

Volume 5: Technical Specifications

Construction of Biosafety level (BSL) -3 Laboratory for NCDC at Sawai Man Singh Medical College, Jaipur on Engineering, Procurement and Construction (EPC) basis

Tender No. - HITES/IDN/NCDC-JAIPUR/EPC/2026-27

Volume 1: NIT & ITB

Volume 2: General Conditions of Contract

Volume 3: Specific Conditions of Contract

Volume 4: Design Basis Report

Volume 5: Technical Specifications

Volume 6: Tender Drawings

Volume 7: Financial Bid

**CLIENT
CONSULTANT**

National Centre for Disease Control (NCDC)

PROJECT MANAGEMENT



HLL INFRA TECH SERVICES LTD. (HITES)
(Subsidiary of HLL Lifecare Ltd., A Government of India Enterprise)

EPC TENDER

FOR

**Construction of Biosafety level (BSL) -3 Laboratory for NCDC at Sawai
Man Singh Medical College, Jaipur on Engineering, Procurement and
Construction (EPC) basis**

VOLUME- 5
TECHNICAL SPECIFICATIONS

Tender No. - HITES/IDN/NCDC-JAIPUR/EPC/2026-27



B-14 A, SECTOR 62 NOIDA, UP 201 307
PH.: 0120 4071 500 FAX: 0120 4071 513
www.hllhites.com

TECHNICAL SPECIFICATIONS

INDEX

Section I	Technical Specification for Civil Works Plumbing Works Fire Fighting Works Drainage Works external Development works & Civil Miscellaneous Works
Section II	Technical Specification for Electrical & Associated Works
Section III	Technical Specification for HVAC & Associated Works
Section IV	Technical Specification for Laboratory Equipments& Systems
Section V	Testing Commissioning & Validation
Section VI	Comprehensive Annual Operation & Maintenance Services
Section VII	List of Proposed and Preferred Makes / Manufactures

SECTION - I
TECHNICAL SPECIFICATIONS FOR CIVIL WORKS, PLUMBING WORKS,
FIRE FIGHTING WORKS, DRAINAGE WORKS,
EXTERNAL DEVELOPMENT WORKS, CIVIL MISCELLANEOUS WORKS

1. GENERAL

- 1.1 The specifications for Civil and Plumbing works shall be in accordance with C.P.W.D. specifications Volumes I and II with up to date correction slips unless otherwise specified in the nomenclature of individual item or in the specifications. The entire work shall be carried out as per the C.P.W.D. specifications in force with up to date correction slips upto the date of opening of tender.
- 1.2 For the item not covered under CPWD Specifications mentioned above, the work shall be executed as per latest relevant standards/codes published by B.I.S. (formerly ISI) inclusive of all amendments issued thereto or revision thereof, if any, upto the date of opening of tenders.
- 1.3 In case of B.I.S. (formerly I.S.I) codes/specifications are not available, the decision of the Engineer based on acceptable sound engineering practice and local usage shall be final and binding on the contractor.
- 1.4 However, in the event of any discrepancy in the description of any item as given in the tender drawing or specifications appended with the tender and the specifications relating to the relevant item as per CPWD specifications mentioned above, the decision of Engineer-in-charge shall prevail.
- 1.5 The work shall be carried out in accordance with the architectural, structural, plumbing and electrical drawings etc. The drawings shall have to be properly correlated before executing the work. In case of any difference noticed between the drawings, final decision, in writing of the Engineer shall be obtained by the contractor. For items, where so required, samples shall be prepared before starting the particular items of work for prior approval of the Engineer and nothing extra shall be payable on this account.
- 1.6 All materials to be used on works shall bear I.S. certification mark unless specifically permitted otherwise in writing. In case I.S. marked materials are not available (not produced), the materials used shall conform to I.S. Code or CPWD specifications, as applicable in this contract.
- 1.7 In such cases the Engineer shall satisfy himself about the quality of such materials and give his approval in writing. Only articles classified as "First Quality" by the manufacturers shall be used unless otherwise specified. All materials shall be tested as per provisions of the Mandatory Tests in CPWD specifications and the relevant IS specifications. The Engineer may relax the condition regarding testing if the quantity of materials required for the work is small. Proper proof of procurement of materials from authentic manufacturers shall be provided by the contractor to the satisfaction of Engineer. Grade of cement used shall be OPC 43 Grade unless otherwise specified explicitly. The contractor shall get the Design Mix for concrete done by the labs approved by Engineer-in-charge. Reinforcement Steel used shall be of TMT Fe-500 D unless otherwise specified.
- 1.8 In respect of the work of the sub-agencies deployed for doing work of electrification, air- conditioning, external services, other building work, horticulture work, etc. for this project and any other agencies simultaneously executing other works, the contractor shall afford necessary coordination and facilities for the same. The contractor shall leave such necessary holes, openings, etc. for laying /

- burying in the work pipes, cables, conduits, clamps, boxes and hooks for fan clamps, etc. as may be required for the electric, sanitary, air-conditioning, fire fighting, telephone system, C.C.T.V. system, ducting.
- 1.9 Unless otherwise specified, the rates for all items of work shall be considered as inclusive of pumping out or bailing out water if required for which no extra payment will be made. This will include water encountered from any source such as rains, floods, or due to any other cause whatsoever
- 1.10 Any cement slurry added over base surface (or) for continuation of concreting for bond is added its cost is deemed to have been built in the scope.
- 1.11 The works in which the use of cement is involved is inclusive of curing.
- 1.12 The contractor shall clear the site thoroughly of all scaffolding materials and rubbish etc. left out of his work and dress the site around the building to the satisfaction of the Engineer-in-charge before the work is considered as complete.
- 1.13 The plastering work (excluding washed grit finish on external wall surfaces) shall include for making grooves, bands etc. wherever required and nothing extra shall be paid for the same.
- 1.14 The brick/concrete work shall be deemed to include making openings and making good these with the same specifications as shown in drawings and/or as directed. No extra payment shall be made to the contractor on this account.
- 1.15 The concrete/plaster work shall include for making drip course moulding, grooves etc. wherever required and nothing extra shall be paid for the same.
- 1.16 Flooring work shall include for laying the flooring in strips/as per sample or as shown in drawings wherever required and nothing extra shall be paid for the same.
- 1.17 The drawing(s) attached with the tender documents are for the purpose of tender only, giving the tenderer a general idea of the nature and the extent of works to be executed. The price quoted by the tenderer shall be deemed to be inclusive of all costs involved for the execution and completion of works in all respect essentially required to make the building and the facility functional, taking into account the design and detailing aspect involved for the works to be executed and completed in accordance with the relevant specifications, standards, BIS codes. The Structural drawings shall be proof checked from IIT/NIT/any other Govt. Institute, as approved by the Client. However, the accuracy and sufficiency of the construction drawings shall be re-checked and coordinated with other services by the contractor to ensure the correctness of drawings and any discrepancy shall be brought immediately to the notice of the Engineer-in-charge. Manufacturers or supplier specific shop drawings shall be submitted by the contractor for approval, before proceeding with work.
- 1.18 The quoted rate shall be for finished items and shall be complete in all respects including the cost of all materials, labour, tools & plants, machinery etc., all taxes, duties, levies, octroi, royalty charges, statutory levies etc. as applicable and any other item required but not mentioned elsewhere in the documents.
- 1.19 The client/executing agency shall not be supplying any material, labour, plant etc. unless explicitly mentioned so.
- 1.20 Stacking of materials and excavated earth including its disposal shall be done as per the directions of the Engineer-in-Charge. Double handling of materials or excavated earth if required shall have to be done by the contractor at his own cost.

- **Clearing**

The contractor shall clear the site of all rubbish, remove all grass and low vegetation and remove all bush wood, trees, stumps of trees, and other vegetation only after consultation with the EIC as to which bushes and trees shall be saved. All disused foundations, drains or other obstructions met with during excavation shall be dug out and cleared.

- **Site Levels**

The contractor shall carry out the survey of the site and shall establish sufficient number of grids and level marks to the satisfaction of the EIC, who shall decide on the basis of this information, the general level of the plot and the yard /plinth level.

- **Bench-marks**

Prior to commencement of construction, the contractor shall in consultation with the EIC, establish several site datum bench-marks, their number depending on the extent of the site. The bench- marks shall be sited and constructed so as to be undisturbed throughout the period of construction.

- **Site investigation**

The contractor shall inspect the site and study the findings from the trial pits or bores in order to assess the problems involved in and methods to be adopted for excavation and earthwork. The contractor shall ascertain for himself all information concerning the sub-soil conditions, Ground water table, periods and intensity of rainfall, flooding of the site and all data concerning excavation and earthwork. Any additional work incurred during execution due to insufficient investigations will not be paid extra.

- **Setting out the work**

The contractor shall do proper setting out for the building, any additional work executed due to improper setting out shall be borne by the contractor.

The contractor shall ensure compliance with all documents throughout the execution time. The contractor shall be responsible for all the errors in this connection and shall have to rectify all defects and/or errors at his own cost, failing which the EIC reserves the right to get the same rectified at the risk and cost of the contractor.

2. SITE DEVELOPMENT AND EARTH WORK

2.1 General

This specification deals with the clearance of the Site of Works and preparation of the same to commence the proposed construction activities. Wherever applicable, this is deemed to include all preliminary works like, Site Clearance, General Levelling etc., at Contractor's cost.

The Contractor, at his own cost, shall visit the site, inspect the same and decide for himself the nature of the ground and the sub-soil to be excavated. No claim on account of extras will be entertained in consequences of any misunderstanding or incorrect information or ignorance of the existing conditions. The following specification but not limited to, shall be followed for site development and earth works.

EARTH WORK

Excavation shall be undertaken to the width of the Basement / Retaining wall footing including necessary margins for construction operation as per approved drawings or

directed otherwise. Where the nature of soil or the depth of the trench and season of the year, do not permit vertical sides, the contractor at his own expense shall put up the necessary shoring, strutting and

planking or cut slopes with or without steps, to a safer angle or both with due regard to the safety of personnel and works and to the satisfaction of the Engineer. All the major excavation shall be carried out by mechanical excavator. No extra payment shall be made for that.

The contractor shall make at his own cost all necessary arrangements for maintaining water level, in the area where works are low enough so as not to cause any harm to the works or problems in carrying out with the execution and the rates for all items of work shall be considered as inclusive of pumping out or bailing out water, if required, for which no extra payment shall be made. This will include water coming from any source, such as rains, accumulated rain water, floods, leakages from sewer and water mains subsoil water table being high or due to any other cause whatsoever. The contractor shall make necessary provision of pumping, dredging, bailing out water coming from all above sources and excavation and other works shall be kept free of water by providing a suitable system approved by the Engineer-in-charge.

The water level may vary due to rainy season or due to dewatering etc. In order to avoid possibility of basement floor of main building being getting uplifted/damaged due to water pressure, the contractor shall make arrangements for lowering the ground water table below the proposed foundation level as approved by Engineer-in-charge. Sub soil water table shall be maintained at least 50 cm below the P.C.C. level during laying of P.C.C., water proofing treatment, laying of basement raft and beams including filling of earth/sand under the basement floor. The water table shall not be allowed to rise above base of raft level until completion of outer retaining walls including water proofing of vertical surface of walls and back filling along the walls up to ground level and until the structure attains such height to counter balance the uplift pressure. However, the contractor should inspect the site and make his own assessment about sub-soil water level likely to be encountered at the time of execution and quote his rates accordingly. Rate of all items are inclusive of pumping out or bailing out water, if required. Nothing extra on this account whatsoever shall be paid to him. The sequence of construction shall be got approved by the Engineer-in-charge.

2.2 Anti-termite treatment

Anti-termite treatment shall be got done through approved specialized agencies only with prior approval of the Engineer-in-charge or his representative. During the execution of work, if any damage shall occur to the treatment already done, either due to rain or any other circumstances, the same shall be rectified and made good to the entire satisfaction of the CLIENT/ HITES or his representative by the contractor at his costs and risks. The contractor shall submit a guarantee bond of ten years for the anti-termite work executed under the contract in the specified format.

Classification of Soils

The earth shall be classified under the following categories

2.3 Hard dense soil

Generally, any soil which requires the close application of picks or jumpers or scarifiers and rippers to loosen the same such as:

1. Stiff clay, hard shale or compact moorum requiring grafting tool and/or pick and shovel.
2. Shingle and river or nallah bed boulders.
3. Lime concrete, stone masonry in lime or cement mortar below ground level.
4. Soft, conglomerate or soft laterite when the stone can be detached from the matrix

with picks and shovel.

5. Existing WBM roads, pavements etc.

2.4 Ordinary/Soft/Decomposed rock (not requiring blasting)

Rock or boulders, which may be quarried or split with crowbars or wedges/picks; such as lime stone, sand stone, hard laterite, hard conglomerate or other soft or disintegrated rock.

2.5 Hard rock (requiring blasting):

Rock which is in solid beds, which can only be removed either by wedging or chiselling, shall be treated as hard rock. An isolated boulder or detached rock, measuring one cubic meter or more, shall also be treated as hard rock, if the same cannot be removed without wedging or chiselling.

(If required, approved chemical may be used for loosening the materials). Blasting is totally prohibited and will not be allowed under any circumstances.

2.6 Authority for classification of Soils/Rocks

The classification of excavation shall be decided by the EIC and his decision shall be final and binding on the contractor.

2.7 Blasting

Blasting shall not be permitted under any circumstances. The Contractor, at his own cost can use alternate chemicals to split rock with the approval of EIC. The contractor shall submit with his tender, the method which he intends to adopt for execution of the work of rock excavation. A list of specialized tools and plants to be used for rock excavation shall be enclosed.

2.8 Trimming of Slopes

All slopes shall be trimmed by hand or mechanically true to line and profile and consolidated to the EIC's satisfaction. Any rock or boulders appearing on the face or likely to be unstable, shall be removed and the void thereof filled with approved material and compacted. No extra amount shall be claimed by the contractor on this account and his quoted rates shall be deemed to have been included for trimming of slopes.

2.9 Shoring/Earth work support

The contractor shall shore and strut the sides of excavation to the satisfaction of the EIC. Should there be any slips or settlement, notwithstanding the shoring, the contractor shall make good the same at his own expense, with concrete or other approved material, as directed by the EIC. Shoring shall be removed gradually side by side with backfilling to prevent any settlement and under no circumstances, until such time as the foundation concrete has hardened enough, to take any loads brought on by the removal. Under special circumstances, shoring shall be left in place, if so directed by the EIC. No extra payment shall be made for shoring. The rate for the same shall be included in the excavation items.

2.10 Dewatering

All excavation shall be kept free from water from any source. The contractor shall provide and clear away on completion, all drains, pumps and other equipment, for this purpose. The contractor shall be responsible for preventing any subsidence of adjoining ground due to pumping.

Contractor shall keep site dewatered till all construction works in basement and all other areas are completed, including waterproofing. No extra amount shall be claimed by the contractor on this account and his quoted rates shall be deemed to have been included for total dewatering.

2.11 Contractor to keep excavation clear

Should any sand, mud, weed, rubbish or other materials be deposited on excavated area, by sandstorm, rain, flood, and landslips or from any cause, whatsoever, such materials shall be removed by the contractor at his own expense.

2.12 Back filling

All materials used as fill shall be to the EIC's approval and shall be well consolidated in layers not more than 200 mm thick. Final compacting must be done just before concrete is to be laid.

All fill materials shall be compacted at a moisture content appropriate to the material being used. The compacted filling shall achieve a density, which shall not be less than 95% of the maximum dry density obtained. Filling shall be free of any wood, organic matter or any other deleterious material.

Sand, soil, gravel etc. from the excavation may be used for backfilling of pits and trenches or for making up levels subject to approval of the EIC and subject to selection of proper materials. The contractor shall take instructions of the EIC regarding the location in which each type of excavated material is to be used according to its quality.

In case the excavated materials are not approved for backfilling, either totally or in part or if their quantity falls short of the quantity required for filling, suitable materials shall be brought to site from an approved source. No extra amount shall be claimed by the contractor on this account and his quoted rates shall be deemed to have been included for total backfilling.

2.13 Disposal of surplus

- Surplus excavated materials and all excavated materials rejected for backfilling, shall be carted away from the site by the Contractor at his own cost.
- Wherever rock excavation is encountered, contractor shall remove the same without any extra cost. The Contractor shall visit the site and assess the site condition before quoting for the work.
- The unused excavated rubble to be disposed in line with all present rules and regulations of govt.

2.14 Excavation in all Soils

Excavation and/or removal of any other material on the site shall be carried out accurately to the lines, levels and dimensions shown in the drawings or as ordered by the EIC, so as to allow proper and efficient concrete work and other work in clean and dry condition. The method of excavation shall be at the discretion of the EIC but should the dimensions of any excavation exceed those shown on the drawings or ordered by the EIC or should the sides collapse, the contractor shall fill such extra space with concrete or other approved material, at his own expenses.

All founding levels will be inspected by the EIC and suitability for bearing of the bottom shall be determined before the concrete is placed. Records of all foundation levels shall be submitted by the contractor to the EIC.

The final 150 mm depth of excavation shall be taken out by hand unless otherwise permitted by the EIC. Extra depth of excavation, if any, beyond those shown in the drawings or ordered by the EIC, shall be filled up with Grade 10 concrete for which payment shall not be made to the contractor.

The contractor shall excavate any soft patches or rock outcrops below the founding level and refill with M-10 concrete. The founding stratum shall be trimmed to required level and rammed to the satisfaction of the EIC before concrete is placed.

Foundations within any one building shall not rest on soil strata with differential bearing capacities. Strip foundations shall not be stepped along the length of the foundations. When excavating for individual footings at different levels care shall be taken not to disturb the bearing stratum of the higher foundations. The excavation bottom shall be watered as directed by the EIC before the foundations are laid.

2.15 Sweet Earth

The Sweet earth for plantation areas, shall be from an approved source and shall be mixed with natural or artificial manure, as directed by the EIC.

3. PLAIN AND REINFORCEMENT CEMENT CONCRETE WORKS

3.1 General

All concrete included in the works shall comply with the General requirements of this section of the specification except where those requirements are modified by the provisions of later Clauses relating to specialized uses for concrete in which case the requirements of those Clauses shall take precedence. All designs and execution shall be according to the latest version of relevant IScodes, CPWD and other relevant manuals mentioned elsewhere in this document. The following specification but not limited to, shall be followed for concrete and steel works.

3.2 CONCRETE WORKS (PLAIN AND RCC)

- (i) Generally, all concrete work shall be as per IS-456 (latest edition) characteristic strength (28 days) shall be 20 N/sq. mm, 25 N/Sq mm, 30 N/Sq mm and 35N/sqmm as may be specified on drawings. The use of concrete admixtures shall be approved by the EIC. The items include for providing all materials, mixing, placing, compacting, cutting, finishing, placing inserts, holding down bolts and flanges, sleeves, puddle flanges, embedding all services pipes, boxes, hooks etc. as shown in drawings at correct location level with required changes in form work, reinforcement etc., complete. All RCC works and all concrete shall be machine vibrated. All concrete shall be with 20mm and down graded nominal size stone aggregates except specified otherwise. Curing of the concrete shall be as per IS-456 (Latest Edition).
- (ii) The rate of reinforcement work shall include for handling/ storing clearing of rust, straightening, bending and placing, binding, fixing in proper position at any height/level with 18 gauge annealed binding wires, necessary chairs, spacer bars, wastage and cement mortar cover blocks at proper positions to maintain proper cover as per IS-456 (Latest Edition).
- (iii) Inverted cantilever, Circular / Curved, offsets, Projection, fins, bands, nibs and sloping members on slab, beams, columns, staircase including drilling, cutting, bonding agent complete to the satisfaction of EIC etc.
- (iv) Holes and openings in RCC slab/walls, parapet, masonry works, pockets in machine foundation, beam, parapets, for rainwater pipe or spouts and plumbing pipes shall be left at the time of concrete casting or raising masonry and making good after fixing fixtures.
- (v) If in the opinion of the EIC, any surface other than specified for obtaining patterns in exposed surface in concrete under specific items, is asked to be left unrendered and painted, then the item will not be measured as item concerning exposed surface and no extra for any reason will be allowed.
- (vi) Jointing new work with the existing concrete/brickwork including shuttering and approved bonding agent for construction joints.
- (vii) Reinforcement shall be by weight actually placed in position as per the bar bending schedule, to be prepared by the contractor and approved by the EIC.

The weight shall be taken as per IS Code for the particular diameter. Rates quoted for reinforcement shall include for cutting, bending, binding the reinforcement bars in any shape, hoisting to all leads and lifts and placing in any position as per detailed drawings, including providing precast cement concrete cover blocks of required thickness for keeping bars in position. 18 gauge annealed binding wire for tying for reinforcement shall be provided by the contractor. The contractor should cover for this in his overall rate for the reinforcement rates including removing rust, Mill scales, oil, grease, paint etc. from reinforcing bars.

- (viii) Centring, shuttering, boxing propping including special nuts, bolts etc. in perfect line, level, plumb and if required to provide camber, slope and removal thereof. Colourless shuttering oil or grease of approved quality shall be applied to forms before placing steel. Rate to include for any shapes including offsets/ chamfering in columns, residues, grooves, drip moulds, irregular shapes etc. Stripping time for the formwork, centring and dropping shall be as per IS-456 (Latest Edition).
- (ix) Work at all heights, depths & levels irrespective of individual storey.
- (x) Work in narrow widths, Piece meal/ small work, screeding under floor etc.
- (xi) All staging upto any height and scaffolding work shall comprise of MS Pipes/ Structural steel sections with necessary coupling arrangement. (NO WOODEN BALLIES / PROPS WILL BE PERMITTED). Adequate size foundation blocks / base plates shall be provide below staging members to disperse the loads as per the founding strata.
- (xii) Contractor shall set up on site concrete pump, hoists, tower cranes, passenger elevator, automatic microchips controlled Batching plant of capacity 30 cum per hour or more (min. 2 nos.) complete with silos/ stock piles for cement and aggregates, and also a D.G. set to be provided for uninterrupted supply of concrete. Use of batching plant for all concrete work is mandatory.
- (xiii) Providing grooves, drip moulds, moulds, chamfers, curved surfaces, and ornamental works in RCC members as per drawing and finishing to specified shape.
- (xiv) Forming all expansion and / or construction joints as directed.
- (xv) Contractor to consider in his quoted rates the necessary arrangement e.g. providing and fixing of required quantity of woven mesh at the junction of Beam and Column or any other RCC members to separate two different grade of concrete mixes. No payment shall be made for over flowed richer mix of one RCC member into the other.
- (xvi) Use of greater than minimum specified quantities of cement to achieve specified or required mix design.
- (xvii) RCC (M30) for all water retaining structures greater than 50 cubic metre as per IS 3370(Latest Edition).
- (xviii) Use of plasticiser / super plasticiser (approved by EIC) and / or additional cement for pumpable concrete.
- (xix) Non-destructive test for defective concrete as directed by EIC, and their remedial measures thereof if required.
- (xx) Providing dowels for anchorage and joining RCC members if required.
- (xxi) Mix designing and testing of all the ingredients of concrete from Indian Institute of Technology / other Institutions of National importance approved by HITES for each grade, pumpable & non-pumpable concrete.

(xxii) Compliance with all requirements of technical specification.

3.3 Quality Assurance Plans and Supervision:

A competent person shall be employed full time whose first duty will be to supervise all stages in the preparation and placing of the concrete. All test on materials, the making and testing of cubes and the maintenance and calibration of all mixing and measuring plant shall be carried out under his direct supervision in the presence of the EIC. Contractor shall set up a laboratory with all testing arrangement at site. On award of the work contractor shall submit their quality assurance plans, complete methodology & sequence of construction for all activities to EIC.

3.4 Materials

a) **Cement**

Cement shall in general comply the following specifications:

i) **Types**

The cement used shall be ordinary portland cement conforming to IS 8112 - 1989 (Latest revision) of grade 43/ IS 12269 - 2013 (Latest revision). PPC conforming to 1489 (Part I) - 1991 (Latest revision) shall be followed.

All cement shall be fresh when delivered. Cement shall be delivered in sound and properly secured bags or other packages ready for immediate use and shall be used direct from the bag. The contractor shall maintain for EIC' inspection a record of receipts and consumption of cement indicating the source, the age and the date of receipt of cement. Cement containing lumps which cannot be broken by a light touch of fingers shall not be used in the works. Admixtures shall not be used without written consent of the EIC.

ii) **Sources**

The contractor shall use the cement as required in the work, from manufacturers as per list of approved makes or from any other reputed cement manufacturer having a production capacity not less than one million tons per annum. Makes and sources of cement shall not be varied from those used for trial mixes; should a change be unavoidable the contractor shall submit his proposals for the prior approval of the EIC and then carry out new trial mixes unless otherwise directed by the EIC. Cement of different kinds shall not be mixed at any stage.

iii) **Manufacturers' Test Certificates for Cement**

The Contractor shall request the cement manufacturer to forward to his site office the Certificate of conformity in accordance with IS (Latest Revision), and he shall cause a copy to be supplied to the EIC within 48 hours of the arrival of the certificate, which shall not be later than 14 days from the day of delivery of the relevant consignment. The test certificate shall be related to the date of delivery at site of consignment. The frequency of deliveries shall be such as to ensure that no cement is more than 3 months old when used in the works.

iv) **Samples of Cement**

Samples of cement to be used in the works shall be deposited with the EIC for his approval together with a certificate stating the name and address of the Manufacturer, the name and address of the supplier from whom it was purchased. The EIC may from time to time take samples of the cement being used in the works for testing. The cement

shall be got tested by the Engineer-in-charge and shall be used on the work only after satisfactory test results have been received. The Contractor shall supply free of charge the cement required for testing including its transportation cost to testing laboratories. The cost of tests shall be borne by the Contractor

v) **Storage of Cement**

The contractor shall provide a proper separate weatherproof store building with raised floor for cement storage on the site and shall at all times protect the cement from damp or any other deleterious influences. Each consignment of cement shall be kept separately and the contractor shall be careful to ensure the consignments are used in the order in which they are received.

In case cement gets affected from damp or any other deleterious influence, such cement shall not be used for construction work. The damaged cement shall be removed from the site immediately by the Contractor on receipt of a notice in writing from the Engineer-in-charge. If he does not do so within 3 days of receipt of such notice, the Engineer-in-charge shall get it removed at the cost of the Contractor.

b) **Aggregates**

i) Materials used as aggregates shall be obtained from a source known to produce aggregates satisfactory for concrete and shall be chemically inert, strong, hard, durable, of limited porosity and free from adherings, coating, clay lumps, coal residues and organic or other impurities that may cause corrosion of reinforcement or may impair the strength or durability of the concrete. Aggregates shall be tested in accordance with the requirements of IS. 383 or IS. 515 and the results of such tests shall be as hereinafter specified, the percentages being by weight unless the context indicates otherwise.

ii) Fine aggregates shall be natural sand or sand derived by crushing material like gravel or stone and shall be free from coagulated lumps. Sand derived from stone unsuitable for coarse aggregates shall not be used as fine aggregates. The caustic soda test for organic impurities shall show a colour not deeper than that of the Standard solution. The amount of fine particles as ascertained by the Laboratory Sedimentation test shall not exceed 10% for crushed stones. The settling test for natural sand or crushed stone shall be made, and after being allowed to set in for three hours the thickness of the layer of silt deposited on the coarser material shall not exceed 8%.

The grading of a natural sand or crushed stone i.e. fine aggregates shall be such that not more than 5 (five) percent shall exceed 5 mm in size, not more than 10% shall pass IS sieve No. 150 not less than 45% or more than 85% shall pass IS sieve No. 1.18 mm and not less than 25% or more than 60% shall pass IS Sieve No. 600 micron.

Only washed sand of quality and grading specified herein above shall be used. Admixture of sand obtained by crushing natural stone may be permitted by the EIC, provided the mixture satisfies the requirements for the fine aggregates here in above specified. But not more than one part of the sand obtained by crushing natural stone may be added to two parts of washed sand.

iii) Coarse Aggregate

Coarse Aggregates shall be crushed stone. The pieces shall be angular, rounded in shape and shall have granular or crystalline or smooth (but not glossy) non-powdery surface. Fragile, flaky and laminated pieces, and mica shall not be present.

The "Aggregates Crushing Value" shall not exceed 45%. The amount of fine particles occurring in a free state or as a loose adherent shall not exceed 1%. When determined by the laboratory sedimentation test, after twenty-four hours immersion in water. A previously dried sample of the coarse aggregates shall not have gained in weight more than 5%. Size of coarse aggregate shall be maintained within tolerance limit of 2.5%.

The grading of coarse aggregate shall be such that not more than 5% shall be larger than 20 mm and not more 10% shall be smaller than 5 mm and not less than 25% or more than 55% shall be smaller than 10 mm. Maximum size of coarse aggregate shall be of 20 mm unless otherwise noted.

The grading of coarse aggregate of nominal size of 40 mm shall be such that not more than 5% shall be larger than 40 mm and not more than 5% shall be smaller than 5 mm and not less than 10% or more than 35% shall be of 10 mm size.

Aggregate (Fine and Coarse) shall be thoroughly washed with clean water if so directed by the EIC.

Fragile, flaky and laminated pieces, and mica shall not be present. Aggregate should be free from fine holes and stone should not be weathered.

iv) Steel Reinforcement

The Contractor shall procure reinforcement steel from primary steel producers from the list of Approved make for Civil Works provided in the agreement. The manufacturer has to give a certificate that the material supplied is not a re-rolled product. Relevant vouchers & test certificates will be produced by the contractor. The Contractor shall have to obtain and furnish manufacturer Test Report /test certificates for each lot. Tests to the Engineer-in-charge in respect of all supplies of steel brought by him to the site of work. Re-rolled sections will not be allowed.

Reinforcement steel, structural steel shall be stored and stacked in such manner so as to facilitate easy identification, removal etc. The contractor shall take proper care to prevent direct contact between the steel and the ground/ water for which he shall provide necessary arrangement at his own cost including ensuring proper drainage of area to prevent water logging as per direction of the Engineer-in-charge. Steel shall also be protected, by applying a coat of neat cement slurry over the bars for which no extra payment shall be made. Test certificates for each consignment of steel shall be furnished and further tests shall be got carried out from the authorized laboratory as per the directions of Engineer-in-charge, before incorporating the materials in the work. Nothing extra will be paid for "straightening of bars" received from market in coils or with bends. All incidental charges of any kind whatsoever including cartage, storage, safe custody of materials, cutting and wastage etc. shall be borne by the contractor.

The reinforcement steel shall in general comply the following specifications:

v) **Type**

Steel for bar and fabric reinforcement shall conform to mild steel of tested quality conforming to IS. 432 (Latest), or high yield strength deformed bar conforming to IS. 1786 or as specified in the drawings. The steel shall be kept clean and free from pitting, loose rust, mill scale, oil, grease, earth, paint or any material which may impair the bond between the concrete and the reinforcement or which may cause corrosion of the reinforcement or deterioration of the concrete. Fabric reinforcement (IRC weld mesh or equivalent) shall be delivered to site in flat sheets only.

vi) **Storage of Reinforcement**

Before and after bending, reinforcement shall be stored on raised racks in separate lots by size and type and protected from damage, contamination and the effects of the weather. For the purposes of identification each lot shall be marked plainly and securely by approved methods.

vii) **Fabrication**

Fabrication shall be accurately done to the dimensions, spacing and minimum cover as per structural drawings. Spacers shall be of cement mortar (1:2) cubes however shall not be leaner than the approved design mix. Steel chairs, spacer bars shall be used in order to ensure accurate positioning of reinforcement. All joints in steel reinforcement shall be overlapped.

viii) **Welded Laps**

Wherever specified, welded laps shall be provided and paid for separately unless specifically included in the item of work. No payment shall be made to the contractor for welding as per EIC's requirements, if the same is necessitated due to the reasons attributable to the Contractor. The welding of bars shall be carried out as per IS: 2751-1979, IS:9417-1979. Before doing welding of bars at site, the contractor shall make minimum 3 joints and get them tested in an approved laboratory at his own cost. The following precautions shall be taken:

- a. If the cold twisted deformed bar has an untwisted end at lapping point, then this portion shall be cut off prior to welding.
- b. Bars shall be free from rust at joints to be welded.
- c. Bars shall be aligned and kept in proper axis in order to minimize crookedness in bar after welding.

The Contractor shall supply free of cost the required steel bars for testing as per the requirement. The cost of tests shall be borne by the Contractor. In case the test results indicate that the steel arranged by the Contractor does not conform to the specifications as defined the same shall stand rejected, and it shall be removed from the site of work by the Contractor at his cost within a week time or written orders from the Engineer-in-Charge to do so. For checking nominal mass, tensile strength, bend test & re-bend test etc. specimen of sufficient length shall be cut from each size of the bar at random at frequency not less than the specified below:

Size of bar	For consignment below 100 tonnes	For consignment above 100 tonnes
Under 10 mm dia bars	One sample for each 25 tonnes or part thereof	One sample for each 40 tonnes part thereof
10 mm to 16mm dia bars	One sample for each 35 tonnes or part thereof	One sample for each 45 tonnes part thereof
Over 16mm dia bars	One sample for each 45 tonnes or part thereof	One sample for each 50 tonnes part thereof

The actual issue and consumption of steel on work shall be regulated and proper accounts shall be maintained. The theoretical consumption of steel shall be worked out as per procedure prescribed in GCC and shall be governed by conditions laid therein.

Steel brought to site and remaining unused shall not be removed from site without the written permission of Engineer-in-Charge.

Bar Bending Schedule: - Contractor shall prepare bar bending schedules and shall get them approved from the Engineer-in-charge or his authorized representative.

Records of Consumption of Cement & Steel:

- a) For the purpose of keeping a record of cement and steel received at site and consumed in works, the contractor shall maintain a properly bound register in the form approved by the Engineer-in-charge, showing columns like quantity received and used in work and balance in hand etc. The contractor's representative shall sign this register daily.
- b) The register of cement & steel shall be kept at site in the safe custody of Engineer-in-charge during progress of the work. This work. This provision will not, however, absolve the contractor from the quality of the final product.

ix) **Water Type**

Water for mixing concrete shall be clean and free from harmful material and comply with the requirements of Clause 5.4 of IS:456: latest.

Water shall be only from sources / bore wells approved by the EIC, and shall be used in a manner as directed by the EIC.

x) **Testing of Water**

Prior to the commencement of the works, or whenever there is a change in the source of supply or when directed by the EIC, the contractor at his own cost shall arrange for samples of water, for mixing concrete, to be submitted to an independent Government authorized testing laboratory, acceptable to the EIC for tests to determine that the water complies with this specification and is satisfaction in all other respects for the manufacture of high-quality concrete.

3.5 Grades and Strength Requirements of Concrete General

Concrete shall consist of the material described under previous sections, using separate coarse and fine aggregate in an appropriate combination determined in the course of the preparation of mix design described hereinafter. The overall grading shall be such as to produce a concrete of the specified quality, which will work readily in to position without

segregation and without the use of excessive water. In the case of mass concrete or blinding concrete specified by nominal mix the use of "all-in" (20 mm and down) aggregate shall be approved by the EIC. No addition of water shall be made at site. It shall be a homogeneous mix before use at site.

Slump

Only specified quantity of water shall be added to the cement and aggregate during mixing to produce concrete having a sufficient workability to enable it to be well consolidated, to be worked in to the corners of the shuttering and around the reinforcement to give the specified surface finish, and to have the specified strength. Water cement ratio shall be maintained as per IS. 456-(latest) unless specified otherwise.

Incase of pumpable concrete the slump & workability required for pumping the concrete shall be achieved by the contractor at his own cost. Nothing extra shall be paid for use of extra cement and / or plasticizers.

Concrete Grades

Grade of concrete used in the works shall be shown on the drawings or as directed by the EIC. Minimum cement contents shall be as per Is 456- (latest) or specified otherwise. The grade of concrete to be adopted in the construction shall be as follows: -

- a) For mud mat, lean concrete, mass filling the concrete mix will be nominal mix concrete of 1:5:10, 1:4:8, 1: 3:6 (Cement: Coarse sand: 20mm Down aggregates) grade as specified in the construction drawings These mixes may be prepared using mechanical mixer.
- b) For all R.C.C work concrete used will be controlled concrete with grade of concrete M20 or more as per construction drawings. The cementitious contents in the mix design shall not be lesser than as indicated in the table below. The water cement ratio and other parameters shall be strictly adhered to as per the table below:

Grade	Min. cement Kg/ Cum.	Water Cement Kg/Cum. (*) ratio
M – 20	300	0.55
M – 25	300	0.5
M – 30	320	0.45
M – 35	340	0.45
M- 40	360	0.40

***Note:** - the actual requirements of cement contents are likely to be more than the minimum indicated. The limit has been fixed strictly from the concrete's durability point of view.

Approved admixtures may be used strictly as per IS 456-(latest) and nothing extra will be paid for the use of the same. Admixture used should not impair durability of concrete nor combine with constituents to form harmful compounds nor increase the risk of corrosion of reinforcement. Dosages of retarders, plasticisers and supertplasticisers if used shall not exceed 0.5, 1.0 and 2.0 percent respectively by weight of cementitious materials.

3.6 MIX DESIGN

The RCC work shall be done with RMC of Design Mix Concrete, unless otherwise specified. The contractor shall carry out design mixes for each class of concrete indicating that the concrete ingredients and proportions will result in concrete mix meeting requirements specified.

As the guarantor of quality of concrete used in the construction, contractor shall carryout mix design and the mix so designed shall be approved by the EIC, however approval by EIC shall not relive the contractor from his responsibility towards quality & sufficiency of design mixes. The mix shall be designed to produce the grade of concrete having

workability and a characteristic strength as indicated in the drawings. The target mean strength of concrete mix should be equal to the characteristic strength plus 1.65 times the standard deviation as indicated below.

<u>GRADE OF CONCRETE</u>	<u>STANDARD DEVIATION (N/Sq mm)</u>
M10, M15	3.5
M20, M25	4.0
M30 to M50	5.0

Mix design shall be carried out as per SP-23 (Hand book concrete mixes) Proportion / Type of aggregates shall be made by trial in such a way so as to obtain dense possible concrete with required workability. All ingredients of concrete should be used by mass only. Contractor shall carry out the mix design and get it tested from the laboratory / Institution as per the instructions of EIC

No substitutions in materials used on the work or alterations in the established proportions be made without additional test to show that the quality and strength of concrete are satisfactory. Design mix shall not be converted into volume mix under any circumstances.

The EIC will reserve the right to inspect at any stage and reject the concrete if he is not satisfied about quality of product at the user's end.

The EIC reserves the right to exercise control over the: -

- a. Ingredients, water and admixtures purchased, stored and to be used in the concrete including conducting of tests for checking quality of materials, recording of test results and declaring the materials fit or unfit for use in production of mix.
- b. Calibration check of the plant.
- c. Weight and quantity check on the ingredients, water and admixtures added for batch mixing.
- d. Time of mixing of concrete.
- e. Testing of fresh concrete, recordings of results and declaring the mix fit or unfit for use. This will include continuous control on the workability during production and taking corrective action, if required.

For exercising such control, the EIC shall periodically depute his authorized representative at the RMC plant. It shall be responsibility of the Contractor to ensure that all necessary equipment, manpower & facilities are made available to EIC and/or his authorized representative at RMC plant.

All required relevant records of produced and used concrete shall be made available to the EIC or his authorized representative. EIC shall, as required, specify guidelines & additional procedures for quality control & other parameters in respect of materials, production & transportation of concrete mix which shall be binding on the Contractor. Only concrete as approved in design mix by Engineer-in-Charge shall be produced and transported to the site.

3.7 Ready Mix Concrete (RMC):

- i. The contractor shall engage Ready Mix Concrete (RMC) producing plants (Distance of plant from site to be approved by Engineer in Charge) to supply RMC for the work. The RMC plant proposed to be engaged by the contractor shall fulfill the following requirements.
 - a) It shall be fully computerized.
 - b) It should have supplied RMC for Govt. projects.
 - c) It should have facility for providing printed advice showing ingredients of concrete carried by each mixer.

- ii. The Ready-Mix Concrete (RMC) producing plants of the main Cement producers shall be preferred.
- iii. The contractor shall, within 30 days of award of the work submit list of at least three reputed RMC plant companies along with details of such plants including details of transit mixer, pumps etc. to be deployed indicating name of Company, its location, capacity, technical establishment, past experience for approval by Engineer-in-charge.
- iv. The Engineer-in-Charge reserves the right to exercise check over the: -
 - a) Ingredients, water and admixtures purchased, stored and to be used in the concrete including conducting of tests for checking quality of materials recordings of test results and declaring the material fit or unfit for use in production of mix.
 - b) Calibration check of the RMC.
 - c) Weight and quality check on the ingredient, water and admixture added for batch mixing.
 - d) Time of mixing of concrete.
 - e) Testing of fresh concrete, recordings of results and declaring the mix fit or unfit for use. This will include continuous control on the workability during production and taking corrective action.

For exercising such control, the Engineer shall periodically depute his authorized representative at the RMC plant. It shall be the responsibility of the contractor to ensure that the necessary equipment manpower & facilities are made available to Engineer and/or his authorized representative at RMC plant.
- v. Ingredients, admixtures & water declared unfit for use in production of mix shall not be used. A batch mix found unfit for use shall not be loaded into the truck for transportation.
- vi. All required relevant records of RMC shall be made available to the Engineer or his authorized representative. Engineer shall, as required, specify guidelines & additional procedures for quality control & other parameters in respect of materials, production and transportation of concrete mix which shall be binding on the contractor & the RMC plant.
- vii. It shall be the responsibility of the Contractor to ensure that the RMC producer provides all necessary testing equipment and takes all necessary measures to ensure Quality control of ready -mixed concrete. In general the required measures shall be:-

- **Control of Purchased Material Quality:**

RMC producer shall ensure that the materials purchased and used in the production of concrete conform to the stipulation of the relevant agreed standards with the material Supplier and the requirement of the product mix design and quality control producer's. This shall be accomplished by visual checks, sampling and testing, certification from materials suppliers and information/data from material supplier. Necessary equipment for the testing of all material shall be provided and maintained in calibration condition at the plant by the RMC producer.

- **Control of Material Storage:**

Adequate and effective storage arrangement shall be provided by RMC producer at RMC plant for prevention of contamination, reliable transfer and feed system, drainage of aggregates, prevention of freeing or excessive solar

heating of Aggregate etc.,

- Record of Mix Design and Mix Design Modification:

RMC producer shall ensure that record of mix design and mix design modification is available in his computer at RMC plant for inspection of Engineer or his representative at any time.

- Computer Print outs of Each Truck Load:

Each truckload / transit mixer dispatched to site shall carry computer printout of the ingredients of the concrete it is carrying. The printout shall be produced to Engineer or his representative at site before RMC issued in work.

- Transfer and Weighing Equipment:

RMC Producer shall ensure that a documented calibration is in place. Proper calibration records shall be made available indicating date of next calibration due, corrective action taken etc. RMC producer shall ensure additional calibration checks whenever required by the Engineer in writing to contractor. RMC producer shall also maintain a daily production record including details of mixes supplied. Record shall be maintained of what materials were used for that day's production including water and admixtures.

- Maintenance of Plant, Truck Mixers and Pumps:

Plant, Truck Mixers and Pumps should be well maintained so that it does not hamper any operation of production, transportation and placement.

- Production of Concrete:

The following precautions shall be taken during the production of RMC at the plant

- a) Weighing (correct reading of batch data and accurate weighing):- For each load, written, printed or graphical records shall be made of the weights of the materials batched, the estimated slump, the total amount of water added to load the delivery tickets number for that load and the time of loading the concrete into the truck.
- b) Visual observation of concrete during production and delivery or during sampling and testing of fresh concrete assessment of uniformity, cohesion, workability adjustment to water content. The workability of the concrete shall be controlled on a continuous basis during production. The batch mix found unfit shall not be loaded into the truck for transportation. Necessary corrective action shall be taken in the production of mix as required for further batches.
- c) Use of adequate equipment at the plant to measure surface moisture content of aggregates, particularly fine aggregates or the workability of the concrete, cube tests etc. shall also be ensured.
- d) Making corresponding adjustment at the plant automatically or manually to batched quantities to allow for observed, measured or reported changes in materials or concrete qualities.
- e) Sampling of concrete, testing monitoring of results.
- f) Diagnosis and correction of faults identified from observations / complaints
 - The RMC plant produced concrete shall be accepted by EIC at site after receipt of the same after fulfilling all the requirements of mix mentioned in the tender documents.
- g) The Item of design mix cement concrete is inclusive of all the ingredients

including admixtures, if required, labour, machinery T&P etc. required for a design mix concrete of required strength and workability, and, shall take into account change, if any, in quantities of concrete, ingredients like cement and aggregates and admixtures etc. as per the approved mix design.

- h) Ready mix concrete shall be arranged in quantity as required at site of work. The ready-mix concrete shall be supplied as per the pre-agreed schedule approved by Engineer.
- i) Frequency of sampling and standards of acceptance shall be as per CPWD specifications.
- j) No addition of water or other ingredients shall be permitted in the RMC at site or during transit.
- k) The RMC shall be placed by pump of suitable capacity and the arrangements shall be made to arrange sufficient length of pipe at site to place the RMC in the minimum required time.
- l) Pre delivery tickets shall be produced with each truck load of RMC.
- m) The representative of RMC supplier shall attend the site meetings as and when decided by the EIC
- n) The contractor shall assess the quantity of RMC requirement at site well in advance and order accordingly to the RMC supplier. It shall be the responsibility of the contractor to arrange requisite quantity of RMC available at site, so that there is no hindrance to the work on this account.

3.8 Batching and Mixing

Only controlled design mix will be used for concrete with strength more or equal to M20. Volume batching may be allowed (Using mechanical Mixers) for mixes up to M10, for these leaner mixes mass volume relationship shall be checked frequently to ensure specified grading is maintained.

For the production of controlled concrete contractor shall set up, on site, automatic microchip controlled batching plant of capacity 30Cum/Hr or more minimum 2 nos. as per the requirement, complete with silos / stock piles for cement and aggregates and D.G sets to be provided to have uninterrupted supply of concrete. The batching plant shall be tested and calibrated as per manufacturers manual and to the satisfaction of EIC, before starting the production of concrete, to provide uniform & consistent cement concrete mix conforming to approved mix design Batching / Mixing plant shall conform to the requirements of IS 4925 & 4926. Batching plant shall have facilities for presetting the quantities to be weighed with automatic cut off when the same is achieved and also shall be equipped with sensors to control water ratio as per moisture contents of aggregates. Printed reports of all the components of all the batches of concrete as separated by on line computer of batching plant, shall be presented to EIC for his approval and records. Cube samples from each batch shall be taken as per the requirement of IS 456-(latest), in the presence of EIC. Cubes shall be tested to record 7days & 28Days cube strength. Contractor shall be responsible for the quality of concrete which will be indicated as per the cube strength results at the end of 7days & 28days. However, 28days strength results will be treated as final.

Contractor shall make his own trial mixes for different grade and submit the report of the final design mix to be adopted for different grades to EIC for his approval and records (Contractor shall take in cognisance while designing concrete mixes, time required for transporting and placing the cement concrete mix at final position). Contractor shall specify along its bid the type and make of the proposed batching plant with brief specifications. All the concrete shall be pumpable including column & wall. Contractor to make provision for adequate no. of pumps as required for horizontal & vertical concreting.

The accuracy of the measuring equipment should be within plus or minus 2% of the quantity of cement being measured and within plus or minus 3% of the quantity of aggregate, water, admixture being measured. All measuring equipment should be maintained in a clean, serviceable condition.

Mixing with mechanical mixer (for M20 or richer) will only be permitted in exceptional circumstances and then with the specific arrangement of the EIC. No water shall be added to mixed concrete other than the quantity of water allowed for in the mix design and incorporated in batching.

Concrete or mortar which has commenced to set shall not be remixed with additional water and in no circumstances shall such concrete or mortar be used in the work.

3.9 Concrete Admixtures & Plasticizers

Admixtures are materials added to the concrete before or during mixing with a view to modify one or more properties of concrete in plastic or hardened state. Concrete admixtures are proprietary items of manufacturers and shall be obtained from established manufacturers having proven track record, with EIC's approval.

3.10(a) Water proofing compound to be added to the concrete of buried, water retained structures, retaining wall etc as directed by the EIC

3.11 Transporting Concrete

From batching plant concrete to the location of proposed construction shall be transported through transit mixers or concrete pumps only. Contractor shall specify the make & type and number of transit mixers to be deployed along with concrete pumps with their make, capacity. The path to be used by transit mixers will be strictly as per the instructions of EIC. From the transit mixers concrete shall be transported to the final floor level / position through pumping only. Concrete and mortar shall be transported speedily and deposited in its place in the works without contamination, loss of ingredients or segregation. Buckets of builder's hoist shall be large enough to contain an integral number of batches. No concrete shall be placed in the works until the contractors' proposed method of transporting concrete have been approved.

3.12 Concrete placement General

Concrete, when deposited, shall have a temperature of not less than 5oC (41oF) and not more than 32oC (90oF).

The concrete shall be placed in the positions and sequences indicated on the drawings, in this specification and/or as directed by the EIC.

Contractor shall give adequate notice to the EIC of his intention to concrete any section of the works.

Except where otherwise directed, concrete shall not be placed unless the representative of the EIC is present and has previously examined and approved the positioning, fixing and condition of the reinforcement or any other items to be embedded and the cleanliness, positioning and suitability of the concreting surface.

The concrete shall be deposited as nearly as possible in its final position. It shall be placed in such a manner as to avoid segregation of the concrete and displacement of the reinforcement, other embedded items, or formwork. It shall be brought up in horizontal layers not exceeding 450 mm in compacted thickness unless otherwise authorised or directed by EIC. Concrete shall not be placed simultaneously on each side of large horizontal specified or approved construction joints.

Shutters for walls or thin sections of considerable height shall be provided with openings or other devices that will facilitate the cleaning of the accumulation of hardened concrete on the shutters or on the metal reinforcement above the level of the concrete and the removal of concrete in the case of segregations.

Placing concrete in cold weather

No concrete shall be mixed or placed while the ambient temperature is above 40-degree C. on a rising thermometer or below 5-degree C. on a falling thermometer. The contractor shall supply an accurate maximum and minimum thermometer and hang it in an approved position on the works. Aggregates that have been exposed to frost shall not be used until completely thawed. Concrete shall be maintained by approved means at a temperature of not less than 4 degree C. during placing, and for a period of three days thereafter. All concrete placed during cold weather or when a frost is predicated or is likely to occur or occurs contrary to expectation, shall be protected from freezing by approved means.

Placing of concrete in wet weather

Concrete shall not be mixed and or placed in rainy weather or when there is likelihood of impending heavy showers. If it becomes necessary to place concrete during rainy weather, the contractor shall provide adequate protection by means of tarpaulin or similar other water proof material to immediately cover fresh concrete to prevent rain falling over it. This protection shall be left on the concrete for a period of 24 hours after placing of concrete.

Concrete placement under water

Concrete placed under water shall be deposited through a tremmie pipe the diameter of which shall be atleast 8 times the size of the largest aggregate used in the concrete mix.

The construction of and the method of handling the tremmie pipes shall be approved by the EIC. The pipes shall be waterproof and sufficiently strong to withstand severe handling conditions and any joints must be sealed with adequate gaskets.

At the commencement of tremmie work the bottom of the pipe shall be sealed before being lowered in to position. The seal shall only be broken by the concrete being placed. The concrete placed in contact with a horizontal construction joint shall have a lower proportion of coarse aggregate and a higher proportion of cement than the remainder of the concrete. The proportion shall be agreed with the EIC's Representative.

All underwater concrete shall be placed in still water within a cofferdam or formwork which shall extend above water level.

The proportions of the mixes shall be agreed in accordance with the strength and workability required by the specification. To allow for losses an addition of 10% of cement shall be added to mixes of concrete scheduled to be placed under water.

3.13 Maintenance of Plant and Equipment

The contractor shall keep Bathing Plant, weigh batching machines, mixing machines, compressors, vibrators and other plant and equipment for concrete and mortar work clean, well maintained and adjusted and where appropriate, shall check the accuracy of the measuring devices at regular intervals, all to the approval of the EIC's Representative. Mixer blades shall be replaced when worn down by 20 mm.

3.14 Night Work

Concrete shall not be mixed, placed, compacted or finished during the hours of darkness, except where necessary to complete a pour. However, concreting in darkness for these exceptions shall be only after obtaining the express permission in writing from the EIC's representative and in his presence only.

3.15 Compacting Concrete

The concrete shall be fully compacted through out the full extent of the layer. It shall be thoroughly worked against the moulds, and around any reinforcement and other embedded items without displacing them, and in to corners of the moulds. Successive layers of the same lift shall be thoroughly worked together adjacent to the common face. The

date of laying concrete shall be marked for curing and removal of form work.

Immersion vibrators shall be of approved type and shall have frequency of not less than 10000 oscillations per minute. They shall penetrate the full depth of the concrete to be vibrated and be immersed at sufficiency close spacing so that the whole volume of the concrete is satisfactorily and uniformly compacted.

Where the underlying layer is of fresh concrete, immersion vibrators shall also penetrate that layer to ensure homogeneity. Immersion vibrators shall be withdrawn slowly to prevent formation of voids. Vibrators shall not be used to work the concrete along the moulds or in such a way as to

damage shuttering or other parts of the structure or to displace the reinforcement or other embedded items. Immersion vibrators shall only be operated by those who have received proper instruction and training in their use.

