
Supporting 3 to * party conference supporting unattended conference.
Supporting 32 party broadcast feature
Supporting internal and external paging interface with different paging groups
Supporting multiple call hop forwarding facility
Supporting off hook Call Announcement on high end Digital Key phone
Supporting the facility of DISA, DDSA, external call forwarding, Trunk –to –Trunk Transfer and walking class of service
Supporting voice calling on intercom
Supporting Boss Secretary function
Supporting direct connectivity or Digital extension port
Supporting CTI
Supporting call budget management
Supporting CLI based routing
Supporting Mobile Integration
Absent message capability in – built
Speed Dial- At least 1000 on system and 10 per extension
Should have extension personal identification number (PIN)/ password- up to 10 digits per extension

Should give call log of at least 10 outgoing numbers and 100 incoming numbers per key phone extensions

Having message/ Ringer lamp on digital phone (dual colour) to indicate the following distinct status on High Mid Key phone:

i. Internal call

ii. External call

iii. Message

13.1.6 Main Distribution Frame (MDF)

A Krone MDF mounted in sheet steel enclosure shall be supplied along with the exchange. I.P.M. shall be provided in the MDF for all junction lines and external one. All cables coming from field will be terminated on the MDF.

13.1.7 Operator’s Console

The operator’s console shall be digital, desk top type, compact in design and electronic based. Electronics switching shall be used to make various connections, cord connections shall not be accepted. The operator console should work on single pair. Status of all the analog extensions and digital extensions shall be indicated on LED display. Suitable Add on module shall be provided for this.

13.1.8 The console shall provide the following facilities:

i) Answering an incoming call
   Operator can answer an incoming call, whether from an internal extension or from external junction line.

ii) Call Waiting
   An unattended call waiting for more than a predetermined time shall automatically go to standby operator.

iii) Setting up External calls
   It shall be possible for an operator to set up external calls.

iv) Automatic Recall
   Incoming calls will be automatically returned to the operator if the called extension does not answer within a predetermined time or called extension is busy.
14.0 CABLE TRAY

Cable Tray & Cable Ladders
These, including all supports, shall be in hot dipped galvanised steel for external use and of heavy duty type capable of bearing, without deflection, the load of the cables installed thereon. Pre-treatment and hot dipped galvanising of the materials shall conform to the requirements of BS729. They shall be smooth and free from all sharp edges. Joints should be mechanically bolted using splice plates with due allowance for longitudinal adjustments and expansion. All joints shall be by proprietary manufacturer’s accessories and rustproof bolts. PVC insulated (25mm2) bonding cable/jumper c/w accessories shall be provided at all joints. Cable trays shall be in perforated sheet steel. Rungs of ladders shall be rectangular in section, spaced at 300mm nominal centres and welded to the rail sections by approved welding procedures. Separate cable trays shall be laid for LV, ULV and IT cabling or wiring. Cable trays shall be paint marked LV, ULV or IT at regular max. 3m intervals.
16.0 PROCUREMENT, INSPECTION OF EQUIPMENT & APPROVALS

Approved list of makes and vendors are given in the end of technical specifications. The makes of equipment/materials supplied shall be strictly as mentioned therein. For items not specially mentioned, prior approval shall be taken before procurement of the same. All equipments/material supplied shall be brand new and shall be procured directly from the manufacturers, dealers or authorised agents.

HSCC Electrical Engineer shall have access to the manufacturer’s premises for stage inspection/final inspection of any item during its design, manufacturing, and assembly and testing. After carrying out the necessary factory tests and routine tests as per IS Standards, a copy of the routine test certificate shall be forwarded along with the call for carrying out the inspection at the manufacturer’s works.

Based on the inspection certificate, HSCC Electrical Engineer reserves the right to carry out the inspection at a mutually agreed date and/or give inspection waiver. A minimum of two weeks will be needed after receipt of complete shop inspection report and other details to depute our inspector for inspection.

It is the responsibility of the contractor to ensure that all electrical works are carried out as per the IE Rules & regulations, National Building Code and IS Codes & Standards. All necessary drawings and details as required by Electricity Board, Electrical Inspector, Fire Department and other Local Statutory agencies, shall be prepared by the contractor. The contractor is responsible to submit the drawings and other details as required to the Local Authorities (refer above) and obtain necessary approvals including sanction of load/enhancement of electrical load from SEB before energizing and commissioning. All official fee required for getting the approval will be reimbursed on account of Client on submission of original documents.
**LIST OF APPROVED MAKES FOR ELECTRICAL SYSTEM**

Contractor shall use the materials of approved make as indicated below unless specified in BOQ or as approved by the HSCC electrical incharge. The contractor shall ensure the correct selection of the approved make meeting the specifications and application duties. Before placing order for procurement, the sample of approved make shall be got verified for its suitability to the specification and application duty. However, HSCC electrical engineer (approving authority) reserves the right to opt for the best preferred listed make. The contractor shall quote the rates for the material and equipment as per the list of approved makes. In the event of the contractor wants to use alternate makes other than those stipulated for any reason, the contractor can send a proposal after ensuring that what he proposes at the least meets both the quality and safety standard of the stipulated makes, and the financial benefit that will accrue to the client. He shall also stand full guarantee to his alternate proposal. The alternate makes can be used only after an approval accorded by the client/HSCC., whose decision will be final in this matter. Any financial implication incurred related with inspection will be borne by contractor.

**Note- 1. Makes to be extent available in the Mauritius including their after sales services otherwise best available makes can be accepted as approved by engineer in charge.**

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<th>MAKE</th>
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<td>Synchronization Panel/AMF Panel</td>
<td>OEM of the DG set or above panel manufacturer as mentioned against s.no.-3</td>
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<td>Diesel Engine:</td>
<td>Cummins/Caterpillar/MTU/Kirloskar oil Engine Ltd /Ashok Leyland/Perkins/Volvo Penta</td>
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<td>Woodward, Control &amp; switchgear</td>
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<tr>
<td>58</td>
<td>Occupancy Sensor</td>
<td>Philips/ Honeywell/ Schneider/Lutron/Legrand</td>
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<tr>
<td>59</td>
<td>Lifts/ Dumb Waiters/ Escalators</td>
<td>Otis /Kone/ Mitsubishi/ Scheindler/Johnson</td>
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<td>60</td>
<td>Lighting Control</td>
<td>Lutron/ Philips/ ABB/ Schneider/ Legrand</td>
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<tr>
<td>61</td>
<td>Chemical Earthing</td>
<td>OBO Bettermann / Erico/Furse / Ingesco</td>
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<tr>
<td>62</td>
<td>Access Control System</td>
<td>Honeywell-Pro-3000/Schneider/Lenel/Cardex</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Brand/Model</td>
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<tr>
<td>63</td>
<td>Boom barrier</td>
<td>Magnetic/ Somfy/ RIB/FAAC</td>
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<tr>
<td>64</td>
<td>CAT 6 UTP, CAT 6A UTP/STP, Optical Fibre-cable</td>
<td>Molex/Systimax/Panduit</td>
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<tr>
<td>65</td>
<td>BMS, field DEVICES</td>
<td>Honeywell _Trends/ L&amp;T – ATMOS/ Siemens/ Schnieder</td>
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