External vibrators shall be of approved type and shall have a frequency of not less than 3000 oscillations per minute. They shall be securely and rigidly clamped to the shuttering. External vibrators shall only be used on shuttering which is strong enough to withstand the vibration without displacement, distortion or other damage.

The contractor shall ensure that sufficient standby vibrators and ancillary equipment are available during concreting operations.

3.16 Quality Control

- i) In order to ensure that the quality of materials and the mix proportions are suitable for the particular grade of concrete required are so maintained, sampling and testing shall be carried out regularly during the course or the works.
- ii) As frequently as the EIC's representative may require and in any case at least once a day while concreting is in progress, the contractor shall sample and carry out a determination of the moisture content and a mechanical analysis of the fine aggregate and each nominal size of coarse aggregate shall lie within the respective limits specified.
- iii) Workability testing shall be carried out in accordance with IS:456. The results shall lie within the range upon which the accepted mix design is based. Testing shall be carried out at such a frequency that the required workability is consistently achieved.
- iv) Samples of concrete shall be taken at random in accordance with IS: 516 at the time and place of deposition of the concrete.
- v) Notwithstanding the foregoing, additional samples shall be taken by the contractor when directed by the EIC. The test cube procedure shall be in accordance with IS: 516 throughout.
- vi) Compliance with the specified characteristic strength shall be assumed if :
 - a) Each of the six cubes in a group has a test strength not less than the characteristic strength or,
 - b) Not more than one cube has a test strength less than the specified characteristic strength but not less than 85% of the specified characteristic strength and the average strength of the group of four test results is not less than the specified characteristic strength plus the standard deviation of the group.
- vii) No loading or free fall is permitted over concrete structures during curing period. Free fall of materials to concrete structures is also not allowed

3.17 Seven-day cube tests

Acceptance of concrete is based on the 28th day results. However, the contractor shall establish a relation ship between 7 days and 28 days strengths by carrying out 7 days tests at the time of performing the laboratory testing and from subsequent quality control testing. This relation ship shall be used in interpreting any further test results to predict the probable value of the corresponding 28 days cube strengths. The contractor shall without delay advise the EIC of any sample that appears likely to fail to meet the specification and the contractor shall take any necessary action to minimize the effect of such failure.

3.18 Acceptance Criteria

The general Acceptance Criteria of any and all of the concrete work shall be as per the relevant Clauses of IS. 456.

If any of the works tests are not up to the standard, the EIC shall have the power to stop the work until the reason is investigated and steps taken to prevent further low results. The contractor shall not be entitled to any claims on account of such delays. Any concrete carried out from the batch that is afterwards found to be faulty, will be liable for rejection and if so directed, the contractor shall at his own expenses dismantle and replace the defective work and any work built thereon or shall take such other measures as may be deemed necessary by the EIC. At the discretion of the EIC, the contractor may be allowed to prove by means of a load test to be carried out at his own expense, that the concrete is capable of safely withstanding the loads as specified in the test.

3.19 Construction joints

Construction joints shall be provided in the position described on the drawings or elsewhere and where not so described on the drawings or else shall be in accordance with the following: -

- a) A joint shall be formed horizontally at the top of a foundation and 75 mm below the lowest soffit of the beams meeting at the head of a column.
- b) A joint shall be formed in the rib of a large tee beam and all beams 25 mm below the soffit of the slab.
- c) Concrete in a haunch or a splay on beam or a brace, and in the head of a column where one or more beams meet, shall be placed without a joint at the same time as that in the beam or beams or brace.
- d) Concrete in the splay at the junction of a wall and slab shall be placed throughout without a joint, but if the provisions of a joint is unavoidable, the joint shall be vertical and the middle of a span.
- e) A joint in a slab shall be vertical and parallel to the principal reinforcement, where it is unavoidable, at the right angles to the principal reinforcement, the joint shall be vertical and at the middle of the span.
- f) Expansion joints, hinges or other permanent structural joints shall be provided in the positions and of the form described in the drawings or elsewhere. Before placing new concrete against concrete that has already hardened the face of old concrete shall be cleaned and roughened and scrubbed and loose aggregate removed from the form. Immediately before placing the new concrete the face shall be thoroughly wetted and a coating of neat cement grout applied thereto. The new concrete shall be well rammed against the prepared face before the grout sets.
- g) Water bars to be provided to all construction joints of retaining wall and water retained structures.

3.20 Form Work and scaffolding / Staging: -

Form work to the fresh concrete shall be sufficiently rigid and shall be such as to prevent loss of slurry from the concrete and details and design of the form work shall conform to IS 14687. The tolerances on the shape, lines and dimensions shall be as per CL. 11 of IS 456

–2000.

All staging and scaffolding work shall comprise of MS. Pipes / Structural steel sections with necessary coupling arrangement. (NO WOODEN BALLIES / PROPS WILL BE PERMITTED). Adequate size foundation blocks / base plates shall be provide below staging members to disperse the loads as per the founding strata.

Form work construction

- i) The contractor should submit detailed drawing of the centering& shuttering and get the same approved from the EIC before laying concrete also he should get the centering shuttering approved in writing before start of concreting. The concreting should be done in the scientific and methodical manner so as to give a uniform finish in line and level, so that minimum rendering or plastering is done. The work found defective, should be dismantled & redone and site cleared.
- ii) Form work shall be so constructed that concrete can be properly placed and thoroughly compacted. Form work shall be firmly supported and adequately strutted, braced or tied to maintain position and size. Forms shall have sufficient strength and rigidity to with stand the weight of wet concrete and necessary pressure due to ramming and vibration of concrete and movement of men material and other loads without excessive deflection from prescribed limits. It shall be capable of adjustment to the lines, levels and dimensions of the finished concrete.
- iii) All form work shall be constructed to be rigid during the casting of concrete and constructed so that the surfaces adjacent to the concrete are with plus minus 6 mm or the required surfaces when supporting the concrete and sufficiently watertight to prevent loss of liquid from the concrete, and it shall be capable of being removed without shock or vibration to the concrete. Forms shall be cleaned with compressed air immediately before placing concrete to remove all rubbish. The inside faces of the form work shall be treated with a mould oil of type to be approved by the EIC and every care shall be taken to prevent mould oil from getting on to the reinforcement.
- iv) Beams boxes shall be erected with an upward camber of 6 mm for each 3 M. of span.
- v) Around the periphery of the building beyond building line, staging shall be erected by the contractor free of cost, using structural steel members duly braced to sustain all loads, with all safety measures like netting, temporary railings / parapets, platforms etc. to provide free access to external façade of the building at each floor level for construction and inspection. . Staging shall grow along with the building.
- vi) Two full set of shuttering materials for each building to be made availbe at site

Removal of Form work (Striking Time)

Unless certainly specified in the drawing, or directed by the EIC, the following shall be minimum intervals of time, which should be allowed between the placing of the concrete and the striking of the mould where ordinary portland cement is used and ambient temperature does not fall below 15 degree Celsius.

- | | | |
|----|--|--|
| a) | Walls, column & vertical faces | 16 to 24 hours as may be decided of all structural members by the EIC. |
| b) | Slab | |
| | i) Spanning upto 4.50 m | 7 days |
| | ii) Spanning over 4.50 M | 14 days |
| | Note: Soffit forms of the slab not to be removed after 3 days, | |
| c) | Beams and arches | |
| | i) Spanning upto 6 M | 14 days |

- | | |
|-------------------------|---------|
| ii) Spanning 6 M to 9 M | 21 days |
| iii) Spanning over 9 M | 28 days |

Note:

1. For other types of cement, the stripping time recommended for ordinary portland cement may be suitably modified. Forms shall not be released until the concrete has achieved a strength of at least twice the stress to which concrete may be subjected to after removal of the form.
2. The number of props left under, their sizes and disposition shall be such as to be able to safely carry the full dead load of the slabs, beam or arch as the case may be together with any live load likely to occur during curing or further construction.

However, the Contractor shall delay the removal of shuttering as long as necessary in order to avoid damaging the work. Where shuttering to soffit is removed prior to the props this is only permissible if the design of the shuttering allows such a sequence of operations without the props being in any way disturbed. If the shuttering and props are not independent, both must be left in place until propping is no longer required.

Where shuttering to sides is removed prior to the shuttering soffit, the side shuttering shall be removed without disturbing the shuttering to the soffit.

No concrete structure shall be loaded until the concrete is at least 21 days old and only then with the approval of the EIC and subject to such conditions as may be imposed.

The contractor may be required to produce evidence that the concrete has attained a strength sufficient to support the live and dead loads to which that part of the structure may be subjected. This evidence shall consist of reports of compression tests made on job cured test cubes. The cost of such tests shall be borne by the contractor. The foregoing provisions of this clause shall not relieve the Contractor of his responsibility to ensure that the stability and strength of any structure or part of a structure is not impaired by the release of shuttering.

Proposals for form work

Not less than 8 days before the contractor proposes to construct any form work his detailed proposals thereof shall be delivered to the EIC. Proposals shall comprise all relevant information

including calculations, detailed drawings, rates of placing of concrete, sequence of placing of concrete and details of any external vibrators which are proposed to be used.

No form work shall be constructed until the Contractors' proposals have been received and approved by the EIC.

Type of form work

Two qualities of form work shall be used i.e. Rough form work and wrought form work, as noted on the EIC's drawings or described hereafter.

Rough form work may be constructed of sawn timber or other material as agreed by the EIC. The edges of the boards shall be planned or otherwise rendered grout tight. Provided it remain grout tight, rough formwork may be used any number of time. This form work shall be adopted for surfaces not exposed/buried needing no surface finish viz. Foundations/Pile caps.

Wrought form work, to all surfaces for which a smooth fair faced finish is required, shall be constructed of purpose-made metal, water proof ply wood panel, hardboard lined form work or of planed timber with edges shot so that tight joints can be formed which will prevent loss of liquid from the concrete. The use of a particular material for wrought form work shall be consistently maintained throughout the structure. The surfaces of the form work in contact with the concrete shall be smooth and free from all blemishes. The number

of times wrought form work may be used shall be subject to the surfaces, joints and edges being clean and undamaged.

3.21 Surfaces of concrete

The contractor shall ensure that the finished face of concrete offers a suitable keyed surface for the application of the finishing media, e.g. plaster, sand and cement screed, etc. The contractor shall also ensure that where thin films of finished, e.g. skim coats "Snowcem", paint, etc. are to be applied that the previous provisions regarding supporting of form work are complied with, so that the concrete faces to be treated are left smooth, unblemished and true to line both vertically and horizontally and require no making good before applying the finish.

Should the contractor fail however, to comply with the provision of this Clause, he shall submit details of his proposed method of redoing the situation to the EIC and must obtain written consent from the EIC to the proposals before continuing with any further work on the affected surfaces.

3.22 Tolerances in concrete surfaces

The permissible tolerance in the surface of the hardened concrete shall not exceed the following limits:

3.23 Type of irregularity

Departure of member planes from position and level.	+12 mm
sections	+ 6 mm
Sharp changes in plane	+ 2 mm
Departure from 3 M. template of any part of planes	+ 3 mm

3.24 Curing

Canvass, Hessian or other approved screens shall be erected at all points where concrete is being placed to shade the concrete from the direct sun or from drying winds and such screens shall be kept in position until the surface of the concrete has been protected as specified in the following Clauses. The contractor shall be responsible for removing such screens and preparing surface of concrete.

As soon as possible after it has been placed and concrete shall be covered with Hessian or other approved material to protect it from the sun and all concrete surfaces shall be kept visibly wet continuously for 14 days after placement, the Hessian being kept in position throughout this period. Surfaces cast against forms shall also be kept moist and covered with Hessian for these periods if the form work is removed before the periods have elapsed.

The top surface of slab shall be kept flooded with water at all times till the curing period of 14 days is over. Columns, wall and beam sides and other surface shall be completely covered by gunny bags and kept thoroughly wet continuously for the period specified for curing. The ceiling of slabs shall be frequently sprayed with water until the end of curing period.

The contractor shall ensure that all times there is an adequate supply of fresh water available for curing the concrete.

Alternatively, curing compound of approved make & as per manufacturer be used.

3.25 Examinations and Repairs

The contractor shall not proceed with the surface finish or making good of concrete surfaces until he has received the EIC's written permission to do so and he shall not apply cement slurry or mortar or any other coating to the concrete surfaces as struck from the shuttering or do anything else which would hinder the proper inspection of the concrete by

the EIC.

Concrete which is defective, has honeycombs, or which contains defective parts shall be cut out completely unless the EIC agrees that a repair may be satisfactorily effected. This agreement shall not preclude subsequent condemnation of the repaired work.

The method of repairing defective concrete which the contractor proposes to adopt shall be submitted to the EIC for his prior written agreement in each particular case.

No repairs or remedial work shall be carried out without prior inspection and instructions of the EIC. (No extra shall be paid to the contractor for the repair works).

3.26 Fair face finish to concrete surfaces

Concrete surfaces shall be finished smooth fair faced where indicated as such on the drawings. These areas shall be entirely free from honey combing, stains, fins, lipping, nail or screw marks, raised grain marks, air holes or any other imperfections. They shall also be of even texture throughout. Very slight variations between member and member may be acceptable but any such variations within a single member cannot be tolerated. The concrete faces shall not be marked with mould oil.

The form work to these areas shall be wrought form work as specified herein.

Following inspection by the EIC the whole surface shall be rubbed down by hand. Any surfaces with major imperfections, i.e. greater than can be easily, completely and permanently obliterated by rubbing down shall be reported immediately to the EIC.

Remedial work is not normally possible to the above fair faced finish surfaces and the Contractor will be required to demolish and recast defective works.

3.27 Reinforcement Fabrication Bending Schedules

The Contractor shall submit to the EIC, for the EIC's approval, bending schedule for all the works, not less than Ten days before the contractor intends to bend the reinforcing steel.

The Approval of the EIC shall in no way absolve the contractor of his responsibilities under the Contract.

Programme of reinforcement details required

The Contractor shall provide a programme which gives the EIC at least 28 days prior notification of any reinforcement details required. The contractor shall justify the practicability of his programme to the EIC should it seem unreasonable before the programme be regarded as valid notification. If progress on site falls behind the contractors' programme, the issue of reinforcement details may be delayed by a period corresponding to the delay in construction.

Bending and placing reinforcement

Reinforcement shall be cut and bent to the shapes and dimensions shown on the finally agreed bending schedules in accordance with the requirements of IS: 2502 and to the tolerances set out therein.

Bending shall be carried out with an appliance which provides a continuous and uniform application of the bending deformation at every section of the bend. There shall be provision for the free movement of the surface of the bar during bending and the bends shall follow the contour of the former without peaking.

High Yield reinforcement must be bent without the application of artificial heating.

Steel reinforcement temporary left projecting from the concrete at construction or other joints shall not be bent out of position unless shown on the drawings or agreed by the EIC. Where such bending and subsequent rebinding takes place the radius of the bend shall not be less than 4 bar diameters.

Reinforcement shall be fixed without forcing in the position shown on the drawings within a tolerance of 5 mm or 5% of the minimum dimension of cross section, whichever be the greater and maintained so that it is not displaced during concreting or other operations.

Horizontal bars shall be supported sufficiently to prevent displacement. This may be chairs bent from steel bar, or by concrete blocks. The method and sufficiency of the support shall be subject to the approval of the EIC.

Where concrete blocks are used, they shall be precast from concrete (not mortar) of the same class as the concrete in which they are to be embedded, except that the largest size of aggregate shall be 10 mm. Each block shall be secured to the reinforcement with wire or a clip embedded in the centre of the block so that, it shall not be in contact with the shuttering or subsequently cause rust marks on the concrete. Intersections of reinforcement shall be bound together with 16 gauge annealed soft iron binding wire.

Unless otherwise noted on the drawings, no intersections of reinforcement may be fixed by welding without the permission of the EIC. High yield and cold worked steel shall, in no circumstances, be welded together.

Should any difficulty arise during the placing of steel in obtaining the appropriate cover, the contractor shall immediately draw the attention of the EIC to the difficulty and shall carryout such corrective measures as the EIC may suggest.

Protection of reinforcement and concrete

The Contractor shall ensure that movement of men and material subsequent to steel fixing is organized so that reinforcement is not thereby displaced.

Reinforcement left projecting from any concrete shall be protected so that there is no risk of corrosion staining to any exposed concrete surface or to any other part of the works. For this purpose, a stiff grout wash will normally be acceptable to the EIC, this wash shall be wire-brushed vigorously before further concrete is placed to remove any ill- bonded material.

Cover/Spacer Block

The contractor shall provide approved type of support for maintaining the bars in position and ensuring required spacing and correct cover of concrete to reinforcement as called for in the

drawings, spacer blocks of required shape and size. Chairs and spacer bars shall be used in order to ensure accurate positioning of reinforcement. Spacer blocks shall be cast well in advance with approved proprietary pre-packed free flowing mortars of high early strength and same colour as surrounding concrete, Pre-cast cement mortar/concrete blocks/blocks of polymer shall not be used as spacer blocks unless specially approved by the EIC.

3.28 Precast concrete units

Precast concrete materials and workmanship shall be in accordance with specifications unless indicated otherwise. Where different tolerances are indicated in this specification or on the drawings from these in the more severe tolerances shall apply. The units shall all be cast in properly made strong moulds to form the shapes required. For work described as "finished fair" the mould shall be lined with sheet steel or other approved material and care should be taken to ensure no damage is caused to edges or surfaces when units are removed from the moulds.

The concrete shall be of the mixes given on the drawings and shall be thoroughly vibrated in the moulds.

All precast work shall be cast under cover and shall so remain for seven days and shall be kept damp in order that the units are properly matured. No units shall be lifted until 18 days have elapsed since casting and no unit shall be erected until it has been approved

by the EIC as free from defects.

No cracked units will be accepted for incorporation in the works.

All reinforced structural precast units shall have the tops clearly marked.

Un-reinforced precast units, such as sills and copings, shall be lightly reinforced as necessary to facilitate handling.

4. **MASONRY WORKS**

Masonry work shall be carried out in conformity of Latest CPWD Specifications for works.

Guide lines for chases in masonry walls as per Indian Standard BIS: 1905 need to be followed. The cutting of chases, recesses etc. should be done without damage to the surrounding masonry. It is desirable to use such tools for cutting which depend upon rotary motion not on heavy impact for cutting action.

4.1 Solid Block Work

Precast Cement Concrete blocks shall be procured from approved manufactures or manufactured at site. Nothing extra shall be payable on account of adding any admixture for making precast blocks or for steam curing. • The Solid CC blocks shall have nominal size of 400mm x 200mm x 200mm or 300mmx200mmx200 for 200mm thick masonry wall & Solid blocks of nominal size 400mm x 200mm x 100mm or 300x200x100 for 100mm thick masonry wall and 400x200x150mm /300x200x150mm for 150 mm thick walls shall conform to IS2185 part I of 1979. • The samples of CC blocks (each sample consisting of 6 specimens) shall be chosen randomly from the lot and tested for various parameters specified below. One sample shall be tested for every 100 cum or part thereof.

- Following parameters shall be tested.
 - a) Compressive strength.
 - b) Water absorption
 - c) Density
 - d) Dimensional Tolerances The material shall meet following parameters:
 - e) Compressive strength shall be no less than 5.0 N/sq. mm.
 - f) Water absorption shall not be more than 5%. c) Density shall be not less than 1500 kg/cum.
 - g) d) Dimensional tolerance in the size shall be not more than + 5mm for length and + 3mm for height and width.

Top course of all plinth, parapets, steps and top of walls below floor and roofs shall be laid with solid blocks, properly radiated and keyed into position to form cut corner. Where blocks cannot be cut to form cut corners, cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) equal to thickness of the course shall be provided in lieu of cut blocks. No additional payment shall be made on this account. Nothing extra shall be payable on account of chasing the CC block masonry work for embedding pipes, electrical boards/boxes etc. and also filling the chases with cement mortar 1:4 (1 Cement: 4 Coarse sand). The chasing shall however be carried out using machine cutters so as not to disturb the joints in the masonry and without any cracks being developed in the masonry. All other specifications for 100 mm thick and 200mm thick hollow/solid block work shall be as described for full brick and half brick masonry work respectively. For unsupported lengths of 100 mm thick walls exceeding 3.5 m, 100 x 200 mm wide R.C. mullions shall be provided at 3.5 m centre, tied to the lintels at door height. Similarly, continuous R.C. beam of size 100 x 150 mm shall be

provided at door height for 100 mm thick wall.

4.2 BRICKWORK:

- i) The bricks shall conform to the IS No. 1077-1986 of minimum crushing strength of 75 Kg./cm². (First Class)
- ii) The building bricks are to be the best quality table moulded kiln burnt, patent bricks, hard sound, square with sharp arises, even and uniform in shape and colour free from cracks, stones, flaws and other defects. Samples of bricks are to be submitted to the Project Manager for approval before full quantity is ordered. All supply of brick to conform to the sample approved. No brick after 24 hours immersion in water shall absorb water more than 15% of its own weight.
- iii) The cement and sand shall be as described under 'Cement Concrete' and the mortar unless specified otherwise in Bill of Quantities is to be composed of one part cement to four parts of coarse sand by volume, thoroughly mixed by hand. Hydrophobic cement used in mortar shall be thoroughly machine mixed. No mortar that has started to set shall be used in the work.
- iv) Every brick shall be thoroughly soaked in water before use. Broken bricks shall not be used except as closers. The courses shall be truly horizontal and the work strictly plumb, joints shall be broken vertically and they shall not exceed 12mm in thickness. All joints in brick work are to be well filled with mortar.
- v) The brick work shall not be raised more than 12 single courses per day and shall be built in English bond, except brick on edge and half brick thick walls shall be built in stretcher bond. Except for brick on edge work, the bricks shall be placed with "frog" facing upwards.
- vi) All joints in brick work on both the faces shall be raked out 6mm deep as the work proceeds, and before the mortar sets.
- vii) The brick work is to be carried out with all necessary setbacks, projections, cuttings and too things in conformity with the drawings.
- viii) The brick work shall be cured by watering and continuously kept wet for 10 days, and the work shall be well protected during rainy season.
- ix) All uneven, irregular and bad brick work poor in workmanship shall be demolished if deemed necessary by the Project Manager and rebuilt by the contractor at the contractors' expenses. If necessary the contractor will have to provide wooden plug, etc. for his own work and for which there will be no special payment on that account. The work will have to be executed at any height and lift and will not form the criterion for any extra amount.
- x) Should any efflorescence be observed in brick work, it should be washed down by clean water and brick surface treated with such chemicals as are deemed necessary by the Project Manager without any extra charge and at the contractors' own expenses, till efflorescence subsides. Should the efflorescence persist, the brick work shall be demolished if deemed necessary by the Project Manager and the work rebuilt with new bricks including making good all the work disturbed without any extra charge.
- xi) **Half brick masonry:** All brick work under 115 mm thick shall be reinforced with one no. 16 gauge 25mm wide MS flat in every fourth coarse. The said flat shall be cast in or securely fixed to adjoining concrete walls or columns by screw with fastener. No extra for the cost of MS flat will be paid.
- xii) **Wall under structural members-** Allowance shall be made for leaving, temporarily open courses immediately below all structural members built into the walls. The open courses shall be left to permit full deflection of structural members. The open

courses shall then be made good and pointed up after the structural members have been fully loaded and before the completion of the work.

4.3 Stone Masonry

Materials for stone masonry work:

Stone: The stone shall be of the type specified such as Pink quartzite, granite, trap, limestone, sand stone, etc. and shall be obtained from the quarries, approved by the Project Manager. Stone shall be hard, sound, durable and free from weathering decay and defects like cavities, cracks, flaws, sand holes, injurious veins, patches of loose or soft materials and other similar defects that may adversely affect its strength and appearance. As far as possible stones shall be of uniform colour, quality or texture. Generally stone shall not contain cryptocrystalline silica or chart, mica and other deleterious materials like iron-oxide organic impurities etc.

Stones with round surface shall not be used.

The compressive strength of common types of stones shall be as per Table 1 and the percentage of water absorption shall generally not exceed 5% for stones other than specified in Table. For laterite this percentage is 12%.

Type of Stone	Max. Water absorption %age by weight	Minimum. Compressive strength kg/sqcm.
Granite	0.5	100
Basalt	0.5	400
Lime Stone (Slab& Tiles)	0.15	200
Sand Stone (Slab& Tiles)	2.5	300
Marble	0.40	500
Quartzite	0.40	800
Laterite (Block)	12	35

- Size of Stones :** Normally stones used should be small enough to be lifted and placed by hand. Unless otherwise indicated, the length of stones for stone masonry shall not exceed three times the height/ breadth/ base of the stone and shall not be greater than three- fourth the thickness of wall, or not less than 15cm. The height of stone may be upto 30 cm or as decided by Project Manager.
- Random Rubble Masonry shall be un-coursed or brought to courses as specified. Un- coursed **random** rubble masonry shall be constructed with stone of sizes as referred in above para and shapes picked up random from the stones brought from the approved quarry. Stones having sharp corners or round surfaces shall, however, not be used.
- Random Rubble Masonry brought to the course is similar to uncoursed random rubble masonry **except** that the courses are roughly levelled at intervals varying from 30cm to 90cm in height according to the size of stones used.
- Dressing:** Each stone shall be hammer dressed on the face, the sides and the bed. Hammer dressing shall **enable** the stones to be laid close to neighbouring stones such that the bushing in the face shall not project more than 10mm on both the exposed faces.

Mortar: The mortar used for joining shall be as specified.

Laying: All stones shall be wetted before use. Each stone shall be placed close to the stones already laid so that the thickness of the mortar joints at the face is not more than 20mm. Face stones shall be arranged suitably to stagger the vertical

joints and long vertical joints shall be avoided. Stones for hearting or interior filling shall be hammered down with wooden mallet into the position firmly bedded in mortar. Chips or spraws of stones may be used for filling of interstices between the adjacent stones in heartening and these shall not exceed 20% of the quantity of stone masonry. To form a bond between successive courses plum stones projecting vertically by about 15 to 20 cm shall be firmly embedded in the heartening at the interval of about one metre in every course. No hollow space shall be left anywhere in the masonry.

The masonry work in wall shall be carried up true to plumb or to specified batter.

Random rubble masonry shall be brought to the level courses at plinth, window sills, lintel and roof levels. Levelling shall be done with concrete comprising of one part of the mortar as used of masonry and two parts of graded stone aggregate of 20mm nominal size.

The masonry in structure shall be carried uniformly. Where the masonry of one part is to be delayed, the work shall be raked back at an angle not steeper than 45 degree.

Bond Stones : Bond or through stones running right through the thickness of walls, shall be provided in walls upto 60cm thick and in case of walls above 60cm thickness, a set of two or more bond stones overlapping each other by at-least 15cm shall be provided in a line from face of the wall to the back.

In case of highly absorbent types of stones (porous lime stone and sand stone etc.) single piece bond stone may give rise to dampness. For all thicknesses of such walls, a set of two or more

bond stones overlapping each other by at least 15cm shall be provided. Length of each such bond stone shall be less than two-third of the thickness of the wall.

Where bond stones of suitable length are not available precast cement concrete block of 1:3:6 mix (1 cement : 3 coarse sand : 6 graded stone aggregate 20mm nominal size) of cross section not less than 225 sqcm and length equal to the thickness of wall shall be used in lieu to bond stones. (This shall be applicable only in masonry below ground level and where masonry above ground level is finally required to be plastered).

At least one bond stone or a set of bond stones shall be provided for every 0.5 sqm of the area of wall surface. All bond stones shall be marked suitably with paint as directed by the EIC.

Quoin and Jamb Stones: The quoin and jamb stones shall be of selected stones neatly dressed with hammer or chisel to form the required angle. Quoin stones shall not be less than 0.01 cum in volume. Height of quoins and jamb stones shall not be less than 15cm. Quoins shall be laid header and stretcher alternatively.

Joints : Stones shall be so laid that all joints are fully packed with mortar and chips. Face joints shall not be more than 20mm thick.

The joints shall be struck flush and finished at the time of laying when plastering or pointing is not to be done. For the surfaces to be plastered or pointed, the joints shall be raked to a minimum depth of 20 mm when the mortar is still green.

Scaffolding: Single scaffolding having one set of vertical support shall be allowed. The supports shall be sound and strong, tied together by horizontal pieces, over which the scaffolding planks shall be fixed. The inner end of the horizontal scaffolding member may rest in a hole provided in the masonry. Such holes, however, shall not be allowed in pillars under one metre in width or near the skew back of arches. The holes left in masonry work for supporting scaffolding shall be

filled and made good with cement concrete 1:3:6 (1 cement : 3 coarse sand : 6 stone aggregate 20 mm nominal size).

Curing: Masonry work in cement or composite mortar shall be kept constantly moist on all faces for a minimum period of seven days. In case of masonry with fat lime mortar curing shall commence two days after laying of masonry and shall continue for at least seven days thereafter.

Protection : Green work shall be protected from rain by suitable covering. the work shall also be suitably protected from damage , mortar dropping and rain during construction.

e) **Square or Rectangular Pillars**

These shall be measured as walls, no extra payment shall be allowed for stone work in square or rectangular pillars over the rate for stone work in walls.

f) Tapered walls shall be measured net, as per actual dimensions and paid for as other walls.

Curved Masonry

Stone masonry curved on plan to a mean radius exceeding 6 metres shall be measured and included with general stone work. Stone work circular on plan to a mean radius not exceeding 6 metres shall be measured separately and shall include all cuttings and waste and templates. It shall be measured as the mean length of the wall.

5. **FLOORING WORKS:**

5.1 **General**

All flooring shall be laid to the best practice known to the trade. The flooring shall be laid to the level except where slopes are called for on the drawings in which case the slopes shall be uniform and so arranged to drain in to the indicated outlets.

Particular care shall be exercised to ensure that all flooring, skirting and dado are perfectly matched for colour and finish. Sufficient extra tiles (not less than 5%) shall be cast/ordered to ensure an adequate supply of matched floor tiles. The contractor shall furnish for approval by the Project Manager, samples of each type of floor finish.

- In order to keep the floor finish as per direction of Engineer-in-charge and as per Finishing Schedule/ Architectural drawings and to provide required thickness of the flooring as per specification, the level of top surface of RCC shall be accordingly adjusted at the time of its centering, shuttering and casting. Alternatively, for maintaining the floor finish, grading with cement concrete with nominal mix 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 10mm nominal size) shall be provided.
- The flooring in the building shall be as per the approved floor finish drawings and laid in such a way that limits in floor levels would not exceed the limits provided in the latest CPWD specifications or manufactures specifications.
- Wherever Vitrified Tile flooring is done, it shall be with multi grade/range 1st Quality tiles.
- Slope in floors shall be provided as per architectural drawings, else the levels at any place when checked over a distance of one meters in any direction should not show variation in floor level more than 3 mm.
- Rate for the items of flooring is inclusive of provision of sunken flooring and

finishing edges of the same in bath kitchen, toilets, cutting holes for traps/ pipes etc., and nothing extra shall be paid on this account unless otherwise specified.

- The pointing work immediately above the dadoing works shall be done with proper slope.
- Protective layer to be provided of any type of flooring and nothing extra shall be paid on this account.
- The ceramic tile used for wall cladding shall be of Size 300x600mm. The thickness for the tile shall not be less than 5mm.
- The ceramic tile used for flooring shall be of Size 600x600mm.
- The vitrified tile used for skirting and flooring shall be of Size 600x600mm. The thickness shall be minimum 9.8mm as specified.
- The Heavy Duty Homogenous digitized vitrified tile used for flooring shall be of Size 600x600mm of thickness not less than 16mm.

Minimum Bed mortars for various types of flooring

- Chequered tiles/stone flooring/kota stone flooring/granite flooring/ Ceramic glazed floor tile flooring/vitrified flooring - 20mm thick bed of cement mortar 1:4 (1 cement: 4 coarse sand). Anti Acid Tiles- 10 mm thick epoxy resin based adhesive.
- For dado, skirting and risers of steps in Chequered tiles/stone /kotastone /granite / Ceramic glazed floor tile /vitrified tiles- 12mm thick bed of cement mortar 1:3 (1 cement: 3 coarse sand).
- The vertical facia and drops shall be finished with epoxy resin based adhesive.

5.2 Granite Work

The granite stonework shall, in general, be carried out as per the CPWD Specifications and relevant specification for marble flooring, skirting, dado and tread/risers of steps under

Flooring Sub Head of the CPWD Specifications shall prevail.

Material

The tiles shall be of approved make and generally confirm to standard as perspecifications. They shall be flat, and true to shape and free from blisters, crazing, welts, crawling or other imperfection detracting from their appearance. The tiles shall be tested as per standard acceptance criteria mentioned.

The tiles shall be vitrified, homogenous throughout its body structure and surface shall be mirror finish/satin/antiskid/matt finish as specified. The underside of the tiles shall not have any finish in order that the tiles may adhere properly to the base. The edges of the tiles shall be preferably free from shine or polish. However, any finish, if unavoidable shall be permissible on only upto to 50 percent of the surface area of the edges.

Preparation of Surface and Laying

Base concrete or the RCC slab on which the tiles are to be laid or RCC Column/Wall for cladding shall be cleaned, wetted and mopped. The bedding for the tiles shall be with cement mortar 1:4 (1 cement: 4 coarse sand) or as specified. The average thickness of bedding shall be 20mm for floor and 12 mm for wall cladding. Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set

and to enable the mason to place wooden plank across and squat on it. Over this mortar bedding neat grey cement slurry of honey like consistency shall be spread at the rate of 3.3 kg of cement per square meter over such an area as would accommodate about 5-6 tiles. Tiles shall be soaked in water washed clean and shall be fixed in this grout one after another, each tile gently being tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible and in straight lines or to suit the required pattern.

The surface of the flooring during laying shall be frequently checked with a straight edge about 2m long, so as to obtain a true surface with the required slope. Where full size tiles cannot be fixed, these shall be cut (sawn) to the required size, and their edge rubbed smooth to ensure straight and true joints. Tiles, which are fixed in the floor adjoining the wall, shall enter not less than 10mm under the plaster, skirting or dado. After tiles have been laid surplus cement slurry shall be cleaned off.

Pointing and Finishing

The joint shall be cleaned off the grey cement slurry with wire/coir brush or trowel and all dust and loose mortar removed. Joints shall then be grouted with epoxy grout of desired contrast colour (of any approved make). The floor shall then be kept wet for 7 days. After curing the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped.

Acceptance Criteria For Tiles: -

S. No.	Property	Standard Laid Down
1.	Deviation in Thickness	± 5.0%
2.	Straightness of side	± 0.5%
3.	Rectangularity	± 0.6%
4.	Surface Flatness	±0.5%
5.	Water absorption	<0.08%
6.	MOHS Hardness	6
7.	Flexural Strength (minimum)	30 N/MM ²
8.	Abrasion Resistance	144 MM ³
9.	Skid Resistance	0.6
10.	Breaking Strength	1113 N
11.	Density (G/CC)	2
12.	Frost Resistance	Frost proof
13.	Chemical Resistance	No Damage
14.	Thermal Shock Resistance	No Damage
15.	Colour Resistance	No Damage
16.	Thermal Expansion	9 x 10-6

5.3 EPOXY FLOORING (BSL-3, BSL-2 & OTHER LABORATORIES)

5.3.1 EPOXY FLOORING:

The joint less Epoxy flooring consists of Epoxy resin based joint less flooring over concrete surface including preparing the surface as required, application of epoxy primer, 3-4 mm or more in thickness epoxy screed and self-levelling 2mm minimum epoxy topping in

required and approved shades. The entire job is to be undertaken by manufacturer's trained and skilled technicians to lay the Epoxy based floor.

Surface Preparation:

Applicator for the works should check out the moisture content in the existing RCC surface and if the percentage of moisture content is high same to be removed by using hot compressed air machine and the surface irregularities shall be removed by using floor screed. The concrete floors shall be roughened using hand grinders to provide a mechanical key for the epoxy screed to bond well the substrate. Presence of dust, laitance etc. should be completely cleaned before commencing the application. Moisture testing should be done to ensure moisture limit not exceeding 5%.

Epoxy Primer:

On the prepared floor surface epoxy primer with high penetrating properties shall be applied, as per manufacturer's recommendations.

Self-levelling Epoxy topping:

The self-levelling top coat mixture shall be spread evenly by means of rollers and serrated trowels. The floor should be rolled by a spike roller to remove trapped airs to uniform level and smoothness.

5.3.2 EPOXY COVING

Epoxy primer shall be applied at the junctions of wall corner. Epoxy coving of size 70 mm on either side shall be applied to the junctions between wall & floor. It is to be made with solvent less epoxy screed/resin incorporating very high abrasion resistant aggregates. Screed mortar shall be applied by trowel. The material should be compacted and finished with a round trowel to a smooth concave finish as per manufacturer's specifications. Sealing of screed surface shall be made with sealer coat to ensure that a smooth finish is obtained in desired colour matching that of the floor finish as per manufacturer's specifications.

5.3.3 Performance properties of Epoxy flooring and Epoxy coving shall meet or exceed the following:

Finish	-	Gloss/ Semi Gloss (as approved)
Compressive strength (ASTM C 579)	-	1000 psi Tensile strength (ASTM C 307) - 1750 psi
Hardness (ASTM D 2240)	-	85-90
Abrasion resistance (ASTM D 4060)	-	0.1 gm max. weight loss
Percent elongation (ASTM D 638)	-	0.15
Flexural Strength) ASTM C 580)	-	4000 psi
Bond strength (ASTM D 4541)	-	> 400 psi (100% concrete
failure) Indentation (MIL D 3134F)	-	No indentation
Coefficient of friction (ASTM D 2047)	-	0.6
Flamability (ASTM D 635)	-	Self extinguishing
Water absorption (ASTM C 413)	-	0.2%
Heat resistance Limitation	-	140OF/60OC (for continuous exposure) 200OF/93OC (for intermittent spills)
Cure rate allow (at 77OF/25OC)	-	06 hours for foot traffic 18 hours for light traffic 24 hours for normal operation

Guarantee / Warranty for wall coating: The Contractor shall give Guarantee / Warranty for Epoxy wall coating and Flooring for a period of 5 years.

6. FINISHING WORKS: -

6.1 General:

Plastering, Painting, Polishing/ Varnishing to be carried out as per latest CPWD Specifications and as specified in DBR, and finishing schedule/tender drawings.

All plaster work shall be of the best workmanship and in strict accordance with the dimensions of the drawings. All plastering shall be finished to true levels including plumbs, without imperfections, and square with adjoining work. It shall form proper foundations for finishing materials such as paint etc. Masonry and concrete surface to which plaster is to be applied shall be clean, free from efflorescence, sufficiently rough and keyed to ensure proper bond.

Wherever directed all joints between RCC frames and masonry walls, shall be expressed by a groove in the plaster. This groove will exactly coincide with the joint beneath. At the corners of all windows and doors or other openings and wherever instructed, 24 gauge expanded galvanized metal mesh strips 300 mm wide shall be placed diagonally to prevent plaster cracks.

Where grooves are not called for, the joint between concrete and masonry in filling, chasing for conduits, pipes, boxes etc. shall be covered by 24 gauge expanded galvanized metal strips, 300 mm wide installed before plastering. The contractor shall supply all necessary labour, material, tools and scaffolding necessary for the completion of the work detailed. He shall be responsible to take proper precautions to all works from damage. Any work rejected through non-compliance with the specifications or damaged work shall be removed and replaced at the expense of the contractor.

All chasing, installation of conduits, boxes, etc. shall be completed before any plastering is commenced on a surface. Chasing or cutting of plaster will not be permitted. Broken corners shall be cut back less than 150 mm on both sides and patched with plaster of Paris as directed. All corners shall be rounded to a radius. Contractor shall get samples of each type of plaster work approved by the EIC.

The materials used for plastering shall be proportioned by volume by means of gauge boxes. Alternatively, it may be required to proportion the materials by weight.

6.2 Plaster Work:

The joints in the brick work, concrete blocks, shall be raked to a depth of 15 mm while the masonry is green. Concrete surfaces to receive plaster shall be suitably roughened. All walls shall be washed with water and kept damp for 10 hours before plastering.

The plaster unless specified otherwise shall be average of 12 mm thick on walls and minimum 6 mm thick for the ceiling. The finished texture shall be as approved by the Project Manager. The mix for plaster unless otherwise specified, shall be one-part cement and four parts sand, to walls and one part cement, 3 parts sand to ceiling.

The interior plaster shall be applied in one coat only. The surface shall be trowelled smooth to an approved surface. All plaster work shall be kept continuously wet for seven days.

The external plaster shall be minimum 15 mm. Preparations of walls to receive plaster work shall be the same as in internal plaster.

The terrace plaster shall be minimum 20 mm. Preparations of walls to receive plaster work shall be the same as in internal plaster. Both layers of all external plaster shall be waterproofed with approved water proofing powder added to cement in proportion of 1.5 Kg. to 50 Kg. of cement as per the manufacturers' instruction, for both the coats.

TEXTURE PAINT

(Work to be carried out as per Manufacturer Specification)

Providing and applying External Texture finish of approved makes as per approved design and pattern. Texture finish shall be applied over the plastered surface with required thickness shall 2 to 2.5 mm thickness to form the necessary approved design by using trowel / putty blade and it should be allowed for drying minimum 12 hrs before the application of top painting , a coat of Latex Based Elastomeric, Fibre Reinforced waterproof coating, 2 coats or more of external weather proof water based emulsion shall be applied over this and a coat of primer may be applied based on the approved texture pattern. Including surface preparation like through cleaning, prewetting & removal of loose mortars, etc. The work shall include for all the above items including labours, tools & tackles, required scaffolding, platforms, etc. for all heights, etc. The contractor shall supply all materials, labour, tools, ladders, scaffolding and other equipment necessary for the completion and protection of all texture work as herein specified shall be applied to all surfaces requiring texturing throughout the exterior of the building as given in the schedule of finishes or elsewhere. The texturing shall be carried out by a specialist sub- contractor, approved by the ENGINEER-IN-CHARGE. Care is to be taken that all surfaces to be textured are thoroughly cleaned and dry.

Storage

Storage of materials to be used on the job shall be only in a single place approved by the Engineer-in-Charge.

Application

For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae, fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes etc. should be repaired using white cement. The prepared surface shall have received the approval of the Engineer-in-charge after inspection before painting is commenced.

Before pouring into smaller containers for use, the texture paint shall be stirred thoroughly in its container, when applying also the texture paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform. Dilution ratio of texture paint with potable water can be altered taking into consideration the nature of surface climate and as per recommended dilution given by manufacturer. In all cases, the manufacturer's instructions and directions of the Engineer-in-charge shall be followed meticulously. The lids of texture drums shall be kept tightly closed when not in use as by exposure to atmosphere the texture may thicken and also be kept safe from dust.

7. FALSE CEILING

General

- a. The false ceiling in the buildings shall be as per the approved finishing schedule appended in DBR, tender drawings as per latest CPWD specifications or manufactures specifications.
- b. False ceiling items in general are carried out as per the manufacturer's

specifications/ as directed by the Engineer – in –Charge.

- c. Location of particular type of false ceiling shall be as per relevant drawing, in its absence written approval of the Engineer – in - charge shall be obtained.
- d. The false ceiling tiles from manufacturers using recycled materials shall be preferred.
- e. Trap doors, as required, of approved size and design shall be provided.

Material – General Description

Providing and fixing tiled false ceiling of approved materials of size 595x595 mm in true horizontal level suspended on inter locking metal grid of hot dipped galvanized steel sections (galvanized @ 120gsm/sqm, both side inclusive) consisting of main "T" runner with suitably spaced joints to get required length and of size 24x38mm made from 0.30mm thick (minimum) sheet, spaced at 1200mm center to center and cross "T" of size 24x25mm made of 0.30mm thick (minimum) sheet, 1200mm long spaced between main "T" at 600mm center to center to form a grid of 1200x600 mm and secondary cross T of length 600mm and size 24x25mm made of 0.30 mm thick (minimum) sheet to be interlocked at middle of the 1200x600mm panel to form grids of 600x600mm and wall angle of size 24x24x0.3 mm and laying false ceiling tiles of approved texture in the grid including, wherever, required, cutting/making, opening for services like diffusers, grills, light fittings, fixtures, smoke detectors etc. Main "T" runners to be suspended from ceiling using GI slotted cleats of size 27 x 37 x 25 x 1.6x mm fixed to ceiling with 12.5 mm dia and 50 mm long dash fasteners, 4mm GI adjustable rods with galvanised butterfly level clips of size 85 x 30 x 0.8 mm spaced at 1200mm center to center along main T, bottom exposed width of 24 mm of all T-sections shall be pre-painted with polyester paint, all complete at all heights as per specifications drawings and as directed by Engineer-in-charge.

Metal Ceiling

GI Metal Ceiling Lay in perforated Tegular edge global white color tiles of size 595x595 mm and 0.5mm thick with 8mmdrop; made of GI sheet having galvanizing of 100 gms/sqm (both sides inclusive) and 20% perforation area with 1.8mmdia holes and having NRC (Noise Reduction Coefficient) of 0.5, electro statically polyester powder coated of thickness 60 microns (minimum), including factory painted after bending and perforation.

Gypsum Board

12.5 mm thick fully Perforated Gypsum Board & tile made from plasterboard having glass fibre conforming to IS: 2095 part I ,of size 595x595 mm, having perforation of 9.7x9.7 mm at 19.4 mm c/c with center borders of 48 mm and the side borders of 30 mm, backed with non woven tissue on the back side, having an NRC (Noise Reduction Coefficient) of 0.79.

Calcium Silicate

15 mm thick densified tegular edged eco friendly light weight calcium silicate false ceiling tiles of approved texture of size 595 x 595 mm in true horizontal level. The calcium silicate ceiling tile shall have NRC value of 0.50 (Minimum), light reflection > 85%, non-combustible as per B.S. 476 part IV, 100% humidity resistance and also having thermal conductivity < 0.043 w/mK.

Fire Performance

Products must be fully tested in accordance with BS 476 parts 6 and 7 with regard to fire propagation and surface spread of flame. Drawings and to the satisfaction of Engineer-in-charge.

8. MODULAR WALL AND CEILING PANELS

The internal partition walls and ceiling in BSL-3 Laboratory, BSL-2 Laboratory and other Laboratory shall be provided in pre-fabricated, non particle shredding modular panels in

powder coated finish, as per schedule provided in Vol-4 DBR. The prefabricated wall and ceiling panels should provide impervious and monolithic construction and surface finish. Outer/external brick walls should be provided with cladding from inside with similar pre-fabricated wall panels

The modular wall and ceiling panels shall be in specified thickness and constructed in 0.8 mm thick GSS sheet on both sides, in-filled with PUF insulation (density 38-40kg/m³), finished in epoxy plaster powder coating in approved shade, oven lacquered smooth to 60 to 80 micron thickness. The surface finish shall sustain Formalin/H₂O₂ fumigation of lab spaces.

All the joints between panels, cut-outs, openings and penetrations shall be sealed with silicone sealant as approved by Engineer-in-charge. The thickness of the wall and ceiling panels for different types of laboratories shall be as under:

- a. Wall & Ceiling Panels in BSL-3 Laboratory : 80-82 mm thickness
- b. Wall & Ceiling Panels in BSL-2 Laboratory : 50-52 mm thickness
- c. Wall & Ceiling Panels in Other Laboratories : 50-52 mm thickness

The wall and ceiling panels should be supported on heavy duty aluminum profile supported by anchoring. All wall and ceiling corners shall be provided with minimum 50 mm (R-50) aluminum coving, in the wall and ceiling colour, corners should be rounded at turn from X-Y direction, milled solid aluminum spheres should be provided in same colour at the 3-D(wall/ceiling/wall junction) and 2-D(wall/ceiling junction). The ceiling should be adequately supported with suspension and hangar system.

Each modular wall panel should not be of more than 1200 mm width. All the vertical and horizontal joints of wall and ceiling panels and covings should be sealed with silicone sealant to render leak proof installation.

The conduits for providing wires and cables for light, power, data, voice and other services shall be factory inserted in the wall panels, as per requirement and as per approved drawings by the Engineer-in-charge.

Service pendant/s constructed/manufactured in SS 304 (18 gauge) shall be provided for connecting services and utilities (like steam, water, compressed air, CO₂ etc.) inside the BSL-3 Laboratory. The ceiling pendant penetration shall be perfectly caulked and sealed with Epoxy Sealant not to allow any ingress of air, due to negative pressure.

After installation of wall and ceiling panels and sealing of all the joints, openings, penetrations, the wall and ceiling joints and penetrations shall be soap bubble tested at 1.25 times of the laboratory room designed working pressure for any leakage. In case any air leakage is detected, the same shall be repaired and sealed and tested again, till no air leakage/ingress of air is observed.

9. FIRE CHECK DOOR OF 120 MINUTES FIRE RATING

Providing and fixing in position single / double, leaf fire check doors and frames at all levels of approved make, design, finish, tested and certified at CBRI, etc. complete in all respect as per specifications and direction of Engineer-In-Charge and consisting of: -

Door frame shall be Single rebate Grooved profile of size 125 x 60 mm made out of 1.60mm (16gauge) minimum thick galvanized steel sheet conforming to IS 2260 & 4351 with grooved seal. Frames shall be Mitered and field assembled with self-tabs. All provision should be mortised, drilled and tapped for receiving appropriate hardware. Rubber door silencers should be provided on the striking jamb. Frames should be provided with back plate bracket and anchor fasteners for installation on a finished plastered masonry wall opening. Once frame installed should be grouted with cement & sand slurry necessary for fire doors on the clear masonry opening.

Door leaf shall be 46mm thick fully flush double skin door with or without vision lite. Door leaf shall be manufactured from 1.2mm (18 gauge) minimum thick galvanised steel sheet. The internal construction of the door should be rigid reinforcement pads for receiving appropriate hardware. The infill material shall be resin bonded honeycomb core with fire rated proprietary insulation filler bonded to both faces of sheet with lock seam joints at style edges. All doors shall be factory prepped for receiving appropriate hardware and provided with necessary reinforcement for hinges, locks, and door closers. The edges should be interlocked with a bending radius of 1.4mm. For pair of doors astragals has to be provided on the meeting stile for both active and inactive leaf. Vision lite wherever applicable should be provided as per manufacturer's recommendation with a beading and screws from inside.

The door frames and door shutters shall be primed with 'H' primer and finished with PU/Powder

coated.

The shutter would be mounted with SS Ball Bearing Hinges of size 100mm x 75mm x 3.0mm of Becker Fire Solutions (4 Nos per leaf), appropriate openings for vision panel glass. Prototype Test certificate for a test carried out earlier at CBRI Roorkee for fire rating of doors, shall be attached along with manufacturers test certificate.

All door shall be factory made and rate to include installation, Fire rated hardware like hinges, panic bar, door closer, Vision Panel 300x 200, Glass, lock, handles, coordinator etc. as desired with necessary reinforcement and direction of Engineer in charge.

Applicable Codes and Standards:

All standards, specifications, acts, and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.

List of certain important Indian Standards, Acts and Codes applicable to this work is given below. However, the applicable standards and codes shall be as per but not limited to the list given below:

IS: 277 Galvanised steel sheet (plain and corrugated) of GPL Grade with Z 120 Coating.

IS: 3614 Metallic and non-metallic fire check doors—Resistance test and Part-2 performance criteria.

Material: -

- a) Door frame shall be Single Rebate Grooved profile of size 125 x 60 mm made out of 1.60mm (16 gauge) minimum thick galvanized steel sheet confirming to IS 2260 & 4351 with grooved seal. Frames shall be Mitered and field assembled with self-tabs. All provision should be mortised, drilled and tapped for receiving appropriate hardware. Rubber door silencers should be provided on the striking jamb. Frames should be provided with back plate bracket and anchor fasteners for installation on a finished plastered masonry wall opening. Once frame installed should be grouted with cement & sand slurry necessary for fire doors on the clear masonry opening.
- b) Door leaf shall be 46mm thick fully flush double skin door with or without vision lite. Door leaf shall be manufactured from 1.2mm (18 gauge) minimum thick galvanised steel sheet. The internal construction of the door should be rigid reinforcement pads for receiving appropriate hardware. The infill material shall be resin bonded honeycomb core with fire rated proprietary insulation filler bonded to both faces of sheet with lock seam joints at style edges. All doors shall be factory prepped for receiving appropriate hardware and provided with necessary reinforcement for hinges, locks, and door closers. The edges should be interlocked with a bending radius of 1.4mm. For pair of doors astragals has to be provided on the meeting stile for both active and inactive leaf. Vision lite wherever applicable should be provided as

per manufacturer's recommendation with a beading and screws from inside.

- c) The door frames and door shutters shall be primed with 'H' primer and finished with PU/Powder coated. The shutter would be mounted with SS Ball Bearing Hinges of size 100mm x 75mm x 3.0mm of Becker Fire Solutions (4Nos per leaf), appropriate openings for vision panel glass. Prototype Test certificate for a test carried out earlier at CBRI Roorkee for fire rating of doors, shall be attached along with manufacturers test certificate

All door shall be factory made and rate to include installation, hardware's like hinges, panic bar, door closer, Vision Panel 300x 200, Glass, lock, handles, coordinator etc. as desired with necessary reinforcement and direction of Engineer in charge.

The following information shall be submitted by the contractor for obtaining approval of the Engineer-in-charge before start of work.

Product Data	:	Manufacturer's data sheets on each product to be used, including preparation instructions and recommendations. Storage and handling requirements and recommendations. Details of construction and fabrication. Installation methods.
Shop Drawings	:	Detailed plans and elevations, details of framing members, anchoring methods, clearances, hardware, and accessories clearly shown.
Manufacturer's Certificates	:	Certifying that products meet or exceed specified requirements.
Operation and Maintenance Data	:	Submit lubrication requirements and frequency, and periodic adjustments required.
Name of installer	:	Approved by the manufacturer, specializing in performing work of this section with minimum three years' experience.
Manufacturer's warranty	:	For all parts and components of the fire rated door set system except counterbalance spring and finish for 5 years

Delivery, Storage and Handling:-

Fire rated door set shall be delivered and stored in manufacturer's unopened packaging until ready for installation. It shall be protected from exposure to moisture and shall be stored in a dry, warm, ventilated weather tight location.

Installation: -

The Contractor shall furnish all materials, labour, operations, equipment, tools & plant, scaffolding and incidentals necessary and required for the completion of all metal work in connection with steel doors, as called for in the drawings, specifications and bill of quantities which cover the major requirements only. Anything called for in the tender documents shall be considered as applicable to the items of work concerned. The supply and installation of additional fastenings, accessory features and other items not specifically mentioned, but which are necessary to make a complete functioning installation shall form a part of this contract.

The Contractor shall submit the details of manufacturers from the list of approved makes from which he intends to procure the doors. The contractor shall procure the doors only after the approval of the manufacturer from the Engineer-in-charge.

All metal work shall be free from defects, impairing strength, durability and appearance and shall be of the best quality for purposes specified made with structural proprieties to withstand safety strains, stresses to which they shall normally be subjected to. All fittings shall be of high quality and as specified and as per approval. The Contractor shall strictly

follow, at all stages of work, the stipulations contained in the Indian Standard Safety Code or its Equivalent British Standard and the provisions of the safety code and the provision of the safety rules as specified in the General Conditions of the Contract for ensuring safety of men and materials. Any approval, instructions, permission, checking, review, etc. by Engineer-in- Charge, shall not relieve the Contractor of his responsibility and obligation regarding adequacy, correctness, completeness, safety, strength, quality, workmanship

- a) Door closer confirming to CE & EN 1154 and B.S. – 476, Part-22, two hours' fire door.
- b) Panic Exit Device – Single / Double leaf confirming to CE & EN 1154 and B.S. – 476, Part-22, two hours' fire rated.
- c) Mortice Lock with lever handle confirming to CE & EN 122090 / DIN 18251 and B.S.- 476, Part-22, two hours' fire rated.
- d) Stainless steel ball bearing hinges 4 nos. on each side of shutters size 100 mm x 100 mm x 3 mm with screws etc. complete.
- e) Vision panel: 6 mm thick borosilicate toughened glass 120 min fire rated glass on each leaf of size 300 x 200 mm.

Testing: -

The fire doors shall be tested by CBRI/ International Test House or any Test Lab approved by the competent authority in accordance with BS 476 part 22. Galvanized steel to be used conforming to IS 277. Testing charges shall be paid by the contractor.

10. STAINLESS STEEL RAILING WORK

The scope of the work includes preparation of the shop drawings (based on the site requirement and architectural drawings), fabrication, supply, installation and protection of the stainless steel railing till completion and handing over of the work.

The stainless steel work shall be got executed through specialized fabricator having experience of similar works. The Contractor shall submit the credentials of the fabricator for the approval of the Engineer-in- Charge.

The Contractor shall submit shop drawings, for approval of the Engineer -in-Charge, for fabricating stainless steel railing with detailing of M.S. stiffener frame work backing along with the fixing details of the M.S. frame work to the R.C.C columns. The details of the joints in the stainless steel railing including location, etc. shall also be shown in the shop drawings.

The Contractor shall procure and submit to the Engineer-in-Charge, samples of various materials for the railing work, for approval. After approval of samples, the Contractor shall prepare a mock up for approval of Engineer-in-Charge / Consultant. The material shall be procured, and the work taken up only after the approval of the mock up by the Engineer-in-Charge. The mock- up shall be dismantled and removed by the contractor as per the directions of the Engineer-in- Charge. The cost of samples shall be borne by the contractor.

The stainless steel shall be of grade 304 with brushed steel satin finish and procured from the approved manufacturer. It shall be without any dents, waviness, scratches, stains etc.

The required joints in the railing provided as per the architectural drawings, shall be welded in a workmanlike manner including grinding, polishing, buffing etc. all complete and compacted. The temporary clamps provided and fixed to hold the stainless-steel railing, in position shall be Removed after the concrete has set properly. The junction of the flooring and the cladding shall be neatly filled with weather silicone sealant of approved colour and shade.

One test (three specimens) for each lot shall be conducted for the stainless-steel pipe in

the approved laboratory. Therefore, the material shall preferably be procured in one lot from one manufacturer.

The finished surface shall be free of any defects like dents, waviness, scratches, stains etc. and shall have uniform brushed steel satin finish. Any defective work shall be rejected and redone by the Contractor at his own cost. The finished surface shall therefore be protected using protective tape which shall be removed at the time of completion of the work. The surface shall then be suitably cleaned using nonabrasive approved cleaner for the material.

The work shall include all inputs of labour, materials (including stainless steel pipes, welding, brazing, concrete, protective film, weather silicone sealant etc including cost of providing and fixing M.S. frames), T & P other incidental charges, wastages etc. The items also included providing and fixing stainless steel anchor fasteners for fixing railing.

The railing shall be fixed in position using stainless steel pipes, stainless steel posts of required diameters and thickness as per approved drawing and polished to satin finish including cutting, welding, grinding, bending to required profile and shape, hoisting, butting, polishing etc.

11. REBAR COUPLERS

Providing and fixing parallel threaded couplers conforming to IS code on "Reinforcement Couplers for Mechanical Splices of Bars for Concrete Reinforcement - Specification", to reinforcement bars including threading, enlargement at connection by forging, protecting the prepared reinforcement bars and related operations as required to complete the works per direction of Engineer-in-Charge.

Scope

The work shall covers the use of reinforcing rebar coupler for joining reinforcing bars to another reinforcing bar to achieve the required length. The coupler made with the process of cutting, cold forging and threading.

Couplers systems

Mechanical splices

The mechanical splice system consists in enlarging the reinforcing bar ends by cold upsetting prior to threading them. The bars are cut square before the enlarging operation

The combination of the square cutting and the cold-upsetting reduces the length of the bar by approximately 40 to 75 mm on each end, depending on the bar size. Extra-long threads are used to assist alignment, or when joining bars that cannot be turned.

Standard splices

Standard splices are accomplished by use of a standard female coupler matching the thread size made on the bars.

Position splices

When both bars would be a burden to rotate, for example because of their size or length, the splice system simply extends the thread onto the ribs of the bar, thereby enabling the coupler to be fully screwed onto it. It is then unscrewed from one bar and back onto the second bar to accomplish the connection.

Transition splices

When there is a need to splice bars of different sizes, it is allowable in most cases to reduce the size of the larger bar and to use a standard coupler.

Headed bars

Development of reinforcement is the main use of headed bars : They conveniently replace

hooked bars as end anchorages in congested areas. They can also be used to reduce lapping length, or as confinement or shear reinforcement where placing of

stirrups is difficult. Typical applications include exterior beam-column connections, roof corners, pile feet, pile caps, cantilevered members, corbels, etc.

Testing codes to be followed

Initial connection Tensile testing required for prequalification by the engineer shall be borne by the Supplier based on one tensile test per bar-diameter as required for the Project and as per IS 1786 standard. IS 1786 for rebar, ACI 318 for Coupler Joint.

Installation and construction operation

The mechanical connection is achieved by screwing the coupler onto one bar, and then screwing in the second bar. Contrary to taper threads, no torque wrench is necessary, and mis-assembly by crossing threads is impossible. Isometric parallel threads have equal resistance in tension and compression. Therefore, the tensile performance of the splice will not be affected if the two bars are not in butt-to-butt contact. Since the safety ratio on the thread engagement length is designed to be at least two pitches, a gap between both bars is admissible. Bars that are not properly aligned may still be connected if this misalignment is within reasonable limits, depending on the length of bar and on their stiffness. Large bars must always be properly aligned

12. STONE CLADDING WORK

Providing and fixing dry cladding upto 15 metre heights with 30mm thick gang saw cut stone with (machine cut edges) of uniform colour and size upto 1mx1m, fixed to structural steel frame work and/ or with the help of cramps, pins etc. and sealing the joints with approved weather sealant as per Architectural drawing and direction of Engineer-in-charge.

The work shall be carried out as per CPWD specification 2009 Shop Drawings and Sequence of execution for cladding work shall be submitted by the contractor for approval of Engineer-in-charge. The work shall be executed after the approval of Engineer-in-charge.

13. FIRE STOP SEALANT

Providing and applying acrylic fire stop sealant, with minimum 2 hours fire rating when tested in accordance with UL 1479 standards, shall be used along the periphery of ducts & Metal pipes without insulation. The products shall be age tested as per Dafstb and DIBT standards. The products shall carry test certificate for mold resistance rating of 0 as determined by ASTM G21-96. and shall have a VOC content of approx. <1 g/l as per LEED 2009. The products shall be UL listed & classified and shall bear the UL approval logo on the packing. (considering 5 mm joint width & 13 mm thick depth of sealant)

14. STAINLESS STEEL HARDWARES FOR DOOR/WINDOW/VENTILATORS

The stainless-steel fittings and fixtures shall be machine made and free of fabrication marks, residual effects of welding /riveting etc.

The fitting shall be finished in a Satin finish (brushed finish-satin's commercial purpose) except wherever specified otherwise. The brush effect shall be uniform and without any variations.

Irrespective of the stipulations contained above, the contractor shall produce samples for all the fitting in advance and a written approval for the chosen sample shall be obtained from the ENGINEER-IN-CHARGE. The decision of the ENGINEER-IN-CHARGE in respect of

the specification, quality and make of fitting to be used at site shall be final and binding on the contractor. Nothing extra shall be payable on this account.

All the fittings shall provide with all such accessories as are required to complete the item

in working condition whether specifically mentioned or not in the Bill of Quantities, specification & elsewhere in this tender document. The quoted rates shall be deemed to be all inclusive for a complete item fit for use including all material. Labour, T & P, Specials, fixing arrangements, nuts, bolts, screws, bushes, all required connection pieces etc. as well as making good the surface wherever required. All the accessories including brackets, nuts, bolts, screws, bushes etc. shall be of the quality and make specified by the manufacture of the fitting.

All the fitting shall be got fixed through the authorized "Fixing Agency" on the approved list of manufacturers of fitting. The said Fixing Agency shall be got approved from the ENGINEER-IN-CHARGE before start of fixing at site.

All the fitting including accessories shall be accompanied with certificate of origin and representative test certificate of conformance with relevant code form the manufacturer with each lot supply. The test certificate should clearly indicate the lot numbers of the supplied fittings.

15. **FRAMELESS SWING GLASS DOOR**

Providing, supplying and fixing of Frameless Swing Glass Door in glazing using 12mm thick toughened glass die cast patch fitting with stainless steel cover including fixing of patch fittings, floor springs, locks, handles etc. using the hardware items as detailed, complete in all respects as per detailed drawings, manufacturers specifications and direction of Engineer in charge.

- a) **Single Leaf:-** Swing Glass Door which includes one no. each of fittings such as

Top Pivot-1 nos., Toprail- 1 nos., Bottom rail with lock and 'H' Pull (600mmx32mm) Handle - 1 set, Floor spring with standard spindle conforming to EN-1154, tested for 500,000 cycles, non-handed unit suitable for doors up to 150kg leaf weight, with variable spring strength (size-EN 2-4) and closing speed adjustment 145°-15° & 15°-0°, fixed hold open at 90° and SS cover plate - 1 set. The top/bottom rail shall be 65mm height and 31mm thick with SSS cover on both sides complete. Featuring hydraulically fully controlled closing cycle including cement box, Finish: Satin Stainless Steel. The above work complete in all respect as per approved drawings and to the satisfaction of Engineer-in- charge.

- b) **Double Leaf:-** Swing Glass Door which includes two no. each of fittings such as Top Pivot- 2 nos., Top door rail - 2 nos., Bottom door rail and lock -2 sets with 'H' Pull Handle (600mm x 32mm) - 2 set, Floor spring with standard spindle conforming to EN 1154, tested for 500,000 cycles, nom-handed unit suitable for doors up to 150 kg leaf weight, with variable spring strength (size EN 2-4) and closing speed adjustment 145°-15° & 15°- 0°, fixed hold open at 90° and SS cover plate-2 sets. The top/bottom rail shall be of 65mm height and 31mm thick with SSS cover on both sides complete. Featuring hydraulically fully controlled closing cycle including cement box, Finish: Satin Stainless Steel. The above work complete in all respect as per approved

16. **DOUBLE GLAZED VIEW PANEL (VP)**

The view panels shall be double glazed and designed to fit flush into the wall panel system on both sides with min. 5 mm thick clear toughened glass. Glass shall be fixed onto aluminum frame work with high performance double coated black colour structural glazing tape (3 M VHB or equivalent). Aluminum frames shall be with 2 mm thick sheet

formed to match panel thickness with epoxy powder coating of 60 to 80 micron thickness. The total thickness of frame shall be as per wall panel thickness such that the glazing is installed perfectly flushed with the outer surface of the frame and wall panel. The gap between the glasses shall have anti-moisture with silica gel granules/molecular sieve. All joints shall be taped and sealed with silicon sealant.

17. METTALIC LABORATORY DOORS AND BIOSAFETY DOORS

Metallic Door frames shall be fabricated from 1.25 mm thick galvanized steel sheet to the required profile and dimensions. The door shutters shall be manufactured from 0.8 mm galvanized sheets press formed to double skin hollow profile with lock seam joints at stile edges. Door frames should be prepared for suitable hardware as scheduled and should have necessary reinforcement to withstand regular wear and tear. All provision should be mortised, drilled and tapped for receiving the hardware. Rubber door silencers should be provided on the striking jamb.

Metallic Door Shutters shall be 44 mm thick fully flush double skin door and shall have no visible screws or fasteners on either face. Door leaf shall be manufactured in 0.8 mm (22 g) thick galvanized steel sheet. The internal construction of the door shall be rigid with steel stiffeners/pads for receiving appropriate hardware. The infill material shall be resin bonded honeycomb paper core or as approved by Engineer-in-charge.

Frames and shutter shall have factory finish in thermos-setting polyurethane aliphatic grade paint (35 micron DFT) or powder coated in approved color.

Frames and shutters to have factory finishes pre-punched cutouts to receive specific hardware's like hinges, lock, door handles, door closer etc.

Each door shall be provided with shall be complete with all fittings, fixtures and requirements like heavy duty door closer, stainless steel kick plate on outer side, Stainless Steel handles, Key -Lock (except doors inside the BSL-3 Laboratory area), lip gasket on sides and top, drop-down gasket at bottom.

Double glazed vision panel to be provided in door shutters with toughened float glass of 5 mm thickness, installed flushed on both sides of door shutter. Glass to be fixed with high performance structural glazing tape (3 M VHB or equivalent)

Biosafety Doors

- a) The Biosafety Doors shall be in SS 316 no. 4 finish construction designed to maintain containment. Frames will be constructed in SS 316 no. 4 finish designed to accommodate flush mounting of access devices such as door access buttons, status lights, magnetic locks etc.
- b) Both the access doors of Fumigation/Transfer Airlocks and Showers of BSL-3 Laboratory and the shower of Effluent decontamination plant room shall be Biosafety doors.
- c) The Biosafety doors shall be air-tight doors, provided with inflatable gaskets, connected to compressed air line from the air compressor, and shall ensure perfect sealing of door when the door is in closed position. The inflatable gaskets shall be interlocked with the door interlock system such that when the door is closed, the gasket should inflate and seal the door and when the door release/open button is pressed, the gasket should deflate to allow opening of the door.
- d) The doors shall be capable to withstand room differential pressure and pressure testing loads.
- e) The door sealing arrangement shall be through inflatable gaskets in high grade neoprene
- f) Interconnecting compressed air supply piping and pressure regulators shall be provided for each biosafety door.
- g) Each Biosafety Door shall be factory tested for air tightness and no leakage at +/- 250 Pa before delivery at site.
- h) Doors for Airlocks shall be provided with sealed vision panel of approx. 400x400mm or 400 mm dia. for viewing, complete with double glazed laminated tempered glass.

- i) All surfaces shall be free from rough edges, burrs, sharp corners or edges
- j) Door shall be complete with all fittings and accessories like heavy duty door closers, stainless steel handles, mechanical locking arrangement etc. All fittings and accessories shall be in stainless steel.

18. STRUCTURAL GLAZING

The Structural Glazing work shall be unitized and shall be executed by specialized agency.

The contractor shall get design, engineering, test, fabricate, deliver, install, and guarantee all construction necessary to provide a complete structural glazing system to the proposed building, all in conformity with the approved designs and drawings, specifications and all relevant construction regulations including providing any measures that may be required to that end, notwithstanding any omissions or inadequacies of the Drawings. Without limiting the generalities of the foregoing, the Structural glazing System shall include, without being limited to, the followings:

- (i) Metal frames, glass glazing, spandrels, ventilators, finish hardware, copings metal closure, windows etc.
- (ii) All anchors, attachments, reinforcement and steel reinforcing for the systems required for the complete installations.
- (iii) All thermal insulation associated with the system. All fire protection associated with the system.
- (iv) All copings, end closure and metal cladding to complete the system.
- (v) All sealing and flushing including sealing at junctions with other trades to achieve complete water tightness in the system.
- (vi) Isolation of dissimilar metals and parts
- (vii) Anticorrosive treatment on all metals used in the system. Polyester powder coating on aluminium sections

The contractor shall also be responsible for the followings:

1. Submission of Shop Drawings, Engineering data and Structural Calculations in connection with the design of the Structural glazing System for the approval of Engineer-in-charge.
2. Mock-ups, samples and test units.
3. Performance Testing of the Structural Glazing framing and glazing assembly.
4. Co-ordination with work of other trades.
5. Protection.
6. All final exterior and interior cleaning and finishing of the Structural Glazing
7. As-built record drawings
8. Guarantees and Warranties.
9. All hoisting, staging and services.
10. Conceptualizing and design of a suitable maintenance system for curtain/structural glazing.

The water tightness and structural stability of the whole Structural glazing System shall be guaranteed and shall be the prime responsibility of the Contractor. Any defect or leakage found shall be sealed and made good all at the expense of the Contractor.

The Structural Glazing system shall be designed to provide for expansion and contraction of components which will be caused by an ambient temperature range without causing

buckling, stress on glass, failure of joint sealants, undue stress on structural elements or other detrimental effects. Specific details should be designed to accommodate thermal and building movements.

The Contractor shall submit Structural analysis & design and shop drawings for the loads conforming to IS 875 part III (the system must pass the proof test at 1.5 times design wind pressure without any failure), and seismic loads as per IS-1893.including functional design of the aluminum sections for fixing glazing panels of various thicknesses, aluminium cleats, sleeves and splice plates etc. gaskets, screws, toggles, nuts, bolts, clamps etc., structural and weather silicone sealants, flashings, fire stop (barrier)cum-smokeseals, microwave cured EPDM gaskets for water tightness, pressure equalisation& drainage and protection against fire hazard. This shall include for linear as well as curvilinear portions of the building. The design shall also ensure that the maximum deflection of any member shall not exceed $1/175$ of the span between supports or 20mm, whichever is less for vertical elements & $1/250$ of the span between supports for horizontal elements. Also no failure of structural silicone Jolts, damage to joinery, components, or permanent set in the framing members in excess of 0.2 percent of the span shall occur under 1.5 times the design load.

Specifications:

- a) Aluminum extruded tubular and other aluminium sections shall be as per the approved designs shop drawings, the aluminium quality as per grade 6063 T5 or T6 as per BS 1474,including super durable powder coating of 60-80 microns conforming to AAMA 2604 of required colour and shade as approved by the Engineer-in-Charge. No visual variation in shade shall be permitted.
- b) Brackets shall be M.S. hot dip galvanised / Aluminum alloy of 6005 T5 of required sizes, sections and profiles etc. to accommodate 3 Dimentional movement for achieving perfect verticality and fixing structural glazing system rigidly to the RCC/ masonry/structural steel framework of building structure using stainless steel anchor fasteners/ bolts, nylon seperator to prevent bimetallic contacts with nuts and washers etc. of stainless steel grade 316, of the required capacity and in required numbers.
- c) Sealing and filling, two part pump filled, structural silicone sealant and one part weather silicone sealant compatible with the structural silicone sealant of required bite size in a clean and controlled factory / work shop environment, including double sided spacer tape, setting blocks and backer rod, all of approved grade, brand and manufacture, as per the approved sealant design, within and all around the perimeter for holding glass.
- d) Shall fix in position flashings of solid aluminium sheet 1 mm thick and of sizes, shapes and profiles, as required as per the site conditions, to seal the gap between the building structure and all its interfaces with curtain glazing to make it watertight.
- e) Shall make provision for drainage of moisture/ water that enters the curtain glazing system to make it watertight, by incorporating principles of pressure equalization, providing suitable gutter profiles at bottom (if required), making necessary holes of required sizes and of required numbers etc. complete.
- f) The Glazing/Glass shall be in 6 mm thickness, heat strenghtened, of approved color and shade with reflective soft coating in size and shape as per approved shop drawings, and as directed by the Engineer-in-Charge. The Glass shall be of approved make having properties as visible Light transmittance (VLT) of 25 to 35 %, Light reflection internal 10 to 15%, light reflection external 10 to 20 %, shading coefficient (0.25- 0.28) and U value of 3.0 to 3.3 W/m² degree K etc. The Glazing shall be fabricated in the factory/ workshop of the glass processor.

Heat strengthened glass shall be examined to detect and discard any glass which exceeds the following tolerance: 1.5mm bow in 600mm; 3mm bow in 1500mm; 6mm

bow in 3000mm; 9mm bow in 4500mm. Where the strengthening process results in essentially parallel ripples or waves, the deviation from flatness at any peak shall not exceed 0.13mm and the difference between adjacent peaks shall not exceed 0.13mm. Where bow tolerance and wave tolerance differ, the stricter requirements shall govern.

Following test shall be carried out by the contractor. Manufacturer at his own cost as per following provisions:

Thickness	Impact Strength	Fragmentation	Surface Compression	Bending strength
IS-2835- 1987	IS-2553- PART-I	IS-2553-PART-I	ASTM C-1048-90	DIN 1249- PART-12

g) Fabrication and Installation

Installation shall be in true line vertically and horizontally.

Work shall be done by competent workmen who are thoroughly skilled in their trade. Assemblies shall be neat and free of defects that impair strength, function or appearance. The work shall be accomplished in compliance with the specified criteria without buckling opening or joints. Under stress on fasteners, sealants and gaskets, opening of welds cracking of glass leakage noises and other harmful effects.

As far as practicable fitting and assembly of the work, shall be done in the shop.

All exposed work shall be carefully matched to produce continuity of line and design. All joints in exposed metal work, unless otherwise shown or specified shall be accurately fitted end rigidly secured with joint sizes conforming to industry standards.

Except where otherwise shown specified, approved or directed, the method of assembly and joining shall be as per approved shop drawings. Fabricate and fasten metal work so that the work will not be distorted nor the fasteners over stressed from the expansion and contraction of the metal.

All welding shall be in accordance with the appropriate recommendations of the Indian welding codes and shall be done with electrodes and/ or by methods recommended by the manufacturer of the alloys being welded. All welds behind finished surfaces shall be done as to minimize distortion and/ or dis-coloration on the finished side. All weld spatter and welding oxides on finished surfaces shall be removed by de-scaling and/ or grinding.

Unless otherwise shown or specified, all weld beads or exposed surfaces shall be ground and finished to match and blend with finish on adjacent parent metal. Grinding and polishing of nonferrous metal shall be done only with clean wheels and compounds free from iron and iron compounds. No soldering and/ or brazing shall be allowed.

The Contractor shall conceal all the fasteners where visible in the finished work.

All aluminium components shall be fabricated before finishing, Cutting of components will not be acceptable.

As the building is exposed to varying weather actions, all fasteners shall be stainless steel, self tapping screws with Aluminum brackets. Steel anchors shall be pre-holed and galvanized. The bolts shall be steel chromium plated along with nuts and covered with butyl sealing compound.

Where aluminium comes into contact with masonry, brickwork, concrete, plaster or

dissimilar metals, it shall be coated with an approved insulation lacquer, paint or plastic tape to ensure that electro-chemical corrosion is avoided.

h) Sealant and Gasket Application

Sealant and gasket shall be provided wherever shown in the approved shop drawings or required for a permanently weather tight installation. The sealing mechanism for each location and use shall be as indicated on approved shop drawings and also in those locations where a mechanism is necessary but is not indicated.

All adjoining surfaces shall be protected to receive sealants against staining by masking and/ or other methods.

Joints and joint surfaces shall be clean, dry and free of any material that may have an adverse effect on the bonding and/ or seal of the sealant and gasket materials.

Apply sealants and gasket under the conditions recommended by the manufacturer(s) Prime all surface to receive sealants and gasket unless recommended otherwise use no sealant that has started to set in its container or a sealant that has exceeded the self life published by the manufacturer.

Fill all joints continuously and completely with sealant forming a neat uniform concave bead. Finish the material flush with adjoining surfaces unless otherwise shown on the drawings. All sealant surfaces shall be tooled smooth.

i) Samples

Contractor shall submit samples for review, labeled samples on 300mm long sections of aluminium extrusion shapes. Samples must show extremes of colour texture variation. Samples will be reviewed by Engineer-in-charge for colour and texture only. Compliance with other requirements shall be the responsibility of the Contractor. Colour and texture range of production material shall match approved samples. The Engineer-in-charge shall also require samples which will show the fabrication techniques and workmanship of the component parts, and the design of accessories and other exposed auxiliary items, before fabrication of the work proceeds.

19. ALUMINIUM WORKS

- a) The aluminum work shall comprise for doors, windows, ventilators and partitions with extruded built up standard tubular sections / appropriate Z sections and other sections of approved make conforming to IS: 733 and IS : 1285, fixed with rawl plugs and screws or with fixing clips, or with expansion hold fasteners including necessary filling up of gaps at junctions, at top, bottom and sides with required PVC / neoprene felt etc. Aluminum sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminum snap beading for glazing / paneling,

C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge.

- b) The aluminum section shall be colour anodized in approved shade by electro chemical process (as per IS 7088), 15 microns thickness with lacquer coating to protect the anodized surface. The shade shall be as approved by the Engineer-in-charge
- c) Fixed glazing shall be provided in aluminum door, window, ventilator shutters and partitions etc. with PVC/ neoprene gasket etc. complete as per the approved architectural drawings and the directions of engineer-incharge
- d) The glazing shall be in reflective heat strengthened glass panes of 6.0 mm thickness of required shade as approved by Engineer-in-charge

20. HORTICULTURE WORKS**a) PREPARATION**

During period prior to planting the ground shall be maintained free from weeds. Grading and final levelling of the lawn shall be completed at least three weeks prior to the actual sowing. Clods of excavated earth shall then be broken upto the size not more than

75mm in any direction. The area shall then be flooded with water and after 10 days and within 15 days of flooding, weeds that re-germinate shall be uprooted carefully. The rubbish arising from this operation shall be removed and disposed of in a manner directed by Engineer-in-charge. Regular watering shall be continued until sowing by dividing the lawn area into portion or approx 5 mts. Square by constructing small bunds to retain water. These 'bunds' shall be levelled just prior to sowing of grass plants. At the time of actual planting of grass, it shall be ensured that the soil has completely settled.

Slight unevenness, ups and downs and shallow depressions resulting from the settlement of the flooded ground, in drying and from the subsequent weeding operations, shall be removed by fine dressing the surface to the final levels by adding suitable quantities of good earth brought from outside, if necessary as directed by the Engineer-in-charge.

b) SOIL

The soil itself shall be ensured to satisfaction of Engineer to be a good, fibrous loam, rich in humus.

a) SOWING OF GRASS ROOTS

Grass roots (Cynodon dactylon or a local approved by the Engineer) shall be obtained from a grass patch, seen and approved beforehand.

The grass roots stock received at site shall be manually cleaned of all weeds and water sprayed over the same after keeping the stock in a place protected from sun and dry winds.

Grass stock received at site may be stored for a maximum of three days. In case grassing for some areas is scheduled for a later date fresh stock of grass roots shall be ordered and obtained.

b) EXECUTION

Small roots shall be debbled about 15 cms (or at other spacings as directed by Engineer-in-charge) apart into the prepared grounds. Dead grass and weeds shall not be planted. Grass areas will only be accepted as reaching practical completion when germination has proved satisfactory and all weeds have been removed. All planting is to be done in moderately dry to moist (not wet) soil.

Other plantations of trees and local plants shall be done as directed and approved by Engineer-in-charge

c) MAINTENANCE OF LAWN

As soon as the grass is approximately an inch high it shall be rolled with a light wooden roller in fine, dry weather and when it has grown to 2 to 3 inches above the ground, weeds must be removed and regular cutting with the scythe and rolling must be begun. A top dressing of annouce of guano to the square yard on well decomposed well broken sludge manure will help on the young grass. The scythe must continue to be used for several months until the grass is sufficiently secure in the ground to bear the mowing

machine. It should be possible to use the inch above the normal level of the first two or three cuttings. That is to say the grass should be cut so that it is from 1 to 2 inches in length, instead of the $\frac{1}{2}$ to $\frac{3}{4}$ of an inch necessary for mature grass. In absence of rain the lawn shall be watered every ten days heavily, soaking the soil through to a depth of at least 25 cms.

Damage failure or dying back of grass due to neglect of watering especially for seeding out of normal season shall be the responsibility of the contractor. The contractor is to exercise care in the use of rotary cultivator and mowing machines.

d) **EDGING**

The contractor shall establish a neat edge where planting areas meet grass areas with spade or edging tool immediately after all planting, including lawn planting, is completed. Particular care shall be exercised in edging to establish good flowing curves as shown on the plans or as directed by the Engineer. Edging must be cut regularly and shall be maintained by the contractor.

21. SIGNAGE AND ASSOCIATED WORKS

1. The Biohazard, Chemical Hazard, Radiation hazard etc. signages shall be appropriately displayed.
2. The sign boards for rooms and area display shall be in English language
3. Suitable pictogram to be provided as per approved samples
4. The colour of signages to be as approved by Engineer-in-charge.
5. All signages details including sizes of sheet, letters, pictogram and border allround to be submitted and got approved from ENgineer-in-charge.
6. The signages work shall be for all heights and floor levels.
7. The scope of work include providing and fixing base frame with removable/ interchangeable signages.

a) PVC sheet / sun board

1. Sheet to be best available brand of minimum thickness 3mm.
2. Top vinyl film to be best available brands of LG, Samsung or equivalent.
3. The thickness of film without adhesive to be around 75 microns and with adhesive to be 100 microns.
4. The fixing to be done with screws / hanging chains/pipes/rods of approved make & material as per discretion of Engineer.
5. The work shall include pictogram & fixing up to any floor and height, wall fixing or hanging on ceiling.

b) Stainless steel

1. The thickness of sheet to be minimum 16 G for plate sign board and 18/20 G for SS letters.
2. The same to be fixed with SS screws.
3. The engraving of letters to be as per standard norms and colours.
4. The individual alphabets/ letters, wherever required to have an inbuilt arrangement for fixing to support base with stainless steel screws complete for all heights and levels. All corners to be smoothly finished & SS welding.

5. The sheet/letters may be shining or mat finish as approved by engineer-in-charge.

22. PLUMBING WORKS

- 1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely furnish all the Plumbing and PHE works as described in Vol-4 DBR and as per approved Designs and Drawings
- 1.2 Without restricting to the generality of the foregoing Sanitary installations shall include the following:
- a) Sanitary Fixtures & CP Fittings
 - b) Soil, Waste, Rain Water and Vent Pipes.
 - c) Internal and External Water Supply System
 - d) Water distribution system from plant room to various locations
 - e) Internal and External Sewerage and Storm water drainage system
 - h) Rain water harvesting system with recharge well.
 - i) STP
 - j) ETP
- 1.3 All works specified in the specification have to be executed in accordance with:
- a) The latest CPWD specifications, wherever applicable.
 - b) The rules and regulations of Local Authority Having Jurisdiction, and as per the statutory regulations applicable.
 - c) Applicable norms laid down by the relevant sections of latest editions of National Building Code (NBC) and all relevant codes of Bureau of Indian Standards shall be followed, as applicable.
 - d) The codes of the Uniform Plumbing Code of India shall be used as a general guide for good engineering practice, design and workmanship norms.
- 1.4 All materials used in the works shall have Bureau of Indian Standards valid certification stamped, marked or cast on the material in an acceptable and approved manner, as specified hereinafter.
- 1.5 Drawings, if any provided in tender, are general schematic and indicate the concept. Contractor shall prepare complete designs and drawings of plumbing and PHE works as per the requirements given in Vol-4 DBR, tender drawings and technical specifications. Work will be executed only as per approved shop drawings, to be submitted by the contractor and approved by Engineer-in-charge
- 1.6 Licence and Permit
- a) Contractor must keep constant liaison with all relevant authorities and shall be responsible for obtaining all approvals relating to water supply, sewerage, storm-water drainage system including rainwater harvesting, STP, ETP etc. complete.
 - b) Contractor shall obtain, from the local authorities all related completion certificates with respect to his work as required for occupation of the building
- 1.7 Cutting & Making Good
- No structural member shall be chased or cut without the written permission of the Engineer-In- Charge.

1.8 Final Installation

The Contractor shall install all sanitary fixtures and fittings in their final position in accordance with the approved trial assemblies and as shown on the Drawings. The installation shall be complete with all supply and waste connections. The connection between building and piping system and the sanitary fixtures shall be through proper unions and flanges to facilitate removal / replacement of Sanitary Fixtures without disturbing the built in piping system. All unions and flanges shall match in appearance with other exposed fittings.

Fixtures shall be mounted rigid, plumb and true to alignment. The outlet of water closet pans and similar appliances shall be examined to ensure that outlet ends are butting and the receiving pipes before making the joint. It shall be ensured that the receiving pipes are clear of obstruction. When Fixtures are being mounted, attention shall be paid to the possibility of movement and settlement by other causes. Overflows shall be made to ensure that necessary anchoring devices have been provided for supporting water closets, wash basins, sinks and other appliances

1.9 Protection against Damage

The Contractor shall take every precaution to protect all Sanitary fixtures against damage, misuse, cracking, staining, breakage and pilferage by providing proper wrapping and locking arrangement till the completion of the installation and handling over. At the time of handling over, the Contractor shall clean, disinfect and polish all the fixtures and fittings. Any Fixtures found damped, cracked, clipped, strained or scratched shall be removed and new fixtures and fittings free from defects shall be installed

1.10 Sanitary Fixtures

- a) The work in general shall be carried out as per CPWD Specifications with up to date correction slips.
- b) Without restricting to the generally of the foregoing the Sanitary Fixtures shall include all Sanitary Fixtures, C.P. fittings and Accessories etc. necessary and required for the Building.
- c) Whether specifically mentioned or not all Fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required

1.11 EUROPEAN W.C.

- a) European-type wall-hung WC with seat, lid and low level flushing PVC cistern, health faucet etc. Flush pipe/bend shall be connected to the W.C. by means of suitable rubber adapter. Wall hung W.C. shall be supported by C.I. floor mounted chair/bolts as per approval of the Engineer-In-Charge.
- b) Each W.C. seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C.

1.12 SINKS

- a) Sinks in laboratories shall be of stainless steel (lab sinks) and vitreous china in toilets.
- b) Each sink shall be provided with R.S. or C.I. brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable angle iron clips or brackets as recommended by the manufacturer. Each sink shall be provided with 40 mm dia C.P. waste with chain and plug or P.V.C. waste. Fixing shall be done as directed by Engineer-In-Charge.

NOTE : All sinks in BSL-3, BSL-2 and Other Laboratories shall be in Stainless Steel 304, with hands free/elbow operated tap.

1.13 ACCESSORIES

- a) Contractor shall install all Chromium Plated and porcelain accessories as shown on the drawings or as directed by Engineer-In-Charge,
- b) All C.P. Accessories shall be fixed with C.P. brass half round head screws and cup washers in wall with raw plugs or nylon sleeves and shall include cutting and making good as required or as directed by Engineer-In-Charge.
- c) Tower rail of SS grade 316, Mirror with frame of PVC or superior material & Glass shelf supported on SS Brackets, Toilet paper holder of SS grade 316 with European WC, Soap rack shall be provided in Toilets

1.14 SOIL, WASTE & VENT PIPES

i) GENERAL

Without restricting to the generally of the foregoing, the soil, waste, vent and rainwater pipes system shall include the followings:

- a) Vertical and horizontal Soil, Waste and Vent Pipes Rainwater Pipes and Fittings, Joints Clamps and connections to Fixtures.
- b) Connection of pipes to Gully Traps & Manholes etc.
- c) All materials shall be new of the best quality conforming to specifications and subject to the approval of Engineer-In-Charge.
- d) Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- e) 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.
- f) Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.
- g) Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.
- h) All works shall be executed as directed by Engineer-In-Charge.

ii) UPVC Pipes (I.S. 13592)

- a) 4/6/10 kg/cm² Class selection shall be as required/specified. All fittings for uPVC pipes up to 200 mm O.D. size shall be injection moulded as per manufacturer, confirming to IS: 13592 and as specified.
- b) For Fittings of sizes which are not injection moulded but fabricated (Locally/ Imported) sample of the same shall be submitted for approval.

iii) Clamps & Structural Support

- a) G.I. clamps shall be of standard design and fabricated from M.S. flat 40x3mm thick with required Galvanization.
- b) Where G.I. clamps are to be fixed on RCC columns or slotted angles, walls or beam they shall be fixed with 40x3mm flat iron "U" type clamps with anchor fasteners of approved design or 6mm nuts and bolts.

- c) Structural clamps shall be fabricated from G.I. (Galvanized) Structural members e.g. rods, angles, channels flats as per detailed drawing or as directed. Contractor shall provide all nuts, bolts, welding material and paint the clamps with one coat of red oxide and two or more coats of black Enamel paint. Wooden saddles, where required shall be provided.
 - d) Slotted angle/channel supports on walls shall be provided. Angles/channels shall be of sizes as per good engineering practice. Angles/channels shall be fixed to brick walls with bolts embedded in cement concrete blocks and to RCC walls with suitable anchor fasteners. The spacing of support bolts horizontally shall not exceed 1 m.
 - e) Wherever G.I. clamps are required to be anchored directly to brick walls, concrete slabs, beams or columns for clamping arrangement and making good with cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20mm nominal size) as directed by the Engineer-In-Charge.
- iv) Traps
- Floor traps in labs shall be of stainless steel, deep seal with an effective seal of 100 mm. The UPVC trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30x30 cm of the required depth. Where traps are suspended below ceilings, they shall be provided with proper structural supporting arrangements
- v) Urinal Traps
- Urinal traps shall be of UPVC deep seal traps or as specified with or without Vent and set in cement concrete block or suspended below ceiling.
- vi) Stainless Steel Gratings
- Floor and Urinal Traps shall be provided with 100-150 mm square or round Stainless steel grating, with rim of approved design and shape. Minimum thickness shall be 4- 5 mm.
- vii) Cleanout Plus
- Contractor shall provide brass cleanout plugs as required. 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. Clean out plugs and air vents for BSL-3 Lab drain shall be provided within containment barrier of Biological Effluent Decontamination Plant room.
- viii) Inspection
- Work should be inspected during installation and tests applied on completion, care being taken that, all work which is to be encased for concealed is tested before it is finally enclosed. Inspection should be carried out to ensure the following:
- (a) Work accords with the drawing and specifications.
 - (b) All pipe brackets, clips etc. are securely fixed.
 - (c) Fixtures are correctly spaced.

- (d) Pipe is protected where necessary.
- (e) Embedded pipe work is properly protected before sealing-in
- (f) All access covers, caps or plugs.
 - Are accessible
 - Are so made that the internal faces truly complete in internal bore.
 - Cause no obstruction in the pipe bore
 - Are well joined.

ix) Testing

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

a 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.

b 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.

A test register shall be maintained and all entries shall be signed and dated by Contractors and Engineer-In-Charge.

1.15 WATER SUPPLY PIPING

- i) 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 as per approved drawings
- ii) 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, sinks, equipment's, storage tanks and appliances.
 - (e) Excavation and refilling of pipe trenches, wherever required
 - (f) Trenches for taking pipe lines wherever required.
- iii) General Requirements
- a) All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Engineer-In-Charge.
 - b) Pipes and Fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
 - c) Short or Long bends shall be used on all main pipe lines as far as possible. Use of Elbows shall be restricted for short connections. As far as possible all Bends shall be formed by means of a hydraulic pipe bending machine for pipes up to 65mm dia.
 - d) Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.
 - e) Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.
 - f) Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.
- iv) Piping Material
- BSL-3 LABORATORY:
- a) The water supply piping inside BSL-3 Laboratory shall be provided in AISI 304 conforming to JIS G3448 standards.
 - b) The OD, thickness and bore of pipes shall be as under:
- | | Outer Dia/Thickness | Nominal Bore SS |
|-------------------|---------------------|-----------------|
| PIPE Grade 304 | 15.88 / 0.8 mm | 15 mm |
| SS PIPE Grade 304 | 22.22 / 1.0 mm | 20 mm |
| SS PIPE Grade 304 | 28.58 / 1.0 mm | 25 mm |
| SS PIPE Grade 304 | 34 / 1.2 mm | 32 mm |
| SS PIPE Grade 304 | 42.7 / 1.2 mm | 40 mm |
| SS PIPE Grade 304 | 48.6 / 1.2 mm | 50 mm |
- c) The fittings for SS 304 piping shall conform to JWWA G116 standards
 - d) The SS 304 piping system shall be capable for pressure upto 12 bar
 - e) All the joints in the SS 304 piping system shall be press-fit type and O-ring/gaskets shall be in EPDM
 - f) All clamps, supports in walls and ceiling inside the high containment areas shall be in SS 304.
 - g) The pipe installation shall not be installed flush on wall and shall be projected with minimum 1.5-2.0 inch gap from the wall to enable

cleaning of pipe surface.

- h) After installation, the entire pipeline system shall be pressure tested at 10 bar to ensure that there are no leakages.
- i) Suitable back-flow prevention devices/valves shall be provided in the main pipeline system at appropriate locations to prevent any back-flow from BSL-3 Laboratory.

BSL-2 LABORATORY, OTHER LABS AND AREAS :

Water supply system in BSL-2 Laboratory, other laboratories and areas shall be done in CPVC piping. In general areas, GI heavy class piping shall be provided. The GI pipe

and fittings shall conform to IS:1239 and CPVC pipes and fittings shall conform to IS:15778

The Galvanizing shall conform to IS:4736, the zinc coating shall be uniform, adherent reasonably smooth and free from such imperfections as flux, ash and drop inclusions, bare patches, black spots, pimples, lumpiness, runs, rust strains, bulky white deposits and blisters. The pipes and sockets shall be cleanly finished, well galvanized in and out and free from cracks, surface flaws laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut cleanly and square with the axis of the pipe.

Galvanized iron pipes shall be jointed with threaded and socket joints, using threaded fittings. Pipes will be made by applying suitable grade of TEFLON tape used for drinking water supply. (Use of red or white lead and sutli will not be permitted for screwed joints). All pipes shall be fixed in accordance with layout and alignment as per approved drawings. Care shall be taken to avoid air pocket. Pipes and underground shall be provided with anticorrosive protection, approved by Engineer-in-charge

v) Clamps

G.I. pipes in shafts and other locations shall be supported by M.S. clamps of design approved by Engineer-In-Charge. Pipe in wall chases shall be anchored by iron hooks. Pipes at ceiling level shall be supported on structural clamps fabricated from

M.S. structural as described in the sub section. Pipes in typical shafts shall be supported on Slotted Angles/Channels as specified elsewhere.

vi) Unions

Contractor shall provide adequate number of unions on all pipes to enable dismantling later. Unions shall be provided near each Gunmetal Valve, Stop Cocks, or Check Valves and on straight runs as necessary at appropriate locations as required and/or directed by Engineer-in-Charge.

vii) Gunmetal Valve

- (a) Valves 65mm dia and below shall be heavy Gunmetal. Ball valves shall be tested at manufacturer's works and the same stamped on it.
- (b) All Valves shall be approved by the Engineer-In-Charge before they are allowed to be used on work.

viii) Ball Valve

Ball Valves have body material as Forged Brass Chrome plated with

Spindle Brass Nickel Plating & Lever handle Steel Chrome plated with green plastic cover. The valve is suitable for water maximum working pressure up to 25 bar (PN 25). The valve is operated by turning. The rotation from open to close is a quarter turn (90°) which closes in a clockwise direction.

ix) Butterfly Valve

- (a) Butterfly valves of approved quality for pressure rating of 230 P.S.I. with locking arrangement and gearbox with handle operated (for above 150mm dia) shall be provided or as specified.
- (b) Butterfly valves shall be of specified quality conforming to IS:13095
- (c) Joints for butterfly valves shall be made with suitable tail /socket pieces on the pipe line and flanged joints made with 3mm thick insertion rubbergasket with appropriate number of bolts, nuts and washers
- (d) Butterfly valves shall be provided on all branches as shown in the approved drawings or as required

x) Non Return Valve

Non-return valves shall be of Cast Iron body and Bronze/Gunmetal seat. They shall conform to class of IS: 5312 with pressure rating PN 1.6 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. An arrow mark in the direction of flow shall be marked on the body of the valve

xi) Air Release Valve

- (a) Air release valves shall be single acting type air valves with cast iron body and bronze/gunmetal internal parts and plastic float.
- (b) Each air release valve shall be provided with isolating ball valve of specification given above

xii) Testing

- (a) 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.
- (b) Pressure shall be maintained for a period of at least two hours without appreciable drop in the pressure after fixing at site. (+10 %). A test register shall be maintained and all entries shall be signed and dated by Contractor(s) and Engineer-In-Charge.
- (c) In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages, and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and Fixtures shall be made good during the defects liability period.
- (d) After completion of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones and the same shall be tested as above.

xiii) Disinfection

After the first flushing, commercial bleaching powder is to be added to achieve a dosage of 2 to 3 mg/l of water in the system added and flushed. This operation should be performed twice to ensure that the system is fully disinfected and usable

1.16 SEWERAGE AND DRAINAGE PIPING AND WORKS

- i) Work under this section shall consist of furnishing all Labour, Materials, Equipment's and Appliances necessary and required to completely finish Sewerage and Drainage system as required by the drawings, specified hereinafter and approved drawings.
- ii) 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 works
 - (d) Rain water harvesting system
- iii) General Requirements
 - a) All materials shall be new of the best quality conforming to specifications and subject to the approval of the Engineer-In-Charge.
 - b) Drainage lines shall be laid to the required gradients and profiles.
 - c) All drainage work shall be done in accordance with the local Municipal bye laws.
 - d) Location of all manholes, catch basins etc., shall be got confirmed by the Contractor from the Engineer-In-Charge before the actual execution of work at site.
 - e) All works shall be executed as directed by Engineer-In-Charge
- iv) Alignment and Grade

The sewer pipes shall be laid to alignment and gradient shown on the drawings but subject to such modifications as shall be ordered by the Engineer-In-Charge from time to time to meet the requirements of the works. No change from the lines, depths of cutting or gradients of sewers shown on the plans and sections shall be permitted except by the express direction in writing of the Engineer-In-Charge.
- v) Drain piping in BSL-2 Laboratory, other laboratories and areas shall be provided in UPVC Pipes, conforming to I.S. 13592.
 - a) 10 kg/cm² Class selection shall be as required/specified. All fittings for UPVC pipes up to 200 mm O.D. size shall be injection moulded as per manufacturer, conforming to IS: 13592 and as specified.
 - b) For fittings of sizes which are not injection moulded but fabricated, sample of the same shall be submitted for approval.
- vi) All underground storm water drainage pipes and sewer lines where specified shall be centrifugally spun RCC (NP-2) pipes. Pipes shall be true and straight with uniform bore. Throughout cracked, warped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, when directed a certificate to that effect from the

manufacturer. For road crossing NP-3 grade shall be used

vii) Laying

R.C.C. spun pipes shall be laid on cement concrete bed or cradles as specified and shown on the detailed drawings the cradles may be precast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12mm below the invert level of the pipe properly placed on the soil to prevent any disturbance. The pipe shall then be placed on the bed concrete or cradles and set for the line and gradient by means of sight rails and bonding rods etc. cradles or concrete bed may be omitted, if directed by the Engineer-In-Charge

viii) After setting out the pipes the collars shall be centered over the joint and filled in with tarred gaskin, so that sufficient space is left on either side of the collar to receive the mortar. The space shall then be filled with cement mortar 1:2 (1 cement: 2 fine sand) and caulked by means of proper tools all joints shall be finished at an angle of 45 degree to the longitudinal axis of the pipe on both side of the collars neatly.

ix) Fittings & Inspection Chambers

Cleanout plugs shall be provided on head of each drain and at location indicated on plans or directed by Engineer-In-Charge. Cleanout plugs shall be of size matching the full bore of the pipe.

x) Cement Concrete for Pipe Support

- a) Wherever specified, all pipes shall be supported in concrete bed all round or in haunches.
- b) Unless otherwise directed by the Engineer-In-Charge cement concrete for bed, all round or in haunches shall be laid as follows :-

Details for Cement Concrete

Description	Upto 3 M depth
Pipes in open ground (No sub soil water)	All round (1:5:10)
Pipes (all) in sub soil water condition	All round (1:3:6)
Pipes under the building or at road crossing or under public places	All round (1:2:4)

(1=1 cement, 2-3-5 coarse sand, 4-6-10) stone aggregate 20 mm nominal size)

- c) R.C.C. pipes may be supported on brick masonry or precast R.C.C or Cast in situ cradles.
- d) Pipes in loose soil or above ground shall be supported on brick or RCC anchor blocks.

xi) Manholes and Chambers

All manholes, chambers and other such works shall conform to CPWD specifications

xii) Testing

- a) The lengths of sewer and drain shall be fully tested for water tightness.
- b) The Contractor shall give a smoke test to the drains and sewer, if directed by the Engineer-In- Charge
- c) A test register shall be maintained which shall be signed and dated

by Contractor, Engineer-In- Charge

- xiii) Drain Piping in BSL-3 Laboratory.
- a) Drain piping in BSL-3 Laboratory shall be done in seamless welded stainless steel 316 pipes and shall be terminated to the Biological Liquid Effluent Decontamination Plant.
 - b) All welded joints in pipeline shall be provided with anti-rust treatment
 - c) The floor trap assembly shall be deep seal type in stainless steel and shall be grouted cat-in-situ and sealed with non-shrinking epoxy sealant
 - d) The selection of fittings and assemblies shall be done considering the effects of steam/condensate from the autoclaves and corrosion effects of decontamination chemicals.
 - e) Proper slope shall be maintained in the drain lines and appropriate non-return valve shall be provided to prevent backflow.
 - f) U-Traps shall be provided with suitable head to counter the high negative room pressure inside the laboratory rooms.

TECHNICAL SPECIFICATION - FIRE FIGHTING WORKS

1. Work under this sub-head consists of furnishing all Labour, Material, equipment and accessories necessary and required to install and complete Fire Fighting System and equipment etc., complete as per National Building Code (NBC)/Statutory guidelines/standards.
2. Without restricting to the generality of the foregoing, the work of Fire Fighting System shall include the followings:
 - a) Providing M.S. black steel pressure pipe line main including Valves, Fire Hydrants, Excavation for Pipes, Laying of pipes, Painting of pipe and Making Connection to supply system.
 - b) Black Steel Pipe, Mains Laterals, Branches, Valves Hangers and Appurtenances.
 - c) Hose Reels, Rubberized fabric lined hose pipes, Hose cabinets & Landing Valves.
 - d) Portable Fire Extinguishers.
 - e) Hydrants & related accessories).
 - f) All civil and structural works, electricals, control & instrumentation, site & shop painting for complete fire-fighting system installations.

3. Applicable / Reference Codes

- a) IS:1239 (Part 1 & 2) - M.S. Pipe Heavy duty
- b) IS:14846 Sluice valves (PN 1.6)
- c) IS:6392-1971 - Steel Pipe Flanges
- d) IS:554 - Pipe threads where pressure tight joints are required
- e) IS:909 - U/G fire hydrants, sluice valve type
- f) IS:5312 (P-1) - NRV
- g) IS:778 - Gunmetal fullway valves with wheel tested to 20kg/cm² class II
- h) Butterfly valves - IS:13095 or BS:5155
- i) IS:5290 - Internal hydrant shall comprise "Single Headed Single Outlet GM Landing Valve" conforming to Type A
- j) IS:12585 - Hose tubing (Thermoplastic)
- k) IS:884 - Hose tubing, Globe valve, Stop cock & Nozzle
- l) IS:636 - Hose pipes rubber lined woven jacketed (RRL) & 63mm dia, conforming to type "A"
- m) IS:903 - The couplings shall be of instantaneous [Branchpipe, nozzle, spring lock type Coupling etc.]
- n) IS:15683 - Portable fire extinguishers

4. Drawings & Technical Submittal

The Contractor shall submit shop drawings for the entire fire fighting system installations to be provided under this contract along with details of General Arrangement drawings for major equipment's for Fire Hydrant and Sprinkler Systems for approval of Engineer-in-charge before proceeding with the work. He shall also furnish all clarifications and explanations as may be desired by the Engineer-in-charge promptly for early finalization of

the shop drawings. The work to be executed as per approved shop drawings & technical submittal by the contractor

5. Approval by Local Fire Service

It shall be the responsibility of the contractor to get the approval from the Local fire Service as required. This shall be without any liability to the Engineer-In-Charge.

6. Piping

- a) All piping shall be heavy class black steel conforming to IS: 1239 unless otherwise stated. Pipes shall be given one primary coat of red oxide paint before being installed.
- b) All Fittings shall be new and from reputed manufacturers, Fittings shall be of malleable castings of pressure ratings suitable for the piping system. Fittings used on welded piping shall be of the weld-able type.
- c) Flanges shall be new and from standard manufacturer as per IS:6392-1971, Table 17 with appropriate number of G.I. Washers, Nuts and Bolts, half threaded with 3 mm insertion neoprene gasket complete
- d) Tee off connection shall be through reducing tees, wherever possible. Otherwise ferrules welded to the main pipe shall be used. Drilling and tapping of the walls of the main pipe shall not be resorted to.

7. Welding

All welded piping is subject to the approval of the Engineer-In-Charge. Sufficient number of flanges and unions shall be provided.

Welding Procedures IS: 823

Welding Electrodes IS: 814, but of approved makes only

8. Pipe Installation and Support

- i) Piping shall be properly supported on or suspended from stands, clamps, hangers etc., as specified and as required. The contractor shall adequately design all the brackets, saddles, clamps, hangers etc. and be responsible for their structural integrity. Shop Drawings of all supports to be submitted for approval before execution of work
- ii) Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint and finish coated black. Where pipe and clamp are of dissimilar material, a gasket shall be provided in between. Spacing of pipe supports on main headers shall not exceed 3.0 meters in any case, and additional supports shall be provided on all bends, tees, valves etc. as per requirements.
- iii) Vertical risers shall be parallel to walls and column lines and shall be straight and plumb.
- iv) Risers passing from floor to floor shall be supported at each floor by clamps or collars attached to pipe and with a 12mm thick rubber pad or any other approved resilient material. Where pipes pass through the terrace floor, suitable curbing shall be provided to prevent water leakage. Risers shall also have a suitable concrete pipe support at the lowest point.
- v) Pipe sleeves of 50mm larger diameter shall be provided wherever pipes pass through wall and the annular space filled with lead wool and finished with retaining rings

9. Flanges

Flanged joints wherever required and specified in approved shop drawings shall be provided:

- i) Flanges shall be as per I.S.6392-1971, Table 17/18 with appropriate number of G.I. Washers, Nuts and Bolts, half threaded with 3 mm insertion neoprene gasket complete.
- ii) For jointing all types of flanged valves, vessels appurtenances, pumps, connections with other type of pipes, to water tanks and other places necessary and required as good for engineering practice

10. Pipe Protection

- i) All pipes above ground and in exposed locations shall be painted with one coat of Red Oxide Primer immediately after bringing the pipes to site and shall be painted with one coat of red oxide primer after erection and proper hydraulic testing, and two or more coats of Synthetic Enamel Paint of approved shade.
- ii) All black steel pipes under floors or below ground shall be provided with protection against corrosion after proper hydraulic testing by application of 100mm wide and 4mm thick layer of anti-corrosive protection tape over the pipe, with overlap of 25mm minimum as per manufacturers specifications.
- iii) Where pipes are buried under ground, after treated, the same shall be back filled with the excavated soil. The top of the pipes shall not be less than 100cms below the ground level. Where this is not possible, the permission of Engineer-In-Charge shall be obtained for burying the pipes at lesser depth.
- iv) Vibration Elimination: Piping installation shall be carried out with vibration elimination fittings wherever required.

11. Testing

All piping shall be tested to hydrostatic test pressure of minimum 14 kg/cm² or 1.5 times the design pressure whichever is higher for a period of not less than 24 hours. All leaks

and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer-In-Charge

12. Painting

- i) After the piping has been installed, tested and run for at least ten days. The piping shall be given two finish coats, 3 mils each of approved colour
- ii) The direction of flow of fluid in the pipes shall be visibly marked in white arrows or as directed by the Engineer-In-Charge.

13. Valves & Accessories

i) Sluice / Gate Valves

Sluice Valves above 65 mm shall be of Cast Iron body and Gunmetal seat. They shall conform to type PN 1.6 of IS:780. Sluice valves upto 65mm shall be of Gunmetal Full way Valve with wheel tested to 20 Kg./cm² class-II as per I.S: 778. Valve wheels shall be of right hand type and have an arrow head engraved or cast thereon showing the direction for turning open and closing.

ii) Butterfly Valves

- a) The Butterfly Valve shall be suitable for waterworks. The Valves conforming to IS:13095 shall be provided. All valves shall be suitable to withstand the pressure in the system and rating shall be PN 1.6. All valves shall be right handed (i.e. handle or key shall be rotated clock wise to close the valve).
- b) The direction of opening and closing shall be marked and an open / shut indicator fitted.
- c) The material of valves shall be as under: Body – Cast iron
Disc – Ductile Iron

Seat – EPDM / Nitrile rubber Shaft – Stainless Steel

- d) The Valve shall be fitted between two flanges on either side of pipe flanges. The Valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakage

- iii) **Non Return Valve**

Non-return valves shall be of Cast Iron body and Stainless Steel seat. They shall conform to API-594 and have companion flanges. They shall be Dual Plate Type suitable for both horizontal and vertical installation. An arrow mark in the direction of flow shall be marked on the body of the valve.

- iv) **Air Release Valve**

Air valves shall be provided at all high points in the piping system for venting valves shall be of the double float type, with G.M. body, vulcanite balls, rubber sealing, etc. Air valves shall be of the sizes specified and shall be associated with an equal size forged ball valve.

- v) **Ball Valve**

- a) The Ball Valve shall be made from forged brass and tested to 20 Kg/ cm² pressure. The valve shall be internally threaded to receive pipeconnections.
- b) The Ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body bonnet gasket and gland packing shall be of Teflon.
- c) The handle shall be of chrome plated steel with PVC jacket. The handle shall also indicate the direction of 'open' and 'closed' situations. The gap between the ball and the teflon packing shall be sealed to prevent water seeping upto 14 Kg / cm² pressure.
- d) The handle shall also be provided with a lug to keep the movement of the ball valve within 90 degree.

- vi) **Suction Strainer**

Strainers shall be of approved type with fabricated steel bodies designed to the test pressure of 16 Kg/ cm². Strainers shall be fabricated by minimum 1.2 mm thick stainless steel sheet with 3 mm dia. perforation holes. Strainers shall be provided with flanges or threaded sockets as required. They shall be designed so as to enable blowing out accumulated dirt and facilitate removal and replacement of screen without disconnection of the main pipe

- vii) **Pressure Gauges**

Pressure gauges shall be of 150mm dia. dial and of appropriate range and be complete with shut off gauge valve etc. duly calibrated before installation. Care shall be taken to protect pressure gauges during pressure testing.

14. Internal Hydrant

The Single headed Internal Hydrant outlet shall be as per IS: 5290 (Type-A),

- a) A cap with chain is provided on the head of the outlet. The hydrant will have an instantaneous pattern female coupling for connecting to HosePipe.
- b) The Landing Valve shall be fitted to a Tee connection on the wet riser at the landing.
- c) The Hydrant shall be constructed from gun metal and finished to a smooth polish on screwed ends. The Hydrant shall have screwed inlet of 80mm dia. flanged type with 4 nos. holes. The Hydrant shall have a PVC plug with chain fixed to the main body of the Hydrant. The Hydrant shall be tested to minimum 20 kg / cm² test pressure. The

Hydrant shall not leak at any screwed joint

15. First Aid Hose Reel Equipment

First aid hose reel equipment shall comprise reel, drum which can swing upto 170 degrees, with hose, guide fixing wall bracket, hose tubing, globe valve, stopcock and nozzle. This shall conform to IS: 884 - 1969. The hose tubing shall conform to IS: 444-1980 or IS:12585 (Thermoplastic). The drum shall be fabricated from GI sheet of minimum 18 gauge thickness.

- a) The hose tubing shall be 20 mm dia and 36.50 m long, or as specified in the The G.M. nozzle 5mm and shutoff valve shall be of 25 mm size to shut off the water supply to the Hose Reel.
- b) The fixing bracket shall be of swinging type. Operating instructions shall be engraved on the assembly. This heavy duty mild steel and cast iron brackets shall be conforming to IS:884 - 1969. The first-aid hose reel shall be connected directly to the M.S. pipe riser through a 25mm dia pipe.
- c) MS bracket shall be fixed on the wall to which the first aid hose reel shall be bolted. The bracket shall be of 40x40x5mm thick MS angle to form a square of 400x400 mm approx. This shall be fixed on the wall. After approval of sample by Engineer-In-Charge further units shall be fabricated in factory and all joints shall be finished with grinder and shall be spray painted after single coat of primer.

16. Hose Pipes, Branch, Pipes & Nozzles

i) Hose Pipes

- a) Two numbers Hose Pipes for Single headed External and Internal hydrants shall be rubber lined woven jacketed (RRL) and 63mm in dia. 15m long, (non percolating Reinforced rubber lined) conforming to IS:636 (Type A). The hose shall be sufficiently flexible and capable of being rolled.
- b) Each run of hose shall be complete with necessary Male & Female Gun Metal coupling at the ends to match with the landing valve or with another run of hose pipe or with branch pipe. The couplings shall be of instantaneous spring lock type. This shall be conforming to IS: 903

ii) Branch Pipes

Standard short sized Branch pipe shall be constructed from alloy of Gunmetal material, 63 mm dia and be complete with male instantaneous spring lock type coupling for connection to the hose pipe. The branch pipe shall be externally threaded to receive the nozzle conforming to IS:903. The branch pipe shall to be tested to 20 kg/ cm² pressure.

iii) Nozzles

- a) The nozzle shall be of Gunmetal, 20 mm internal diameter. The screw threads at the inlet connection shall match with the threading on the branch pipe. The inlet end shall have a hexagonal head to facilitate screwing of the nozzle on to the branch pipe with nozzle spanner.
- b) End Couplings, Branch pipe, and Nozzles shall conform to IS:903 - 1985.

17. Orifice Plate

- a) The internal hose cabinet shall accommodate the Hose Pipes, Branch Pipe, Nozzle and Hydrant Outlets and shall be fabricated from FRP. The overall size shall be 2100x1200x900 mm, or as specified in the Architectural details. This shall have lockable centre opening glazed doors/glass front door of min. 6 mm thickness as per the requirement and as per Architectural details. Where the niche for wet riser is provided with shutters, separate hose cabinet as above may be dispensed with. Sample of the fire door shall be approved by Engineer- In-Charge.

- b) The hose cabinet shall be of colour / shade as approved by Engineer-In-Charge.

18. HOSE CABINET (INTERNAL)

- a) The internal hose cabinet shall accommodate the Hose Pipes, Branch Pipe, Nozzle and Hydrant Outlets and shall be fabricated from FRP. The overall size shall be as specified in the drawing. This shall have lockable centre opening glazed doors/glass front door of min. 6 mm thickness as per the requirement and as per drawings. Where the niche for wet riser is provided with shutters, separate hose cabinet as above may be dispensed with. Sample of the fire door shall be approved by Engineer-In-Charge.
- b) The hose cabinet shall be of colour/shade as per statutory requirement and as approved by Engineer-In-Charge

19. FIRE BRIGADE INLET CONNECTIONS

- i) Fire Brigade Inlet connection shall be provided near the pump house and to the external fire ring system as specified , for the following purposes :-
 - (a) Fire Brigade suction draw out connection for fire static tank with provision of foot valve.
 - (b) Fire brigade inlet connection to fire static tank.
 - (c) Fire brigade inlet connection to the external ring main. Each connection shall be in accordance with similar dia of Sluice valve and Non return valve.
- ii) The locations of the fire brigade connections shall be easily accessible to the fire brigade, without any possible hindrance and shall be as approved by the Engineer-in- Charge.

20. VALVE CHAMBER

Contractor shall provide suitable Brick Masonry Chamber in cement mortar 1:4 (1 cement: 4 coarse sand) on cement concrete foundations 150 mm thick in 1:5:10 mix (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) 12 mm thick plaster inside and outside finished with a floating coat of neat cement inside with cast iron surface box approved by fire brigade including excavation, back filling complete

21. PORTABLE FIRE EXTINGUISHERS

Portable fire extinguishers shall be provided and shall conform to IS:15683 and distribution of extinguishers in each building shall be in conformity with IS:2190 - 2010

- i) **ABC Type Dry Powder Extinguisher**
 - a) The Extinguisher shall be filled with ABC Grade 40, Mono Ammonium Phosphate (MAP base) from approved manufacturer.
 - b) The Capacity of the extinguisher when filled with Dry Chemical Powder (First filling) as per IS:4308, Part-II-8/IS:15683, shall be 6 kg \pm 2 % or 10 \pm 3 %.
 - c) It shall be operated upright, with a squeeze grip valve to control discharge. The plunger neck shall have a safety city, fitted with a pin, to prevent accidental discharge. It shall be pressurized with Dry Nitrogen, as expelling. The Nitrogen to be charged at a pressure of 15 kg / cm².
 - d) Body shall be of mild steel conforming to relevant IS Standards. The neck ring shall be also mild steel and welded to the body. The discharge valve body shall be forged brass or leaded bronze, while the spindle, spring and siphon tube shall be of brass. The nozzle shall be of brass, while the hose shall be of braided nylon. The body shall be cylindrical in shape, with the dish and dome welded to it. Sufficient space for Nitrogen gas shall be provided inside the body, above the powder filling.

- e) The Neck ring shall be externally threaded the threading portion being 1.6 cm. The filler opening in the neck ring shall not less than 50 mm. Discharge nozzles shall be screwed to the hose. The design of the nozzle shall meet the performance requirement, so as to discharge at least 85 % of contents upto a throw of 4 meters, continuously, at least for 15 seconds. The hose, forming part of discharge nozzle, shall be 500 mm long, with 10 mm dia internally for 6 kg capacity and 12 mm for 10 kg capacity. It shall have a pressure gauge fitted to the valve assembly or the cylinder to indicate pressure available inside. The extinguisher shall be treated with anti-corrosive paint, and it shall be labelled with words ABC 2.5 cm long, within a triangle of 5 cm on each face. The extinguisher body and valve assembly shall withstand internal pressure of 30 kg / cm² for a minimum period of 2 minutes. The pressure Gauge shall be imported and suited for the purpose.
- ii) **Carbon Dioxide Extinguisher**
 - a) The Carbon Dioxide Extinguisher shall be as per IS: 15683.
 - b) The Body shall be constructed of seamless tube conforming to IS: 7285, and having a convex dome and flat base. Its dia shall be maximum 140 mm, and the overlay height shall not exceed 720 mm.
 - c) The discharge mechanism shall be through a control valve conforming to IS: 3224. The internal siphon tube shall be of copper or aluminium conforming to relevant specifications.
 - d) Hose pipe shall be high pressure braided Rubber hose with a minimum burst pressure of 140 kg/cm², and shall be approximately 1.0 meters in length having internal dia of 10 mm. The discharge horn shall be of high quality unbreakable plastic with gradually expanding shape, to convert liquid carbon dioxide into gas form. The handgrip of Discharge horn shall be insulated with Rubber of appropriate thickness.
 - e) The gas shall be conforming to IS: 307 and shall be stored at about 85 kg/cm². The expansion ratio between stored liquid carbon dioxide to expanded gas shall be 1:9 times and total discharge time shall be minimum 10 sec. and Maximum 25 sec.
 - f) The extinguisher shall fulfil the following test pressures :- Cylinder : 236 kg/cm²
Control Valve : 125 kg/cm²
Burst pressure of Hose : 140 kg/cm² minimum.
 - g) It shall be an upright type. The cylinder, including the control valve and high pressure Discharge Hose must comply with relevant Statutory Regulations and be approved by Chief Controller of Explosives, Jaipur and also bear IS marking.
 - h) The Extinguisher including components shall be ISI Mark.

22. POWER CABLING

Contractor shall provide all power /control cables from the motor control centre to various motors, level controllers and other control devices. All power cables shall be aluminium conductor XLPE insulated armoured and PVC sheathed and control cables of copper conductor PVC insulated armoured and PVC sheathed. All cables shall have stranded conductors of 1100 Volt grade. The cables shall be in drums as far as possible and bear manufacturer's name. Cables shall be laid as per standard practice conforming to relevant Indian Standards by providing proper cable supports and clamps as required. Cables and wires in conduits shall be laid on the metallic trays

23. FIRE SURVIVAL CONTROL CABLE

Fire Survival Control Cable with Class -2 copper conductor twin twisted with ceramifiable Silicone insulation along with drain wire, Aluminium Tape and Low Smoke Zero Halogen (LSZH) outer sheath as per BS-7629 Part -1. Outer sheath should be Anti Rodent. Fire test in accordance with BS: 6387-1994 CWZ.

24. CABLE TRAYS

- a) Contractor shall provide G.I. perforated cable trays of sizes with G.I. sheet thickness of 2.0mm. Cable trays shall be supported from the bottom of the slab at intervals of 60cms at both ends by welding support rods with insert plates OR Anchor fasteners including clips, bolts, nuts, support rods and any other materials required to fix the trays.
- b) The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8 mm dia round headed bolts, nuts and washers.
- c) Factory fabricated bends, reducers, tee/ cross junctions etc. shall be provided as per good engineering practice. The radius of bends, junctions etc. shall not be less than the minimum permissible radius of bending the largest size of cable to be carried by the cable tray

25. COMMISSIONING AND TESTING

After satisfactory completion of instalation of Fire Fighting system, the Contractor shall provide all facilities including necessary piping, labour, tools and equipment's etc. for carrying out testing and commissioning of the firefighting system complete as per requirement in the presence of Engineer-In-Charge or his representative and during the visit of the Fire Officer whenever and as may be required. Generally, the following test/inspection has to be carried out:

- (i) For the automatic operation of the fire system
- (ii) For checking the Pressure available at the farthest and highest point in fire down comer system.

TECHNICAL SPECIFICATION -WATER TREATMENT PLANT

1. GENERAL

The scope of work shall include:

- Water treatment plant equipment and accessories
- Water supply pumps
- Piping, valves and accessories
- All incidental jobs connected with Water Treatment Plant system services installation such as cutting chases in brick and making good, cutting/drilling holes through walls, floors and grouting for fixing of fixtures, equipment foundation, Structural supports & other supports as required at site shall be part of Water Treatment Plant system works.
- Cleaning of all equipment and piping including flushing of all pipe work to remove any foreign matter shall be carried out in sections as the work progresses
- Contractor shall submit the samples/catalogues of each material/equipment giving technical data. Contractor shall place the order only after getting written approval of samples/catalogues from Engineer-in-charge
- Contractor shall temporarily cover & protect all equipments & open pipe ends etc. It is the responsibility of the Contractor to protect all the installed fittings and all equipments until the time of testing, commissioning & handing over to the owners
- The location of the Water Treatment Plant System pipe lines, indicated in the drawing is only indicative. The contractor shall submit the shop drawing for the approval of Engineer-in-charge before executions of the installations at site
- Testing & commissioning of all systems including submission of test reports.

2. PUMPS MONOBLOCK PUMP

Water supply pumps shall be suitable for clean filtered water. Pumps shall be single/multi stage, monobloc horizontal, centrifugal pumps with CI casing and Bronze impeller, Carbon steel Shaft, mechanical seal and coupled to a TEFC electric motor. Each pump should operate to a curve required by the operating conditions.

The MOC shall be CI casing, Bronze impeller & Carbon steel shaft.

All parts in contact with water shall be corrosion resistant material. Each pump shall be provided with a totally enclosed fan cooled induction motor of suitable H.P. The motors shall be suitable for 400/440 volts, 3 phase, 50 cycles A.C. power supply and shall conform to IS 325 operating at 2900 RPM nominal speed

Each pumping set shall be provided with 150 mm dia gunmetal "Borden" type pressure gauge with ball valve and connected piping

Pump or the whole set shall be stable on rubber vibration eliminating pads appropriate for each pump as recommended by the manufacturer and approved by Engineer-in-charge

Contractor shall submit the technical data sheets, performance curve, GA/foundation drawing, installation drawing of all water supply pumps for approval of Engineer-in-charge.

SUBMERSIBLE PUMP FOR SUMP

Submersible pumps shall be single stage, single entry pump. Pump shall be with dynamically balanced impeller connected to a common shaft to the motor. Stuffing box shall be provided with mechanical seals.

Each pump shall be provided with water cooled squirrel cage induction motor suitable for 415 + 10% volts, 3 phase, 50 cycles A.C. power supply.

Each pump shall be provided with liquid level controller for operating the pump between predetermined levels.

The pumping set shall be for stationary application and shall be provided with pump connector in it. The delivery pipe shall be joined to the pump through a rubber diaphragm, and bend and guide pipe for easy installation, without disturbing delivery pipe the pump unit shall have a back pull out design. A rust proof chain shall be provided for each pump.

Pump shall be provided with all accessories and devices necessary and required for the pump to make a complete working system.

3. **LEVEL CONTROLLERS:**

Level controllers shall be electronic low voltage type using required number of stainless-steel type probes, shrouded in PVC sheath or encapsulated in a stainless steel pipe.

4. **PIPE & FITTINGS**

Water supply piping shall be in medium class GI conforming to IS 1239. Fittings shall be of malleable cast iron galvanized of approved make. Each fitting shall have manufacturer's trade mark stamped on it. Fittings for G.I pipes shall include couplings, bends, tees, reducers, nipples, unions, bushes etc. Fittings etc. shall conform to IS : 1879. (Part 1 to X) 1987.

Butterfly Valves

All valves 65 mm dia and above shall be C.I. slim seal butterfly valves. Butterfly valves shall be of best quality conforming to I.S. 13095 of class specified.

Non Return Valves (Check Valves)

Non-return valves shall be cast iron dual plate type with cast iron body and gunmetal internal parts conforming to IS: 5312

Ball Valves

All ball valves shall be heavy duty of approved make. Valves shall have suitable for test pressure of 25 Kg/Sqcm.

5. **WATER TREATMENT PLANT**

Contractor shall get the existing water quality tested and submit the technical data sheet of the proposed water treatment plant of Suitable Capacity of dual media filter/activated carbon filter for the approval of Engineer-in-charge..

MULTIGRADE PRESSURE SAND FILTER/ACTIVIATED CARBON FILTER, WATER SOFTENER & BRINE TANK

Filter shall conform to the code of unfired pressure vessel conforming to I.S. 2825.

Filter shall be multigrade pressure sand filter/activated carbon filter may be altered to suite the design of the most efficient performance.

Filters shall be vertical type of required diameter or as per manufacturers standard design. The shell and dished ends shall be fabricated from M.S. sheet. Tank suitable to with stand 1.5 times the working pressure. The shell shall have a minimum thickness of 6 mm and dished ends 8 mm or as per manufacturer recommendations.

Each filter shall have at least one pressure tight manhole cover for inspection and repairs.

Each filter shall be provided with screwed or flanged connections for inlet, outlet individual drain connections and all face piping, valves and all other connections

necessary and required. Face piping shall be MS / GI. (Heavy Duty).

6. **Pipe protection**

Where specified, required or approved all pipes in chase below ground shall be protected against corrosion by applying two coats of bitumen paint and wrapping with polythene tape and finishing with one more coat of bitumen paint.

7. **Pipe Support**

Piping shall be properly supported on or suspended from clamps, hangers as specified and as required. The contractor shall adequately provide all the brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency.

Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint and finish coated back. Where pipe and clamps are of dissimilar materials a gasket shall be provided in between

8. Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor by clamps or collars steel structural supports attached to pipe and with a 15 mm thick rubber pad or any resilient material. Where pipes pass through the terrace floor, suitable flashing shall be provided to prevent water leakage. Risers shall have a suitable clean out at the lowest point and air vent at the highest point

9. The work shall be complete in all respect and shall include starter panel for pump motors, cabling and wiring connection, earthing etc. as required

10. **WATER PROOFING**

10.1 General:

10.1.1 The Contractor shall be responsible for the water proofing design, proper installation and performance of waterproofing systems to make the sub structure and superstructure completely watertight.

10.1.2 The Contractor shall engage a qualified waterproofing specialist sub-Contractor, preferably manufacturer's authorized applicator to carry the water proofing in accordance with the manufacturer's recommendations & approved water proofing details.

10.1.3 For the Quality assurance and quality of workmanship, waterproofing specialist applicator should be proficient in handling and installing water proofing membrane / crystalline compound etc. CIDC certified and trained applicator to be preferred.

10.1.4 Waterproofing specialist applicators should have a proven track record, technical reliability, capability to supply full technical assistance, expert supervision during installation and performance guarantee. The Contractor shall submit the name of his Specialist waterproofing Contractor (waterproofing applicator) for approval along with work experience details.

10.1.5 The waterproofing compounds shall be in accordance with approved make of materials annexed in the contract agreement. The contractor shall get the waterproofing product and its make approved by the Engineer-in-charge. However, this approval shall not exempt the Contractor from responsibility for the success of waterproofing treatment done by him.

10.1.6 Total quantity of the water proofing compound required shall be arranged only after obtaining the prior approval of the make by Engineer-in-charge in writing. Materials shall be kept under double lock and key and proper account of the waterproofing compound used in the work shall be

maintained. It shall be ensured that the consumption of the compound is as per specified requirements.

- 10.1.7 The contractor shall prepare a sample for demonstration to the engineer-in-charge.
- 10.1.8 The finished surface after water proofing treatment shall have adequate smooth slope as per the direction of the Engineer-in-charge.
- 10.1.9 Before commencement of treatment on any surface, it shall be ensured that the outlet drain pipes / spouts have been fixed and the spout openings have been eased and rounded off properly for easy flow of water.
- 10.1.10 The Contractor shall get water proofing work done checked by engineer-in-charge or his authorized representative by flooding of water for sufficient duration as directed by Engineer-in-charge. However, this approval shall not exempt the Contractor from responsibility for the success of water proofing treatment done by him.

10.2 Crystalline Water Proofing Compound:

RCC/Concrete work in Basement Raft, Retaining walls, Basement slabs, Water tanks, STP, Pump house, Lift pit, Terrace slab, waterproofing protection screed at terrace and other water retaining structures shall be admixed with Crystalline Water Proofing Compound to reduce permeability of concrete in addition to proposed Waterproofing System as per following specifications:

Providing and mixing integral crystalline admixture for water proofing treatment to RCC structures at the time of transporting of concrete into the drum of the ready-mix truck, using integral crystalline admixture @ 0.80% (minimum) to the weight of cement content per cubic meter of concrete) or higher as recommended by the manufacturer's specification in reinforced cement concrete at site of work. The material shall meet the requirements as specified in ACI-212-3R2010 i.e. by reducing permeability of concrete by more than 90%, compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure. The crystalline admixture shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per

specification and the direction of the Engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage.

- 10.3 HDPE Membrane Water Proofing System under Basement Raft: Water proofing under Basement Raft shall be done with fully bonded & weldable HDPE membrane water proofing system, to be laid above lean concrete of grading M-10 (design mix) of thickness not less than 100mm, with following specifications:

Supplying and installing 1.5 mm composite thick (Bare film thickness of 0.9 mm HDPE membrane) fully bonded weldable HDPE membrane conforming to IS 16471:2017 requirements of UG waterproofing structures, requirements to provide Type A fully bonded protection of UG waterproofing structures. The membrane shall comply with EN 13251:2016 durability certification. The HDPE membrane should be largest width of manufacturer comprising of an HDPE layer and a pressure sensitive adhesive layer which is covered by a weatherproof protective layer with lap Joint Strength at overlaps

>15000 N/m ASTM D 6392:2012. The membrane shall have a minimum of 75mm side and end laps which shall be thermofused with leister machines at all the joints for assuring watertightness and achieving monolithic membrane. End laps and side laps should be a minimum of 100 mm with the weld size of minimum 60 mm in case of a single weld system. In case of a double weld system, comprising of two parallel welds of 15 mm wide each with a 20 mm air channel gap in between the

two weld lines. This membrane shall be continued over the vertical surface but terminated minimum 100mm below the top edge of the raft slab/footings and fixed as per recommendation.

Contractor shall submit methodology statement with all detail in illustrative sketch form and get it approved from Engineer-in-charge before start of work. Application shall be carried out by approved applicator of manufacture and as per recommended by Manufacturer.

Method of Application: As per recommended by approved manufacturer. The HDPE membrane should be having the following minimum properties :

PROPERTIES	TYPICAL VALUE	TEST METHOD
Color	White/ Off White	Visual Observations
Roll Size Length	20 m	
Thickness of Composite Membrane	1.5mm	ASTM D 3767
Tensile Strength	25 MPa	ASTM D 412Modified
Elongation	400%	ASTM D 412Modified
Low Temperature Flexibility	- 25 Degree C Pass	ASTM D 1970
Peel Adhesion to Concrete	800 N/m	ASTM D 903:1998
Lap Joint (Side and End Laps) Strength at overlaps	15000 N/m	ASTM D 6392:2012
UV Exposure	28 Days pass	conforming to IS 16471:2017
Puncture Resistance	890 N (± 5 to 10%)	ASTM E 154

10.4 PU Membrane Water Proofing System for Basement Walls : Water proofing on outer face of Basement Retaining Walls shall be done with two component hybrid PU membrane water proofing system with following specifications:

Providing & applying 2 components, solvent free, liquid applied elastomeric seamless hybrid Polyurea Polyurethane Membrane, using plural component airless spray equipment, to form a minimum system thickness of 1.5 mm in two alternative coats with a total consumption of 1.5-1.6 kg / m². The membrane shall have 100% Solids, VOC Free, Tensile strength > 10 Mpa as per ASTM D 412, Elongation > 400% as per ASTM D 412, Static Crack bridging up to 2mm as per ASTM C 836, Shore A Hardness > 85 ASTM D 2240, Puncture Resistance > 1000 N as per ASTM E 154. Apply primer coat of epoxy primer by roller/ airless spray guideline and coverage @ 5-6 m²/ltr depends on porosity of concrete. Allow to cure for max 5-6 hours. Broadcast anti slip grains of 200- 300 micron (dried/ Silica sand) on wet primer at coverage of 0.8-1 kg/m² and allow to come to touch dry condition before application of Membrane. Protection Board in Verticals: Providing and installing of 8mm thick dimple board of approved make to prevent the damage of membrane (PU Coating) during backfilling. The protection board is to be spot-bonded on the applied waterproofing.

The Contractor shall submit methodology statement with all detail in illustrative sketch form and get approved from Engineer in charge. Application shall be carried out by approved applicator of manufacture and as per recommended by manufacturer.

Method of Application : As per recommended by approved manufacturer.

All surfaces must be clean and free from debris, loose or flaking material, standing water, oil, grease and organic growth. Concrete surfaces must be free from laitance and any

traces of shuttering, release oils and curing compounds.

Bug holes shall be filled with epoxy putty.

Taken care of tie rod holes, if any tie rod hole not properly treated, the same will be filled with polymer modified mortar/ non-shrink grout.

Primer application shall carry out as per manufacturer's recommendation. Broadcast Dry sand onto the wet primer.

After proper drying of primer polyurea coating shall be applied by spraying machine in two coats, which shall be applied in two alternate directions.

10.5 Protection Board in Verticals: Providing and installing of 8mm thick dimple board of approved make to prevent the damage of membrane during backfilling. The protection board is to be spot-bonded on the applied waterproofing. The dimpled protection board should have compression resistance > 120 kPa, elongation > 20 % according to EN 12311-2 and unit weight ~ 400 g/sqm, can be installed on damp and wet substrates. The backfilling shall be done within 2-3 days of fixing drainage boards. All systems to be installed as per manufacturer's recommendation etc.

10.6 Construction Joints: in Raft, Retaining Walls, Water Tank, STP, Lift Pit below plinth shall be treated by providing and applying of swellable type water stop tape, 20mm x 10mm thick in linear meter (expansive nature) for construction joints treatment of RCC structure, such as raft slab, retaining walls, water storage tank and at the junctions of raft slab with the retaining walls, STP, Lift Pit below plinth etc. After cleaning the surface, the swellable water stop tape shall be applied throughout the length shall be applied using single component swellable PU adhesive. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge.

10.7 Expansion Joints: The joints shall be provided with Shalitex Expansion Joint Filler Board, over which a solvent-free, thixotropic two part epoxy based adhesive for bonding Modified Flexible Poly-olefin (FPO) Waterproofing tape shall be provided to cover the prepared substrate. Properties of epoxy based adhesive:

Consumption: 0.6 kg/m to 0.7 Kg/m, mixed density: 1.75 kg/ltr;

bond strength > 1.5 N/mm².

Post Application of the Adhesive provide a flexible FPO based membrane.

Properties of FPO:

Chemical Base Modified flexible Polyolefin (FPO) with advanced adhesion. Fire Rating Euroclass E (EN ISO 11925-2, classification to EN 13501-1).

Service Temperature -30°C min. to $+40^{\circ}\text{C}$ max. in wet conditions -30°C min. to $+60^{\circ}\text{C}$ max. in dry conditions,

Mechanical / Physical Properties: Tensile Strength > 12 N/mm² (EN 12311-2), Tear Strength > 40 N/mm (ISO 34-B), Elongation at Break > 600 % (EN 12311-2) Seam strength > 300 N/5cm (2 mm) (EN 12316-2) > 400 N/5cm (2 mm) (EN 12317-2)

Behaviour under hydrostatic pressure: 6bar/72h No leakage (EN 1928-B),

Resistance: Chemical Resistance: as per manufacturer's spec. Thermal Resistance Thermal ageing: Passed (SIA V280, 1996).

Bonding test: No cracks at -40°C (EN 495-5)

Artificial weathering: 7500 h passed (SIA V280, 1996).

The top finished surface shall be provided with SS plate as per DSR item 5.43.

10.8 Waterproofing system in toilets:

Providing and applying Two-part acrylic polymer modified cementitious elastomeric waterproof coating having minimum 1 N/mm² tensile strength, at average 1.5mm thickness DFT, and shall cover 2.00 kg / sqm. The coating shall have an elongation of a minimum of 120% when tested as per ASTM D 412 and having crack bridging ability of up to 2mm. Thorough surface preparation by mechanical means to level and plain the surface of walls and floors of the toilet areas. All cracks and crevices to filled and made good to receive waterproofing coating treatment. The coating shall cover all the floor area of the wet area (toilet) and be applied over on to the vertical walls for required height above the floor. The periphery of the toilet floor shall be additionally reinforced with an extra third coat of the coating with a fibre band sandwiched between the first and the second coat, which shall also be done around protrusions (pipes) meant for plumbing purpose. The last coat when wet, shall be sprinkled with clean and washed sand, to facilitate the floor screed or plaster.

Pipes being fixed for plumbing shall be fixed in holes which are mechanically core cut, more than the dia of the pipes. Pipes shall be fixed by grouting the annular space with non-shrink cementitious grout of proprietary make. Before grouting the pipes shall be wrapped with a two-way self-adhesive tape at least 2 inches wide and then grouted to fill in the grout, ensuring total watertight plumbing fittings. Contractor shall submit methodology statement with all detail in illustrative sketch form and get approved from Engineer in charge. Application shall be carried out by approved applicator of manufacture and as per recommended by manufacturer. Applied area of cementitious elastomeric coating (horizontal and vertical) shall be measured for payment.

Method of Application:

Cleaning the slab to remove loose dust, dirt, oil, debris (sunken slab for toilets or balcony) with water jetting, saturating the slab with water.

Repairing of cracks (if any) with using polymer modified mortar, carry out cementitious injection grouting at leakage points modified with Plasticized Expansive Grout Admixture as per manufacturer's specification.

Carry out / making 50 mm thick cement mortar (1:3) and modified with Polymer bonding agent at dosage of 2.5 Litre per 50kg cement.

Pipes being fixed for plumbing shall be fixed in holes which are mechanically core cut, more than the dia. of the pipes. Pipes shall be fixed by grouting the annular space with non-shrink cementitious grout of proprietary make. Before grouting the pipes shall be wrapped with a two- way self-adhesive tape at least 2 inches wide and then grouted to fill in the grout, ensuring total watertight plumbing fittings.

Applying first coat of Elastomeric Polymer modified cementitious waterproofing compound as primer coat as per manufacturer's specification.

Laid 45gsm fibre mesh (alkali resistant) on first layer of coating become sandwich between two layers.

Apply second coat of Elastomeric Polymer modified cementitious waterproofing compound by brush or roller so as fibre mesh is completely covered.

Coating shall be applied over on to the vertical walls for a height of 4 feet above the floor.

The last coat when wet, shall be sprinkled with quartz sand, to facilitate proper bonding of the protective screed on floor/plaster on wall and filling light bats in sunken portions.

If required in sunken portions for providing and filling light weight AAC bats (of size 40- 60 mm) with cement mortar mixed in the ratio 1:3:6 (1 cement : 3 coarse sand : 6 block bats) including mixing of approved water proofing compound in recommended proportion. The laid bat mix shall be well rammed and compacted as required. Further surfaces shall be screeded with cement concrete mix 1:1.5:3 (1 cement : 1.5 coarse sand : 3 stone grit of size 6 mm and below by volume) admixed with approved integral water proofing compound in recommended proportion, laid to an average thickness of 25mm and finished smooth or ready to receive finish material as specified. Care shall be taken prior to filling all pipes passing through sunk portion such that the pipes are pressure tested by maintaining pressure for 24 hours and junctions of pipes passing through walls, slabs are well grouted and sealed.

10.9 Waterproofing System for Roof / Terrace Insulation):

Terrace Slabs shall be provided with Elastomeric PU coating composite Waterproofing and Insulation systems as follows:

Repairing cracks on mother roof slab by cutting & making V grooves in 25x25 mm, and filling with a polymer modified cementitious mortar, of 1:3 proportion and filling the groove with CM (1:3) as recommended by manufacturer specification.

Surface preparation shall be done as per manufacturer specifications followed by single component PU water proofing coating.

Making fillet with polymer modified mortar or as per manufacturer of minimum size 50mm x 50mm.

Applying a base coat of one component polyurethane based waterproofing coating, having elongation > 400%, crack bridging minimum 2 mm, tensile strength of > 2.0 Mpa (as per ASTM D 412), solid content –80% to 90 %, avg. DFT 1.5mm in two coats shall be applied at all the corners above the mother slab of roof and over the concrete haunches provided in the periphery of the slab at the junctions of the parapet wall.

Spray applying an average 80 mm thick polyurethane foam (CFC and HCFC free), with a core density of 45-50 kg /m³, thermal conductivity of 0.023 W/m.k at 25°C mean temperature (as per ASTM C518-91), tensile strength of > 300kPa (as per ASTM D 1623), compressive strength with rise of >300kPa (as per ASTM D-1621), closed cell content having apparent volume of > 90% (as per ASTM D 6226/ 2856) and fire resistance property conforming to Class B2 as per DIN 4102.

Supplying and applying a base coat of one component polyurethane based waterproofing coating, having elongation of > 400% and tensile strength of > 2 MPa (as per ASTM D 412) with avg. DFT 1.5mm in two coats over a PU foam.

Supplying & laying 300 gsm Geotextile (non-woven polyester) over the entire membrane maintaining proper overlaps of 100 mm.

Applying average 150 mm (to maintaining the required gradient for proper drainage of water and minimum 60mm thick concrete at khurra/ mouth of rain water pipe) thick M25 grade concrete screed admixed with integral crystalline admixture as per recommended dosages for including providing control joints in 3M X 4M grids size and providing the angular haunch of 50mmX50mm using M25 grade concrete at the corners of the slab-parapet wall junctions all around the periphery. Screed concrete shall be cut by mechanical means and filling the groove with a one component (Thermatech) Polyurethane Sealant that is moisture triggered and cast immediately on saw cutting joints on green concrete. The width of sealant fill shall not exceed 10mm. Becker rod along with polysulphide/

Polyurethane sealant shall be provided to seal the saw cut joints.

Contractor shall submit methodology statement with all detail in illustrative sketch form and get approved from Engineer in charge. All material from single manufacturer. Application shall be carried out by approved applicator of manufacture and as per recommended by manufacturer.

Material:

PU coating on mother slab – a base coat of one component polyurethane based waterproofing coating, crack bridging ≤ 2 mm, having elongation $> 400\%$ and tensile strength of > 3 Mpa, applied at 1.5 kg/ sqm (as per ASTM D 412).

PU Puff insulation - minimum 80 mm thick polyurethane foam, with a core density of 45-50 kg

/m³, thermal conductivity of 0.023 W/m.k at 25°C mean temperature (as per ASTM C518/91), tensile strength of > 400 kPa (as per ASTM D 1623), compressive strength with rise of

> 300 kPa (as per ASTM D-1621), closed cell content having apparent vol of $> 90\%$ (as per ASTM D 2856) and fire resistance property conforming to Class B2 as per DIN 4102.

PU coating on Insulation – a base coat of two component polyurethane based waterproofing coating, having elongation of $> 400\%$ and tensile strength of > 3 MPa, applied at 1.5 kg/ sqm. (as per ASTM D 412), over a PU foam.

SRI Coating: Providing and applying UV resistant, a spray / roller applied solar reflective cum waterproof coating for terrace area with elastomeric property and having a SRI value not less than 100-105 (as per ASTM E 1980), with crack bridging ability up to 1mm (as per ASTM C 836: 1995) and elongation at break of 200 % (as per ASTM D 412 : 2002), having tensile

strength ≥ 1.0 Mpa with a coverage of 1.5 kg / sqm (2 liter per sqm) in 3 coats sandwiched with a fabric between 1st and 2nd coat, entire coating system applied over a primer. The termination of the SRI coating shall be terminated at the drip moulds of the plaster of the parapet wall, above the haunch. After completion of SRI coating, additional lacquer coating shall be applied to achieve a zero dust adherence on the coating so as to maintain the SRI value. Actual applied area shall be measured for payment.

SRI coating with total water proofing system shall be applied by approved applicator of approved manufacturer's only with 10 years composite guarantee against leakages of total water proofing system to be provided by the contractor/ applicator.

10.10 Water proofing system for UG & OH water tanks

Food grade epoxy coating (approved colour & shade) water proofing system for water tank as per manufacturer specification and as approved by Engineer- In-charge.

Providing and applying food grade epoxy coating treatment to water tank on inside surface after proper surface preparation, carry out cementitious injection grouting at leakage points using Plasticized expansive grout admixture, treatment of construction joints using polymer modified mortar prepared by using SBR Latex-screed modifier cum bonding agent, application of polymer modified vatta/ fillet at floor-wall junction prepared by using SBR, filling pipe cut- outs using Non shrink cementitious grout and hydro swell water bar, application of one coat of epoxy primer and two coats of Solvent free food grade epoxy resin coating in 2 coats etc. complete including all tools and tackles as per manufacturer's specification.

Food grade epoxy coating shall be having adhesive bond strength > 1 Mpa, Pot life of 30 min @ 30°C and cured film shall be non-toxic and shall meet the requirements of IS: 9833:1981. Contractor shall furnish 10 years warranty for the coating. Application shall be carried out by approved applicator of manufacture and as per recommended by manufacturer.

Method of Application

The cleaning and preparation of the substrate on which the waterproofing coating is applied as follow.

One coat of primer and two coats of Solvent free epoxy resin coating @ 300 microns DFT in 2 coats.

10.11 Treatment of Pipe Penetrations:

Grouting & Sealing around the periphery joints of pipes passing through the floor and walls in various locations by filling micro concrete of approved manufacturer in the gap between the cut outs in the slab and the pipe surface and sealing around the periphery joints of the pipes using two component (1:1) moisture insensitive epoxy putty conforming to ASTM C882. The waterproofing should be continued over the pipes.

10.12 Grouting & Sealing of faulty construction joints, cracks, tie rod holes, honeycombed concrete surface in RCC UG structures/Water Tanks/ETP/STP etc :

Providing and applying crystalline mortar by mixing in the ratio of 4.5:1 (4.5 parts crystalline mortar: 1 part water) for the treatment of faulty construction joints, cracks, tie rod holes and spalled & honeycombed surface of RCC underground structures like basement, water tanks, bridge deck etc. to ensure water tightness. The crystalline mortar shall conform to the EN 1504-3 having compressive strength Class R4 > 45 MPa and adhesive bond strength Class R3 > 1.5 MPa. The work shall be carried out all complete as per specification and the direction of the Engineer-in- charge. The product performance shall carry guarantee for 10 years against any leakage.

For patching of tie rod holes, preparing tie rod hole surface and then priming the area with integral crystalline slurry @0.070kg per sqm and while the surface is tacky, repairing and then filling the tie rod holes with crystalline mortar @0.040kg per hole. The crystalline mortar shall be tightly rodded into tie rod holes or packed tightly (For 25x25x25 mm tie rod hole, use 0.040 kg to fill the hole)

10.13 GUARANTEE:

The water proofing work shall carry Ten Years guarantee to be reckoned from the date of completion of the entire work under the contract against faulty workmanship, finishing, unsound materials, efficiency of water proofing treatment and other related problems.

The Contractor, for the work of water proofing, will have to execute a guarantee bond on non- judicial stamp paper of value Rs.100/- or more in the prescribed Proforma in this bid document for removing any defects in waterproofing done by it in this contract for 10 years after completion of entire work in the contract agreement.

TECHNICAL SPECIFICATIONS -SEWAGE TREATMENT PLANT (STP)

Design, Engineering Supply, Installation, Testing & Commissioning of STP shall be carried out by the Contractor on EPC Basis & as directed by Engineer-in-charge.

Note: GRIHA norms & relevant IS standards (output water for irrigation/ flushing/ sewer/ portable) for output water parameters should be complied with.

The Sewage Treatment Plant shall be designed on MBR technology for the following raw sewage flow rate and characteristics:

1. SEWAGE GENERATION AND CHARACTERISTICS & TREATED WATER PARAMETERS:-

Flow Rate : As per DBR or meeting functional requirements.

1.1 DESIRED QUALITY AFTER TREATMENT

a. DESIRED EFFLUENT QUALITY (AFTER TREATMENT):

Sl. No	Parameter	Unit	Treated water
1	pH	-	6.5 - 8.5
2	Suspended solids	Mg/l	< 100
3	BOD	Mg/l	< 150
4	COD	Mg/l	< 300
5	Oil & Grease	Mg/l	< 5

b. DESIRED SEWAGE QUALITY (AFTER TREATMENT):

Sl. No	Parameter	Unit	Treated water
1	pH	-	6.5 - 8.5
2	Suspended solids	Mg/l	< 5
3	BOD	Mg/l	< 5
4	COD	Mg/l	< 10
5	Oil & Grease	Mg/l	Nil

c. EXPECTED TREATED WATER CHARACTERISTICS AFTER FILTRATION AND SOFTENER (FOR COOLING TOWER MAKE-UP)

Sl. No.	Parameters	Characteristics
1	pH	6.0 – 7.0
2	Total Dissolved Solids	200 ppm
3	Suspended solids	< 5 mg/liter
4	Turbidity	Nil
5	Total Hardness	Less than 50 ppm

Table Given above is Indicative & Treated Discharge Effluent/Sewage Water shall meet all relevant norms including BIS standards & GRIHA compliances.

2. TECHNICAL EQUIPMENT SPECIFICATIONS

i. PRIMARY TREATMENT

a. SCREENS

Quantity	:	2 Nos.
Dimension	:	Wide: 800mm X Height: 1000mm
MOC	:	Stainless Steel 304
Type	:	Perforated

Screening Size	:	20mm & 10mm
Lifting Arrangement	:	Yes

b. MECHANICAL SCREENS

c. Quantity	:	1 Nos.
d. Dimension	:	50 m3/hr
e. MOC	:	Stainless Steel
f. Type	:	Drum Type
g. Screening Size	:	≤5mm
h. Location	:	Before Anoxic Tank

ii.

PUMPSET**a. RAW SEWAGE TRANSFER PUMPSET (Collection Tank to****Anoxic Tank)**

Quantity	:	3 Nos. (2W + 1S)
Type	:	Submersible, Vertical
MOC of Body / Impeller	:	CI / Bronze
Capacity	:	25 m3/hr
Head	:	10-12 mtr
Solid Handling Capacity	:	20 mm
Motor Rating	:	Asrequiredfulfilling technicalparameters
Lifting Arrangement	:	Manual (Chain Pully)

b. PLANT ROOM SUMP PUMPSET

Quantity	:	2 Nos. (1W + 1S)
Type	:	Submersible, Vertical
MOC of Body / Impeller	:	CI / Bronze
Capacity	:	25 m3/hr
Head	:	10-12 mtr
Solid Handling Capacity	:	20 mm
Motor Rating	:	Asrequiredfulfillingtechnical parameters
Lifting Arrangement	:	Manual (Chain Pully)

c. SLUDGE TRANSFER / RECIRCULATION PUMPSET

Quantity	:	3 Nos. (2W + 1S)
Type	:	Monoblock. Centrifugal
MOC of Body / Impeller	:	CI / Bronze
Capacity	:	75 m3/hr
Head	:	12 mtr
Solid Handling Capacity	:	8-10 mm
Motor Rating	:	Asrequiredfulfilling technical parameters

Providing, installation, testing & commissioning of screw Sludge disposal pump for the disposal of sludge to Screw Press. The pumps shall have CI casing, bronze Impeller & SS shaft & sleeve with mechanical rotary shaft seal connected by a flexible tier type coupling to TEFC induction motor mounted on a common channel base-plate with coupling guard, 150 mm dia. pressure gauge with GM isolation cock, suitable vibration eliminator pads of approved design. Motor to be suitable for including all necessary piping, valves and other accessories and concrete foundation complete as required. (2 Working + 1 Stand-by or as required).

d. SLUDGE DISPOSAL PUMP PUMPSET

Quantity	:	1 Set (1W+1S)
Type	:	Screw, Horizontal MOC of Body /
Impeller	:	CI / Bronze
Drive	:	V – Belt
Direction of Rotation	:	Clockwise
Capacity	:	3 m ³ /hr
Head	:	40 mtr
Solid Handling Capacity	:	Sludge - STP
Motor Rating	:	As required fulfilling technical parameters

e. PERMEATE/SUCTION PUMP

Quantity	:	2 Nos. (1W + 1S)
Type	:	Centrifugal Self Priming with Mech. Seal
MOC of Body / Impeller	:	CI / Bronze
Capacity	:	60 M ³ /Hr.
Head	:	16 mtr
Operation	:	VFD operated

iii. AIR DIFFUSION SYSTEM

a. AIR BLOWER FOR EQT, SHT & AT

Quantity	:	2 Nos. (1W + 1S)
Type	:	Twin Type Rotary
MOC of Body	:	Cast Iron
Drive	:	V – Belt
Direction of Rotation	:	Clockwise Suction
Silencer with Air Filter	:	Yes
Pressure Gauge / Relief Valve	:	1 Each
Capacity	:	1180 m ³ /hr
Discharge Pressure	:	0.45 kg/cm ²
Motor Rating	:	As required fulfilling technical parameters

b. AIR BLOWER FOR MEMBRANE SCOURING

Quantity	:	2 Nos. (1W + 1S)
Type	:	Twin Type Rotary
MOC of Body	:	Cast Iron

Drive	:	V – Belt
Direction of Rotation	:	Clockwise Suction
Silencer with Air Filter	:	Yes Pressure Gauge / Relief
Valve	:	1 Each
Capacity	:	200-350 m ³ /hr or as required
Discharge Pressure	:	0.45 kg/cm ²

c. AIR DIFFUSER FOR AERATION TANK

Type	:	Fine Bubble Tube Aerator
Air Transfer Capacity	:	3 – 5 cfm / meter water depth Length of
Diffuser	:	1000 mm
Dia. of Diffuser	:	63mm or as required
Connection Size	:	20mm or as required
MOC of Membrane	:	EPDM or as required MOC of Pipe
Support	:	SS / EPDM or as required Fitting
Material	:	PVC Shaddle

d. AIR DIFFUSER FOR EQUALISATION AND SLUDGE HOLDING TANK

Type	:	Disc
Air Transfer Capacity	:	4 - 12 Nm ³ /hr Dia. of Diffuser 75mm or as required
Connection Size	:	1" BSP or as required
MOC of Membrane	:	EPDM
MOC of Pipe Support	:	SS / EPDM or as required
Fitting Material	:	PVC Shaddle

iv. ANOXIC MIXER

Location	:	In Anoxic Tank
Type	:	Submersible
Capacity	:	As per Tank Volume
MOC	:	SS

v. MBR MODULE

Quantity	:	Suitable for 1 MLD or as per manufacture recommendation
Capacity	:	50 M ³ /Hr.
Type Of Membrane	:	Hollow Fibre/Flat Sheet MOC of
Membrane	:	PVDF
Pore Size	:	0.04 to 0.08 micron
Permeate MOC	:	SS-304
Air Diffuser	:	PVC/PP

vi. ULTRA VIOLET UNIT

Quantity	:	2 No.
Capacity	:	25 m ³ /hr

MOC Reactor	:	Stainless Steel 316L
MOC Quartz Jacket	:	High Purity Quartz (UVT > 95%)
UV Dosage	:	60mJ/cm ² (65% UVT) Voltage
End Connection	:	65mm or as required Max. Operating
Pressure	:	80psig or as required Max. Operating
Temperature	:	45 Degree C
Control Panel Rating	:	IP54
Control Panel MOC	:	Sheet Steel with Electrophoretic Dipcoat Priming and Textured PowderCoating
Ballast Type	:	Electronic with Programmed Soft Start
Lamp Replacement Reminder	:	Yes
Lamp Running Hour Counter	:	Yes Lamp Failure
Indication	:	Yes
UV Monitoring System	:	Yes

vii. SLUDGE DEWATERING

a. SCREW PRESS

Quantity	:	1 No.
Capacity	:	3 m ³ /hr
Solid at Outlet	:	18-22 %
Noise Level	:	Less than 65 db
Vibration Level	:	<50 Microns

Thickening cum compaction cylinder:

Diameter/Length	:	Dia.110mm/1000 mm long
MOC	:	SS 304 in thickening zone and SS-304 in pressure zone
Filter Screen	:	SS -304
Weir Type for flow control	:	Rinsing Hollow Pipe Screw Gear Box
Type	:	Heli worm

viii. INSTRUMENTATION

a. LEVEL INDICATOR & CONTROLLER

Quantity	:	3 set
Dimension	:	As Required within EQT, MBR & TWT
Type	:	Electronic
High / Low level Alarm	:	Yes, Auxiliary NO/NC

b. AIR FLOW METER

Quantity	:	2 Nos.
Type	:	Vertical - Rotameter
MOC of Body	:	High Grade Acrylic
Capacity	:	60 & 15 M ³ /Hr Operating
Temperature	:	Ambient Operating

Pressure	:	6PSI
MOC of Float	:	SS 316

c. WATER FLOW METER

Quantity	:	2 No. or as required
Type	:	Electromagnetic
Capacity	:	50M3/Hr or as required
Operating Temperature	:	Ambient
Operating Pressure	:	6PSI or as required
Connection Size	:	50mm or as required
MOC of Connection	:	SS

d. pH METER

Quantity	:	1 No. or as required
Type	:	Flow Through / Tank (Optional)
Sensor O/P	:	Milli Volt
Application / Fluid	:	Treated Sewage
Range	:	00.00 – 14.00 pH

e. ENERGY METER

Quantity	:	1 No. or as required
Type	:	Electronic
Range	:	10 – 40 Amps or as required.

ix. INTERCONNECTING PIPE & FITTINGS**a. PIPING**

Submerged Air Pipe Line	:	SS 304
Diffuser Line	:	Flexible
Air Line	:	MS Epoxy Painted Effluent & Submerged
Water Pipe Line	:	PVC Heavy Class
Water Line	:	MS Duly Painted
Pipe Class	:	Medium Class
MOC of Fittings	:	As Required

x. ELECTRICAL WORK**a. ELECTRICAL CONTROL PANEL**

Quantity	:	1 Set or as required
Fabrication Material	:	14Gauge CRCA Sheet Steel duly Anticorrosive Paint & Powder Coated
Gland Plate: Top & Bottom	:	
Description	:	As required
Electrical Accessories	:	ISI Approved

b. CABLE & CONDUITING

Quantity	:	1 Lot within Plant Room
Type	:	Flexible – Triple Layer ISI Marked

TECHNICAL SPECIFICATION - EFFLUENT TREATMENT PLANT

Design, Engineering Supply, Installation, Testing & Commissioning of ETP shall be carried out by the Contractor on EPC Basis & as directed by Engineer-in-charge.

The specifications for ETP Capacity shall be as defined in Design Basis Report, meeting functional requirements & as per directions of the Engineer –In -Charge. The Contractor shall submit shop drawing illustrating the detailed piping & instrumentation details of entire ETP system, which shall be approved by HITES prior to start of execution work at site.

The ETP shall be of compact type & housed in common pump room of STP. The ETP shall be constructed in RCC. The ETP shall be designed as water retaining structures, with necessary chemical dosing as required by the manufacturer's design. All the Equipment, piping, pumps, air blowers & electrical panel shall be housed in the ETP skid including MS puddle flange (galvanized), inlet , outlet, overflow, vent, moving ladders & railing. The plant shall be complete with a central electric panel fully pre/site wired & with all power & control cables to all pumps & equipments including all instrumentation, level & other controllers.

ETP shall be complete with SS perforated basket screen with chain lifting arrangement, Flash Mixer, Flocculator, tube Settler, media inside tube settler, lime/alum/polyelectrolye dosing system with HDPE tank & pumping system, all valves, strainers, pressure gauges, air blower, agitator & all required pumps.

PVC pipes (10 kg/sqcm)- For all submerged waste water piping, MS (C class)- For all exposed air piping & flexible stainless-steel pipe for submerged air pipe, GI (C class)- for all other water piping shall be used in ETP.

Approval of Technical datasheet & Shop drawings for ETP shall be sought from Contractor before commencement of work.

TECHNICAL SPECIFICATION -SOLAR WATER HEATING SYSTEM

Design, Engineering Supply, Installation, Testing & Commissioning of Solar Water Heating systems shall be carried out by the Contractor on EPC Basis & as directed by Engineer-in-charge. Solar Hot water system shall include flat plate solar collectors or panels as per (BIS) OEM standards, absorber coating shall be suitably selective coating having absorptivity should be greater than 90% & emissivity should be less than 20%. Solar collector having copper fins & tubes with laser/ultrasonic welded with brass flanges & EPDM rubber gaskets.

Solar collector absorber should be Cu-Cu type of suitable dimensions as per BIS standard. It shall be provided with rockwool or any other suitable insulation at sides & bottom of suitable thickness with proper density & K value. All the specifications of items used in solar collector should be according to BIS standard.

Solar water heating system shall be indirect heating system with closed circulation, SS 304 heat exchanger having surface area should be 0.24 Sq. mtr/100 Liter. For closed circuit make up tank of suitable capacity shall be of PVC construction & shall be provided with soft water provision & to refill at particular interval.

For Hospital Building Closed Coupled Solar Hot Water System integrated with Heat Pumps shall be used. In a "close-coupled" SWH system the storage tank is horizontally/vertically mounted on the roof. Internal solar thermal circulation shall be Thermosyphon/Force circulation depends upon the system capacity and site conditions. Solar water heating system produces hot water at a temperature of 60 Deg. C and in accordance with the IS-12976:1990 and IS-12933:1990 (Part 1 to part 5). Solar hot water system may be with recirculation pump & heat exchanger system, Hydro pneumatic pump to supply water from raw water storage tank to solar storage tank if height of hot water storage tank is higher than raw water storage tank or provide a separate tank which having height more than hot water storage tank. Hot water storage tank of suitable capacity & MOC of SS 304 of required shell & dish thickness. It shall be provided with suitable insulation of required thickness, K value & density & 24 G aluminum cladding.

In force circulation of solar water heating system, circulation pump to be controlled by differential temperature controller (DTC) which will automatically run in day time & off in night time even when required. Circulation pump to be install in 1W + 1 S arrangement which can be automatic switching from one to other.

Hot water returns or recirculation pump to be run on timer-based arrangement, when the line water will get cold on certain temperature, recirculation pump will run and when pipeline fill with hot water it will OFF automatically. Recirculation pump to be install in 1W + 1 S arrangement which can be automatic switching from one to other.

Hot water circulation pump for Heat pump should be synchronized with Heat pump, when heat pump will run then only circulation pump will run and when it will stop then circulation pump will automatically stop.

Suitable Heat exchangers with primary & secondary pumps, which shall be horizontal/ vertical centrifugal type of suitable head & discharge with motor conforming to IE3 class efficiency with brass impeller, SS 304 shaft & CI casing. Cold water tank for providing water to solar storage tank of suitable capacity made out of PVC with low- & high-level controllers. Electrical control panel for the entire system with necessary cabling, level controllers, sensors, wires & other accessories shall be provided.

System to ensure that the solar hot water generated during the sunshine hours of the day is stored in a Solar Insulated tank (Heat Bank) & then the Heat is transferred to the main storage tank, which temperature maintained by Heat Pump on desired temperature so that the **Hot Water is made available at the Controlled Temperature** for final usage.

In other buildings, conventional Solar Hot Water System shall be used with/without any recirculation pumps. It supplies the hot water by gravity as a preheated water to the electric geysers at all user points. Wherever, pumps are provided, one standby provision to be

considered.

TESTING: All G.I pipes of Primary Circuit (Collector Circuits) shall be tested to hydrostatically for a period of 30 minutes to a pressure of 2 kg/Sq.cm without drop in pressure and all other G.I pipes for a pressure of 6 Kg/Sq.cm.

HOT WATER STORAGE TANK

SS-304 horizontal/vertical hot water storage tank with the required thickness (as Required) to withstand working pressure of 5 kg/Sq cm. The hot water storage tank is provided with a manhole, cover, drain, vent, overflow, inlet and outlet connections etc. as required and as per direction of Engineer in Charge.

Hot water storage tank shall be insulated with 100 mm thick Rock wool insulation of 48 Kg/cu mt. density and cladding with 26 SWG aluminum sheets.

Each hot water storage tank shall be provided with the following:

- Safety valve
- One AIR Release valve
- Pressure and temperature relief valve
- Primary flow connection
- Hot water supply connection
- Hot water return connection
- Drain connection
- Thermometer fitted (inserted) in thermo well
- Pressure gauge
- Make up tank
- Ball valve

The hot water storage tank shall be hydrostatically tested to one and half times the working pressure of a system for a period of 2 hours without any leak. Field tests are to be performed at site to satisfy the capacity and operation of the unit by the CLIENT/ HITES/project in-charge.

PIPING

a. HOT WATER PIPING

Supply and return pipes of the hot water system complete with necessary pipes, bends, flanges, fittings, gaskets and valves are to be provided to connect Solar water heating system, hot water storage tank.

The hot water supply and return pipes are insulated with 50mm Rock wool of 48 Kg/cu mt. density and cladding with 26 SWG aluminum sheets.

b. HOT WATER SOLAR PIPING

GI solar & Heat Pump hot water piping complete with bends, flanges, fittings, gaskets and valves to connect the solar panels to the hot water storage tank with necessary valves and fittings.

This also includes the solar circulation pumps as per requirement to circulate the hot water to the tank from the solar panels & Heat Pump.

The hot water supply and return pipes are insulated with 50mm Rock wool of 48 Kg/cu mt. density and cladding with 26 SWG aluminum sheets.

c. PIPE INSULATION

Pipe insulation shall be 50mm Rock wool of 48 Kg/cu mt. density and cladding with 26 SWG aluminum sheets.

d. INSTALLATION

Pipe installation shall be carried out with proper workmanship in accordance with approved drawings/ Engineer in Charge. Pipe shall be aligned parallel to walls and ceiling and not across the room. Change of direction shall be through hydraulically formed welding fittings as specified.

Alignment shall follow the approved drawings/ Engineer in Charge and wherever necessary pipe shall be rerouted under the instructions of Engineer in Charge in order to meet the site conditions and or interference from other services.

e. PAINTING

Pipe supports shall be of steel with a prime coat of red oxide and two finish coats of matt black paint after installation. Supports shall be spaced as follows:

Size	Horizontal	Vertical
Upto 15 mm	1.25 m	1.8 m
20 to 25 mm	2.00 m	2.5 m
32 to 125 mm	2.50 m	3.0 m
150mm &Over	3.00 m	3.0 m

f. SUPPORTS

- Additional supports shall be provided at the bends, at heavy fittings like valves, near equipment and as directed by Engineer in Charge. Pipe hangers shall be from structural steel, steel inserts in concrete, wall brackets or floor supports as decided by the Engineer in Charge depending upon the location of the support. Hangers shall not be secured to light weight roof, wall, false ceiling or any other member which is not structurally meant for such loading. Hangers from structural steel shall be from suitably designed clamps or attachments and in no case should drilling or punching of such steel members be allowed. All pipe supports shall be capable of being adjusted in height to the tune of 50 mm.
- Pipe clamps shall be specially fabricated fittings for pipes. All clamps shall be of galvanized steel and finish coated with matt black paint. Clamps shall take into account pipe movement owing to temperature variations & anchors, and in no case shall the clamping arrangement induce stresses beyond the safe load limits of the pipe under fully filled conditions. Where pipes are insulated, the clamping shall interpose a hard insulation material or shall be designed so that the insulation is not compressed for more than 60 % of its compression strength.
- Vertical pipe risers shall be supported at each floor and in addition, the riser shall have a duck-foot support.
- All pipe joints shall be welded except where flange joints are specified hereinafter. Pipes upto 40 mm NB shall use socket - weld fittings of 150 lbs rating with fillet welding and larger sizes shall used with butt-welding type single V 35 deg weld preparation. Flange joints shall be provided at the following positions:
 - Pair of flanges for isolation of equipment
 - Mating flange for equipment flange connections
 - Mating flange for valves, strainers as the case may be
 - Pair of flanges at every 40 m continuous run of piping

- e. All piping shall be laid and tack welded in position with flanges, valves etc. After inspection and approval by the Engineer in Charge as to the alignment and height, the piping shall be full welded. Piping may be presented for such approval in sections. Slip-on flanges shall be demounted for welding. Random samples of valves shall be tested for leaks and seating. Necessary hand pump and blank flange facilities with pressure gauge, valves etc. should be provided at site.
- f. All pipe insulations shall be carried out in sections after duly testing.

g. TESTING

Piping shall be hydrostatically tested to 1.5 times more than the rated pressure for a minimum period of 24 hours without any leak and loss of pressure.

Circulation pump to be install in 1W + 1 S arrangement which can be automatic switching from one to other.

A. SOLAR THERMAL COLLECTOR

1. The scope of work covers supply, erection, testing and commissioning of the Solar Collector Panels meeting the requirements and the intent of this specifications.
2. Manufacturer's catalogues and guaranteed performance details to be submitted for Approvals before ordering the supply of the equipment.

a. COLLECTOR:

Solar Collector Type: copper to copper type with minimum size of 2 sq. mtr.

- Collector Frame Extruded - Aluminum 1.4mm thick or as required
- Gasket for Glass (Beading) - EPDM "U" Type
- Glazing (Cover) - 302mm Toughened clear glass
- Collector Body - Aluminium
- Bottom Insulation - 40 mm Rockwool (Minimum)
- Side Insulation - 20 mm Rockwool (Minimum)
- Absorber Plate - Copper
- Riser Copper - Dia- 12.7 mm or as required
- Inlet Header Copper - Dia- 25.4 mm or as required
- Reflective Foil - Aluminum or as required
- Grommet - EPDM or as required
- Collector Back sheet - Aluminum or as required
- Absorber area - 2 Sq. Mtr. or as required
- No. of Riser tubes per collector - 9 per collector
- No. of Absorber Plate per collector - 9 per collector
- Glazing transmissivity > 80%
- Coating absorptivity > 0.90
- Coating emissivity < 0.20
- Absorber riser bonding - Ultrasonic/Laser Welding

- Collector efficiency at ambient temp. $> 65\%$ or as required
- Finish - (Powder Coating) Golden yellow for frame,
Black for Glass retaining angle
- Working Pressure - 5 Kg./cm^2 or as required
- Operating Conditions T $> 50\text{deg.C}$ or as required

b. COLLECTOR SUPPORT FRAME/ STRUCTURE

The structure should be in a position to withstand a wind velocity of 100 Kms/hr. It shall be made of angle iron 35mm x35mmx5mm and shall have vertical support at top and

bottom edge of the inclined plane of the collector at a distance of 2.5 m or less. The vertical support shall be firmly grouted to the roof in the ground in case of ground mounted system. The grouting blocks shall be of minimum equal to 300 mm x 300 mm x 300 mm and finished properly. In case the grouting is carried out on roof already water proofed with asphalt the back support of the collectors may be anchored to the parapet or the size of the grouting block shall be increased to provide for a dead weight anchoring of 75 kg per leg of the vertical support. Any other alternative method of grouting/supporting shall be submitted the documents to Engineer-In-Charge / Project In charge for their approval prior to execution.

c. ABSORBER

- (1) The absorber shall consist of riser, header and sheet for absorber. The diameter of header shall be 25.4 mm and Thickness 0.71 mm. The diameter of the riser shall be 12.7 mm and thickness 0.56 mm and made of copper only. The distance between the riser from center to center shall be 120 mm. Type, Grade, Size, Workmanship and Finishes shall be as per IS: 12933. The riser and header pipes shall be of copper. The welding between Copper tube riser and Copper Sheet should be Laser-Welding or Ultrasonic-Welding
- (2) The sheet shall be coated with selective coating to satisfy solar absorption of more than 0.90 & solaremissivity < 0.12 . or as required.
- (3) The selective coating shall not get damage when the sample is raised to 1250 Degree C temperatures.
- (4) All tests such as solar absorption test, emissivity test and temperature tests are to be carried out as per standard tests.
- (5) Riser and header assembly designed for working pressure up to 2.5 Kg/cm^2 and shall be tested for leakage at the Min. hydraulic pressure of 3.5 kg/cm^2 .
- (6) Sheet for absorber shall be made of copper only.

d. PUMPS FOR FORCED CIRCULATION, HTC & RE_CIRCULATION OPERATIONS

All Pumps used in the solar system for Forced Circulation, HTC & Re-Circulation Systems shall be Horizontal type with Centrifugal operation & having SS Impeller & Shaft and with CI Body. All Pumps shall be suitable for 3-Phase Operation & shall be for 1 Working & 1 Standby mode.

e. ELECTRICAL HEATER

Electrical Heater shall be ISI Marked immersion type. Electrical heater capacity shall same as Heat pump capacity or design to achieve Delta 40 degree of per day hot water requirement.

f. ELECTRICAL HEATER CONTROL PANEL

The Electrical Heaters shall operate through temperature controller with switchgear & contactor & It should be the part of main control panel.

g. CONTROL PANEL FOR PUMP OPERATION

The Operation of the Pumps in the above operations shall be DOL Starter based with adequate rating. The Main Control Panel Shall be sub-divided into sub-Zones for following operations

- Forced Circulation Zone
- Heat Transfer & Control Zone (for Primary & Secondary Pump sets)
- Hot Water Re-Circulation in Building Zone
- Heat Pump Zone

Note: Contractor shall provide Control Panel with makes as specified in the list of approved makes with digital differential temperature controller / PLC including necessary electronic parts like Contractors, Relays, Indicators, MCBs, Control fuses etc. for satisfactory working of pumps.

h. TEMPERATURE GAUGE

DIAL Type temperature gauge duly calibrated and suitable for temperature range 0-120 deg. Celsius shall be provided.

Contractor shall provide all valves, strainer, float valves and NRV etc. as per requirement.

Contractor shall provide 1:2:4 cement concrete foundation of size 300x300x250 mm (1 cement: 2 coarse sand: 4 stone aggregate of size 20 mm nominal size) for each and every footing of system. This will be scope of Civil Contractor with complete guidance from Solar Contractor.

i. PAINTING OF STANDS

Proper cleaning and degreasing of the surface should be done before painting. Two coats of zinc chromate red oxide primer shall be applied followed by one coat of epoxy paint and approved color recommended by the CLIENT/ HITES.

j. PIPING

- | | | | |
|----|-----------------|---|---|
| a) | Material | : | Medium class (B class) GI as per IS 1239 shall be used for piping. |
| b) | Back insulation | : | Insulation of R value = 1.67 m ² °C/W to withstand a temperature of 100°C shall be used. |

Typical insulation detail shown below and also conforming to ECBC standards.

Thin plastic sheet shall be used as covering between glass wool and aluminum cladding besides other retaining material like chicken mesh etc.

26 SWG aluminium sheet shall be used for cladding the insulated pipe.

k. VALVES / NIPPLE / TEES / BENDS

Gun metal valve as per IS 780 specifications shall be used. Nipple / Tees and bends shall be of GI as per IS 1239 Part II.

Gun metal ball valve shall be provided in each row outlet with Air vent.

l. VALVES

Gate valves or butterfly valves for shut-off or sectionalizing service, globe or ball valves for flow modulation. For on-site control, use gate valves. Specialty valve shall be employed where appropriate, such as check valves on a pump discharge, pressure regulating valves for equipment requiring lower-than-available system pressure, solenoid valves, etc. Flanged or threaded end valves are preferred.

Locate valves in accessible locations, not more than six feet above the floor, if frequently used, and with a union on the downstream side of threaded end valves.

Provide each valve with brass, aluminum or plastic disc not less than 32mm diameter engraved with numbers, piping service and normal operating position (i.e. NO, NC) corresponding to valves shown on the diagram. Fasten disc to valve with 14 gauge brass wire or 16 gauge jack chain.

m. GATE VALVE

The primary function of a gate valve is for starting and stopping of flow. It has a disc actuated by a stem screw and hand wheel, moves up and down at right angles to the path of flow of fluid and seats against two faces to shut off flow. As the disc of the gate valve presents a flat surface to the direction of flow, this valve is only for starting and shutting the flow in the pipe.

These valves are of Gun Metal (GM) make. Supplying, fixing and testing correspond to IS 778-1984, Specifications for Copper Alloy Gate, Globe and Check Valves for Water Works.

All globe and check valves shall have working parts suitable for hot and cold water, as required. Valves shall be tagged with permanent label under hand wheel indicating type or duty.

All valves should have manufacturer's test certificate indicating the date of shop test and other quality control tests with the material used for the same.

n. BALL VALVE

The ball valve shall be of high-pressure type and shall be of sizes as specified and/or shown in the drawings the normal size of a ball valve shall be that, corresponding to the size of the pipe to which it is fixed. Ball valves shall have body of carbon steel. The ball and the shaft shall be of stainless steel. The seat shall be of PTFE.

The valve shall be complete with socket weld ends and the float of copper sheet. The minimum thickness of copper sheet used for making the float shall be 0.45mm for a float exceeding 115mm dia. The body of the high-pressure ball valve when assembled in working condition with the float immersed to not more than half of its diameter shall remain closed against a test pressure of 3.5kg/sqcm.

The ball valve shall generally conform to IS specification No.1703: 1977. The weight of ball cock and the size of the ball cock shall be as per IS specification.

o. SYSTEM LAYOUT AND DESIGN

Maximum number of collectors in series shall be not more than Ten for Thermosyphon system and not more than 15 for force circulation system.

Maximum number of collectors in parallel in one row with header-to-header connections should not be more than six.

Air venting at appropriate places without hindrance of a spring-loaded valve to prevent air locking in the system should be provided. For this purpose, system shall have at a suitable point atmospheric pressure conditions preferably in the high temperature zone. Flow rates commensurate with optimum heat removal from collector plates.

System shall have a suitable expansion / make up tank at a high point in the system to ensure that collectors run full all the times. Capacity of this expansion

make up tank should be 1% of the system capacity for all systems above the capacity of 5000 LPD and 1.5% of the system capacity for the systems of capacity ranging from 1000 LPD to 5000 LPD.

Expansion cum make-up tank is for closed loop system and make up tank is for open loop system.

SECTION - II

TECHNICAL SPECIFICATIONS FOR ELECTRICAL & ASSOCIATED WORK

1. GENERAL

This chapter covers technical specifications for various electrical equipment and internal & external electrical works for various buildings & facilities to be constructed newly or pre- existing.

2. SCOPE OF WORK

The scope of work shall cover internal Electrical Installations, 33/0.433 kV CSS, 415V Radiator Cooled Silent type DG Set in weather proof accoustic enclosure, Main LT Panels, Hybrid Type Capacitor Panel with Active Harmonic Filters (With Common Controller), Indoor/Outdoor type Al Conductor sandwich type bus duct, HT/LT cabling, control cabling and external electrical Installation works complete as required for Electrification of proposed Campus. It shall cover designing of complete Electrical System for the entire complex, preparation of shop drawings, supply of all equipment, material, electrical Fixtures & Accessories required, installation, testing and commissioning of all electrical installations for the project for the following, but not limited to, main items/systems:

2.1 ESS & External Electrical Installation

- i. 33/0.433 KV CSS
- ii. 415V Radiator Cooled Silent type DG Set in weather proof accoustic enclosure,
- iii. Main LT Panel
- iv. Hybrid type Capacitor Panels (APFC) with Active Harmonic filters
- v. Aluminium conductor sandwich type indoor/outdoor bus duct,
- vi. 1.1 kV LT power cabling with terminations
- vii. Control Cabling
- viii. All Associated Equipment & accessories required
- ix. Lightning Protection System & Earthing Network
- x. Street Lighting System
- xi. Electrical distribution comprising of respective Main LT pane. Separate distribution shall be provided for Lighting load, AC Load, Power/Medical Equipment load and UPS Load. UPS power shall be distributed through suitable cabling & LT panels in all buildings. Separate Electrical Floor Panels at each floor shall be provided for feeding HVAC load of AHUs, FCUs, Split ACs and Ventilation Fans.

The Electrical distribution should include - Emergency power supplying distribution system as per NBC 2016 for critical requirement for functioning of fire and life safety system and equipment, shall be planned for efficient and reliable power and control supply to the following systems and equipment where provided:

- i. Fire Pumps
- ii. Pressurization and smoke venting; including its ancillary systems such as dampers and actuators;
- iii. Fireman's Lifts (including all lifts).
- iv. Exit Signage Lighting;
- v. Emergency Lighting;
- vi. Fire Alarm System;
- vii. Public Address (PA) System (relating to emergency voice evacuation and annunciation);

- viii. Access Control System
- ix. Lighting in fire command centre and security room.
- x. Any other system as required

2.2 Internal Electrical Installations

It shall include the following items of work to be carried out simultaneously with the civil work within the buildings:

- i. Wiring & Conduiting (MS/PVC Conduits) for internal electrification, LV & Allied works as per requirement.
- ii. Wiring for 6A Light Points and socket Outlets
- iii. Wiring for Call Bell, Fan & Exhaust Points.
- iv. Wiring for 16A/20A Power socket outlets.
- v. Wiring for 3 Phase Power socket Outlets
- vi. 1.1 KV L.T. Cables and Sub main wiring.
- vii. GI perforated cable Tray
- viii. Raceways
- ix. Aluminium Conductor, sandwich type Rising Mains
- x. MV Panels/Floor Panels and Double Door MCB Type Distribution Boards and VTPN DBs.
- xi. Supply and Installation of LED Light fittings, fans, Exhaust Fans & fixtures
- xii. Earthing & Lighting Protection System
- xiii. Wiring for Telephone
- xiv. Wiring for LAN Networking & Wifi
- xv. CCTV, Access Control System
- xvi. Fire Detection and Alarm System
- xvii. Public Address System
- xviii. Any other system as required.
- xix. Testing and commissioning of all electrical installations

The scope of work shall also include any other item or item of work, equipment, material or accessories not specifically mentioned above but is required for the satisfactory completion & trouble-free operation & maintenance of electrical equipment/work. This shall also include spares required for commissioning of the equipment/work.

2.3 CONDUIT SYSTEM, CABLE TRAY, CABLE LADDER AND TRUNKING INSTALLATION

This section describes the supply and installation of wiring facilities systems include conduits, cable trays, cable ladder and Trunking system, c/w associated fittings and accessories. All cables running above the suspended false ceiling, columns, or on surface should be supported by proper clamps, on cable tray or cable ladder system. No free hanging of cable is allowed.

2.4 Standards

The complete wiring facilities system should be manufactured, supplied, installed and tested in accordance with the latest revision of the Indian standards and the appropriate BS / IEC include:

1. Steel Conduit and Fitting Accessories IS : 9537 (Part-II)/ BS4568 & BS731

2. PVC Conduit and Fitting Accessories	:	9537/1983 (Part-III)/ BS6099 & BS4607
3. Cable Tray	:	BS729
4. Cable Ladder	:	BS729
5. Cable Trunking	:	BS4678

The complete wiring facility system should conform to the requirements of all relevant local codes, as applicable, together with the additional requirements referred to in the approved specification and drawings.

2.5 PVC Conduit and Accessories

PVC Conduit

1. All conduits should be high impact rigid 2mm thickness PVC heavy duty type and should comply with I.E.E. regulations for non-metallic conduit as per IS-9537/1983 (Part-III).
2. All sections of conduit and relevant boxes should be properly cleaned and glued by using epoxy resin glue and the proper connecting pieces.
3. Inspection type conduit fittings such as inspection boxes, drawn boxes, fan boxes and outlet boxes should be of M.S. or otherwise mentioned.
4. Conduit should be terminated with adopter/PVC glands as required.

PVC Conduit Accessories

1. Accessories used for conduit wiring should be of an approved type conforming to IS: 3837-1966.
2. All accessories used should be of standard white or black color, identical to conduit used.
3. Plain conduits should be joined by slip type of couplers with manufacturer's standard sealing cement.
4. All conduit entries to outlet boxes, trunking and switchgear are to be made with adaptors female thread and male bushes screwed.
5. PVC-switch and socket boxes with round knockouts are to be used. The colors of these boxes and the conduits should be the same.
6. Standard PVC circular junction boxes are to be used with conduits for intersection, Tee-junction, angle-junction and terminal. For the drawing-in of cables, standard circular through boxes should be used.
7. Samples of accessories should be submitted for approval prior to installation.
8. All jointing of PVC conduits should be by means of adhesive jointing. Adequate expansion joints should be allowed to take up the expansion of PVC conduits.

2.6 Installation

Layout

1. The conduit layout and conduit routes should be as approved.
2. Conduit routes should be chosen for easy, straight runs with minimum bends and crossings. Generally they should follow the structure of building, running at right angles or in parallel to floors and ceilings. Conduits should be kept within 300 mm of floors and ceilings when running parallel to them.
3. Outlet boxes for housing accessories should be used as draw boxes. The total number of draw boxes should be kept to a minimum and should be provided so that conduit runs do not exceed 12 m or have more than two right angle bends.
4. All conduits should be kept clear of gas and water pipes. In particular, conduits should be at least 150 mm away from gas pipes. Where proximity to these pipes is unavoidable, they should be effectively segregated e.g. using rubber or other insulating material to prevent appreciable voltage differences at possible points of contact. Segregation from extra low

voltage circuits and telecommunication circuits should also apply unless these are wired to the same voltage requirements as lighting and power circuits.

5. Conduits from different distribution boards should not be connected to the same junction box. Each run of conduit should be assembled complete with draw-in-wires.

Wiring / Cabling

1. All the wiring installation should be as per IS: 732 with latest amendment.
2. The conduit system must be installed free of obstructions and sharp corners before any cables are drawn in. Conduits should be thoroughly cleaned to remove dirt immediately prior to the drawing in of cables. Cables should be continuous throughout conduit lengths and no joints are permitted. There should be no kink in cables, neither any cut, abrasion or chink in the cable insulation.
3. Cables for power and lighting circuits and extra low voltage systems should not be drawn into the same conduit. Lighting and power circuits should run in separate conduits except, where an adopter box is employed as final distribution point, a number of final circuits are grouped together in larger conduits between the distribution board and the adopter box provided that all final circuits in one conduit are of the same phase. In the case of three phase circuits, all three phases including neutral, if any, should be drawn into the same conduit.

Nominal Cross- Sectional area of Conductor in Sq.mm	20mm		25mm		32mm		38mm		51mm		64mm	
	S	B	S	B	S	B	S	B	S	B	S	B
1.0	2	3	4	5	6	7	8	9	10	11	12	13
1.5	5	4	10	8	18	12	-	-	-	-	-	-
2.5	5	3	8	6	12	10	-	-	-	-	-	-
4.0	3	2	6	5	10	8	-	-	-	-	-	-
6.0	2	-	5	4	8	7	-	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	2	3	3	5	5	10	7	12	8
25	-	-	-	-	3	2	5	3	8	6	9	7
35	-	-	-	-	-	-	3	2	6	5	8	6
50	-	-	-	-	-	-	-	-	5	3	6	5
70	-	-	-	-	-	-	-	-	4	3	5	4

Notes:

- i. The above table shows the maximum capacity of drawing in of cables in conduits
- ii. The columns Head 'S' apply to runs of conduits which have distance not exceeding 4.25 m between draw in boxes and which do not deflect from the straight run by an angle of more than 15 degrees. The columns heads 'B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.
- iii. Conduit sizes are the nominal external diameters.

2.7 Cable Tray/ Cable Ladder

Cable Tray and Cable Ladder systems are intended for the support and accommodation of cables and possibly other Electrical equipment in Electrical/Instrumentation/Communication systems.

The cable trays / ladders should be fabricated according to the design specified by IEC 61537 and should be tested for Safe Working Load (SWL). The relevant details of SWL and the load chart with respect to SWL, supporting distance and the deflection should be according to the following chart.

Safe Working Load (SWL) with a span length up to 5 meters								
Description	Side Height (in mm)	Width (in mm)	Span length (in meters)					
			1.5m	2m	2.5m	3m	4m	5m
			Permitted Load (in kg/meter)					
Perforated tray	60	100-500	150	100	50	-	-	-
	85	100-500	175	110	50	-	-	-
	100	150-500	185	130	75	60	-	-
Cable Ladder	60	200 - 600		225	150	110	45	-
	110	200 - 600		310	-	140	65	50

Safe Working Load (SWL) with a span length up to 10 meters									
Description	Side Height (in mm)	Width (in mm)	Span length (in meters)						
			4m	5m	6m	7m	8m	9m	10m
			Permitted Load (in kg/meter)						
Perforated Cable Tray for long span distance	110	200 - 300	160	110	75	-	20	-	-
		400 - 600	200	150	100	-	40	-	-
	160	200 - 300	230	180	140	100	70	-	-
		400 - 600	250	200	160	130	100	-	-
Cable Ladder for long span distance	110	200 - 300	160	110	80	40	-	-	-
		400 - 600	210	150	100	70	-	-	-
	160	200 - 300	230	180	140	100	70	-	-
		400 - 600	250	200	160	130	100	-	-
	200	200 - 600	-	-	300	250	200	140	100

Fabrication of Tray / Ladder and accessories at site and welding is not permitted. In unavoidable circumstances, If any cut or holes are made in the trays/Ladder/accessories, zinc spray need to be applied over the surface. The metal edge has to be protected by edge protection sleeves to avoid cable damage. Edge of the supports has to be protected with plastic END caps. Screwed connections and internal fixing Devices should not create any damage to the cable when correctly fixed. Sudden or jerky motions should not be used to tighten reusable screw connections.

Cable Tray:-

The cable tray and all accessories should be fabricated from sheet steel and has to be galvanized against corrosion confirming to EN10346/ ISO1461-1999 for installations in indoor and outdoor applications respectively. The cable trays should be supplied in standard lengths of 3000 mm and the width of the tray should be as follows.

Width: 100, 150, 200, 300, 400, 500.

All the cable tray accessories like Bend's, TEES's, Cross over's etc. should be in accordance with IEC 61537 and should be factory fabricated. The accessories should be from the same material as of the tray and modular type, it should be connected with the trays by using fasteners. Typical details of trays, fittings and accessories etc. are shown in the enclosed drawings.

For Cable trays, the thickness of cable tray should be 2 mm up to span length of 1.5 meter, 2.5 mm for span length between 2 to 3 meter and 3 to 4 mm for span length between 4 and 10 meter

Cable ladder:-

The cable Ladder and all accessories should be fabricated from sheet steel and has to be galvanized against corrosion confirming to EN10346/ ISO 1461-1999 for installations in indoor and outdoor applications respectively. The cable ladders should be supplied in standard lengths of 3000 mm and the width of the ladder should be as follows.

Width: 200 to 600 mm in multiples of 100 mm

Maximum rung spacing in the ladder should be 300mm. The rungs should be made of C profiles suitable to fix cables by special metal clamps according to the drawing. The ladder should be of riveted and foldable type for easy transportation and to avoid damage during transportation and storage. All the ladder accessories like Bend's, TEES's, Cross over's etc. should be designed in accordance with IEC 61537 and should be factory fabricated. The accessories should be made from the same material as of the ladder and modular type, it should be connected with the ladder by using fasteners. The details of ladders, fittings and accessories etc. are shown in the enclosed drawing.

The Cable Ladders thickness should be 2.5 mm up to span length of 1.5 to 2 meter, 3 mm for span length between 2.5 to 4 meter and 3 to 4 mm for span length between 5 and 10 meter

Mounting Accessories (supports and Brackets):-

The mounting accessories should be fabricated from steel and has to be hot dip galvanized against corrosion confirming to ISO 1461-1999 for installations in both indoor and outdoor applications and should be of completely modular type.

All supports and Brackets should be factory made, hot dip galvanized after completing welding, cutting, drilling, other machining operations and tested according to IEC 61537 according to the arrangements in the enclosed drawing. The system should be designed such that it allows easy assembly at site by using Bolts and Nuts. The main support and brackets should be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hard ware etc. to form various arrangements required to support the cable trays. Welding of the components at the site should not be allowed.

Corrosion Protection: -

The cable tray/ ladder/accessories should be Galvanized according to EN10346 / ISO 1461-1999 for installations indoor and corrosive outdoor applications respectively. Sample tray/ ladder/ accessories/ mounting accessories and supports should be salt spray tested according to ISO 9227 for > 150 hours & 500 hours. (*155 hours according to class 3 for pre-galvanized surface and 550 hours according to class 6 for Hot dip Galvanized surface as per ISO)

2.8 WIRES AND CABLES

The wires should be single core PVC insulated 1.1 KV grade stranded twisted wires and should comply with following standards with update amendments under the specifications.

- **IS-3961: Current rating for cables.**
- **IS-5831: PVC insulation and sheath of electric cables.**
- **IS-694: PVC insulated cables for working voltage up to and including 1100 volts.**
- **IEC-54 (I): PVC insulated cable.**

The wires should be color coded - (red, yellow, blue) for Phases, black for Neutral and green for Earth. All LT cables for normal power/control circuits within buildings should be XLPE insulated and PVC sheathed Aluminum conductor and control cables should be PVC insulated and PVC sheathed copper conductor respectively. Cables in service duct, open trench, direct-laid underground in soil should be by means of armored cables. Non-armored cables should only be laid in conduits, trunkings or tray/ladder for mechanical protection.

All cables should be manufactured and constructed in accordance of the following standards with the latest revision:

1.	IS: 694	HRPVC/XLPE insulated (heavy duty) electric cables for working voltage up to and including 1100 volts.
2.	IS: 424-1475(F-3)	Power cable-flammability test.
3.	IS: 7098(I)	Specification for cross-linked polyethylene insulated LSZHPVC sheathed cable for working voltage up to 1.1 KV.
4.	IS: 1554	Specification for PVC insulated (heavy duty) electric cables for working voltages up to and including 1100 volts.
5.	ASTM-D: 2863	Standard method for measuring the minimum oxygen concentration to support candle-like combustion of plastics (Oxygen Index).
6.	ASTM-D: 2843	Standard test method for measuring the density of smoke from the burning or decomposition.
7.	IEEE: 383	Standard for type of tests Class-IE, Electric cables, field splices and connections for power generation station.
8.	ASTME: 662/ IEC: 754(x)	Standard test method for specific optical density of smoke generated by solid materials
9.	IS: 10418	Cable drums.
10	IS-10810	Testing method of cable.
11.	IS-6121	Cable glands.

2.9 SWITCHES & SOCKETS

2.10 BSL-3 Containment Space:

The switches and sockets inside BSL-3 containment space should be dust proof, polystermoulded finish, impact resistant and UV stabilized, chemical resistant and should be IP 66 rated (Schneider CLIPSAL 56 series or equivalent). The switches and socket modules should be 10A – 20 A rated depending on the connected load.

The sockets should be supplied along with plug tops both having screwed lock ring arrangement for connections and should maintain IP Integrity in plugged-in conditions. The power sockets should be 5 Pin module. Each power point module should be complete with back box (mounting enclosure), switch module, socket module, plug top and flanged cover plate.

The switches should have rotary switch action, with clear marking of ON and OFF positions. The switch for light points should be supplied along with back box (mounting enclosure) and flanged cover plate.

2.11 26/16AMP Switch and Socket Outlets – Outside Containment Space:

Switch socket outlets should be modular type as per BS: 1363 single pole 6Amp 3round pin, except otherwise specified and suitable for surface or flush mounting according to location.

Switches should be of the quick-make and break type silent action totally enclosed with solid silver alloy contacts. Switched socket outlets for indoor use should be housed in suitable galvanized steel boxes as per BS: 4662 with conduit knockouts. Types and finishes of socket plates should match those for the lighting switches.

2.12 Miniature Circuit Breaker

The MCB should be suitable for manual closing, opening and automatic tripping under overload and short circuit. The MCB should be rated for 10KA fault level. The MCB should generally conform to IEC/ IS: 60898

The MCB should be suitable for housing in the lighting boards and is suitable for connection at the outgoing side by tinned cable lugs and for bus-bars connection on the incoming side.

2.13 Earth Leakage Circuit Breaker

ELCB should be 4 pole 415 volts 50Hz, 30-300mA sensitivity. The rating of the ELCB should be as required and approved. These should be suitable for manual closing and opening and for automatic tripping under earth fault circuit of 30-300 mA. The enclosure of the ELCB should be moulded from high quality insulating material. The material should be fire retardant, anti-tracking, non-hygroscopic, impact resistant and should withstand high temperature. All parts of switching mechanism should be non-greasing, self-lubricating material so as to provide consistent and trouble free operation. Operation of ELCB should be independent of mounting position and trip free type.

2.14 Lighting/Small Power Distribution Boards

Distribution boards should be of standard make with MCBs as per approved make given. Distribution boards should be of steel sheet construction double door all welded enclosure of IP42 protection and powder coated painted. Ample clearance between the conductors of opposite pole and sheet steel body should be maintained in order to obviate any chance of short circuit. Removable conduits entry plates should be provided at top and bottom to facilitate drilling holes at site to suit individual requirements. Additional / separate adopter box of suitable size should be provided to accommodate wires, cables and No. of conduits etc. The MCB should be mounted on high grade rigid insulating support and connected by electrolytic copper bus bars. Each incoming MCB isolator should be provided with solder-less cable sockets for crimping. Phase separation barriers made out of arc resistant materials should be provided between the phases. Bus bars should be colour-coded for phase identification. Distribution boards should be recessed in wall or mounted on surface of wall with necessary mounting arrangement.

Distribution board should be provided with proper circuit identification name plate and danger sticker/plate as per requirement. All the distribution boards should be provided with engraved name plates with 'lighting', 'power' or 'UPS' with DB Nos., as the case may be. Each DB should be provided with circuit list giving details of each circuit. All the outgoing circuit wiring should be provided with identification ferrules giving the circuit number & phase. Each distribution board should have separate neutral and earth connection bar mounted within the DB each having the same number of terminals as the total number of outgoing individual circuits from the distribution board. Conduit & cable armoring should be bonded together & connected to the distribution board earth bar.

Distribution Boards should be tested as per IEC61439-III standards and have following features:

Recess/ Surface type with integral loose wire box.

Phase/ neutral/ earth terminal blocks for termination of incoming & outgoing wires.

Din Channel for mounting MCBs.

Arrangement for mounting incomer MCB/ RCCB/ RCBO/ MCCB as required.

Copper Bus bar

Earthing bolts- 2 nos.

Wiring from MCBs to phase terminal block.

Terminal blocks 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.

Terminal block should be made of flame retardant polyamide material.

Colour terminal blocks and FRLS wires for easy identification of RYB Phases, Neutral and Earth.

Horizontal TPN DBs should have Separate Insulated Neutral bar for each phase to achieve per phase Isolation (PPI)

2.15 MAIN LT PANEL

Medium Voltage power control centers (generally termed as switchboard panels) should be in sheet steel clad cubicle pattern, free floor standing type, totally enclosed, compartmentalized design having multi-tier arrangement of the incomers and feeders as per details given in the schedule of quantities. The panels should be of extensible type with provision of bus bar extensions. All panels should conform to the requirements of the latest addition of IS and should be suitable for 415 V, 3 phase AC supply or 230 V single phase AC supply as required.

All switch board panels or power control centers of free standing type should have a bus bar chamber at the top and the cable compartment at the bottom or as approved by the Developer/Consultants depending upon the specific requirements of the job. The space between the bus chamber and cable compartment should be suitably compartmentalized to accommodate either air circuit breakers or molded case circuit breaker of various ratings. The cable terminations should be carried out on the rear side of the panels for which adequate space and clamping arrangements should be provided. Where panels have to be installed with very little access space at the rear, the cable terminations should be carried out in suitable cable alleys provided on the front of the panel. All the live parts should be properly shrouded with Bakelite barriers. All the equipment should be accessible from the front. However, protection relays, KWH meters, etc. may be mounted on the rear side/front side.

Arrangements and marking of bus bars, main connections and wiring should be in accordance with latest IS code. The structure of the panel should be robust and provided with adequate bracing's to withstand the operation of the equipment and stresses due to system short circuit. The panels should be fabricated out of best quality heavy gauge sheet steel. The panel should be machine pressed with punched openings for meters, indicating lamps etc. The enclosure system should be Modular in nature with bolted on construction. Enclosure parts/kits should be interchangeable to reduce downtime during modification or maintenance work. Enclosure system and switchgear components should be from same manufacturer.

Panel should be equipped with monitoring devices Ammeter/Voltmeter etc.

BUSBAR

The bus bars should be suitable for 4 wire, 415 Volts, 50 Hz, system. The main bus bar should be made of high conductivity electricity conductor grade electrolytic AL 91E Aluminum and should be liberally sized. In case of copper bus bar it should be electrically conductor grade electrolytic copper and at the time of joining of two copper buses tinning will be done on the copper strips ends to a length equal to the lap length of the joint plus one each. The bus bars should have uniform cross section throughout. The bus bars should be capable of carrying the rated current at 415 Volts continuously. The bus bar will run in a separate busbar chamber using bus insulators made of non-deteriorating, vermin proof, non-hygroscopic materials such as epoxy fiber, reinforced polyester or molding compound. The interval between the two insulators will be designed after considering:

- a. Strength and safe load rating of the insulator,
- b. The vibrating force generated during a fault,
- c. A Factor of safety of 1.8
- d. A set of insulators at both ends of the bus.

The bus bars should be designed to withstand a temperature rise of 45o above the ambient. To limit the temperature rise in the bus bar chamber a set of louvers can be provided at strategically places considering the air circulation. The louvers provided will have a brass wire mesh covering from inside with more than 100 openings per sq. inch. The overall temperature of bus bar should

not exceed 85°C in any case. A current density of 1.0 Amps/Sq. mm should not be exceeded for Aluminum bus bars.

All the bus bars should be insulated with PVC heat shrinking sleeves suitably throughout (except at joints) the length. The electro galvanized galvanized high tensile steel nuts, bolts, plain or spring washers of suitable size will be used in connecting the various section of the bus bar. A minimum of 1.6 times the width of bus bar will be the lapping length of each joint.

EARTHING

The panels should be provided with an aluminum or copper earth bus of suitable size running throughout the length of the switchboard. Suitable earthing eyes/bolts should be provided on the main earthing bus to connect the same to the earth grid at the site.

INTERLOCKING

The panels should be provided with the following interlocking arrangement.

- a. The door of the switch-fuse compartments is so interlocked with the switch drive or handle that the door can be opened only if the switch is in 'OFF' position. De-interlocking arrangements should also be provided for occasional inspection.
- b. It should not be possible for the breaker to be withdrawn when in 'ON' position.
- c. It should not be possible for the breakers to be switched on unless it is either in fully inserted positions or for testing purposes in fully isolated position.
- d. The breaker should be capable of being raked in to 'testing' 'isolated' and 'maintenance' positions and kept locked in any of these position.
- e. A safety latch to ensure that the movement of the breaker as it is withdrawn, is checked before it is completely out of the cubicle should be provided.

PROTECTION & INSTRUMENTATION

Protection and instrumentation should be as per standard specifications. All ACBs, MCCBs of Main LT Panel and Incomer MCCBs should have inbuilt Earth Fault Protection

CONTROL WIRING

The control wiring of all the panels will be done with PVC single core flexible copper wires of cross section 1.5 sq. mm and 2.5 sq. mm. All the wiring involving current transformers or circuits with currents of more than 5 Amps will be wired with 2.5 sq. mm cross section wire and the others with 1.5 sq. mm. Similarly all the interconnecting between the incoming bus and the outgoing of 100 Amps and above rating should be done by insulated copper strips of suitable sizes and equipment below 100 Amps rating should be wired with insulated copper conductors. All of the control wiring will be done by properly dressing all the wires in a laminar manner either in a PVC duct of liberal size or bunched together by PVC strapping tapes at a distance not exceeding 150 mm. Each wire will terminate with a copper ferule crimped to the wire.

SURFACE TREATMENT

Each part of the fabricated panel will be subjected to seven tank treatment and all sheet metal accessories and components of power control centers and switchboard panels should be thoroughly cleaned, degreased, de-rusted and hot dip phosphatized before red oxide primer is applied. The panel should be stove enameled gray shade finish and the interior surfaces of the panel should be painted to an off-white shade.

ENCLOSURE

The panel enclosure should be totally dust and vermin proof and should be suitable for indoor installation. All the cubical will be adopted with front located, outward openings, lockable doors having hidden hinges and a bolted back cover both using no deteriorating neoprene rubber gasket. Enclosure design should be in accordance with degree of protection IP 54 as per latest IS code. All the nut bolts handles, meters, knobs etc. appearing from outside of the panel should be in symmetry so as to give a neat appearance.

NAME PLATE

The panel as well as the feeder compartment doors should be provided with name plate giving the switchboard/feeder descriptions as indicated on the approved drawings.

METERING, INSTRUMENTATION AND PROTECTION

Ratings, type and quantity of meters, instruments and protective devices should be as per approved SLD and GA Drawing.

Current Transformers

CTs should conform to latest IS codes in all respects. All CTs used for medium Voltage application should be rated for 1 kV. CTs should have rated primary current, rated burden and class of accuracy as specified in schedule of quantities/drawings. Rated secondary current should be 5A unless otherwise stated. Minimum acceptable class for measurement should be 0.5 to 1 and for protection class 10. CTs should be capable of withstanding magnetic and thermal stresses due to short circuit faults. Terminals of CTs should be paired permanently for easy identification of poles. CTs should be provided with earthing terminals for earthing chassis, frame work and fixed part of metal casing (if any). Each CT should be provided with rating plate indicating:

- Name and make
- Serial number
- Transformation ratio
- Rated burden
- Rated Voltage
- Accuracy class

CTs should be mounted such that they are easily accessible for inspection, maintenance and replacement. Wiring for CT should be with copper conductor PVC insulated wires with proper termination works and wiring should be bunched with cable straps and fixed to the panel structure in a neat manner.

Potential Transformer

PTs should conform to latest amendment up to date IS Codes.

Measuring Instruments

Direct reading electrical instruments should conform to latest IS codes in all respects. Accuracy of direct reading should be 1.0 of Voltmeter and 1.5 for Ammeters. Other instruments should have accuracy of 1.5. Meters should be suitable for continuous operation between -100C and +5000C. Meters should be flush mounting and should be enclosed in dust tight housing. The housing should be of steel or phenolic mould. Design and manufacture of meters should ensure prevention of fogging of instrument glass. Pointer should be black in colour and should have Zero position adjustment device operable from outside. Direction of deflection should be from left to right. Selector switches should be provided for Ammeters and Volt meters used in three phase system.

MCCB's & RCCB's

MCCBs should comply with standards IS/IEC 60947-1 & 2. The breaking capacity performance certificates should be available for category A to the above mentioned standards.

MCCB should have a rated operational voltage (U_e) of 415V, insulation voltage (U_i) of 750 V (AC 50/60 Hz) & impulse voltage (U_{imp}) of not less than 8kV. MCCBs should be current limiting type with trip time of less than 10 m sec under short circuit conditions. The MCCBs should be either 3 or 4 poles fixed type. The design is required to minimize the effects of short circuit currents i.e. limit the let through energy and improve the life of cables.

RCCBs must conform to IS12640 -1 and IEC/EN 61008 standards.

RCCBs should be suitable for operation at 240V/415V, 50Hz supply. The RCCB ratings should be available from 25A-125A in SPN and TPN versions with the sensitivity of 30mA (for personal protection) and 100/300mA (for Fire protection), as per the BOQ requirements. Rated conditional short circuit should be 10KA RMS

RCCBs should carry ISI marking. RCCBs should have clear indication of 'Tripping on earth leakage fault' on front facia. RCCBs should have Electrical life of 10,000 operations for all ratings. RCCBs should have bi-connect facility to terminate fork type busbar and wires, simultaneously. Terminal capacity should be minimum 25 sq.mm. for ratings up to 32A, and 35 sq.mm. for ratings above 32A, to ensure perfect termination of wires and cables. Terminals of RCCBs should have captive screws.

2.16 EARTHING

A complete earthing network comprising cables, copper tapes, electrodes and earth bonding of all relevant necessary non-current carrying metal parts of equipment/ apparatus should be connected as required. The Earthing should conform to IS 3043.

All earthing conductors should be of high conductivity copper/ G.I. and able to protect against mechanical damage as per requirement. The cross-sectional area of earth conductor should not be smaller than half that of the largest current carrying conductor.

Pipe Earth Electrode

G.I. pipe should be of medium class 100mm dia and 3m in length.

G.I. Pipe electrode should be cut tapered at bottom and provided with holes of 12mm dia drilled not less than 7.5cm from each other up to 2m of length from bottom. The electrode should be buried in the ground vertically with its top being 20cm minimum below ground level. Clamping of the earth leads to the earth rod should be made by earth clamp. The clamps should be capable of providing high pressure contact between the earth rod and the earth leads to achieve low contact resistance.

When two or more electrodes are driven to form a group, the heads of the electrodes in the group should be bonded to each other by means of a 25 mm x 3mm GI / Copper strip, laid at a depth of at least 600 mm in soil.

Plate Earth Electrode`

The plate earth electrode should consist of copper plate or G.I. plate. The plate electrode should be buried in ground with its faces vertical and top not less than 4.5m below Ground level. The plate should be filled with charcoal dust and common salt filling, extending 15cm around it's on all sides. A watering pipe of 50mm dia of medium class G.I pipe should be provided.

The top of the pipe should be provided with a funnel and a G.I. mesh screen for watering the earth. In the case of pipe electrode a removable plug should be provided.

The earthing lead from electrode onwards should be suitably protected from mechanical injury by suitable dia medium class G.I. pipe in case of wire and size according to strip size. The overlapping of strips at joints should done in approved manner

- a. GI strips should be riveted with rivets/ bolted and welded.

- b. Copper strips should be riveted with rivets/ bolted brass nuts, bolts and washers and brazed.

Earth Strip

Earth strips/grids should be of bare GI/ Copper strips of 25 mm x 3 mm as specified.

Earth strips should be riveted or joint with proper connector to earth electrodes. In order to minimize the mutual inductance between strips, earth strips should be positioned at a distance not less than 6m apart unless otherwise specified.

2.17 LIGHT FIXTURES AND FITTINGS

The Laboratory room should provide 400-450 lighting Lux level. All the Light Fixtures should be LED, surface mounted type constructed in CRCA Powder coated housing, LED panel with suitable driver. The construction should be in slim panel.

Rating - 18 – 48 W 20 W, or per requirements and approved designs

Light Fixtures in BSL-3 Lab (inside containment space) should be IP 65 rated

Light Fixtures (outside containment Space) – IP 20 rated

2.18 Fire Detection and Alarm System

The complete BSL-3 Laboratory and support areas should be provided with Addressable type Fire Detection and Alarm System conforming to as per IS: 2189-2008.

The system should include Addressable Main Fire Alarm Control Panel, battery charger, batteries, addressable heat detectors, addressable smoke detectors, manual fire alarm station, fire alarm bells/hooters, response indicators, conduiting, wiring and all necessary accessories required to complete fire alarm system installation as per IS: 2189-2008. Equipment like control panel, smoke detector, heat detectors etc should be EN-54/ UL approved

The fire control panel should be addressable type. The Main Fire Control Panel should be constructed to sheet steel of red colour, and provided with windows for the alarm and trouble lights. All components should be of the plug in type, for simple replacement and extension in the future. Control panel should be wall mounting type conforming to IS 513-1986.

2.19 Communication Facility (Intercom & LAN)

The intercom and LAN should be fully wired in CAT 6 cable, as per requirements. The system should be complete with required conduit and wiring and RJ outlets.

The EPABX should provide for upto 2 incoming lines and 30 outgoing lines. All the BSL-3 Lab rooms and support areas should be provided with intercom connection. The EPABX should support the following features:

- Superior voice quality
- Digital key telephone with LCD display-Headset connectivity
- Call waiting service
- Music on hold
- Message wait and ringer lamp
- Keys for hold, transfer, forward, conference, mute, phone book, cancel etc.

The telephone instruments inside BSL-3 Laboratory containment space should be flush mounting type to be installed in wall panel, should be in full stainless-steel body and should provide true-hands-free operation. The front cover should be resistant to chemicals and solvents and should be provided with keypad touch switch pad and speaker with volume control. The unit should operate on 220/110 V AC.

The telephone instruments outside BSL-3 containment space should be provided with normal handset.

For LAN, manageable/unmanageable switch with rack as per requirement should be provided.

2.20 Door Interlock & Access Control System

The door interlock and access control system should be provided with combination of proximity card based, numerical key pad lock based and push button based system. The system should be complete with access logic controllers, door electromagnets, proximity cards and card reader/s, numerical keypad locks, door release push buttons, emergency door release buttons, PC communicator, control and power wiring and cabling and other required accessories, hardware, and software.

A suitable software should be programmed/loaded on the computer to allow perform the following operations.

- Assign the access rights to the individual proximity cardholder/s
- Create database for bio-metric readers for the authorized persons and assign them access rights.
- Enable/disable access for specified time periods (for visitors etc.)
- Record the transactions and generate transaction reports

Biometric (finger scanner type)/Proximity Card Reader and Access Logic Controller should in general meet the following specifications:

No. of doors control per ALC	-	Minimum 4
Recognition of holidays	-	Yes
Anti-pass back system	-	Yes (system to refuse exit unless there is valid entry)
LCD display on the controller to	-	Yes show status
Frequency	-	125 KHZ
Card Reading Time	-	Less than 1 second
Output interface	-	RS-232 / RS-422 / RS 485
Baud rate	-	More than 19000 bps
Power	-	12 to 24
VDCID Number	-	1 to 10 digits from keypad or card
Use capacity	-	Not less than 100

Access Control Software should be suitable to operate on latest Windows OS.

The electromagnetic lock should conform to the following specifications as minimum.

Holding Force	-	Atleast 650 Lb. per door
Operating Voltage	-	12/24 VDC or 12/24 VAC
Protect against corrosion	-	The electromagnetic lock and its accessories should be of anticorrosive material/finish
Residual Magnetism	-	There should be no residual magnetism after release of electromagnetic lock

The access control system should be powered through UPS supply for uninterrupted operation even during mains power failure.

Access Control system in following configuration should be provided:

- 1 Door System - To control Entry/Exit for restricted access of main entry points.
- 2 Door System - To provide interlocked doors for controlled access for Airlocks
- 4 Door System - To provide controlled access for change-Shower-Change

Note: Systems for Change-Shower-Change should be provided with privacy switch such that if a

person enters the outer change and activates the privacy switch, the channel should not allow access from either side, till the person deactivates the privacy switch and exits.

2.21 Closed Circuit TV System (CCTV)

- i. A CCTV System should be provided for surveillance of the Laboratory and supports areas. Wherever new building is planned, the CCTV system should also cover the building externals.
- ii. The CCTV system should be complete with wall/ceiling mounted high resolution colour cameras, multiplexer cum DVR, remote controller, High resolution LED screen monitor 40", associated power and control cabling etc. and required hardware and software.
- iii. The output of the CCTV system cameras should be displayed on the monitor set and should also be possible to be viewed through LAN (with restricted and controlled access), for remote monitoring.
- iv. The cameras should be connected first to the multiplexer cum DVR where output of all cameras should be recorded. From multiplexer, the output of the cameras should be viewed on the monitor.
- v. The high resolution colour cameras should be suitable for indoor and outdoor installation, as per requirement and should be equipped with varifocal lenses to enable adjustment for best view.
- vi. The cameras should also have auto Iris lens to control the aperture according to the light fluctuations. The cameras should be suitable to withstand BSL-3 Laboratory fumigation/ disinfection.
- vii. The camera should meet the following minimum specifications:
 - Image sensor : 1/3"
 - H-Resolution : Min. 480 TVL
 - Min Illumination : 0.1 Lux /F1.2
 - Input Voltage : 12/24 V DC
 - Operating Temperature : 20DegC to +50 oC
 - Lens : Verifocal Lens 4-9 mm
 - Iris Control : Electronic

2.22 Outdoor cameras should be IP 66 or better.

- i. The multiplexer cum DVR should be suitable for saving up-to 32 channels (or higher, as per project specific requirement) analog data, with play back feature. For convenient backups the DVR should be compatible with Windows based OS so that it can be backed up through a PC.
- ii. The DVR memory / Hard disk capacity should be selected to store CCTV data for minimum 60 days at approx. 5fps per channel from all the channels. For convenient backups the DVR should be compatible with Windows based OS so that backed up Hard Disk is immediately available through the user's PC. The multiplexer cum DVR should conform to the following specifications as minimum:
 - 32 channels (or higher, as per project specific requirement) Video Input
 - 1 Channel Audio support
 - Simultaneous recording, playback, backup and network recording and playback
 - Upto 20 fps recording rate and upto 480 fps real time display speed
 - Real time monitoring and recording on the PC monitor and CCTV monitor
 - VGA Output support
 - Built in Hardware Quad splitter for analog channels

- Built in software multiplexer for minimum 8 channel split monitoring
- A variety of recording and playback conditions
- Easy interface using Jog/Shuttle
- **Remote controller**

2.23 **ONLINE UPS (For BMS, CCTV, Access Control and Biosafety Cabinets) & INVERTER (For Lighting backup).**

One On-line UPS should be provided for un-interrupted power supply to critical installations of the BSL-3 Laboratory to prevent any possible breach of containment, in case of main power failure.

One dedicated UPS/Inverter should be provided for lighting backup to cover minimum 50% of lighting provided in BSL-3 and support areas.

The UPS and Inverter should meet the following specifications:

S. No.	Functionality/Description	Minimum Specifications
1.	Make	As per approved list of makes
2.	Capacity	3-Phase x 2 Nos. (Capacity as per approved design)
3.	Service	Continuous
4.	Waveform	Stepped approximation to a sine wave
5.	Input Voltage	230V AC
6.	Input Connection	India 3 Pin 6A. Power cable to be provided as required
7.	Output Voltage on Mains & Battery	230V
8.	Output Frequency with battery	50Hz \pm 5%
9.	Output Ports	3-pin 6A (Surge Protection)
10.	Output Ports	3-pin 6A (Battery Backup) OR more
11.	Operating Temperature	0 - 40 °C or better
12.	Operating Humidity	0 - 90% Non-Condensing or better
13.	Battery Rack	To be provided
14.	Battery Type	Sealed maintenance free and leak- proof
15.	Battery Backup	Min. 30 Minutes at full load or better
16.	Charger	Built in
17.	Indicators & Audible Alarm	I) Online II) On Battery III) Low Battery IV) Overload
18.	Accessories	All required cables, connectors & interfaces, mounting arrangement etc. for successful installation, commissioning of UPS

3. **OUTDOOR & LANDSCAPE LIGHTING**

- a) The actual position of all fittings, the wiring details and cable routes shall be coordinated with other services and architectural elements at site and submitted for the approval of the Engineer-In- Charge.
- b) The Contractor has to ensure that products being supplied are of high technology, aesthetics and glare free performance and these products meet international guidelines.
- c) All technical submissions shall be approved by the Engineer-In-Charge prior to the respective stages of construction with respect to the approved design. In case of major deviations, it shall be brought under the notice of Engineer-In-Charge for its review and approval. The submission shall include the following as a minimum requirement,

- i) Equipment catalogues submission with manufacturer's data
 - ii) Sample submission include all wiring accessories
 - iii) Shop Drawings of the lighting, circuit numbers, cable routings, switching arrangement, mounting height, etc. The positions and mounting heights shall be coordinated with other services. Fixing details of all wiring accessories shall also be included.
 - iv) Sensor placement for daylight, presence movement for Street lights and Pole lights only.
 - v) Drawings showing the installation details
- d) Fixtures & Poles types
- Pole shall be GI and should have anti-rust coating and PU painted. Light fitting shall be IP 66 IK 08 with minimum LED wattage of 45-54 W. Fixture housing should be made of Die cast Aluminum, in vandal- resistant V2 self- extinguishing polycarbonate, UV-stabilized Optics.
- i) The Lux level for lighting shall be as follows :-
 - Public Parking – 20-30 lux
 - Internal Roads – 35-45 lux
 - Main Approach Roads – 50-60 lux

4. DIESEL GENERATING SET

4.1 SCOPE

- a) The scope shall cover complete supply, installation, testing and commissioning of direct radiator cooled diesel engine alternator set. All minor civil works, electrical and other works associated with the testing, installation and commissioning of the sets shall be carried out by the contractor
- b) Fuel Oil System from day tank to engine.
- c) Lube Oil System and speed governing system.
- d) Alternator with excitation system and automatic voltage regulator (AVR) and necessary protection and metering CT's in terminal box of alternator.
- e) Radiator cooling.
- f) Acoustically Treated DG Set Enclosure.
- g) Erection/testing and final checking up of the installation at site, commissioning.

4.2 CODES & STANDARDS

The construction, manufacture, inspection, testing and performance shall comply with all the currently applicable statutes, safety codes, relevant Bureau of Indian Standards (BIS) British Standards (BS), International ElectroTechnical Commission (IEC) Publication, NEMA, VDE and DEMA Standards.

Some of the applicable Standards are listed below:-

IS 1601	:	Performance and testing of IC engines for General Purpose.
BS-649	:	Performance and testing of diesel engines for General Purpose.
IS-4722	:	Rotating electrical machines.
IS-4889	:	Method of determination of efficiency of Rotating Electrical Machinery.

IS-6491	:	Degree of protection provided by enclosures for Rotating Electrical machinery.
IS-4729	:	Measurement and evaluation of vibration of Rotating Electrical Machines.
AIEE-606	:	Recommended specification for speed governing of internal (1959) combustion engine generator units
IS-2705	:	Current transformers.
IS-1248	:	Electrical indicating instruments.
ISO-8528	:	Reciprocating IC engine driven AC Gensets Section (Part II)

- 4.3** The DG set shall be silent type air cooled with radiator, manually and automatically operated, designed for continuous operation at 100% load at 100% time duty operation except the time required for periodic maintenance as per relevant IS/BS 5514. The DG set shall comprise of diesel engine, coupled to four pole alternator on a single frame with integrated microprocessor based genset monitoring and control system having self regulated, brushless/static excitation system.

- 4.4** All equipment shall be of the class most suitable for working under the conditions specified and shall withstand the atmospheric conditions without deterioration.

4.5 PERFORMANCE REQUIREMENT

- a) The equipment shall be capable of delivering continuously at the generator terminals, 100% output at 100% load at 100% time except for periodical maintenance when operating under the site and ambient conditions described in this specification as per relevant IS/BS 5514. Genset should have a minimum 50% single step loading capacity and it should be able to take full load within 25 seconds from start.

The design parameters of the generator and excitation system shall be so chosen, that the set is stable while running at any load between no-load and full load. It should have isochronous speed control with load sensing governing system and should be capable of paralleling between sets at isochronous speed.

- b) Engine should be heavy duty four stroke, turbo charged after cooled, V construction Electrical start. Engine should have a minimum lub oil change period of 500 hrs..
- c) The DG set should be capable of running at 100% load continuously for a minimum 500 hours before any change of lube oil or filters.

4.6 DIESEL ENGINE – CONSTRUCTION

- i) Material of construction of major parts.

- M.S. Base Frame
- Crankcase - Aluminum alloys or as per manufacturer design.
- Crank - Shaft, connecting rods - forged alloy steel
- Piston - Al. Alloy casting
- Piston rings - Alloy steel
- Engine block - cast iron or as per manufacturers design.
- Cylinder liner - cast iron

All other materials of construction for pipe/pipe fittings etc. shall be as per relevant standards.

- ii) One common base frame shall be provided for mounting the engine and alternator, complete with electric suspension between generating set and foundation, leveling lines

etc. as required.

- iii) All externally mounted hardware shall be high tensile steel only.
- iv) The normal speed of the engine shall preferably be 1500 RPM and the direction of rotation shall be clearly marked on the set.
- v) The engine shall be fitted with an exhaust gas driven turbocharger complete with its own self contained lubrication system. The turbo charger shall be positioned at the free end of the engine. The turbo charger will be provided with a provision to check its lube oil level.
- vi) The engine shall be fitted with a charge air intercooler. Air from the turbocharger compressor passes through the inter cooler and then to the engine manifold. The intercooler shall be of tubular construction or as per manufacturer design with aluminium bronze tubes, mild sheet steel and cast iron water heaters.
- vii) The engine shall be capable of starting and operating for a few minutes without supply of water for cooling. Contractor shall indicate the maximum time for which the diesel engine can operate.

4.7 FUEL OIL SYSTEM

- i) The manufacturer shall furnish a 3 mm thick mild steel day tank of 990 ltr. Capacity. The day tank shall be suitably located in the acoustic enclosure and shall be complete with gauge glasses, filling, draining and vent connection with brass float valve and level switch for low and high level alarm.
- ii) The fuel oil system shall be provided with a full flow simplex oil cartridge filter.
- iii) The fuel oil system shall be equipped with a crankshaft driven fuel oil transfer pump, which will draw the fuel oil from the day tank via filters and shall be as per the engine manufacturer design.
- iv) Direct injection systems shall be designed, taking into account the type of fuel used, engine speed, etc. so as to achieve safe knock free performance with low emission smoke exhaust. Exhaust system pollution level shall be indicated and has to be approved by concerned authorities.
- v) The interconnected piping from day storage tank to engine together with piping, fitting, relief valves, return line of surplus oil from the injectors and other accessories shall be supplied & erected by the contractor without any extra charge.
- vi) Engine will be supplied with a fuel leakage module to detect the fuel leakage from the engine and transfer it back to the day tank for reuse.

4.8 LUBRICATING OIL SYSTEM

- i) All lubricating parts of the engine shall be connected to pressurized lubricating oil distributing piping systems being continuously charged by gear type lube oil pump mounted at the free end of the engine, and driven from the engine crankshaft. The pumps shall take suction from a sump tank integral with the engine through a foot valve, suction filter through oil cooler, and deliver oil to a main supply header. High pressure oil shall be supplied to the main and big end bearings, crankshaft bearings, governor, auxiliary drive gear etc. Suitable lubricating arrangement for engine cylinder valve gear, cams and pistons at the required level shall be arranged. A pressure relief valve shall be mounted on the main supply header for safety against too high pressure while starting with cold oil. A timer based auto running (auto priming pump) shall be provided to keep the engine lubricated all the time.

- ii) All necessary accessories such as pressure gauges, temperature indicators, pressure relief valves, bypass valves; pressure switches shall be furnished within the contract without any extra charge.

4.9 ENGINE STARTING SYSTEM

The electric starting system shall comprise starter motor, starter batteries (minimum 2 No. of 180AH each) and battery charger and all the required instrument and accessories as required.

4.10 GOVERNING SYSTEM

The governor shall be electronic type.

4.11 EXHAUST SYSTEM

Engine exhaust system shall be fitted with residential type silencer; ducting, bends, thermally insulated aluminium clad exhaust piping etc. shall be provided along with structural support with stays for the engine.

4.12 ENGINE MOUNTED INSTRUMENT PANEL

Engine will be supplied with an engine mounted microprocessor based fully integrated generating set monitoring, metering and control system which should be equipped with digital electronic governor along with digital AVR to facilitate discreet control of speed and voltage. It should be equipped with starting control including integrated fuel ramping to limit the black smoke frequency overshoot with optimized cold weather starting. The indicating panel should have a communication network facility to facilitate remote hooking on a common network. Engine instrument panel should be equipped with a digital alarm and status mirage to monitor and display the following parameters of engine and generator.

Engine Indicators Digital tachometer Running hours counter

Starting attempts counter

Lube Oil pressure low (for idle and for rated speed) Lube Oil temperature high

Coolant temperature high Exhaust gas temperature high Over speed

Electrical Indicators 3 x current

3 x voltage Frequency Active power Reactive power Power factor

Frequency totalizer Battery voltmeter Signal alarms Control panel fault 24 Vdc fault Failure to start

Fuel day tank level low Battery low voltage Controls and selectors

Operating mode selector switch (stop, manual, auto, test) Start/stop pushbuttons

Manual control selector switch (idle, rated, synchro, loading) Emergency stop pushbutton

Fault reset pushbutton

4.13 ALTERNATOR

- a) The alternator shall be industrial type, SPDP, IP23, Class H insulation, self ventilated, air cooled, rotating field, salient pole, brushless, machine with exciter and shall be rated continuous duty with temperature rise class H. The alternator should comply to standard IEC, VDE, BS, ANSI.
- b) The alternator shall have a continuous rating of not less than the value specified under specific requirement in Annexure-I at 0.8 pf (lag) and the voltage specified.
- c) The short circuit ratio (SCR) of the generator at rated KVA and rated voltage shall

not be less than 0.5.

- d) The alternator shall withstand without mechanical damage an over speed of 20% for a period of 2 minutes.
- e) The alternator shall be capable of withstanding without damage/injury for three times the line current for 10 seconds.
- f) The alternator shall be capable of withstanding for fifteen (15) seconds. A current of fifty (50) percent in excess of its rated current, the voltage being maintained as near the rated value as possible, consistent with max. capacity of the prime mover.
- g) Six nos. embedded PT-100 of platinum to measure the winding temperature and 2 nos bearing PT-100 to measure temperature shall be provided.
- h) The leads of embedded WTDs shall be wired upto the terminal block in a separate terminal box. Manufacturer shall indicate the setting values for each WTD/BTD for alarm and trip.
- i) Online greasing facilities with grease nipples and grease relief devices shall be provided.
- j) All external nuts and bolts shall be of high tensile steel only.
- k) Alternator shall be provided with anti-condensation space heater of adequate rating suitable for 240V, 50 Hz, 1ph A.C. supply and shall be wired upto a separate terminal box.
- l) Two independent earth terminals on the frame, complete with nuts, spring washer and plain washer shall be provided.
- m) Alternators shall be provided with a suitable terminal box for terminating the bus duct. Suitable arrangement shall be provided in the terminal box for formation of star point for alternator neutral earthing.
- n) The alternator should be capable to sustain the unbalanced current between the phases upto minimum 25% of rated current.
- o) The radio interference should be within the limit of the CISPR standard.
- p) Alternator should be dynamically balanced complete with rotor and shaft.
- q) The alternator should have double long life regreasible bearing. It should be flanged on the engine, connected with elastic coupling.
- r) The Alternator shall be capable of handling at least 50% non-linear load.

4.14 EXCITATION SYSTEM

- a) The alternator shall be provided with a complete diode type brushless excitation system, capable of supplying the excitation current of the generator under all conditions of output from no load to full load and capable of maintaining voltage of the generator constant at one particular value.
- b) The exciter shall have class-H insulation.
- c) The excitation system shall comprise a shaft driven AC exciter with rotating rectifiers. The rectifiers shall have in-built protection for over-voltage.
- d) The alternator should be complete with shunt and booster excitation. The exciter shall be fast response type and shall be designed to have a low time constant to minimize voltage transients under severe load changes. The excitation voltage response ratio shall be at least 0.8.
- e) The rated current of the main exciter shall be at least 10% more than the alternator rated exciter current and it shall have a 40% overload capability for

10 seconds.

- f) No external supply shall be required during starting and normal running of the alternator.

4.15 AUTOMATIC VOLTAGE REGULATOR

- a) An automatic high speed, dead band type voltage regulator shall be provided complete with all accessories. The regulation system shall be provided with equipment for automatic and manual control.
- b) The regulator shall regulate the output voltage from generator current and potential signals. Series compounding transformer shall be provided to enable maintaining adequate terminal voltage in the event of terminal faults. Alternatively excitation system shall be provided with arrangement for field forcing. Contractor shall co-ordinate suitable of protection relays for generator with the operational characteristics of automatic voltage regulator, specially under short circuit conditions.
- c) Voltage regulation and steady state modulation shall be within + 1% of the line voltage with manual voltage adjustment capability within + 5%.
- d) Necessary equipment for field suppression and surge protection shall be provided.
- e) The response time of the exciter and the generator shall be properly matched to avoid hunting.
- f) AVR system shall be provided with equipment for automatic and remote operation/control as required.
- g) Necessary equipment shall be furnished for the following :-
 - i) To prevent automatic rise of field voltage incase of failure of potential supply.
 - ii) To initiate transfer from automatic to manual control of excitation on fuse failure in the generator potential signal. Circuit to assure correct division of reactive power for parallel operation. The excitation and voltage regulation shall be designed to cause necessary de-excitation in case of short circuit. Cross current compensation circuit shall be provided.

4.16 PAINTING

- a) All steel surfaces, which are to be painted, shall be thoroughly cleaned, degreased and supplied with primer prior to assembly and shall be applied with two coats of epoxy paint shade RAL 7032 as per IS5.
- b) All castings shall be sand blasted, degreased and cleaned before painting.

4.17 TESTS

Following tests shall be carried out at the engine manufacturer's works in the presence of Engineer-in-charge or his representative, if so desired.

DG set and the auxiliaries shall be assembled at the manufacturer's works and the following tests shall be performed.

- a) One (1) hour at full load with fuel consumption
- b) One (1) hour at 3/4 load with fuel consumption
- c) One (1) hour at 50% load with fuel consumption
- d) Four (4) hours at full load followed by a 1 hour continuous load at 110% and with fuel consumption.

Before each test, the engine shall be brought to a steady state under the conditions of the test.

The alternator shall be subjected to following routine tests As per IS:

- a) Measurement of resistance of stator and rotor windings
- b) Insulation resistance of stator and rotor windings
- c) High voltage tests on stator and rotor windings
- d) Open circuit and short circuit tests
- e) Temperature rise test
- f) Regulation test

VOLTAGE REGULATOR

- a) Sensitivity test
- b) Response time test

TEST AT SITE

- a) The tests shall be performed after proper installation of the diesel generating unit at site to prove the proper operation of interlock circuits and the capability of the engine to start and pick-up load in the specified time, under supervision of the employer representative responsible for supervision, testing and commissioning.
- b) Guarantee tests to prove guaranteed performance of the DG set shall also be carried out at site after proper installation. The load test with available load at site will be given for about 8 hours.

4.18 TEST CERTIFICATE

- a) Test certificate shall be submitted in three (3) copies.
- b) The test reports shall furnish complete identification of the data, including serial number of each equipment.

4.19 GUARANTEED PERFORMANCE

The contractor shall furnish, along with the offer the technical particulars as called in the Annexures. The performance figures quoted in the technical particulars sheet shall be guaranteed with the tolerance permitted by relevant standards

4.20 SYSTEM OPERATION:

Automatic Mode

While the normal mains supply is healthy the diesel alternator set will be at rest and the load will be supplied by the mains.

The AMF system shall monitor the main supply voltage & when the main supply voltage drops below a certain preset value, the system shall sense these conditions & shall give automatic start command to the control systems.

After a time delay of 1.5 seconds from the main supply failure the diesel engine shall start.

When the DG set attains its rated speed and voltage a closing signal shall be given to the ACB of the DG set.

When the voltage in the mains gets restored, its quality is monitored for about one minute and if proven satisfactory the main supply breaker shall close automatically for transfer of the load from Diesel engine to the main supply at L.T. Panel.

The set shall stop after idle running of one minute after restoration of main supply.

The diesel alternator set reverts to its standby conditions & its ready to start should the mains supply fail again.

4.21 TECHNICAL PARTICULARS OF DIESEL GENERATOR SETS

- | | | |
|------------------------------------|---|---|
| 1. Quantity and rating | : | suitable capacity Diesel Generator unit |
| 2. Mode of operation | : | Auto/ Manual start |
| 3. Alternator | | |
| 4. Output rating at 0.8 p.f. (lag) | : | Suitable capacity (at site conditions) continues output at 100% load and of 50°C at 100% time except at the time of periodic maintenance. |
| 5. Class of insulation for Stator | : | Class H & Rotor |
| 6. Rated voltage & frequency | : | 415 V, 50 Hz |
| 7. Maximum permissible time | : | Less than 20 seconds for Building up rated voltage From stand still Variation of voltage from No |
| 8. load to full load | : | ±5% of rated voltage |
| 9. Frequency variation | : | ± 1% |
| 10. Capacity of largest rating | : | To be furnished Motor starting |
| 11. Dynamic voltage response & | : | Less than 15% of rated voltage under permissible voltage drop operating condition at 3.6 above. during largest rating motor starting |
| 12. Temperature detectors | : | 6 nos. RTD and 2 nos. BTD of type PT-100 for winding temperature and bearing temperature measurements |
| 13. Type of excitation system | : | Brushless, shunt and booster |
| 14. Type of control for voltage | : | Automatic regulator. |
| 15. Type of fuel for engine | : | High speed diesel according to IS 1460 & as approved by the Central Pollution Control Board. |
| 16. Day oil tank capacity | : | Capacity of tank 990 lts. |
| 17. Lube Oil | : | Viscosity SAE-40 |
| 18. Maximum permissible starting | : | Less than 20 Seconds Starting time for attaining Full speed |
| 19. Engine starting | : | Electric starting system |
| 20. Type of governor | : | Electronic class A1 (Electronic Isynchronics Governor) |
| 21. Lubricating system | : | Pressure fed type |
| 22. Cooling system | : | Radiator cooling |
| 23. Engine cranking system | : | To be included |
| 24. | | |

4.22 SOUND ATTENUATED ACOUSTIC ENCLOSURE

A suitable “**SOUND ATTENUATED**” **ACOUSTIC ENCLOSURE**” to provide high level of “**NOISE REDUCTION**” shall be provided to house the D.G. Set.

ACOUSTIC ENCLOSURE

The acoustic enclosure housing for the diesel generating set shall be designed on the best engineering practice. It should have aesthetic looks and bring down sound noise to 75 dB when measured from a distance of 1 meters away from the DG Set as per noise pollution norms.

Enclosure construction shall be fully bolted keeping in view the major service requirements all doors shall be provided with specially designed hinges and lockable handles, Battery, Fuel tank and ACB shall be housed inside the enclosure.

The DG Set shall be supported on a base frame in CRCA Sheet enclosure with suitable ducting for air inlet and outlet. The enclosure frame shall be of rectangular steel tubes. The doors & enclosure is treated and painted with duco paint for longer life and weather proof. Requisite air circulation for heat dissipation and combustion shall be provided by axial fans. All oil & fuel connections shall be through steel braided pipes for fuel safety reasons.

The acoustic enclosure consists of the following:- ACOUSTIC INSULATION

High density resin bonded glass wool shall be provided on all five sides including doors and roof to absorb noise.

Resin bonded Rockwool of high density (as per manufacturer's standard) with minimum 100 mm thickness with tissue paper (min 50 gm/sq.m) covered with perforated 1.6 mm painted MS sheet shall be used as sound absorption material on all five sides including doors is provided. The air ducts shall also be covered with mineral wool.

Acoustic hoods with noise splitters provided to block and reduce the sound leakage

4.23 EXHAUST SYSTEM

The exhaust gas is taken out of enclosure through suitable size class C MS pipe (minimum 3.25m higher than the enclosure) and noise suppressor duly insulated with 50 mm rockwool insulation, 24 G Aluminum cladding.

4.24 AIR CIRCULATION AND VENTILATION SYSTEM

Proper care shall be taken for engine heat rejection to ensure safe working temperature inside the enclosure. Requisite air circulation shall be provided by means of required nos. of axial flow fans with GEC, NGEF, Crompton, ABB make motors of required capacity with downstream flow silencer. The Air Circulation system shall ensure that the temperature rise inside the enclosure is never more than 5 deg C above the ambient temperature.

A suitably designed residential type noise suppressor complete with acoustic and thermal insulation shall be provided.

4.25 FUEL TANK AND BATTERY SYSTEM

The enclosure shall be provided with separate chambers for fuel storage tank and battery storage for safety purpose.

4.26 ARRANGEMENTS

The engine and alternator are coupled by means of a flexible coupling and both the units including the radiator shall be mounted on rigid fabricated base frame to form a compact arrangement of the equipment. Base frame shall be of MS steel and suitably machined to ensure perfect alignment and alternator with rigid construction to ensure minimum vibrations.

The complete enclosure shall be detachable which can be dismantled in parts of its easy installation anywhere.

4.27 PAINTING

The acoustic enclosure shall be painted with good quality Duco Automotive paint with a prior red oxide primer base and other protection for making it suitable for installation in open areas.

VIBRATION ISOLATION

To avoid transfer of vibration from genset to enclosure & surrounding specially designed Spring Type vibration isolators shall be used.

SAFETIES

The enclosure shall have the following safeties;

- a) High Enclosure Temperature
- b) Emergency Stop Push button outside the enclosure.

The enclosure shall also be provided with space heater complete with thermostat and controlling ELCB working on 220 V A.C. supply and chamber illumination lamp working on 24 V DC supply.

5. Technical details of VHP PASS-BOX

5.1 CONSTRUCTION DETAILS

Pass box Dimensions (internal)	: Approx. 600 W x 600 D x 600 H (mm)
Pass Box Dimensions (overall)	: As per manufacturer
MOC of internal chamber & return path	: S.S. 316
MOC of Support structure and paneling	: S.S. 304
Surface finish Ra (Internal)	: $\leq 0.6 \mu\text{m}$
Surface finish Ra (External)	: $\leq 1.2 \mu\text{m}$
Leak tightness	: Less than 3% of the chamber volume at twice the operating pressure of chamber.
Pressure inside the chamber	: $\geq 15 \text{ Pa}$ w.r.t adjoining room negative room pressure
Pass box chamber air classification	: ISO Class 5
Light	: NLT 400 Lux averages of 5 readings.
Noise level	: NMT 75 dBA
Structure	: Internal chamber & return airpath S.S. 316 chamber & Support Structure & Paneling S.S.304.
Door	: Toughened glass door on both sides
Components	: All components inside the chamber should be compatible with H_2O_2 .
Construction	: External and internal body construction free from sharp edges and easily cleanable
Gasket and 'O' rings	: Gasket and 'O' rings used in the equipment should be EPDM / PTFE / VITON / Silicon.
Service plenum	: SS 304 service plenum should be provided for accessing blowers and valves.
Operator panel	: Operator panel with HMI 9" should be provided at both side (Entry & Exit) to interface with the unit and display the equipment operating phase,

process Status information, parameter values and alarms displaying.

Diffuser	: SS 316 Diffuser grill should be provided below HEPA filter.
PAO Inject Port	: SS 304 injection port to introduce PAO
PAO Check Port	: SS 304 100% PAO port for measuring upstream concentration
Control panel	: Integrated/Remotely Located electrical control panel

5.2 OPERATION AND BIO-DECONTAMINATION PROCESS

i) Leak test

Leak Test should be performed automatically using pressure decay method before starting the bio-decontamination, to verify that the pass box is leak tight. The pass box should be designed and tested for an hourly leak test rate of 3% of the chamber volume.

During the leak test, the supply & exhaust valves should remain closed, and fans should be stopped. The pass box chamber should be pressurized with sterile compressed air up to a pre-defined *leak test set pressure*.

Leak test time monitoring should start when the chamber pressure reaches *leak test start pressure*. If the pressure inside the chamber falls below *leak test end pressure* after a delay time of *leak test time*, an alarm *leak test failed* should be displayed on the HMI.

ii) Drying Phase

In the *Drying Phase*, the chamber environment should be prepared for decontamination phase by reducing the humidity within the set point/limit.

iii) Bio-decontamination cycle

The PLC should check all process related inputs healthy condition before starting the cycle, if the condition are not as per set limits, alarm should be displayed on HMI.

During the *Decontamination Process*, the air and sterilant should be introduced inside the Pass Box Chamber. During the Decontamination process, the chamber RH should be controlled with in the required range (70 to 90 %). RH & H₂O₂ concentration should be measured and recorded during decontamination phase. When the decontamination process is completed, the system should automatically start the Aeration to remove the sterilant from inside the chamber to less than 1 PPM. If the bio decontamination process is aborted/failed due to any reasons, alarm should be generated, and pass box should enter into safety aeration phase.

5.3 AUTOMATION, CONTROLS & REPORTS

- PLC based control with color touch screen display for monitoring and control should be provided
- Communication should be provided between PLC and HMI.
- Important parameters and screens should be password protected for safety.
- System should generate following reports during bio decontamination cycle.
- Batch Report
- Alarm Report

5.4 AFETIES & INTERLOCKS

Mode /condition	Interlock
Setup mode	Only entry door should open
Service mode	Any One door could be opened at a time

Pass box mode	Any One door could be opened at a time
Bio decontaminating mode	Both doors cannot open until cycle is completed
Leak test mode	Both doors should not open
Safe mode	Both doors should not open

5.5 INDICATIONS AND ALARMS

Sr. No.	Indications & Alarms
1.	Supply Fan Fault
2.	Exhaust Fan Fault
3.	Supply HEPA differential pressure Low fault
4.	Supply HEPA differential pressure High fault
5.	Chamber differential pressure high fault
6.	Chamber differential pressure Low fault
7.	Exhaust HEPA differential pressure low fault
8.	Exhaust HEPA differential pressure high fault
9.	Supply HEPA filter DPT analog input fault
10.	Exhaust HEPA filter DPT analog input fault
11.	Chamber DPT analog input fault
12.	RH sensor analog input fault
13.	Temperature sensor analog input fault.
14.	Bio decontamination successfully completed
15.	Bio decontamination aborted
16.	Leak test passed
17.	Leak test failed
18.	Consecutive Leak test failed
19.	Entry Door Inflatable Gasket Fail Due to Low Pressure
20.	Exit Door Inflatable Gasket Fail Due to Low Pressure
21.	Entry door open
22.	Exit door open
23.	Compressed Air Pressure Low for process
24.	Compressed Air Pressure Low for valves
25.	Chamber Air Humidity delay fault
26.	Communication Fault HMI to PLC
27.	Supply valve position fault
28.	Exhaust valve position fault
29.	Chamber temperature out of limit
30.	PPM Level high

6. Technical details of distribution piping and butterfly valves of VAPORIZED HYDROGEN PEROXIDE DECONTAMINATION SYSTEM FOR AIRLOCK.

6.1 Distribution Piping

Piping should be provided for distribution of vaporized hydrogen peroxide to the BSL-3 spaces, fumigation air-lock etc., as required.

Material of Construction of piping system: SS – 316 L

Type: Orbital welding joints with internally electropolishing.

Size: 1.5" standard (May vary according to final size of space as per manufacturers recommendations)

Insulation: Distribution piping should be insulated as per manufacturer's

6.2 Butterfly valves for Isolation:

Motorized Butterfly valves should be provided in each distribution line for isolation of spaces, when the system is not in use. The valves should be programmed for control through the Building Management System to allow selective operation, as per the need.

Material of Construction: SS 316L contact part, PTFE /EPDM sealing.

Type: Actuated with positioning feedback system

7. Technical Specifications for Compact Prefabricated Sub-Station of 33KV/11KV/433 V, Dry type Transformer including HT Panel and LT Panel

7.1 GENERAL:

The Compact substation shall be of modular construction housed in a single enclosure consisting of HT panel **RMU** with Two Load break switches, one VCB with SF6 and all other metering and protection (If Applicable), one No 11kV/433V **Dry Type** Transformer and **LT** distribution Board etc, All three Equipment shall be one housing separated in compartments.

The Substation should be suitable for outdoor application, compact and easily transportable and installation. The Substation shall have minimum maintenance requirement with no accidental access to live parts and fully complied with all statutory requirements.

The Compact substation shall be fully compartmentalized. The Compact substation shall be suitable for bottom cable entry.

The Compact substation shall be Metal clad housing fabricated out of CRCA sheet steel of min. 2mm thick for outer enclosure and Min 3 mm for the base Frame.

All sheet Metal components shall undergo rigorous seven tank process (degreasing de-rusting, phosphate and sealing). Painting shall be n shade RAL 7032 (Siemens Grey).

Selection of HT/ LT Board and Transformer components rating shall be as per the enclosed specifications/BOQ.

7.2 System Requirements:

1.	System HT	: 33KV/11kV, 3 phase, 3 wire, 50 Hz, 630 Amps.
2.	System LT	: 433V, 3 phase, 4 wire, 50 Hz 1500 Amps.
3.	Installation	: Outdoor.
4.	Transformer	: Energy Efficient cable entry type Transformer, as per IS standard
5.	Interconnections	: Aluminum Flat busbar transformer to LT connection. XLPE Cable for HT to Transformer Compartment.

7.3 DETAILS OF EQUIPMENTS: Energy Efficient indoor type Transformer, as per IS:1180.**HT SWITCH GEAR**

- i) The switch gear shall be part of compact substation and which in turn is part of ring main supply system of 33/11 kV, 3 phase, 50 HZ solidly earthed neutral system. Highest system voltage will be 12 kV.
- ii) The switch gear section shall have provision for Minimum One incomer and one outgoing to be part of ring main Unit.
- iii) Specification and other particulars of the switchgear are broadly categorized under the following heads.
 - a) Cubicle with busbars, relay, instruments, earthing device etc.
 - b) Vacuum Circuit breaker.
 - c) Load break switch (2 No) Instrument transformer (PTs, CTs)
 - d) Panel lighting

7.4 Cubicle**7.4.1 Construction**

- i) The switch gear along with the load break switch shall be one section of the compact substation and all the components of the switch gear section shall be accessible for easy maintenance.
- ii) Sheet steel shall be of minimum 2 mm thickness for partition between sections and hinged front and bolted rear doors.
- iii) Electrical continuity between all metal parts not alive and the earth terminals of the unit shall be ensured.
- iv) Insulated partition shall be provided for Busbars, CTs, PTs, outgoing cables & circuit breaker and relays and controls. Cu/Al busbars shall be provided.
- v) Hinged doors shall be provided for accessing the switchgear section. Three point locking arrangement with single operating handle shall be provided for all hinged doors. Hinge locks, lock covers etc., shall be fabricated from anti-corrosive material. The hinges shall be sturdy and robust.
- vi) Cubicles will be exposed to high winds, dust and rain. Neoprene gaskets of high quality shall be used. The top cover of kiosk shall have necessary slope to avoid stagnation of rain water.
- vii) Base frame shall be of sufficient thickness and galvanized to give corrosion resistance even if water accumulation is there.
- viii) All mechanical indications of breaker / LBS position, operation shall be visible after opening CSS door.
- ix) Lifting lugs, base frame of adequate thickness, foundation bolts of min. 20mm Dia. with suitable washers shall be provided. Lifting guides shall be provided at the bottom to prevent touching of wire ropes with body of unit while lifting the compact substation.

7.4.2 Cable termination:

- i) Both incoming and outgoing cables of the compact Substation are with bottom entry. Cable terminations shall be made with the sealing kits of specified type.

- ii) Blank G.I. plates gasketed and bolted to the cubicle for glanding and terminating control and power cables shall be provided.
- iii) The cable shall be secured properly in the compact Substation with suitable support

7.5 Relays

- i) All relays specified shall be flush mounted in dust proof cases and shall match the appearance of the instruments mounted on the same panel. Each relay shall be identified with relay number indicated in the approved control scheme.
- ii) Protective relays shall fixed type.
- iii) Relay contacts shall withstand repeated operation and shall make or break the maximum currents in their circuit without deteriorating. All spare contacts shall also be wired up to the external terminals.
- iv) All Protective relays shall be Self Powered Numerical Type relays and Over Current Setting stars.
- v) Relay shall be supplied with RS-232/RS-485 Communication ports using modbus protocol.

7.6 Indicating Instruments (If applicable as per specifications/SLD)

- i) All indicating instruments shall conform to IS 1248 and integrating meters to IS 722.
- ii) Indicating instruments shall be 3 1/2 Digit LED Type of size 96 x 96 mm and shall conform to 1.0 accuracy class. Meters shall be Programmable for CT&PT ratio selection.
- iii) Provision/Space for Fixing of One number DLMS Compatibility HT TVR Meter of class 0.2S accuracy shall be provided for future requirement.
- iv) One number LT Smart meter/MFM of class 0.5S shall be provided for metering on LV side.

7.7 Control Circuits

- i) All incoming control and power circuits shall be fed through isolating ON/OFF rotary switch and HRC fuses with insulating base and holder. Closing circuit, tripping and control circuit, and lamp circuit shall be segregated and protected by independent fuses.

7.8 Control wiring and ferrules

- i) All wiring shall be carried out with 1100 volts grade core wires having multi-strand copper conductor. All control circuit shall be with copper conductor having a minimum cross-sectional area of 1.5 sq.mm per core and CT circuit shall be 2.5 sq.mm copper conductors. The wire shall be insulated with PVC.
- ii) All control wiring shall be terminated using ring and pin type copper lugs on to the stud type terminals. More than two wires shall not be terminated onto a single terminal.
- iii) All holes or tubes for wiring runs shall be bushed and shall have room for reasonable future additions. All cable runs shall clear injurious gases and heat emitted by control gear operation or shall be adequately protected from them.
- iv) Control cables when laid in HT and LT bus bar chamber, cable shall be taken through conduits. No joints or tees shall be made in wires between terminals. The wire shall be identified by numbered ferrules at each end, all in accordance with the connection diagram, equi-potential terminals shall have

the same ferrule numbers.

- v) All ferrules shall be made of non-deteriorating materials. They shall be white except in case of warning ferrules, which shall be red. Ring type ferrules shall have the character engraved on it. The ferrules shall be firmly located in each wire so that they cannot move freely on the wire. Wiring across hinges shall be by flexible wire

7.9 Inscription

- i) Each unit and each component shall be clearly labeled to indicate its purpose.
- ii) Nameplates at front and back of each cubicle shall be engraved on white background with black lettering of 10mm size.
- iii) Each component label shall include the component symbol shown on the connection or schematic diagram.
- iv) All components mounted inside the cubicle shall be provided with screwed inscription plate.
- v) The characters to be engraved on the cubicle labels shall be furnished at later stage.

7.10 Earthing

An earth bar adequate cross section shall be fixed preferably at the back of the switchboard. The earth bar shall be electrically continuous and shall run the full extent of each board. The earth bar shall have GI material. Each unit shall be constructed to ensure satisfactory electrical continuity between all metal parts not intended to be alive and the earth terminals of the unit.

7.11 Paintings

The switch gear unit cubicle shall be furnished with colour code to be indicated at the time of drawing approval conforming to IS 5-1961 latest. The sheet metal parts shall be subjected to following pre-treatment before final painting.

- a) Degreasing
- b) Pickling for complete rust removal
- c) Phosphating
- d) Corrosion resistant primer painting. Two final coats spray painting shall be given.

7.12 Space heater

Space heaters of each 200 Watts with Thermostat control unit shall be provided.

7.13 Testing & commissioning

Routine tests as per relevant IS standards to be conducted at works & site and test certificates shall be furnished. Type test certificates for each equipment shall be furnished.

7.14 11kV 3-way Ring Main Unit:

7.13.1 Key RMU Configurations of RING MAIN UNIT:

- **3 WAY RMU** –Non-extensible Two Motor operated load break switch (LBSs) with manual operated earthing switches and one (1) vacuum circuit breaker/SF₆ with disconnector and manual operated earthing switch.

(with Bus PT metering module and base channel and suitable space for mounting battery charger, Auxiliary PT of suitable rating

inside metering cubical. The Battery charger along with batteries required for Electrical operations of RMU Compatible for SCADA/DMS System.)

7.13.2 Load Break Switch Parameters:

Parameter	Value
Rated Short Circuit Making Capacity	50 kA peak at rated voltage
Rated Load Interrupting Current	630 Amps

7.13.3 Earth switches Parameters:

Parameter	Value
Rated short time current	21KA
Rated short time current withstand duration	3 sec
Rated peak withstand current	52KA peak at rated voltage

7.13.4 System Parameters:

Parameter	Value
Nominal System Voltage	11 kV
Highest System Voltage	12 kV
Rated Voltage	12 kV
System frequency	50 Hz
Number of Phases	3 Phase/3 Wire

7.13.5 Circuit Breaker Parameters:

Parameter	Value
Lightning Impulse Withstand Voltage Phase-to-Phase & Phase-to- Earth:	75kV (peak)
Power Frequency Withstand Voltage to Earth, Between Poles, & Across Opening Span	28kV rms for 1 minute
Rated Short Time Withstand/Breaking Current:	20kA (rms)
Rated Duration of Short Circuit:	3 seconds
Rated Normal Current:	630 Amps (rms)

7.13.6 Load Break Switches:

- The Load Break Switches shall be maintenance free. the position of power contacts and earthing contacts shall be clearly visible from the front of the RMU through the Mimic facia.
- The position indicator shall provide positive contact indication in accordance with IS 9920. In addition, the manufacturer shall prove the reliability of indication in accordance with IS 9921. These switches shall have three positions (or states), i.e., Open, Closed, and Earthed, and shall be constructed in such a way that natural interlocking prevents unauthorized operations.
- The switches shall be fully assembled, tested, and inspected in the factory.
- In case of Manual operation without motors, opening and closing shall be driven by a fast- acting mechanism independent of manual operator action.
- A facility shall be provided with an electrical operating mechanism allowing an operator at the RMU site to operate the Load Break

Switches without any modification of the operating mechanism and without de-energizing the RMU.

- The switch and earthing switch mechanisms shall have a mechanical endurance of at least 1,000 operations.
- Load break switch status aux contacts shall be 2NO+2NC and for Earth switch 1NO+1NC with good quality limit switches.

7.13.7 Circuit Breaker:

- The Circuit Breaker shall be maintenance free and, when standing in front of the RMU, their positions shall be clearly visible, through the Mimic facial. The position indicator shall provide positive contact indication in accordance with IS 9920. The breakers shall have two positions (or states), i.e., Open, Closed with Duty cycle O-0.3sec-CO-3min-CO and Earthing thru Isolator, and shall be constructed in such a way that natural interlocking prevents unauthorized operations. They shall be fully assembled, tested, and inspected in the factory.
- It shall be fitted with a local system for manual closing /tripping. The Circuit Breaker shall be capable of closing fully and latching against the rated making current. Mechanical indication of the OPEN, CLOSED, and EARTHED (On Isolator) positions of the Circuit Breaker shall be provided. The mechanical spring charge indications like free/charged shall be shown in the front of the circuit breaker.
- Circuit breaker shall perform O-C-O operation in the absence of Aux supply. All breakers should be BMS compatible.
- Each Circuit Breaker shall operate in conjunction with a suitable protection relay under transformer feeder/ circuit phase and earth fault conditions.
- All operating handles for the switches/circuit breaker shall be located on the front panel of the Ring Main Unit.
- Breaker status aux contacts shall be 5NO+5NC.
- Min no. of operations of Circuit breakers at rated current (as per IEC 62271-100) shall be guaranteed with Mechanical Endurance – Class M1(2000 operations).

7.13.8 Instrument Transformer

Current Transformer (CT)

- Separate cores shall be used for metering and protection.
- All current transformers shall be designed to have over current factors to withstand the fault currents of the associated system as applicable to the switchboard.
- Current transformer used for protection shall an accuracy limit factor not less than 10. All current transformers shall have 1 Amp. Secondary and shall be of ring type resin cast polarity of primary and secondary of all the CTs shall be clearly marked.

7.13.9 Current Transformer Specifications:

i)	Type	Resin cast
	class, cores	1.0/0.5 for metering, 5P10 for protection for transformer feeder.

iii)	Short time rating	20 KA for 1 sec.
iv)	Dynamic stability current	47 KA peak
v)	Insulation level	
	a) Impulse withstand voltage	75 KV peak
	b) PF withstand voltage	28 KV (RMS)

7.13.10 Voltage Transformer (PT)

- i) Voltage transformer shall be built up of CRGO electrical steel. The voltage transformers shall be resin cast dry type. The PTs shall be 3 nos. of single – phase type of suitable ratio and burden.
- ii) HT side and LT side of PTs shall be protected by HRC fuses. LT terminals shall be terminated on separate power terminal block located in the same panel.
- iii) Control supply shall be 24 V Dc obtained through a single phase Aux PT and with a battery backup of up to 8 hours.

7.13.11 Bus Potential transformers Specifications:

i)	Type	Resin cast, natural air cooled
ii)	Ratio	11KV / 110 V
iii)	Rated burden	20VA / Phase, class 0.5
iv)	Voltage factor	1.1 continuous, 1.5 for 30sec
v)	Neutrals	Neutrals to be brought out for earthing on HV and LV side
vi)	Insulation level	
	a) Impulse withstand voltage	75 KV (P)
	b) PF withstand voltage	28 KV RMS

7.14 Indicating Lamps:

- a. Indication lamps shall be complete with lens covers and holders.
- b. Each lamp shall be fitted with a durable resistance integrally wired in series within the lamp. Alternatively, lamps with built in transformers are acceptable.
- c. The lamp cover (lens) shall be translucent of red colour.
- d. Bulbs and covers shall be interchangeable, easily replaceable from the front without the need for any special means.

7.15 Terminals:

- i) Terminals shall be stud type of copper material.
- ii) Terminals shall be provided with transparent cover(s).
- iii) Separate terminals shall be available for each termination of loop-in and loop-out power connections.
- iv) Terminals shall be suitable for ring type copper cable lugs of size depending upon the circuit rating.

7.16 Labeling:

- i) Labels to identify all the main assemblies, sub-assemblies and components of the Kiosk shall be provided.
- ii) Name and rating plate/marking shall be provided as required by relevant

standard applicable to each component/assembly to be identified

- iii) Labels shall be of two colour, three-layer plastic material with matt or semi matt finish or of the anodized Aluminium sheet.

All labels other than “danger” or “warning” labels shall have black lettering on a white background. Danger label shall be as per applicable standard and shall not be fixed on to removable parts.

7.17 Additional Requirements:

- **Mimic:** A single line diagram showing the direction of power flow shall be drawn on the Cubical.
- Fluorescent lamps for sufficient illumination shall be provided and for that power supply shall be provided from LT side of Substation.
- DC Fluorescent lamps for emergency lighting shall be provided.

7.18 Dry Type Star Rated Transformer:

7.18.1 General

The transformer shall be 3 phase 33/11/0.433 KV dry type cast resin , outdoor type ,Star Rated, AN/AF Energy Efficient, DYN11 with cable entry type installation as per Technical Specification and IS 1180 with all fittings and accessories enclosed. The transformer is fed from HT switchgear. On the LT side, it is connected to LT switchboard through busbar. Transformer shall be as per ECBC compliance and IS 11171.

7.18.2 Standards:

The materials shall conform in all respects to the relevant Indian/International Standards specifications, which shall mean latest revisions, amendments/changes adopted and published, unless otherwise specified herein before. International and Internationally recognized standards to which these standards generally correspond are also listed below:

Indian Standard	Title	International and Internationally recognized standards
IS -2026	Specification for Transformers	IEC 76
IS 12444	Specification for Copper wire rod	ASTM B-49
IS -3347	Specification for porcelain Transformer bushing	DIN 42531,23,3
IS-335	Specification for Transformer Oil	BS 148, D-1473, D-1533- 1934, IEC Pub 296
IS – 5	Specification for colors for ready mixed paints	
IS – 104	Ready mixed paint, brushing zinc chromate, priming	
IS – 2099	specification for high voltage porcelain bushing	
IS – 649	Testing for steel sheets and strips and magnetic circuits	
IS - 4257	Dimensions for clamping arrangements for bushings	
IS - 7421	Specification for Low Voltage bushings	

IS - 3347	Specification for Outdoor Bushings	DIN 42531 to 33
IS - 5484	Specification for Al Wire rods	ASTM B - 233
IS - 9335	Specification for Insulating Kraft Paper	IEC 554
IS - 1576	Specification for Insulating Press Board	IEC 641
IS / 6600	Guide for loading of oil Immersed Transformers	IEC 76
IS 2362	Determination of water content in oil for porcelain bushing of transformer	
IS 6162	Paper covered aluminium conductor	
IS 6160	Rectangular Electrical conductor for electrical machines	
IS 5561	Electrical power connector	
IS 6103	Testing of specific resistance of electrical insulating liquids	
IS 6262	Method of test for power factor and dielectric constant of electrical insulating liquids	
IS 6792	Determination of electrical strength of insulating oil	
IS 10028	Installation and maintenance of transformers.	

Material conforming to other internationally accepted standards, which ensure equal or higher

quality than the standards mentioned above would also be acceptable. In case the Bidders who wish to offer material conforming to the other standards, salient points of difference between the standards adopted and the specific standards shall be clearly brought out in relevant schedule. Four copies of such standards with authentic English Translations shall be furnished along with the offer. In case of conflict the order of precedence shall be (i) IS (ii) IEC (iii) Other standards. In case of any difference between provisions of these standards and provisions of this specification, the provisions contained in this specification shall prevail. Anything not covered by this specification, will be as per relevant CEA, REC, IS and CBIP manual in order.

SYSTEM DETAILS: The transformers shall be suitable for outdoor installation with three phase, 50Hz, 11KV system in which the neutral is effectively earthed and they should be suitable for service under fluctuations in supply voltage up to $\pm 12.5\%$ permissible under Indian Electricity Act and Rules there under.

7.19 RATING:

- a) Primary voltage : 11KV/33KV
- b) Secondary voltage : 0.433 KV

The windings of the transformers shall be connected Delta on the primary side and Y (Star) on the secondary side. The neutral of the LT winding shall be brought out to a separate terminal. The vector group shall be Dyn11.

7.20 TEMPERATURE RISE:

The temperature rise over ambient shall not exceed the limits as per IEC.

7.2.1 BUSHINGS:

- i. The bushings shall conform to IS:2099/1973 "Specification for High Voltage Porcelain Bushings". The bushing rods and nuts shall be made of brass.
- ii. For 11KV, 17.5 KV class bushings shall be used and for 0.433 KV, 1.0 KV class bushings shall be used. Bushings of plain sheds as per IS-3347 shall be mounted on the side of the Tank and not on top cover.
- iii. Dimensions of the bushings of the following voltage class shall conform to Indian Standards mentioned below :

Voltage Class		Indian Standards	
		For Porcelain parts	For metal parts
1.0	KV	IS:3347/Part-I/ Sec.1/1965-1967	IS:3347/Part-I/ Sec.2/1957
17.5	KV	IS:3347/Part-III Sec.1/1972	IS:3347/Part-III/ Sec.2/1967

7.2.2 LT SECTION

7.2.2.1 General

LT Cubicle shall consist of following:

- i. One Number Fixed 4P Make ACB, 415V, 36 KA EDO ACB of 800 Amps rating with in-built overload, short circuit, earth fault & neutral protection releases along with all associated accessories for incomer to LT Distribution board.
- ii. Air Circuit Breaker shall be type tested and shall confirm to IS/IEC60947 (part 2), EN 60947-2. ACB shall have rated operational voltage up to 690V AC, rated insulation voltage of 1000C AC, rated impulse withstand voltage of 12KV and shall have short time rating of 50KA and $I_{cs}=100\%I_{cu}$ and I_{cw} for 1 sec at 415V AC 50/60Hz. The ACB shall be rated at 50 Deg. C and shall be suitable for Pollution Degree 4 requirements.
- iii. All ACBs shall have $I_{cu}=I_{cs}=I_{cw}$ for 1 Second with Combined Test Sequence Certification from Independent Testing Approved Authorities CPRI/ERDA/ASTA/KEMA, etc.
- iv. Front Facia of ACB shall have information on following: Rated Current, Poles, Release, Breaking Capacities, Serial Number, ON/OFF Status, Spring Charge/Discharge Status, Voltage Ratings of Shunt, Closing Coil, Motor, Undervoltage Release
- v. Releases shall also be available with LCD display which display all three-phase current & neutral current. These releases will also display maintenance date like no. of operations, physical contact wear & fault history (20 trips & 10 events). To protect the load and cables from repetitive over temperature protection (over terminals). In case of BMS connectivity through ethernet TCP/IP on ACB, the release shall enable the user full control over the breaker and to get the protection data.

- vi. Necessary Bus bar interconnections for LT panel with secondary terminals of the transformer.
- vii. The Board shall be of metal clad single busbar, fully compartmentalized.
- viii. The incomer and the associated items shall be housed in a partitioned panel, whereas the rest of the outgoing feeders shall be neatly distributed and compartmentally modular construction need to be adopted. However, it shall be ensured that sufficient working clearance and adequate space for cabling is provided.
- ix. LT Side Instrument Transformers, indicating instruments, control circuits, Control Wiring and ferrules, inscription, shall be as per the specification indicated under HT switchgear.
- x. The rated continuous current of the equipment and components shall be as given in the schemes. These ratings shall be obtained with the components mounted in their housing as in service without exceeding the permissible temperature rise.
- xi. LT side shall be fitted with a LED Lamps.
- xii. Bottom of LT Board shall have removable gland plates in two pieces to accommodate minimum 15 runs of LT Armored cable, size varying from 120 sq. mm to 300 sq. mm

7.2.2.2 Busbar and Connections

- i. Busbar shall be made of E91E grade aluminum alloy or electrolytic copper, Cross section of bus bars selected shall ensure the thermal rating and dynamic stability for the short circuit rating specified.
- ii. High tensile cadmium plated bolts with suitable spring washers shall be used busbar joints.
- iii. Busbars shall be PVC sleeved with heat shrunk insulation. Wire mesh shall be provided wherever necessary to prevent inadvertent touching of busbars.
- iv. Bus bars shall be supported on non-hygroscopic and non-inflammable insulators of material such as glass reinforced moulded plastic material, epoxy cast resin etc. Separate supports shall be provided for each phase of the bus bars. Insulation level of neutral bus bar shall be same as that of phase bus bars.
- v. Bus bars shall be contained in a separate vermin-proof compartment within the Kiosk and shall have bolted sheet steel covers for providing suitable access.
- vi. Busbar clearances in the air shall be as per applicable standard for 500V, 3 phase system.
- vii. Temperature for busbars, droppers and connections shall be as per IEC for an ambient of 50°C while carrying maximum continuous current.
- viii. The busbar, busbar connections and supports shall have sufficient strength to withstand thermal and electromechanical stresses produced by the specified short circuit level of the system.
- ix. Busbars shall be capable of carrying the short time current .The

duration of short-time current shall be 1 sec. For the specified current and duration, there shall be no damage to the equipment.

- x. Main busbars and connections shall be prominently marked and displaced for standard sequence counting from rear to front, top to bottom, or left to right as viewed from the switching device operating mechanism side.
- xi. Busbars and connections shall be provided with colour coded PVC sleeves. All live parts shall be properly shrouded with insulating material.
- xii. Earth busbar shall be provided separately. Material of earth busbar shall be GI.

7.2.2.3 MODULAR CASE CIRCUIT BREAKERS (MCCB):

- i. Modular case circuit breakers (MCCBs) shall be provided for use in lieu of switch fuse for Kiosk incomer.
- ii. MCCBs shall be suitable for 3 Phase 415 Volts AC 50/60 Hz supply with rated insulation voltage (U_i) of 800VAC and rated Impulse voltage (U_{imp}) of 8 kV.
- iii. The MCCB shall have rated ultimate short circuit breaking capacity (I_{cu}) equal to rated service short circuit breaking capacity (I_{cs}) as per the attached table at 415 volts AC
- iv. MCCBs with thermal Magnetic release shall be equipped with adjustable thermal & adjustable magnetic settings.
- v. MCCBs above 200A shall be equipped with microprocessor-based trip units for O/L, S/C and inbuilt earth fault protection.
- vi. O/L protection in Microprocessor MCCBs should be variable from 0.25-1 In with variable trip class which will help user to select the settings as per load characteristics.
- vii. S/C protection in Microprocessor MCCBs should be variable from 1.5-12 In with adjustable time delay which can be used for co-ordination purposes.
- viii. Inbuilt ground fault protection 20% to 70% of In
- ix. Adjustable Neutral Overload protection 50% to 100% of Ir
- x. All Thermal Magnetic MCCBs should have Ambient temperature compensation features.
- xi. Overload setting of Thermal magnetic MCCBs should be from 0.67In to 1.0In. and Short Circuit settings should be from 6In to 12In wherever MCCBs selected are with variable thermal and variable magnetic.
- xii. All microprocessor MCCBs should have LSING inbuilt protection with individual fault indication LED for LSIG faults.
- xiii. MCCBs shall be of Four pole construction arranged for simultaneous Four pole manual closing and opening and for automatic tripping at short circuit and overload.
- xiv. Operating mechanism shall be quick make, quick break and trip free system.
- xv. The ON, OFF & TRIP positions of the MCCB shall be clearly

indicated so as to be visible to the operator when mounted as in service. Operating handle shall be provided on front of the Kiosk.

- xvi. MCCBs shall be capable of withstanding the thermal stresses caused by overloads and short circuits. The maximum tripping time under short circuit shall not exceed 20 milli seconds.
- xvii. MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit ratings.

Current transformers

(i)	Type	Resin cast / tape wound
(ii)	Ratio	As per load
(iii)	Accuracy class	0.5
(iv)	Burden	2.5 VA

Meters

	AMMETER	Energy Meter
(i) Type	Digital	Smart Meter/MFM
(ii) Accuracy class	0.5	0.5 S
(iii) Size	96 x 96	As per Manufacturer standard

7.2.3 GENERAL REQUIREMENTS:

7.2.3.1 GUARANTEED PERFORMANCE REQUIREMENTS:

The vendor shall guarantee satisfactory performance of the equipment supplied under all conditions and requirement as laid down by this specification.

7.2.3.2 TESTING AND COMMISSIONING

- i) Routine tests as per relevant IS standards to be conducted at works and at site. Test certificates shall be provided.
- ii) Type test certificates for identical equipment shall be provided.
- iii) All fittings, fabrications, hard wares etc. as specified shall be inspected and tested in accordance with IS recommendation. Type test certificates from National Test House or from reputed agency shall be considered.

33/11kV HT CABLES

The size & runs of the HT cables shall be decided as per the Electrical Load requirements and rated short circuit capacity of Substations & HT cable Schedule shall be got approved from Engineer-In-Charge.

1. CONSTRUCTION

All HT cables shall be of 33/11 kV grade, armored, aluminum conductor, XLPE insulated, earthed & PVC sheathed. All HT cables shall be manufactured & tested in accordance with relevant IS Code Specifications.

2. CABLE JOINTS/ TERMINATIONS

Terminal joints shall be carried out as per IS specifications. Heat shrink cable termination kit shall be used for terminations & straight through joints.

3. INSTALLATION OF CABLES

Cable laying in ground, Cable trays, Ducts or fixing on Wall shall be carried out as per CPWD specifications for Electrical works Part II as amended up to date. Cable route marker shall be provided at regular intervals as per CPWD specifications. Cost of cable route markers is deemed to be included in the cost of cables/cable laying.

LT CABLES

i. GENERAL

LT Cables shall be supplied, inspected, laid, tested and commissioned in accordance with drawings, specifications, relevant Indian Standards specifications as per given below. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drums.

Total number of runs and size of LT power cables shall be designed so that voltage drop is achieved 6% or 8 Volt between both ends whichever is less.

ii. CODES OF PRACTICE GUIDE

Sr No.	Reference	Description
1	IS 694	: 1990 IEC 60227 - 1 to 5: 1979 PVC insulated cables for working voltages up to and including 1100 V
2	IS 694	: 2010 Polyvinyl chloride insulated sheathed and unsheathed cables with rigid and flexible conductor for rated voltages up to and including 450/750 V: Part general requirements (fourth revision)
3	IS: 7098	: 1988 (Part-I) XLPE insulated (heavy duty) electric cables. For working Voltages up to and including 1100 V (third revision)
4	IS 4288	: 1988 PVC insulated (heavy duty) electric cables with solid aluminium conductors for voltages up to and 1100 V (second revision)

iii. CABLE CONDUCTOR MATERIAL

- a) The LT Power cables shall be XLPE insulated, PVC sheathed, Copper conductor armoured cable having sizes up to & including 16 sqmm, unless stated otherwise.
- b) For LT Power cable having sizes above 16 sqmm, cables shall be XLPE

insulated, PVC sheathed, Aluminium conductor, armoured cables, unless stated otherwise.

- c) LT Control cables shall be XLPE insulated, PVC sheathed type, copper conductor, armoured cables, unless stated otherwise.
- d) All LT Power & Control cables shall conform to IS: 7098: 1988 (Part-I) with up to date amendments.

iv. INSTALLATION OF CABLES

Cables shall be laid directly in ground, pipes, masonry ducts, on cable tray, surface of wall/ceiling etc. as indicated on drawings and/or as per the direction of Engineer In Charge. Cable laying shall be carried out strictly as per CPWD specifications.

v. INSPECTION

All cables shall be inspected at site and checked for any damage during transit.

vi. JOINTS IN CABLES

The Contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoiding of cable joints. This apportioning shall be got approved from Engineer-in-Charge before the cables are cut to lengths.

vii. LAYING CABLES IN GROUND

Cables shall be laid by skilled experienced workmen, using adequate rollers to minimize stretching of the cables. The cable drums shall be placed on jacks before unwinding the cable. With great care it shall be unrolled on over wooden rollers placed in trenches at intervals not exceeding 2 meter. Cables shall be laid at depth of 0.75 meters below ground level for LT Cables and 1.20 meter below ground level for HT cable. A cushion of sand total of 250 mm shall be provided both above and below the cable, joint boxes and other accessories. Cable shall not be laid in the same trench or alongside a water main.

The cable shall be laid in excavated trench over 80mm layer of sand cushion. The relative position of the cables, laid in the same trench shall preserved. At all changes in direction in horizontal and vertical planes, the cables shall be bent smooth with a radius of bent not less than 12 times the diameter of cables. Minimum 3 meter long loop shall be provided at both ends of cable.

Distinguishing marks may be made on the cable ends for identifications of phases. Insulation, tapes of appropriate voltage and in red, yellow and blue colours shall be wrapped just below the sockets for phase identifications.

viii. CABLE ROUTE MARKERS:

Cable route marker shall be provided at regular intervals as per CPWD specifications. Cost of cable route markers is deemed to be included in the cost of cables/cable laying.

ix. PROTECTION OF CABLES:

The cables shall be protected by bricks laid on the top layer of the sand for the full length of underground cable. Where more than one cable is laid in the same trench, the bricks shall cover all the cables and shall project a minimum of approximately 80mm on either side of the cables. Cable under road crossings and any other places subject to heavy traffic shall be protected by running them through Hume Pipes of suitable size. Hume Pipes for road crossing of the cables shall be laid at a depth of 1000 mm.

x. EXCAVATION & BACK FILL

All excavation and back fill required for the installation of the cables shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layer not exceeding 150mm. Each layer shall be properly rammed and consolidated before laying the next layer.

The Contractor shall restore all surfaces, road ways, side walks, curbs, wall or the works cut by excavation to their original condition to the satisfaction of the Engineer-in-Charge.

xi. LAYING OF CABLES ON CABLE TRAY/SURFACE OF WALL/ CEILING

Cable shall be laid on perforated M.S. Cable tray/ladders. Cables shall be properly dressed before cable ties/clamps are fixed. Wherever cable tray is not proposed, cables shall be fixed on surface of wall or ceiling slab by suitable MS clamps/saddles. Care shall be taken to avoid crossing of cable.

xii. CABLES ON HANGERS OR RACKS

The Contractor shall provide and install all iron hangers racks or racks with die cast cleats with all fixings, rag bolts or girder clamps or other specialist fixing as required. Where hangers or racks are to be fixed to wall sides, ceiling and other concrete structures, the Contractor shall be responsible for cutting away, fixing and grouting in rag bolts and making good.

The hangers or racks shall be designed to leave at least 25mm clearance between the cables and the face to which it is fixed. Multiple hangers shall have two or more fixing holes. All cables shall be saddled at not more than 150mm centres. These shall be designed to keep provision of some spare capacity for future development.

xiii. CABLES TAGS

Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond

the glanding as well as below the glands at cable entries. Tray tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 metres.

xiv. TESTING OF CABLES

Prior to installation burying of cables, following tests shall be carried out. Insulation test between phases, phase & neutral, phase & earth for each length of cable.

i. Before laying.

ii. After laying.

iii. After jointing.

Along with the test as prescribed in IS Code, cross sectional area shall also be checked. On completion of cable laying work, the following tests shall be conducted in the presence of the Engineer in Charge.

i. Insulation Resistance Test (Sectional and overall)

ii. Continuity Resistance Test

iii. Earth Test

All tests shall be carried out in accordance with relevant Indian Standard code of practice and Indian Electricity Rules. The Contractor shall provide necessary

instruments, equipments and labour for conducting the above tests & shall bear all expenses of conducting such test.

4. **HYBRID POWER FACTOR CORRECTION PANEL**

The contractor shall carry out Design, fabrication, assembling, wiring, supply, installation, testing and commissioning of HPFC (Hybrid power factor correction) panel having IGBTs, microprocessors, capacitors, reactors and other associated accessories, as explained below:

Design, assembly / fabrication, installation, testing and commissioning of 3 phase, 440 V, 50 Hz TP&N HPFC system (Auto + manual option) of Minimum Rating 600kVAR+300 A AHF IGBT based controller with Super Heavy Duty type capacitors and Aluminum wound detuned filter & other associated accessories. The unit shall improve the monthly average power factor to 0.99 minimum and mitigate harmonic distortion on the LV bus referring to guideline of NEC 2023. The Hybrid Panel shall be Internet of things (IoT) enabled and communicable/integrable with EMS. The APFC panel should be Green Premium product having the capability for environmental monitoring where it is able to provide the real time data for the temperature and humidity inside the panel ambient. Panel has to be certified for IEC 61921/IS 16636.

The HPFC panel shall be fabricated out of 14/16 gauge CRCA sheet steel in cubicle compartment, free-standing, floor-mounted, dust and vermin proof with reinforcement of suitable size, angle iron, channel, 'T' sections and/or flats wherever necessary. Pre-treatment of panel shall be carried out before epoxy powder coating with at least eight tank process. The HPFC panel shall adhere to IP 41 protection standard.

Cable gland plates shall be provided on top / bottom / both of the HPFC panel. Lifting hooks shall also be provided at least on all four corners of the panel.

The HPFC panel shall be suitable for 415V, 4 phase, 4 wire, 50 Hz supply system. The panel shall have a tolerance of 10% for the voltage and 5% for the frequency. Two numbers of earthing terminals shall be provided on either side of the panel.

The HPFC Panel shall, in its default configuration, shall implement the following:

- Step-less Power Factor Correction (for both leading and lagging current)
- Harmonics Compensation up to 50th order
- Load Current Balancing in the three phases
- Neutral current compensation in neutral phase
- All capacitor banks shall be controlled with suitable rating thyristor switches.

4.1 HPFC Panel: The HPFC Panel shall comprise: Capacitor Panel & Active Harmonic Filter shall be in one unit & same make and shall have common controller for capacitor bank & separate controller for AHF.

i. Incomer:

ACB four pole a having thermal magnetic based over-current and short-circuit protection and at least 50kA breaking capacity (Ics) as the incomer of the panel. 100% Icu breakers shall be used.

ii. Metering and Indication:

- a) A HMI display meter showing voltage, current, frequency, PF, THD, kW, kVA, and other related parameters
- b) Required number of CTs of suitable rating.
- c) Required number of three phase digital ammeter showing current of HPFC panel

- iii. An active filter part and a passive filter part shall be provided. The ratio of the rating of active filter to that of the passive filter shall be at least 1:1.

4.2 Detuned capacitor bank unit: Each fixed detuned capacitor bank unit shall comprise:

Incomer:

- a) A three pole, thermal magnetic based MCCB having over-current and short-circuit protection and at least 36 kA breaking capacity as the incomer
- b) 100% lcu breakers shall be used
- c) Three pole capacitor duty contactor of suitable rating Power Circuit:
 - Three phase delta connected capacitors of suitable rating
 - The capacitor unit shall be heavy-duty MPP type and have an AC voltage rating of 525V
 - A series detuned reactor of suitable rating connected to the capacitor bank
 - The series detuned reactor shall be a 14% reactor having linearity of at least 180%
 - Heavy duty exhaust fans and suitably placed ventilation louvers for proper heat dissipation from the reactors and capacitors shall be provided.

Control Circuit:

- a) On and Off indication lights for each detuned capacitor bank
- b) Start and Stop push buttons for each detuned capacitor bank
- c) Auto/Manual selector switch for auto mode (through the HPFC Panel's DSP microprocessor) or manual mode of operation of the capacitor banks
- d) On delay timer for the detuned capacitor bank so that all the detuned banks don't get switched on at the same time

4.3 Active Filter Unit:

Active filter unit shall provide the required reactive power in a step-less mode to meet the requirement for neutral compensation. Each Active filter unit shall comprise:

i. Incomer:

- a) A four pole MCCB having thermal magnetic based over-current and short-circuit protection and at least 36kA breaking capacity (lcs) as the incomer of the 3-Ph HPFC Panel
- b) 100% lcu breakers shall be used

ii. Metering and Indication:

- a) On/Off selector switch for the Active filter

iii. Power Circuit:

- a) Suitable rating four phase inverter stack.
- b) The inverter stack shall be rated for the full rating of active filter and shall have sufficient margins for overloading the filter
- c) Four single phase inductor chokes of suitable rating
- d) Inductor chokes shall have overload margin of at least 150% for 1 minute

- e) Suitable rating four pole AC1 duty power contactor
 - f) The contactor shall be connected to the input of the IGBT power stack
 - g) The inverter stack shall comprise suitable number and rating (with sufficient margin for overload) of IGBTs, DC Capacitors and IGBT driver circuits to meet the full power output of the inverter stack
 - h) Resistors, capacitors and other passive components of suitable rating (with sufficient margin) and quantity to continuously carry the full load of the filter
 - i) Cables, bus-bars and other associated hardware of suitable rating (with sufficient margin) to continuously carry the full load of the filter
 - j) Heavy duty exhaust fans and suitably placed ventilation louvers for proper heat dissipation from the inverter stacks and inductor choke shall be provided
 - k) Heavy duty PWM filter comprising capacitors, resistances and/or inductors to filter out the switching ripple from the filter output
- iv. Control Circuit:
- a) Control MCB of rating 6A, FP, 10 kA, C-Curve to provide power supply to the control circuit of the Active filter
 - b) Advanced DSP microprocessor controller which shall monitor the voltage and current in the three phases (Red, Yellow and Blue) to compute the exact power requirement in the three phases, and thus, implement the following features - step-less compensation of leading and lagging power factor, harmonics compensation and load balancing
 - c) Suitable number and rating of voltage and current sensing circuits
 - d) Necessary control and firing cards with proper wiring and lugs of required rating shall be provided
 - e) Suitable number and rating of any other items, e.g. relays, SMPS, etc.

4.4 HMI (Human Machine Interface):

The HMI (Human Machine Interface) installed in the HPFC Panel shall have the following features:

- a) A 7-inch, colored touch screen LCD/ LED interface
- b) It must at-least have Ethernet port, USB port and SD card port
- c) It must support MODBUS TCP communication protocol
- d) Start, stop and trip status (with trip code) on the home screen
- e) Internal CAN communication with the DSP controller
- f) The HMI must display the following (minimum) numerical parameters:
 - Irms - All 3 phase currents + Neutral
 - Irms (Fundamental Current) - All 3 phase fundamental currents
 - iTHD (%) - All 3 phase current harmonic distortion
 - Iunb (%) - All 3 phase current unbalance

- Vrms - All 3 phase voltages
 - Urms - All 3 line voltages
 - V1rms (Fundamental Voltage) - All 3 phase fundamental voltages
 - vTHD (%) - All 3 phases voltage harmonic distortion
 - Vunb (%) - All 3 phase voltage unbalance
 - Grid Frequency
 - Active Power (kW) - All 3 phases + Total
 - Reactive Power (kVAr) - All 3 phases + Total
 - Apparent Power (kVA) - All 3 phases + Total
 - Power Factor (PF) - All 3 phases + Total
 - Displacement Power Factor (dPF) - All 3 phases + Total
 - Ipk - Peak Current of 3 phases of power stack
 - Utilization (%) - Utilization percentage of 3 phases of power stack
 - Vdc - DC bus voltage of power stack
 - Stack Temperature - Temperature of 3 phase IGBTs of power stack
 - Control Card Temperature
 - System Running hours
 - Fan Running hours
 - Advanced logging capabilities
 - The HMI must save a minimum of 50,000 time stamped event logs
 - The logs view must be password protected
 - The logs should capture system events like system On/Off
 - System trip event should be logged with associated trip code and time stamp
 - User entry into settings should get logged
 - Any failed user login attempt (wrong password) should be logged
 - Changes in user settings must be logged
 - Logs must be accessible day-wise for ease of navigation
 - Logs must be arranged in First In - Last Out fashion to display the latest events on top
 - User must be able to export the logs to an external USB storage device
 - HMI must have provision for Ethernet communication or suitable communication bus
- g) The HMI must provide graphical information for the following (minimum) data:
- Individual harmonic bar chart of 3-phase currents - upto 50th/51st order

- Individual harmonic bar chart of 3-phase voltages - upto 50th/51st order
- Simultaneous graphical display of 3-phase currents and 3-phase voltages on single window with user select-able options

4.5 Additional Features in HPFC Panel:

The HPFC Panel shall have the following features, in addition to those already mentioned above:

- Panel shall be suitable for operation within an ambient temperature between 0°C and 45°C .
- Panel shall have an audible noise level lesser than 70 db
- Panel shall have harmonic attenuation: 96 % & operating efficiency: 97% i.e. losses less than 21.5 W/kVAR.
- Panel shall have a reaction time of less than 200 micro-seconds
- Selection between the features - PF compensation, harmonics compensation load balancing and neutral compensation of the filter shall be programmable using the HMI
- In the default mode, harmonics compensation is set at 1st priority, PF compensation is set at 2nd priority and load balancing is set at 3rd priority
- Panel shall also have provision for selection of individual harmonic orders for compensation in the harmonic compensation mode through the HMI
- Panel shall only compensate the load balancing requirements arising from distributed loading in the three phases or due to two phase loads
- Any compensation requirements arising due to the unbalanced current in the neutral shall be compensated
- Auto fold-back of the HPFC Panel panel if total current requirement exceeds the rated
- capacity of the filter
- Bus-bars or cables shall be suitably color coded and mounted using appropriate insulator supports
- Suitable clearances shall be provided for the bus-bars and other live parts of the system as per international standards
- All live parts of the system shall be properly shrouded
- Inspection terminal strip, number ferruling, and other labeling shall be suitably provided
- Stickers marked with "DANGER" shall be provided wherever required
- Detailed drawings and manuals shall be provided wherever required

4.6 Protections: Following protections shall be provided:

- Over voltage (AC) protection
- Over voltage (DC) protection
- Phase sequence protection
- Over current protection

- One phase disconnection (double phasing) detection/protection
- Over temperature protection
- Temperature sensor abnormality detection
- Protection circuits for the IGBT stack and its components
- Temperature based de-rating to protect the system and longer operational life
- The system will de rate its capacity by sensing the control card temperature
- System will sense abnormally high stack temperature and trip itself to protect the converter with suitable error indication
- The system will sense abnormality with stack temperature sensing circuit and generate a suitable error indication

All components and wiring used in the system shall adhere to the relevant ISI and IEC standards. Contractor shall also submit four sets of installation and maintenance manual.

The HPFC Panel shall have the following settings options for the user:

- Define priority between Harmonic, Reactive and Unbalance compensation e.g: User can easily choose to do only one of the three or a combination of the three. Filter will utilize its full capacity as per defined priority.
- Individual harmonic selection

4.7 Tests At Manufacturer's Works:

All routine and type tests as per IS:2834 relevant to capacitor banks as amended up to date shall be carried out at manufacturer's works and test certificates to be submitted.

4.8 Test At Site:

- Insulation resistance with 500 V DC Meggar shall be carried out and test results should be recorded.
- Residual voltage shall be measured after switching of the capacitors and the same shall not be more than 50 volts after one minute. Each discharge resistor shall be tested for its working.

4.9 Installation:

Hybrid Power Factor Capacitor Panel shall be installed with adequate clearance from the adjacent walls on suitable frame work of welded construction. The earth terminals

provided on the body of capacitor bank shall be bonded to main capacitor panel earth bus with 2 nos 8 SWG copper or 6 SWG GI earth wire.

5. Special Conditions for Electrical Services:

- a) GENERAL:-The design and workmanship shall be in accordance with the best engineering practices, to ensure satisfactory performance and service life. The requirement offered by the contractor shall be complete in all respects.
- b) The contractor shall obtain all sanctions (electrical loads, approval of drawing/ESS/D.G.'s estimator/approval of meter room etc. from the concerned authorities and permits required for the electrical installation work. The actual fee payable in this regard will be reimbursed against receipt/documentary evidence. On completion of work, the contractor

shall obtain NOC from SEB & Director of Safety of the concerned state/Pollution Control Board; a copy of the same shall be delivered to HITES/Engineer In Charge.

- c) All the services testing, commissioning and handing over shall be done as per NBC performa.

The HITES shall have full power regarding the materials or work to be got tested through independent agency at the EPC contractor's expenses in order to prove their soundness and adequacy. The contractor will rectify the defects/suggestions pointed out by HITES/independent agency at his own expenses.

The installation shall comply in all respects with the requirements of Indian Electricity Act 1910, Indian Electricity Rules (IER) 1956 and other related Laws and Regulations as amended up to date, there under and special requirements, if any, of the State Electricity Boards etc. The bidder is liable to furnish the list of authorized licensed persons/employed/deputed to carry out the works/performance the assigned duties to fulfill the requirement of Rule No.3 of IER 1956 as amended up to date.

5.1 Drawings

i. Tender Drawings:

The tender drawings are meant to give general idea to bidder regarding the nature of scope & works to be executed. Any information/data not shown in tender drawings shall not relieve the contractor of his responsibility to carry out the work as per the specifications & terms of the EPC contract. Additional information required by the bidder/tenderer for successful completing the work shall be obtained at his end.

ii. Shop Drawings:

The contractor shall prepare detailed coordinated electrical shop drawings indicating Light Points, Power Points, Cal Bell points, Ceiling Fan, Exhaust Fan Points, Switch Boards, Distribution Boards (Light, Power & UPS), Lighting Fixtures, Convenience outlets, Single Line Diagram for complete HT/LT electrical scheme, CSS, DG Sets, HT Panels, Transformers, LT Panels, Capacitor Panels, Bus Ducts, RTCC Panels, PCC Panel, UPS Units, UPS Incoming/ Outgoing panels, Lift Panels, Rising Mains, HT/LT Cable Schedules, Solar PV System, Earth Pit Layout, Earth Strip routes, HT/LT Cable Routes, Street Light Layout & Street Cable routes, Schematic Diagrams & Floor wise Shop Drawings for all LV works namely, Telephone, LAN, Wifi, CCTV, Access Control, Fire Alarm, Public Address System, Information Display System, Boom Barriers, Queue Management System etc. and other relevant services components as mentioned in DBR and submit to the HITES for approval or the Engineer-in-Charge before commencing the work.

GA Drawings, SLD & Control wiring diagrams, Room trench details for all HT/LT Panels, Capacitor Panels, UPS panels, Floor Electrical Panels, CSS/Transformers, DG Sets, UPS Units, Rising Mains etc. shall be prepared & submitted. The shop drawings shall indicate all setting out details and physical dimensions of all equipment/items/components with wiring and cable details, cable schedule and routes, manhole trap and fixing details as well as for conduit indicating run and size of wire/cables, outlet/pull/junction boxes etc. with fixing details etc. for the above mentioned work. All work shall be carried out on the approval of these drawings. However, approval of these drawings shall not relieve the contractor of his responsibility for providing maintenance free and fool proof system including any missing component/accessories to meet the intent of the specifications. Contractor will submit 2 prints for preliminary approval and finally six prints for distribution. The recommended location/ position of the all equipment as shown on the layout drawings will be adhered to unless stated otherwise.

iii. **As-Built Drawings:**

On completion of the work and before issue of certificate of virtual completion, the contractor shall submit to the HITES, required Sets of 'As Built' drawings (in AutoCAD & PDF format) along with soft copy of the executed works incorporating all such changes and modifications during engineering and execution along with Operation and Maintenance Manuals, Warranty & Guarantee Certificates from Original Equipment Manufacturers (OEM), authorized Contractors & Vendors, as applicable.

These drawings must provide:

- Run and size of conduit, inspection and pull boxes including routing and locations.
- Number and size of conductor in each conduit.
- Locations and rating of sockets and switches controlling the light and power outlet.
- A complete wiring diagram as installed and schematic drawings showing all connections in the complete electrical system.
- Location of outlets of various services, junction boxes, light fixtures.
- Location of all earthing stations route and size of all earthing conductors.
- Layout and particulars of all cables.
- Location and details of CSS/Transformers, HT/LT Panels, Feeder Pillars, capacitor control panels etc.
- UPS panel, and relay panels with description detailed control wiring diagram.
- Location of CSS/transformer and its details and control wiring diagram.
- Location of Hume pipe and manhole including HT/LT cable layout and scheduling
- Location of DG Sets, Exhaust and auxiliary equipment with schematic drawings.
- Layout of cable trays with support and their fixing details.
- Location of all earthing station, route and size of all earthing conductor.
- Layout and particulars of rising mains with fixing details.

The contractor shall submit 2 sets of samples of each type of accessories and apparatus,

proposed to be used in the installation at site for approval (drawings or samples) as required shall be submitted by contractor and the choice of selection out of the approved list lies with the HITES. For all non-specified items, approval of the HITES shall be obtained prior to procurement of the same. HITES shall in no way be liable for rejection of the any material due to poor quality, poor workmanship, poor material etc.

5.2 MANUFACTURER'S INSTRUCTIONS

Where manufacturers have furnished specific instructions, relating to the material/equipment to be used on this job, covering points not specifically mentioned in this document, manufacturers' instructions should be followed.

5.3 MATERIALS AND EQUIPMENT

All the materials and equipment shall be of the approved make and design. Unless otherwise called for any approval by HITES's Engineer-in-Charge, only the best quality materials and equipment shall be used.

5.4 GENERAL DETAILS

a) Space Heaters & Lighting.

One of more adequately rated heaters thermostatically controlled with On-Off switch and fuse shall be provided to prevent condensation in any panel compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation. CFL lamp shall be provided in any panel compartment.

b) Fungistatic Varnish

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

c) Ventilation Opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

d) Degree of Protection

The enclosures of the Control Cabinets, Junction Boxes and Marshalling Boxes, Panels etc. to be installed shall provide degree of protection as called for in specifications/General arrangement, whenever it is not mentioned it shall be as given below:

- Installed out door: IP-55.
- Installed indoor in air-conditioned area: IP-52.
- Installed in covered area: IP-52.
- Installed indoor in non-air-conditioned area where possibility of entry of water is limited: IP-42.
- For L.T. switchgear (AC and DC distribution boards): IP-52.

The degree of protection shall be in accordance with IS: 13947 (Part-I)/IEC-947 (Part-I). Type test report for degree of protection test, on each type of the box shall be submitted for approval.

5.5 Rating Plates, Name Plates and Labels

Rating Plates, Name Plates and Labels are to be provided & attached permanently in a conspicuous position to all equipment & items installed in various buildings. A rating plate of non-corrosive material engraved with manufacturer's name, year of manufacture, equipment name, diagram, type or serial number etc. together with details of the loading conditions of equipment. The rating plate of each equipment shall be according to relevant BIS & IEC norms, as applicable.

All such nameplates, instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

5.6 First Fill of Consumables, Oil and Lubricants

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, welding/soldering/brazing material for all copper/G.I. earthing and essential chemicals etc. which will be required to put the equipment/scheme covered under the scope of the specifications, into successful operation, shall be furnished by the Contractor unless

specifically excluded under the exclusions in these specifications and documents.

5.7 DESIGN IMPROVEMENTS / DEVIATIONS

The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply. If for any reason, Contractor wishes to deviate from specification, prior permission from HITES will be sought.

If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly in the specification.

6. QUALITY ASSURANCE PROGRAMME

To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Purchaser's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be outlined by the Contractor and shall be finally accepted by the Purchaser after discussions before the award of Contract. A quality assurance programme of the contractor shall generally cover the following:

- His organization structure for the management and implementation of the proposed quality assurance programme.
- Documentation control system.
- Qualification data for bidder's key personnel.
- The procedure for purchases of materials, parts components and selection of sub- contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
- System for shop manufacturing and site erection controls including process controls and fabrication and assembly control.
- Control of non-conforming items and system for corrective actions.
- Inspection and test procedure both for manufacture and field activities.
- Control of calibration and testing of measuring instruments and field activities.
- System for indication and appraisal of inspection status.
- System for quality audits.
- System for authorizing release of manufactured product to the Purchaser.
- System for maintenance of records.
- System for handling storage and delivery.
- A quality plan-detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

6.1 QUALITY ASSURANCE DOCUMENTS

The Contractor shall be required to submit the following Quality Assurance Documents within three weeks after dispatch of the equipment:

- All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication and reports including radiography interpretation reports.

- Welder and welding operator qualification certificates.
- Welder's identification list, listing welders and welding operator's qualification procedure and welding identification symbols.
- Raw material test reports on components as specified by the specification and/or agreed to in the quality plan.
- Stress relief time temperature charts/oil impregnation time temperature charts.
- Factory test results for testing required as per applicable codes/mutually agreed quality plan/standards referred in the technical specification.
- The quality plan with verification of various HITES inspection points as mutually and methods used to verify the inspection and testing points in the quality plan were performed satisfactorily.

7. INSPECTION, TESTING AND INSPECTION CERTIFICATE

- The HITES or duly authorized representative shall have at all reasonable times free access to the Contractor's/ Manufacturer's premises or works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection, if part of the works is being manufactured or assembled at other premises or works, the Contractor shall obtain permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. Inspection may be made at any stage of manufacture, dispatch or at site at the option of the Purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.
- All equipment being supplied shall conform to type tests and shall be subject to routine tests in accordance with requirements stipulated under respective sections. Bidder shall submit the type tests reports for approval. The Contractor shall intimate the HITES the detailed programme about the tests at least three (3) weeks in advance in case of domestic supplies.
- The Contractor shall give the HITES thirty (30) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account. The HITES, unless witnessing of the tests is virtually waived off, will attend such tests within thirty (30) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Contractor may proceed with the test which shall be deemed to have been made in the presence of HITES and he shall forthwith forward to the HITES duly certified copies of tests in triplicate.
- The HITES shall within fifteen (15) days from the date of inspection as defined shall inform in writing to the Contractor of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and make the necessary modifications accordingly.
- When the factory tests have been completed at the Contractor's or Sub-contractor's works, the HITES shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the HITES, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the HITES. Failure of the issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificate shall not bind the HITES to accept the equipment should, it, on further tests after erection, is found not to comply with the Specification. The equipment shall be dispatched to site only after approval of test reports and issuance of clearance by the HITES.
- The contractor shall arrange all necessary tools and testing facilities for inspection purpose including arrangement of air travel (inland as well as abroad), conveyance, lodging, boarding and other miscellaneous expenses etc. HITES shall depute its inspection engineers (2 or more as decided by HITES) after receipt of inspection call from the contractor. All such expenses incurred by the contractor towards inspection of equipment by HITES' inspection engineers shall be borne by the contractor.

- For tests whether at the premises or at the works of the Contractor or of any Sub- Contractor, the Contractor except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be required by HITES or this authorized representative to carry out effectively such tests of the equipment in accordance with the Specification.
- The inspection by HITES and issue of Inspection Certificate thereon shall in no way absolve the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract.
- The HITES will have the right of having at his own expenses any other tests(s) of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests to satisfy that the material comply with the specifications.
- The HITES reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipment for these tests shall be provided by the Contractor.

8. TESTS

8.1 Charging Tests

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the HITES and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The pre-commissioning tests to be performed as per relevant I.S. given and shall be included in the Contractor's quality assurance programme.

8.2 Commissioning Tests

- 8.2.1 The available instrumentation and control equipment will be used during such tests and the Contractor will calibrate all such measuring equipment and devices as far as practicable. However, unmeasurable parameters shall be taken into account in a reasonable manner by the Contractor for the requirement of these tests. The tests will be conducted at the specified load points and as near the specified cycle condition as practicable. The Contractor will apply proper corrections in calculation, to take into account conditions, which do not correspond to the specified conditions.
- 8.2.2 All instruments, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.
- 8.2.3 Pre-commissioning test shall be carried out as per relevant IS and/or as specified in the relevant clause.
- 8.2.4 The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning of the equipment.

9. PACKAGING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of availability of Railway wagon/truck/trailer sizes in India should be taken account of the Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. HITES takes no responsibility of the availability of any special packaging/transporting arrangement.

10. PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pipings and conduit equipment

connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

11. FINISHING OF METAL SURFACES

11.1 General

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts and bolts and spring washers shall be electro galvanized. All steel conductors used for earthing/grounding (above ground level) shall be galvanized according to IS: 2629.

11.2 Hot Dip Galvanizing

- 11.2.1 The minimum weight of the zinc coating shall be 700 gm/sq.m and minimum thickness of coating shall be 85 microns.
- 11.2.2 The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.
- 11.2.3 After galvanizing drilling or welding shall be performed on the galvanized parts of the earthing materials. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.
- 11.2.4 The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.
- 11.2.5 Sharp edges with radii less than 2.5mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.
- 11.2.6 Coating thickness,
- 11.2.7 Uniformity of zinc,
- 11.2.8 Adhesion test,
- 11.2.9 Mass of zinc coating.
- 11.2.10 Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

11.3 Painting

- 11.3.1 All sheet steel work shall be degreased, pickled, phosphate in accordance with the IS-6005 "Code of practice for phosphating iron and sheet". All surfaces which will not be easily accessible after shop assembly shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.
- 11.3.2 After phosphating, thorough rinsing shall be carried out with clean water followed

by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, staving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be shovelled.

11.3.3 Powder coating/electrostatic painting of approved shade shall be applied.

11.3.4 The exterior color of the paint shall be as per shade no. 697 of IS-5 or as approved by Engineer-in-charge and inside shall be white or as approved by Engineer-in-charge. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments, if required.

11.3.5 In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures like electrostatic painting etc. the procedure shall be submitted along with the Bids for HITES's review and approval.

12. HANDLING, STORING AND INSTALLATION

- In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Purchaser or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented.
- Contractor shall follow the unloading and transporting procedure at site, as well as storing, testing and commissioning of the various equipment being procured by him separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer's Engineer(s) and shall extend full co-operation to them.
- In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the HITES. Contractor shall be held responsible for any damage to the equipment consequent for not following manufacturer's drawings/instructions correctly.
- Where assemblies are supplied in more than the one section, Contractor shall make all necessary connections between sections. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.
- The Contractor shall submit to the HITES every week, a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.
- The Contractor shall be fully responsible for the equipment/material until the same is handed over to the HITES in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken over by HITES, as well as protection of the same against theft, element of nature, corrosion, damages etc.
- The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment, which require indoor storage.
- The words 'erection' and 'installation' used in the specification are synonymous.
- Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.
- The minimum phase to earth, phase to phase and section clearance along with other technical

parameters for the various voltage levels shall be maintained as per relevant IS.

13. PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

14. DESIGN CO-ORDINATION

The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

15. DESIGN COORDINATION MEETING

The Contractor will be called upon to attend design co-ordination meetings with the Engineers of HITES/ Client during the period of Contract. The Contractor shall attend such meetings at his own cost at mutually agreed venue as and when required and fully co- operate with such persons and agencies involved during those discussions.

16. TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipments.

17. SAFETY CODES & PRECAUTIONS

The Contractor at his own expenses shall arrange for safety provisions as required to comply with the statutory regulations, ISI recommendations and CPWD codes.

The contractor shall provide necessary barriers, warnings, signals and other safety measures to avoid accidents. He shall indemnify HITES against any claims arising out of negligence in this respect.

18. REGULATIONS AND STANDARDS

All equipments their installation, testing and commissioning shall conform latest CPWD/ IS specifications in all respects. Indian Standard Code of Practice for Electrical Wiring Installation IS:732-1989. It shall also be in conformity with Indian Electricity Rules and the Regulations, National Electric Code, National Building Code 2016, ECBC latest amended, CPWD specifications amended up to date and requirements of the Local Electric Supply Authority. In general, all materials equipment and workmanship shall conform to the Indian Standards specifications and code. Some of the applicable codes/standards are as under:

a.	CPWD General specifications for electrical works	Part-I (Internal) 2023
b.	CPWD General specifications for electrical works	Part-II (External) 2023
c.	CPWD General specifications for electrical works	Part-III (Lifts & Escalators) 2003
d.	CPWD General specifications for electrical works	Part-IV (Substation) 2013
e.	CPWD General specifications for electrical works	Part VII (DG Sets) 2013
f.	CPWD Guidelines for Substation & Power Distribution Systems of Buildings	2019

g.	Guide for uniform system of marking and identification of conductor and apparatus terminals.	IS 11353 -1985
h.	Low voltage switchgear and control gear assemblies	IS/IEC 61439
i.	Specification for low voltage switchgear and control gear assemblies	IS 8623 (Part -2-1993)
j.	Code of practice for selection, Installation and maintenance of switchgear and control gear.	IS 10118 Part – 1 - 4
k.	PVC insulated (heavy duty) electric cables	IS 1554
l.	PVC insulated cables for working voltages up to and including 1100V.	IS 694
m.	Conduit for electrical installations	IS 9537
n.	Accessories for rigid steel conduits for electrical wiring	IS 3837
o.	Boxes for the enclosure of electrical accessories	IS 14772
p.	General and safety requirements for luminaries	IS 1913
q.	Code of practice for earthing	IS 3043
r.	Electrical accessories – circuit breakers for over current protection for household and similar installations.	IS 8828
s.	Low Voltage switchgear and control gear	IS 13947 Part 1 – 5
t.	Residual current operated Circuit Breakers	IS 12640
u.	Current Transformers	IS 2705
v.	Voltage Transformers	IS 3156
w.	Direct acting indicating analogue electrical measuring instruments and their accessories	IS 1248 part – 1 to 9
x.	Control Switches (switching device for control and auxiliary circuits including contactor relays) for voltages up to and including 1000V AC and 1200 V DC.	IS 13947 & IS 1336

In case of contradiction in specification the priority of the documents shall be CPWD/IS Specifications, Drawings, and Technical Specifications.

LIFTS

1.0 General

1.1 This specification covers manufacture, testing as may be necessary before dispatch, delivery at site, all preparatory work, assembly and installations, commissioning putting into operation of Lifts.

1.2 Location

1 No. 13 Passenger Lift & 1 No. Good Lift in NCDC Jaipur, at SMS Jaipur. The work shall be executed as per CPWD General Specifications for Electrical Works (Part III Lifts & Escalators – 2003) as per relevant IS and as per directions of Engineer-in-Charge. These additional specifications are to be read in conjunction with above and in case of variations; specification given in this Additional conditions shall apply. However, nothing extra shall be paid on account of these additional specifications & conditions as the same are to be read along with the schedule of quantities for the work.

2.0 Passenger lifts –

1.	Type	Passenger Elevator & Goods Elevator
2.	Number of lifts required	1 Nos. + 1 Nos.
3.	Load:	13 Passenger (Passenger Lift), 2 Tonne (Service Lift)
4.	Rated speed	1.0 M/sec. (Passenger Lift), 0.5 M/sec. (Service Lift)
5.	Travel in meter	Approx. 12.00 Mtrs
6.	Numbers of floors served	G+1
7.	Lift Pit	To be designed as per lift manufacturer
8.	Clear inside size of lift car:	As per manufacturer's standards
9.	Dimension of lift machine room	As per architecture. (To be designed as per lift manufacturer)
10.	Position of counter weight	At the sides
11.	Position of machine room	Machine Room less
12.	a) Type of control	Microprocessor based AC variable voltage variable frequency. (Lift drive motor and controller shall be suitable for operation with supply voltage variation between + 10% to – 10%)
	b) Type of operation	Duplex collective selective operation with/without an attendant.
	c) Potential free contacts	Potential free contacts for each floor position and up and down movement of the lift shall be provided in the controller which can be used for the building automation system at a later date.
13.	Car entrance door	
	a) Number	One
	b) Size	As per manufacturer

	c) Type of doors opening	Power operated, Horizontal sliding – center
	d) Car open in front only	Yes,
14.	Lift Car	
	I) Construction design	As per General specification for electrical works (Part-III- Lifts & Escalator) – 2003
	II) Interior Finish	
	i) Panels	The sides and facia panel shall be scratch proof honeycomb/moon rock finish) of stainless steel sheet.
	ii) Flooring	Suitable decorative flooring as per the standard design of manufactures for passenger lifts.
	iii) Ceiling manufacturer.	SS ceiling as per the latest standards of the
	iv) Lighting	LED Fitting as per standard design
	v) Ventilation	Suitable ventilation in the ceiling.
15.	Type of signal system	<p>a) Digital floor position indicator in the car and at all landings (to be provided above the car/landing doors)</p> <p>b) Travel direction indicator in the car and at all landings (to be provided above the car/ landing doors)</p> <p>c) Gongs & visual indication on all landings for pre arrival of the car for two or more cars.</p> <p>d) Overload warning Audio & Visual indicator, inside the car (lift should not start on overload)</p> <p>e) Battery operated alarm bell and emergency light.</p> <p>f) Car operating panel with fade proof luminous buttons with additional brail inscriptions in car and with intercom</p> <p>g) Luminous hall buttons with additional brail inscriptions at all landings.</p> <p>h) Fireman's switch at ground floor.</p>
16.	Landing entrance	
	a) Locations of landing entrance	All doors on the same side. on different floors.
	b) Number	As per No. of stops
	c) Size	As per manufacturer
	d) Type of doors	Power operated, Horizontal sliding – center opening
	e) Lift in use/lift out of order sign	A suitable box above the lift landing with LED illuminated bilingual (in English & Hindi) sign of “LIFT OUT OF ORDER” coming up simultaneously

at all floors.

f) Fire resistant rating of the door Shall not be less than one hours.

17. Electric Supply
 - a) Power: - 415 V \pm 10%, AC, 3Phase, 50 Hz, 4 wire system.
 - b) Lighting: 230 V, AC, 50 Hz
 - c) The entire lift equipment should be suitable for operation at +10% to - 10% of the rated supply wanted.
18. Emergency Supply
 - i) Inverter backup with trickle/boost charges arrangement for at least 30 minutes with maintenance free batteries for emergency light, alarm bell and inter-com system.
 - ii) A separate maintenance free battery system should be provided for Automatic Rescue Device (ARD)
19. Door Close Safety

Full Height Infrared light curtain door safety in addition to a pressure operated switch (mechanical safety switch)
20. Controller Panel
 - i) The controller panel shall be of suitable steel gauge having Vermin/dust proof arrangements with suitable in-built ventilation system.
21. To Automatic Rescue Device
 - i) Automatic Rescue Device (ARD) should

Monitor the normal power supply in the main controller and shall activate rescue operations within ten seconds of normal power supply failure. It should bring the elevator to the nearest floor at a slower speed than the normal run. While proceeding to the nearest floor the elevator will detect the zone and stop. After the elevator has stopped, it automatically opens the doors and parks with door open. After the operation is completed by the ARD the elevator is automatically switched over to normal operations as soon as normal power supply resumes.
 - ii) All the lift safeties shall remain active during the ARD mode of operation.
 - iii) The battery capacity should be adequate so as to operate the ARD at least seven times a day. Provided the duration between usages is at least 30 minutes.

SECTION - III

TECHNICAL SPECIFICATIONS FOR HVAC & ASSOCIATED WORK

1.0 TECHNICAL SPECIFICATIONS - HVAC SYSTEM

A. GENERAL

Scope of work shall include design, engineering, supply, installation, testing & commissioning of HVAC systems. All material shall be conforming to relevant IS specifications wherever exists and subject to approval of the Engineer in charge. The HVAC system shall be carried out strictly as per NBC -2016/ASHRAE/ISHRAE/CPWD/ECBC latest versions.

Note: All work shall be carried out as per the given technical specification in this tender, however any items missed out which are required to complete the work shall be carried out strictly as per latest CPWD specification/ ASHARE/ DBT/ relevant IS standard with up-to-date correction slip.

1.1. DRAWINGS

The contractor on award of work will furnish detailed stage-wise GFC drawings as required in advance for approval of Engineer-In-charge.

1.2. GOOD FOR CONSTRUCTION DRAWINGS/ TECHNICAL DATA SHEETS

The contractor shall prepare and furnish all shop drawings including floor plans & Terrace, Schematic HVAC Layout/ pipe routing etc.

The manufacturing of equipment shall be commenced only after the shop drawings/GA Drawings/ technical data sheet along with pump curves are approved in writing by the Engineer-in-charge. Such drawings shall be coordinated with other services work. These shop drawings will be approved by HITES which will be considered as a base for execution of HVAC work.

1.3. COMPLETION / AS BUILT DRAWINGS

On completion of the work and before issuance of certificate of virtual completion, the contractor shall submit to the Engineer -in-Charge, General layout drawings, drawn at approved scale indicating layout of pump house piping and its accessories as installed. AS built drawings shall be prepared taking approved shop drawings as base & incorporating all changes/ modifications as per site conditions. These drawings shall include the following: -

- a. Panels and other equipment/accessories location and their dimensions etc.
- b. HVAC floor layout including terrace Plan etc.
- c. Complete schematic as installed.
- d. Route of all cables and pipes run along with detail sizes and mode of installation.

1.4. DRAWINGS & DOCUMENTS

The contractor shall submit to the Engineer-in-charge, the following documents on completion of the work and before issuance of virtual completion.

- a) Warranty for required equipment installed like Pumps, Panels, Chillers, Cooling Tower, HWG, AHU, FCU etc.
- b) As Built Drawings
- c) Material Test Certificates
- d) Catalogues/Brochures
- e) Operation and Maintenance Manuals
- f) List of recommended spares and consumables
- g) All approvals including technical approvals and sanctions
- h) NoC from Fire authority before commencement of execution & after completion of the entire work etc.

1.5. MANUFACTURING

The responsibility for ensuring the manufacture of the equipment as per the specifications shall be solely that of the contractor. The contractor shall be responsible for selection of materials as per agreed specifications.

1.6. MAKE OF MATERIALS/MANUFACTURER'S INSTRUCTION

Only approved makes as mentioned in our approved make list of tender documents of material shall be used. The Contractor shall furnish Technical data sheets / GA drawings of all items before placing P.O. The contractor shall get the samples of required items approved from the HITES as conveyed by E-I-C before commencing the supply. In case of any discrepancy/anomalies w.r.t specifications, prior intimation from Contractor to E-I-C to be given. Final decision lies with HITES for according approvals.

Any specific instruction furnished by the manufacturer covering the points not mentioned in technical specifications of the tender shall be brought to the notice of E-I-C in writing for further instructions in this regard at appropriate time.

1.7. MATERIAL TESTING

The E-I-C 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.

1.8. INSPECTION AND TESTING

- a) 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-in-charge.
- b) The Engineer-in-charge, may at his sole discretion, carry out inspection at different stages during manufacturing and final testing after manufacturing.
- c) 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.

1.9. TRAINING OF DEPARTMENT PERSONNEL

- d) The contractor shall train the CLIENT/ HITES's personnel to become proficient in operating the equipment installed. Training shall be done before the expiry of the defects liability period (one year after completion & handing over).
- e) The period of training shall be adequate and mutually agreed upon by the Engineer-in-charge and contractor.
- f) The CLIENT/ HITES's personnel shall also be trained for routine maintenance work and lubrication, overhauling, adjustments, testing, minor repairs and replacement.
- g) Nothing extra shall be paid to the contractor for training CLIENT/ HITES's personnel.

1.10. PERFORMANCE GUARANTEE

At the close of the work and before issue of final certificate of virtual completion by the engineer, the contractor shall furnish written guarantee indemnifying the CLIENT/ HITES 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 CLIENT/ HITES.

- Any defective material or equipment supplied by the contractor.
- Any material or equipment supplied by the CLIENT/ HITES which is proved to be damaged or destroyed as a result of defective workmanship by the contractor.

AIR COOLED SCREW/ SCROLL CHILLING UNITS

1. GENERAL

The contractor shall furnish and install where indicated on plans air cooled Rotary Screw/ Scroll chilling units. Each unit shall be guaranteed by chilling unit manufacturer to produce a capacity of not less than specified tons of refrigeration at specified leaving water temperature with the temperature of ambient air entering the condenser not exceeding 113 degree F (45 degree C). The construction and rating of the chillers shall be in accordance with latest ARI standard 590 and shall comply with ANS. B 9.1 safety code, National Electrical code and ASME code. Necessary 3 ph, 50 Hz, 220/415 volts, A.C. Power supply shall be made available for all units.

2. CODES & STANDARDS

ASHRAE 15	Safety code for Mechanical refrigeration
ASHRAE 23	Methods of testing and rating positive displacement refrigerant compressors and condensing units
ASHRAE 30	Methods of testing liquid chilling packages
ASME SEC VIII DIV I	Boiler and pressure vessel code
ANSI B 31.5	Code for refrigeration piping
AHRI 550/590 (2003)	Standard for Air Cooled Screw chilling packages
AHRI 575	Standard for method of measuring machinery sound within an equipments space
ISO 1940	Mechanical vibration – Balance quality requirements of rigid rotors
ISO 10816-1	Mechanical vibration – Evaluation of machine vibration of measurements on non-rotating parts. General guidelines
TEMA – C/R	Heat Exchanger with acceptable deviation
ASTM: C591	Specification for Polyurethane/ Ployisocyanurate Foam

3. BASIC UNIT

Each unit shall consist in general of multiple semi hermetic screw/scroll compressors, air cooled condenser coils, DX/flooded type chiller, condenser fans, outer weather proof casing, automatic control panel and accessories.

3.1 Compressor (Screw)

- 3.1.1 Each unit shall have multiple rotary, double bolted hermetic screw compressor. The rotary screw shall be manufactured from forged steel with precision cast male and female profiles which are asymmetrical. The profile of screws shall permit safe operation up to a speed of 3000 RPM for 50 Hz operation. The compressor shall unload from fully loaded to the minimum capacity by means of hydraulically actuated slide valve positioned over both the male and female rotors.

The compressor housing shall be of high-grade cast iron, machined with precision, to provide a very close tolerance between the rotors and the housing.

The rotors shall be mounted on antifriction bearings designed to reduce friction and power input. There shall be multiple cylindrical bearings to handle the radial and axial loads.

There shall be built in oil reservoir to ensure full supply of lubricants to all bearings and a check valve to prevent back spin during shut down.

There shall be oil pump or other means of differential pressure inside the compressor for forced lubrication of all parts during startup, running and coasting for shut down. An oil sump header shall be provided in the casing.

The units shall be complete with automatic capacity control mechanism, by use of slide valve to permit modulation between 20% to 100% of capacity range.

3.2 Compressor (Scroll)

- i. Each unit shall have multiple hermetic Scroll compressors (Where scroll compressors are used).
- ii. The fixed and orbiting Scroll/Screw be made of high strength cast iron, allowing minimum thermal distortion and having maximum efficiency. The orbiting Scrolls shall touch in all the dimensions to provide a highly enclosed compressor chambers for maximum efficiency.
- iii. The compressor housing shall be of high grade cast iron, machined with precision, to provide a very close tolerance between the scrolls and the housing.
- iv. The rotors shall be mounted on plain bearings designed to reduce friction and power input.
- v. There shall be built in oil reservoir to ensure full supply of lubricants to all bearings and a check valve to prevent back spin during shut down.
- vi. There shall be oil pump or other means of forced lubrication of all parts during startup, running and coasting for shut down. An oil header shall be provided in the casing.
- vii. The compressor profile shall have provision to trap impurities and separate them.

4. COMPRESSOR MOTOR

- a. The driving motor shall be Hermetic squirrel cage type protected against damage by means of built in protection devices.

5. VARIABLE SPEED DRIVE

A variable speed drive shall be factory installed on the chiller and exactly same as per global catalogue. It shall vary the compressor motor speed by controlling the frequency and voltage of the electrical power to the motor. The adaptive capacity control logic shall automatically adjust motor speed and compressor pre-rotation vane position independently for maximum part-load efficiency by analyzing information fed to it by sensors located throughout the chiller.

Drive shall be PWM type utilizing IGBT's with a power factor of 0.95 or better at all loads and speeds. It must also employ harmonic filters to minimize current and voltage distortions.

The variable speed drive shall be unit mounted in a NEMA-1 enclosure with all power and control wiring between the drive and chiller factory installed, including power to the chiller oil pump. Field power wiring shall be a single point connection and electrical lugs for incoming power wiring shall be provided. The entire chiller package shall be UL listed.

The following features shall be provided : a door interlocked circuit breaker, capable of being padlocked; UL listed ground fault protection; over voltage and under voltage protection; 3 phase sensing motor over current protection; single phase protection; insensitive to phase rotation; over temperature protection; digital readout at the chiller unit control panel of:

- Output frequency
- Output voltage
- phase output current
- Input kilowatts (KW) and Kilowatt-hours (KWH)
- Self diagnostic service parameters

6. **DRIVE :**

The compressor shall be driven directly or through speed increasing gears as required. The gears and pinions shall be pressure lubricated. The gears shall be provided with oil filter and submerged oil pump. The gears should be of helical type with crown teeth designed such that more than one tooth is in contact at all times to provide even distribution of compressor load and quiet operation. Gears should be integrally assembled in the compressor rotor support and be film lubricated. Each gear should be individually mounted in its own journal and thrust bearings to isolate it from impeller and motor shafts.

7. **CONDENSER**

7.1 Condenser coil

The condenser coils shall be made of seamless copper tubes, integrally grooved type arranged in staggered rows and are mechanically expanded into super slit aluminum fins (the coil shall be circuited for sub cooling. The coil shall be minimum three rows deep with atleast 12 fins per inch) Or micro channel type, parallel flow aluminium alloy tubes metallurgically brazed as one piece to enhance aluminum fins. Condenser coil shall be post coated with an electro-deposited and baked flexible epoxy coating (E coat) i.e. finished with polyurethane UV resistant top coat suitable for highly corrosive applications.

7.2 Condenser fans

The units shall be furnished with necessary number of direct driven propeller type fans arranged for horizontal or vertical discharge. Condenser fan motor shall have class 'B' motor insulation, inherent protection device and shall be permanently lubricated type with resilient mounting. Each fan shall have a safety guard and shall have a low noise level.

8. **COOLER**

8.1 The cooler shall be direct expansion shell and tube type, with steel shell and seamless copper tubes. The refrigerant head shall be removable type. The tubes shall be supported in the shell by adequate stiff supports to eliminate vibrations and noise. The tube ends shall be fixed firmly into the tube sheets to prevent leakage of refrigerant gas.

8.2 The cooler shall be tested and stamped against leaks in accordance with ASME code for the refrigerant being used and otherwise tested and constructed in accordance with ASME or equivalent approved code requirements.

8.3 The cooler shall have a minimum of 2 independent direct expansion refrigerant circuits.

8.4 The cooler shall be factory insulated with 19 mm thick closed cell polyvinyl chloride and further protected by means of heater cables.

9. **CONTROLS**

9.1 All the controls shall be factory wired and located in a weather proof enclosure. These shall include fuses, selector switch, oil safety switch, high and low pressure cutouts, interlocks for crankcase heaters and inherent motor protection devices, fan control thermostat, recycling pump-down circuit, high discharge temperature cutout indicator lamps shall be provided for the compressor units.

9.2 Necessary starters for compressor motors and condenser fan motors shall be included and provided within the unit. The compressor & the condenser fans shall be electrically interlocked such that the compressor can run only when at least one of the condenser fans are running.

9.3 Air Chilling Machine Control System

The Air chilling unit shall be complete with microprocessor based type control system, which shall have the following features:-

Electric expansion valve for economic operation of the system

9.3.1 Self-diagnostic capability to locate faults and give early warning.

9.3.2 Leaving chilled water temperature control and reset capability, with provision to accept over ride commands from a central BMS system.

9.3.3 Automatic sequencing of various functions for starting, running and stopping of the various components of the unit based on demand.

9.3.4 A programmable microprocessor complete with key pad and LED display window to perform the above functions.

9.4 The control package shall also consist of, but not limited to, the following components:

9.4.1 Low control voltage to unit.

9.4.2 Field power and control circuit terminal blocks.

9.4.3 ON/OFF switch.

9.4.4 Replaceable relay board.

9.4.5 Leaving chilled water set point board.

9.4.6 Diagnostic digital display module.

9.4.7 Microprocessor board.

Temperature reset board.

9.5 The control system shall have an extended module for control and monitoring from a central BMS including the reset of chilled water temperature, ON/OFF / Fault etc.

10. REFRIGERANT CIRCUIT

The refrigerant piping between compressors, chiller and condenser shall be of heavy gauge copper with brazed joints. The circuit shall include sight glass, moisture indicator, solenoid valves, electronic expansion valves, filter driers and necessary shut off valves with charging connections.

11. UNIT CASING

All the above components shall be housed in an outer casing fabricated from galvanized steel, zinc phosphate with multiple coats of baked enamel paint to make the whole casing weather proof for outdoor installation. Removable panels shall be provided for access to all working parts.

12. AHRI/ EUROVENT CERTIFICATION, IF APPLICABLE or as mentioned in DBR.

The chilling unit shall be AHRI certified as per AHRI 550 / 590 – 2003 STANDARD. All suppliers shall furnish computer printouts along with their technical bids, giving details of capacity output at design conditions as given in tender.

13. MISCELLANEOUS

Each system shall be provided with the following:-

- 13.1 Necessary charge of refrigerant gas and lubricating oil.
- 13.2 Spring vibration isolators below the unit rated by the isolator manufacturers to absorb 90% of unit vibration and as approved by the engineer.
- 13.3 Dial type thermometers and pressure gauges for the inlet and outlet of the chilled water lines. (Priced Separately).
- 13.4 Flexible connectors between chilled water lines and cooler inlet and outlet.
- 13.5 Water flow switch at the outlet of chilling unit (Priced separately).
- 13.6 Butterfly valve at the outlet and balancing valve at the inlet of the chillers (Priced separately).

14. Fouling Factor:

The fouling factor for the cooler shall be not more than 0.0005 (FPS units).

TITLE AIR COOLED CHILLER PACKAGE – DATA SHEET A		
S.No.	Description	Requirement
1.	Number Required	As per DBR
2.	Location	As per DBR
3.	Duty:- Continuous	(18 hrs. /day) (Approximate)
4.	Capacity required at specified design conditions per chilling package	As per DBR
5.	Refrigerant	R134a / R410a
6.	Maximum noise level at a distance of 1.5 meters	80 dBA
7.	Compressor – type & No. of compressor per chiller	Semi-hermetic/hermetic
8.	Lubrication	Forced feed with an oil pump / differential pressure
9.	Capacity control	Automatic in stages
10.	Static and dynamic balancing of screws	As per ISO 1940
11.	EVAPORATOR	
	12.1 Type	Shell and tube, flooded/DX
	12.2 Liquid to be cooled	Water
	12.3 Chilled water quality	Potable water
	12.4 Chilled water inlet temperature	54 Deg.F
	12.5 Chilled water outlet temperature	44 Deg.F
	12.6 Minimum chilled water flow per chilling package	As per DBR
	12.7 Fouling factor-water side (FPS unit)	0.0005
	12.8 Chiller and suction line insulation	Closed cell polyvinyl chloride foam
	12.9 Maximum water side pressure drop	As per DBR
12.	CONDENSER	
	13.1 Type	Air cooled
13.	Motor	415 V +/- 10 %, 3 phase, 50 Hz
14.	Control Panel	Microprocessor based control panel
15.	Control panel to be interfaced with building automation system	Provision to be available
16.	Type of starter	Star Delta- Closed transition

		type
17.	Type of Fan	Dual Speed / With VSD

CHILLER PACKAGE -DETAILS TO BE FURNISHED BY TENDERER ALONG WITH OFFER		- DATA SHEET B
S.No	Description	Tenderer To Furnish
1.0	Air Cooled Chilling Unit	
	General Data	
1.1	Number of chillers	
1.2	Location	
1.3	Make and country of origin	
1.4	Model number and year of introduction model	
1.5	Detailed list of installations of that model in India	
2.0	Operating Parameters	
2.1	Minimum refrigeration capacity (TR)	
2.2	Minimum chilled water flow rate (USGPM)	
2.3	Maximum chiller pressure drop (Feet of water)	
2.4	Entering chilled water temperature (deg F)	
2.5	Leaving chilled water temperature (deg F)	
2.6	Evaporating temperature (deg F)	
2.7	Fouling factor for chiller	
2.8	KW/TR at full load conditions	
2.9	Entering Air temperature (deg F)	
2.10	Leaving Air temperature (deg F)	
3.0	Compressor	
3.1	Manufacturer	
3.2	Model	
3.3	Type of compressor	
3.4	Speed (operating)	

	3.5	Speed (maximum)	
	3.6	Refrigerant used	
4.0		Evaporator	
	4.1	Manufacturer	
	4.2	Model (No)	
	4.3	Shell dia. (mm)	
	4.4	Tube length (m)	
	4.5	No of tubes (No.)	
	4.6	Material of tubes (Name)	
	4.7	Dia. of tubes (mm)	
	4.8	No of integral fins / cm (No.)	
	4.9	No of refrigerant circuits (No.)	
	4.10	No of water passes (No.)	
5.0		Compressor Motor	
	5.1	Manufacturer	
	5.2	Type	
	5.3	Motor Voltage	
	5.4	Rated output	
	5.5	Power characteristics	
	5.6	No of Motors	
6.0		Starter for Compressor Motor	
	6.1	Manufacturer	
	6.2	Type of starter	
7.0		Miscellaneous Details	
	7.1	Type of capacity control	
	7.2	Noise level of chiller (in dBA) at 1.5 m distance	
	7.3	Equipments size (LXBXH)	
	7.4	Equipments operating weight (kg) / pounds	

	7.5	Full refrigerant charge quantity	
8.0		Documents to be furnished with bid.	
	8.1	Computerized printout (certified) from chiller manufacturer indicating power consumption in IKW/TR at full load and various part load conditions as per AHRI format	
	8.2	Catalogues furnishing detailed technical data for compressor, evaporator, condenser, microprocessor or micro-computer control panel etc.	

Technical details of CHILLED WATER AND HOT WATER PUMP:

Pumps should be as per IS:1520-1660, IS:9079,IS:325 and should be Horizontal Split Casing/Monoblock Type/Vertical inline pump to suit duty. Pump should meet the following construction specification:

S. No.	Description	Specification
1.	Casing	: Cast Iron as per IS :210; grade FG260
2.	Impeller	: Bronze as per IS : 318;
3.	Impeller ring	: Bronze
4.	Shaft	: High Tensile steel -EN8 or SS 410
5.	Shaft sleeve	: Stainless steel or Bronze
6.	Bearings	: Heavy duty Ball/Roller Bearings.
7.	Base Plate	: Cast Iron
8.	Flanges	: Conforming to I.S.1536/1960
9.	Seal	: Mechanical
10.	Max. Speed	: 1500 RPM
11.	Driver/Motor	: TEFC Squirrel Cage Induction Motor
12.	Pump duty	: As per requirement
13.	Power supply	: 415 V +/- 10%, 50 Hz, 3Ph

Impeller should be made in one piece and securely keyed to the shaft. Measures to prevent loosening during operation including rotation in the reverse direction should be provided. The critical speed of the pump should be at least 30% above the rated speed. All the pumps should be provided with mechanical seals. Common base plate should be provided for pump and motor. Suitable holes should be provided for grouting and these should be so located that the base can be grouted in place without disturbing the pump and the motor. Adequate space should be provided between pump drain connection and base plate for installation of minimum 15mm dia. drain piping. Foundation bolts should be complete with nuts and washers. The contractor should select driver rating at least 15% in excess of the maximum B.H.P of the pump plus transmission losses if any. Drivers should be supplied with starters unless otherwise stated. Pump and driver should be mounted on a single bed-plate and directly driven through flexible coupling in case of horizontal split casing pumps.

The following accessories should be provided with each pump among other standard accessories:

- Coupling guard for horizontal split casing pumps.
- Lubrication fittings and seal piping.
- Test and/or air vent cocks.
- Pressure gages for pump inlet and outlet

1.1 Technical details of DOUBLE SKINNED AIR HANDLING UNITS

1.1.1 CASING

Double skin panels (each not exceeding 750 mm wide) should be made of 0.60mm pre-plasticized coated Galvanized sheet steel and 0.60mm galvanized sheet inside with minimum 43 mm thick P.U. insulation of 38 Kg/Cu.M injected between the panels.

The panels should be bolted from inside on to the framework with neoprene/soft rubber gasket in between to make the joints airtight. Suitable doors with powder coated hinges and latches should be provided for access to various panels for maintenance.

The Fan and the motor arrangement should be mounted on to the extruded aluminum framework. The entire housing i.e. The Air Handling Unit should be mounted on GI Base channel framework.

Drain pan should be constructed of 18 gauge SS sheet with 25 mm thick 38 Kg/Cu.M. nitrile foam insulation. The K-value should not be more than 0.014 Kcal/hr-sq.mtr-°C/M at 10°C mean temperature.

The pan should have necessary slope to facilitate for fast removal of condensate. The coil should be mounted on the rollers in order to facilitate easy removal of the coil from the drain pan for cleaning. Outlet should be provided on both the sides of drain pan.

a. MIXING BOX

AHU's requiring mixing boxes for re-circulatory units shall be complete with fresh and return air dampers.

b. DAMPER

Dampers shall be opposed to blade type. Blades shall be made of double skinned aerofoil aluminium sections with integral gasket and assembled within a rigid extruded aluminium alloy frame. All linkages and supporting spindles shall be made of aluminium or nylon, turning in Teflon bushes. Manual dampers shall be provided with a Bakelite knob for locking the damper blades in position.

Linkages shall be extended wherever specified for motorised operation. Damper frames shall be sectionalised to minimise blade warping. Air leakage through dampers when in the closed position shall not exceed 1.5% of the maximum design air volume flow rate at the maximum design air total pressure.

c. MOTOR AND DRIVE

Fan motors shall be energy efficient (IE-3) and shall be $415 \pm 10\%$ volts, 50 cycles, three phase, totally enclosed fan-cooled class F, with IP-55 protection. Motors shall be especially designed for quiet operation and motor speed shall not exceed 1440 rpm. Drive to fan shall be provided through belt-drive arrangement. Belts shall be of the oil-resistant type.

d. FAN

Fans shall be centrifugal type. Fans driven by variable frequency drive shall be backward inclined irrespective of static pressure value. Fan casing shall be made of galvanised steel sheet. Fan wheels shall be made of galvanised steel. Fan shaft shall be grounded C40 carbon steel and supported in self-aligning Plummer block operating less than 75% of first critical speed, grease lubricated bearings. Fan wheels and pulleys shall be individually tested and precision balanced dynamically. Fan motor assembly shall be statically and dynamically balanced to G6.3 grade as per relevant ISO/AMCA standard. Computerized fan selection print outs shall be submitted along with the offer.

Motors shall be mounted inside the AHU casing on slide rails for easy belt tensioning, and be totally enclosed, EFF1 fan cooled, to be class 'F' insulation. Motors shall drive heavy duty V-belt, constant pitch, drive selected at 110% of motor horsepower. Both fan and motors assemblies shall be mounted on a deep section aluminium alloy or galvanized steel (depending on size) base frame.

Combination spring and rubber anti vibration mounts shall be provided for isolating the unit casing. Frame retardant, waterproof silicone rubber impregnated flexible connection shall be provided at the fan discharge.

e. COOLING & HEATING COILS

Chilled & Hot water coils shall have 12.5mm (1/2") to 15mm (5/8") dia. tubes minimum 0.5 mm thick with aluminium fins firmly bonded to copper tubes assembled in a zinc coated steel frame. Face and surface areas shall be such as to ensure rated capacity from each unit and such that the air velocity across each coil shall not exceed 150 meters per minute. The coil shall be pitched in the unit casing for proper drainage. Each coil shall be factory tested at 21 Kg./Sq.cm air pressure under water. Tube shall be hydraulically/mechanically expanded for minimum thermal contact resistance with fins. Fins spacing shall be 11 to 13 fins per inch (4 to 5 fins per centimetre). The cooling coils

shall be ARI certified

f. FILTER SECTION

Each unit shall be provided with a factory assembled filter section containing washable synthetic type air filters having anodised aluminium frame. The filter shall have minimum 90% efficiency down to 10 microns. The media shall be supported with HDPE mesh on one side and aluminium mesh on other side. Filter banks shall be easily accessible and designed for easy withdrawal and renewal of filter cells. Filter framework shall be fully sealed and constructed from aluminium alloy. Wherever required, separate sections for Fine Filters shall be provided in the AHU.

g. VIBRATION ISOLATORS

Vibration isolators shall be provided with all air handling units. The fan and motor framework shall be isolated from the AHU framework by means of spring type vibration isolators. The AHU shall be mounted on PCC blocks/frames suitable for the weight of the AHU. The framework of the AHU and the PCC blocks/frame shall be isolated by means of neoprene mats of size 150mmx150mm in two layers with 20g G.S.S. sheet sandwiched in between.

h. ACCESSORIES

Each air handling unit shall be complete with the accessories including but not restricted to the following.

- Insulated isolation valves, Y-strainer, header drain valves, unions and insulated condensate drain piping upto sump or floor drain in air handling unit room / nearest point.
 - Manual air vents at high points in the cooling coil and drain plug in the bottom of the coil.
 - Thermometers in thermometer wells and pressure gauges in test points in chilled water supply and return lines.
- i. Double skinned panels shall be 40+/-2 mm with thermal break profile, shall be made of 0.8mm Pre-plasticized Aluminium on outside and 1.0mm Aluminium sheet inside with Puf insulation of 42 (+/-5%) kg/Cu M. Outer sheet of panels shall be made of galvanized pre-coated sheet of 0.8 mm thickness. fan section with backward/ forward curve centrifugal fan and motor suitable for 415+/-10%, 50 Hz, IE-3 motor, three phase, totally enclosed fan- cooled class F, with IP-55 protection. Coil section with copper tube cooling coil with aluminium fins & 18 G SS drain tray, filter section with Cleanable approach. Pre-filter (EU-4) 90% down to 10 microne with extruded aluminium frame, Fine filter (EU-7) 99% to 3 microne with extruded aluminium frame, Fine filter shall be after fan discharge .filter shall be sized maximum face velocity of 2.5m/s. Coil size shall be selected for maximum face velocity of 2.5m/s, Maximum fan outlet velocity shall be 10m/s. AHU shall have a LED lamp with a limit switch for the maintenance. Sound level at 1m distance shall be less than 60 dBA. AHUs shall be suitable for outdoor installation.

1.2 Technical details of ELECTRIC HOT WATER GENERATOR

- 1.2.1 The shell of the generator should be vertical / horizontal, shell type, designed, constructed, and tested for the specified water flow rates and temperatures. The hot water generator should be suitable for Indoor / Outdoor application (exposed to sky)
- 1.2.2 The shell of the generator should be made 10mm M.S steel sheet and dish of 12mmM.S steel sheet with electric fusion welded seams. In accordance with ASME section 4/unfired pressure Vessel code IS 2825
- 1.2.3 Electric heaters should be provided in banks of equal capacity distributed over three power phase, heaters should be mounted within seamless copper/Incoloy sheathed electrically

resistant U-tubes floor mounted with EPDM Rubber and S.S steel with magnesium anode for Longevity and easy maintenance of heaters. The heaters should be easily removable externally, without opening terminal plate or disturbing other components. Heaters should be suitable for $415 \pm 10\%$ volts, 50 cycles, three phase AC supply and should be in direct contact with water contained in shell.

- 1.2.4 The hot water generator should be provided with following accessories.
- Inter locking of electric panel cover with incoming switch / limit switch.
 - Flow switch, automatic alarm for low water level and reset type high temperature switch with respective indication lights.
 - Drain point with GM valve and Descaling point with GM valve.
 - Automatic airvent and automatic high temperature pressure relief valve.
 - Step control thermostat for individual heaters bank/Master safety thermostat.
 - Temperature indicator, ammeter/voltmeter
 - Flanges for water pipe connections.
- 1.2.5 The shell should be tested in the factory upto two times the working pressure as specified by head of water column in tender or 21 kg/sq. cm. gauge whichever is higher.
- 1.2.6 The shell should be insulated with 50mm thick resin bonded fiberglass wool insulation and covered with 26 SWG aluminium cladding.
- 1.2.7 The electric control cabinet should be provided and mounted directly on main frame. All controls and terminals should be factory wired and tested. The control cabinet should consist of following major controls of rated capacities:
- Incoming S.F.U / M.C.C.B
 - ON / OFF Rotary switch for individual banks with light.
 - SCR with MCB for individual heaters.
 - Indicating lights for ON status for individual banks.
 - Fault indicating lights.
 - Alarm with manual reset.
 - Cabling and control wiring.
 - Three phase ammeter and voltmeter with selector switches.
 - Control cabinet should be BMS compatible.

The control cabinet door should be openable only after switching off the incoming power supply.

1.3 Technical details and specifications for CHILLED AND HOT WATER PIPING

- 1.3.1 Following material should be used for pipes and fittings.

Pipes Nominal size (mm)

IS 1239 Part-1 (Mild steel medium class (Black steel) tube)

IS 3589 Gr. FE 48 (6mm thick ≤ 300 NB, 8mm thick > 300 NB & ≤ 600 NB, 10mm thick above 600 NB) (welded black steel pipe, class 2)

Fittings Nominal size (mm)

Material Specification ≤ 40 Socket welded, ASTM A85 as per ANSI B16.9

50-150 But welded, ASTM A234 Gr. WPB as per ANSI B16.9 ≥ 200
Site fabricated from IS 3589 Gr. FE 48 (6mm)

Flanges Nominal size (mm)

Material Specification ≤ 150 ASTM A85 as per ANSI B16.5 (#150 class) ≥ 200

All jointing in the pipe system should generally be by welding, unless otherwise mentioned, or

directed at site. All welding should be done by qualified welders and should strictly conform to BIS Code of practice for manual metal arc, welding of Mild Steel.

Spacing of pipe supports should not exceed the following:

Pipe size

Upto 12 mm

15 to 25 mm

30 to 150 mm

1.3.2 Over 150 mm 2.5 meter

1.3.3 All welded joints (except pipe welded end-to-end) should be made by use of one-piece welding flanges, caps, nozzles, elbows, branch outlets and tees of approved make. Cut samples should be submitted for approval, if directed. All such fittings etc., should be of a type which maintain full wall-thickness at all points, simple radius and fillets, and proper bevels or shoulders at ends. All job welding should be done by the electric arc welding process in accordance with the following:

- All joints should have 45-degree bevel type, pipe mill-bevelled or machine-bevelled by the contractor.
- All scale and oxide should be removed with hammer, chisel or file and bevel left smooth and clean.

1.3.4 All pipes and their steel supports should be thoroughly cleaned and given one primary coat of red oxide paint before being installed. For vibration isolators remolded polyurethane pipe sections of 160 Kg/m³ density with adhesive should be fixed between pipe and MS support. 8 mm thick MS 'U' clamp with resistoflex should be fixed on the pipe so that the pipe is kept in position.

1.3.5 Ball and butterfly valves conforming to the following specifications should be provided as per approved Drawings:

Size Construction EndsType

15 to 40 mm Brass

ASTM B6250 mm and over Body Cast iron, Wafer ButterflyValves should have non-rising spindles unless specified otherwise and should be suitable for PN 10/ PN 16 rating.

1.3.6 BUTTERFLY VALVES

Butterfly valves should perform the function of isolating valves. Butterfly valves should have cast iron body with black nitrile rubber seat and should be suitable for PN 10/ PN 16 rating as indicated in the schedule of quantities. All butterfly valves should be provided with locking devices. Valves 250 mm and above diashould be gear driven.

Butterfly/Ball valves should be provided at

- i. Suction and delivery side of pumps.
- ii. Inlet and outlet of each condenser, chiller & cooling towers.
- iii. Inlet and outlet of AHU, FCU, TFA etc.
- iv. All drain connection from equipment

1.3.7 BALANCING VALVES

Manual double regulating balancing valves should be provided at chiller, condenser, various tap-offs and each AHU outlet line.

The valves should have built-in pressure-drop measuring facility to compute flow rate across the valve. The test cocks should be long enough to protrude out of pipe insulation.

1.3.8 All ball valves and ball valves with Y strainers should be bronze forged body construction with chrome plated bronze ball and handle of stainless-steel constructions.

1.3.9 NON RETURN VALVES

Nonreturn valves should be dual plate check valve conforming to relevant Codes and in accordance with the following specifications:

Size

50 to 150 mm Body cast iron, Flanged gun metal plate.

200 mm to 450 mm Body cast iron, plate Flanged carbon steel with 11% chrome overlay.

The spring and hinge/stop pin should be SS304 and bearing PTFE material. Valves should be PN 10/PN 16 rating.

1.3.10 Y-STRAINER

The Y-strainer should be fabricated out of MS 'C' class pipe two size higher than that of strainer pipe size. Flanges as per BS 10 should be provided at inlet & outlet of connections. The body should be pressure tested at 10 Kg/Sq. cm and should be hot dip galvanized. Permanent magnet should be provided in the body of the strainer to arrest MS particles. Filter element should be of nonmagnetic 20-gauge SS sheet with 3 mm perforation. Strainers should be provided at inlet of each AHU & chilled water pumps. It should be easily removable when required to be cleaned. Isolating butterfly valves at either end of the strainer should be provided.

1.3.11 Flanges should be of PN 10/PN 16 rating. Flanges should be provided with bolts, washers, nuts and suitable rubber insertion gaskets (minimum 5 mm thick)

1.3.12 All piping work should be carried out as per ASHRAE Standards and in a workman like manner, causing no or minimum disturbance to the existing services, buildings and structure.

1.4 Technical details of the SHEET METAL DUCT WORK, DAMPERS AND TERMINAL OUTLETS

1.4.1 All the supply and exhaust duct work within containment area/barrier (i.e. from Supply air HEPA Containment housing to BSL-3 Lab containment area and from BSL-3 Lab containment area up to Exhaust Air HEPA Containment Housing) should be done in 24/26 swg stainless steel 304 sheet. Duct fabrication should be done as per SMACNA and should pass pressure decay testing under SMACNA Standard 126-2020.

Suitable provision should be provided in containment area ducting to enable gaseous decontamination of potentially contaminated duct line using VHP/Formalin etc.

Ducting in non-containment area should be constructed out of best quality cold annealed, Class VIII flat galvanized sheet steel (galvanized to specifications of IS : 277 (latest edition). The grade of coat for GS sheet should be 120 gm / sq m (table 2 of IS 277-1992). The joints should be finished straight and neat. The duct work should be supported / secured from roof slab or any other building member using angles, rods as may be required.

Thickness of sheets should be as shown in the tables given below:

Maximum size of Rectangular Duct (in m)	Round Duct dia (mm)	Thickness of GS Sheet in mm
Upto 750	Upto 600	0.63 (24 G)
751 to 1500	601 to 750	0.80 (22 G)
1501 to 2250	750 to 900	1.00 (20G)
2251 & above	901 & above	1.25 (18 G)

The fabrication of duct should be done as per IS : 655 (latest edition). Transverse joints, connections, bracing, seam etc. should be as per IS : 655. All the ducts over 300 mm in either dimension should be cross braced except those on which rigid board insulation is applied. Stiffening angles should be black structural steel and riveted to the duct work. The longitudinal seam on all ducts may be Pittsburgh seam hooked and hammered. Ducts of size 600 mm and above should be

reinforced between the joints. Where drive-slips are used, angles should be riveted to the ducts 50mm from slips.

- 1.4.2 Simple elbows, transformation sections should be formed with Pittsburg corner seams. Complicated fittings should be constructed with double corners. Elbows, bends and offset pieces should have a center line radius of not less than 1.5 times the radial of width of the duct. Turning vanes should be provided at required spacing such that the aspect ratio of each individual elbow formed by vanes should not be more.
- 1.4.3 Dampers should be provided in the duct work for proper control and balancing of air distribution. Dampers should have easily accessible operating mechanism. The operating mechanism should consist of links, levers and quadrants as required for proper control and setting in a desired position. The position of the handle of Damper operating mechanism should be clearly visible and it should indicate the position of the damper in duct. Dampers, splitters, and their operating mechanism should be fabricated of GS sheet of two gauges heavier than duct piece having these fittings and should be easily accessible through suitable access doors in the ducts.

1.5 Technical details of CENTRIFUGAL FANS FOR LABORATORY EXHAUST

Details and technical requirements are as under:

- 1.5.1 Fans, Aero foil, forward or backward curved, SISW or DIDW, should be licensed to bear the AMCA Air and Sound Certified Ratings Seal. The test standard used should be ANSI/AMCA 210-85, ANSI/ASHRAE Standard 51-1985 "Laboratory Method of Testing Fans for Rating" and AMCA 300 "Reverberant Room Method for Sound Testing of fans".
- 1.5.2 All fans should be dynamically trim-balanced to ISO1940 and AMCA 204/3 - G2.5 quality grade after assembly. A computer printout with vibration spectrum analysis should be attached to the fans.
- 1.5.3 Fan should be of G.S.S. , the Steel sheet should be JFE Galvazinc (Base metal cold rolled), JIS G3302, SGCC with Z22 (minimum coating weight on both sides @ 220 g/m²) zinc coating & Zero Spangle, skinpassed, chromated and dry.
- 1.5.4 Fans housing should be of an appropriate thickness to prevent vibration and drumming. The fan scroll should be attached to the side plate by means of continuous lock seam or intermittent spot welding. The wheel and inlet cone should be aerodynamically designed and constructed to provide maximum performance and efficiency as published by the manufacturer.
- 1.5.5 Fans must be physically capable of operating safely at every point of rating at or below the "minimum performance" limit for that class as defined in AMCA standard 99-2408-69 "Performance Class of Operating Limits for Centrifugal Fans".
- 1.5.6 Shafts sizes should be carefully calculated and designed such that the maximum operating speed (RPM) should not exceed 75% of the first critical speed. For any application that is not a standard product from catalogue of the fan manufacturer detailed calculation of critical speed characteristic should be submitted for approval.
- 1.5.7 Shafts should be made of carbon steel (C45) machined and polished to tolerance of standard ISO 286-2 - grade g6. Protective coat of anti-rusting should be applied to all bare surfaces of the shafts at the factory.
- 1.5.8 Bearings should be of self-alignment (concentric) type with adaptor sleeve bearing. Bearings of eccentric locking collar with grub screw type are not acceptable. Bearings should be maintenance free with permanently lubricated sealed ball bearing type. Bearing life should be at least 75,000 hours based on basic rating life, L10 of ISO 281 standard. Calculation sheet of Bearing Life should be submitted for approval.
- 1.5.9 Blower Motor should be of a minimum 130% of the fan power absorbed (Brake horsepower) and should have sufficient torque available for starting and continuous operation. Blower motor should be provided with Variable Frequency Drive (VFD) and should be controlled through the BMS. Blower motors should be energy efficient (IE-3) and should be 415±10% volts, 50 cycles, three phase, totally enclosed fan-cooled class F, with IP-55 protection. Motors should be especially

designed for quiet operation and motor speed should not exceed 1440 rpm. Drive to fan should be provided through belt-drive arrangement.

- 1.5.10 Belts and pulleys should be sized for a minimum 150% of the installed motor horsepower. The belt speed should not exceed 30m/s. The pulley should be of Taper Lock SPZ, SPA, SPB or SPC type. Conventional type of pulley is not acceptable. Both fan and motor pulley should be balanced to the quality grade G.2.5.
- 1.5.11 Fan outlet velocity should not exceed 10% of the main duct air velocity designed (0.1" per 100 ft or 1 Pascal per meter duct length). Pressure Loss is as referred to in SMACNA Standard.
- 1.5.12 Fan should be selected at 20% higher capacity of design requirement.

1.6 Technical details of DUCTING AND PIPING INSULATION

- 1.6.1 Thermal insulation material for Duct & Pipe insulation should be closed cell Aluminum faced Elastomeric Nitrile Rubber. The duct insulation should have self- adhesive backing with a peel-off cover for easy installation at site. Thermal conductivity of the insulation material should not exceed 0.038 W/moK or 0.212 BTU / (Hr-ft²-°F/inch) at an average temperature of 30°C. Density of the nitrile rubber should be 40-60 Kg/m³. The product should have temperature range of -40 °C to 105°C. The insulation material should be fire rated for Class 0 as per BS 476 Part 6 : 1989 for fire propagation test and for Class 1 as per BS 476 Part 7, 1987 for surface spread of flame test. Water vapour permeability should be not less than 0.024 per inch (2.48 x 10⁻¹⁴ Kg/m.s.Pa i.e. $\mu > 7000$: Water vapour diffusion resistance).
- 1.6.2 The insulation thickness for duct work should be as follows:
 - a) Supply Air duct- 19 mm
 - b) Return/exhaust Air duct - 13 mm
 - c) Chilled water and hot water piping – 25 mm
- 1.6.3 Before applying insulation, all pipe work and fittings should be brushed and cleaned, and dust, dirt, mortar and oil removed.

Insulation should be applied only after the piping system has been satisfactorily tested for leaks at 1.5 times the working pressure or at minimum 10 kg/sq.cm. test pressure. Piping Insulation should be covered with 26-gauge aluminum sheet cladding and finished in neat and clean manner so as to achieve true surface. All longitudinal and transverse joints in the outer cladding should have a minimum overlap of 50 mm duly beaded and grooved and should be sealed.

1.7 FILTERS

j. PRE-FILTERS

Air flow	As required for specific system
Frame	Aluminum anodised, cassette type made of 2.00 mm thick sheet
Medium	Polypropylene non-woven supported by anodised aluminium mesh on one side HDP mesh on other side, 11 folds per feet of face area
Sealing of media	By means of ductile epoxy resin
Efficiency	90 % down to 10 micron particle size (minimum)
I.P.D.	<3mm wg at rated cfm
F.P.D.	6 mm wg (maximum)
Thickness	50mm
Filter face velocity	500FPM (maximum)

k. MICRO VEE (FINE FILTER)

AIR FLOW	As required for specific system
----------	---------------------------------

FRAME	Aluminum anodised, flanged type made of 2 mm sheet
Medium	Polypropylene non woven supported by anodisedaluminium mesh on one side HDP mesh on other side 11 folds per feet of face area
Sealing of media	By means of ductile epoxy resin
Efficiency	99.9 % down to 5 micron particle size (minimum)
I.P.D.	<8mm wg at rated cfm
F.P.D.	15 mm wg
Thickness	305mm or as specified in schedule of quantities Filter face
velocity	500 FPM (maximum) for 305 mm thick
Gaskets	Rubber gasket on flange.
Packing in carton box.	Each filter shall be packed in a polythene bag and then placed

I. HEPA FILTER (ABSOLUTE)

AIR FLOW	As required for specific system
FRAME	Aluminum anodised, flanged type made of 18G sheet
Medium	Micro Fibre glass paper,Borosilicate. Sealing of mediaBy means of ductile epoxy resin
Efficiency	99.97 % down to 0.3 micron particle size (minimum)
I.P.D.	<15mm wg at rated cfm
F.P.D.	40 mm wg
Separators	Corrugated aluminium
Thickness	305 mm or as specified in schedule of quantities Filter face
velocity	500 FPM (maximum) for 305 mm thickness
Gaskets	Rubber gasket, 6 mm thick to be fixed on flange and sealed on internal edges with epoxy resin.
Packing	Each filter shall be packed in a polythene bag with either face protected by flat hard board/ ply. Assembly to be packed in strong cardboard cartons printed with handling and opening instructions.

m. HEPA FILTER CONTAINMENT HOUSING

The HEPA Filter Containment Housing shall be made in SS 304 (14 gauge) with air tight and leak proof construction. All joints shall be seamlessly welded, buffed and polished. The HEPA Containment Housing shall have provision to carry out on site HEPA filter scanning, testing and validation, magnehelic gauge to monitor pressure drop across the HEPA filter, fumigation ports to allow IN-SITU decontamination of HEPA filters and Bag-In- Bag-Out facility for filter change.

Each containment housing shall have the following features:

1. **Differential Pressure Ports** – Differential pressure ports along with Magnehelic Gauge to monitor the pressure across upstream and downstream of HEPA filter
2. **Aerosol Injection Port** – Port for injecting aerosol at upstream side and downstream side of HEPA filter
3. **Manual Scanning** – A scanning facility towards HEPA Filter downstream side for manual scanning and testing of filter

4. **Bag In-Bag Out** – Bag in-Bag Out facility for filter replacement
5. **Isolation dampers** – Bubble tight Isolation dampers at Containment Housing inlet and outlet, leak tested to ensure a 'bubble tight' seal at a differential pressure of 10 inches water gauge.
6. Components like doors, filter locking and seal arrangements shall be in SS 304.

Each Containment Housing shall be factory assembled and shall be factory tested in accordance with ANSI/ANSE-N510-1995 at +/- 1000 Pa pressure.

AIR-CONDITIONING VARIABLE REFRIGERANT FLOW/ VARIABLE REFRIGERANT VOLUME

- The scope of this section comprises the supply, erection, testing and commissioning of VRV/VRF System 160 HP (Minimum) for NCDC Branch Center Building & VRV/VRF System 192 HP (Minimum) for BSL-3 Laboratory Building.
- Supply of 415v - 3 Ph - 50 Hz Top Discharge type all inverter Variable Refrigerant Flow system, each Outdoor unit comprises of All Inverter Scroll Compressors, with Heating / Cooling mode, air cooled condenser with protective coated fins, Propeller type Fan with motor, electronic expansion valve, refrigerant cooled PCB, wide voltage range will be preferred, Outdoor mounting frame, microprocessor panel and other standard accessories as per specification. The unit shall be suitable for operation with R-410a refrigerant.

1.0 4-WAY CASSETTE UNIT

- Supply of variable refrigerant flow 220-240v / 1ph / 50 Hz 4-Way cassettes units comprising of coil, filter, drain pump & fan with all related accessories. The unit shall be ceiling mounted type.

2.0 HI-WALL UNIT

- Supply of 220-240v / 1ph / 50 Hz Inverter type Hi-Wall units comprising of coil, filter, fan & drain pump. The unit shall be Mounted type and complete with all standard accessories.

3.0 TFA UNIT-FLOOR MOUNTED

- Supply of factory-built ceiling suspended/floor mounted double skin draw through type Treated fresh air Unit (100% fresh air) with filter section, coil section, fan section, made of extruded Al section frame structure of 50 ± 2 mm thick panels consisting of GI casing of thickness 0.6mm outside layer and 0.6mm plain GI sheet inside layer with polyurethane foam (PUF) insulation of density 40 ± 2 Kg/cum factory injected between them by injection moulding machine. Thermal break profile has to be considered.
- Pre-filter section with Pre filter non-woven synthetic media washable type of 90% down efficiency to 10microne. Filter face velocity shall be limited to 500 FPM maximum.
- Fine filter section complete with fine filters. Velocity across fine filters shall not exceed 500 FPM. Filters shall have efficiency not less than 95% down to 1 Microns (EU-8/MERV-14). Filter material shall be noncombustible type.
- Cooling coil section shall be of face velocity limited to 500 FPM maximum, Coil shall be of 6 / 8 row DX cooling coil with aluminium finned copper tubes (tube thickness not less than 0.43mm & 12-13 Fins /Inch). Coil section provided with 18g stainless steel drain pan on top and bottom complete with 19 mm thick closed cell class- O nitrile insulation, the drain pan shall be a minimum of 25 mm deep. Drain outlet shall be of SS 25mm dia. Fan discharge shall be of fire retardant canvas connection and necessary vibration isolation arrangement.
- Fan section shall be of Double skin Horizontal Draw through type with backward/ forward curve centrifugal fan and motor shall be TEFC drive motor (IE3 and VFD compatible) suitable for $415 \pm 10\%$ volts, 50 Hz, 3 phase, fan outlet velocity not more than 1870 FPM. LED lamp with a limit switch also provided for the maintenance
- The static pressure will be confirmed after calculating of HVAC approved duct layout.

4.0 CENTRALIZED CONTROLLER

Supply of main Intelligent Touch Manager with plus adapter as per specifications to hook up indoor units as mentioned above IDU Units. Controller shall however, be suitable for minimum 128 groups of indoor units. Centralized controller shall act as master controller for controlling of cooling & heating mode of outdoor units and their associated indoor units. Controller shall be suitable of Remote Access with computer and shall have web access. Controller shall be

suitable to auto sequence the outdoor as well as indoor units catering to 24x7 operated areas as required. Controller shall be suitable to configure the inside temperature as per temperature set point on controller, monitoring & reports generation, control for air flow settings, zonal control. Controller shall have time scheduling arrangement for Indoor Units as well as Outdoor Units. Controller shall be BMS Compatible with Modbus RS 485 communication protocol.

5.0 VENTILATION FANS

a. CENTRIFUGAL FANS

- Fans, Aerofoil, forward or backward curved, SISW or DIDW, shall be licensed to bear the AMCA Air and Sound Certified Ratings Seal. The test standard used shall be ANSI/AMCA 210-85, ANSI/ASHRAE Standard 51-1985 "Laboratory Method of Testing Fans for Rating" and AMCA 300 "Reverberant Room Method for Sound Testing of fans".
- All fans shall be dynamically trim-balanced to ISO1940 and AMCA 204/3 - G2.5 quality grade after assembly. A computer printout with vibration spectrum analysis shall be attached to the fans.
- Fan should be of G.S.S. , the Steel sheet should be JFE Galva zinc (Base metal cold rolled), JIS G3302, SGCC with Z22 (minimum coating weight on both sides @ 220 g/m²) zinc coating & Zero Spangle, skin passed, chromated and dry.
- Fans housing shall be of an appropriate thickness to prevent vibration and drumming. The fan scroll shall be attached to the side plate by means of continuous lock seam or intermittent spot welding. The wheel and inlet cone shall be aerodynamically designed and constructed to provide maximum performance and efficiency as published by the manufacturer.
- Fans must be physically capable of operating safely at every point of rating at or below the "minimum performance" limit for that class as defined in AMCA standard 99-2408-69 "Performance Class of Operating Limits for Centrifugal Fans".
- Shafts sizes shall be carefully calculated and designed such that the maximum operating speed (RPM) shall not exceed 75% of the first critical speed. For any application that is not a standard product from catalogue of the fan manufacturer detailed calculation of critical speed characteristic shall be submitted for approval.
- Shafts shall be made of carbon steel (C45) machined and polished to tolerance of standard ISO 286-2 - grade g6. Protective coat of anti-rusting shall be applied to all bare surfaces of the shafts at the factory.
- Bearings shall be of self-alignment (concentric) type with adaptor sleeve bearing. Bearings of eccentric locking collar with grub screw type are not acceptable. Bearing shall be maintenance free with permanently lubricated sealed ball bearing type. Bearing life shall be at least 75,000 hours based on basic rating life, L10 of ISO 281 standard. Calculation sheet of Bearing Life shall be submitted for approval.
- Motor installed shall be of a minimum 130% of the fan power absorbed (Brake horsepower) and shall have sufficient torque available for starting and continuous operation.
- Belts and pulleys shall be sized for a minimum 150% of the installed motor horsepower. The belt speed shall not exceed 30m/s. The pulley shall be of Taper Lock SPZ, SPA, SPB or SPC type. Conventional type of pulley is not acceptable. Both fan and motor pulley shall be balanced to the quality grade G.2.5.
- Fan outlet velocity shall not exceed 10% of the main duct air velocity designed (0.1"

per 100 ft or 1 Pascal per meter duct length). Pressure Loss is as referred to in SMACNA Standard, unless otherwise specified.

b. AXIAL FLOW FANS (DIRECT DRIVE)

- Fans shall be licensed to bear the AMCA Seal. The test standard used shall be ANSI/AMCA 210-85, ANSI/ASHRAE Standard 51-1985 "Laboratory Method of Testing Fans for Rating" and AMCA 300 "Reverberant Room Method for Sound Testing of fans".
- To achieve the minimum and equal clearance between the blade tips and casing, tube casing shall maintain its roundness by means of using one piece of sheet metal with 90 edge flanging up.
- Fan motor base support shall be properly secured (locked and sealed) to the fan housing and be of adjustable type to have precise control of motor shaft central position as well as running clearance between blade tips and casing. Motor (KW/HP) shall be able to be changed or upgraded at site without changing fan housing or ducting construction.
- Fans supplied shall be complete with factory fabricated mounting bracket (ceiling or foot mounted) and suction/ discharge matching flanges as accessories.
- All hubs shall be cast Aluminum alloy (Grade LM2) unless for Smoke Extractor Fans where high temperature (250C/2Hrs) air is expected then Aluminum alloy or steel fan impeller blades are required. Otherwise, impeller blade material with Polypropylene (PP), Glass-reinforced Polypropylene (PPG) and Glass-reinforced Polyamid (PAG), to provide self-balancing, anti-static, anti-sparking characteristic is preferable.
- Running clearance between blade tips and casing shall not exceed 1% of the impeller diameter, and 2% for smoke spill high temperature fan where mechanical expansion coefficient is different from normal ambient temperature. Fan manufacturer shall provide the fan assembled with the same clearance between blade tips and casing of the tested prototype. Note that the air performance and pressure loss are greatly affected by this clearance.
- Impellers shall be secured to the drive shaft by a key and keyway. Axial location shall be provided by a collar or shoulder on the drive shaft together with a retaining washer and screw fitted into a tapped hole at the end of the shaft and locked in position. Blades shall be secured in place to the angle setting by setscrews, locking nuts or setting pins.
- Fan motor shall be totally enclosed and external terminal box of at least IP55 shall be provided.
- Fan RPM shall be as per DBR / requirement.
- All fans after assembly shall be dynamically trim-balanced to ISO1940 and AMCA 204/3 – G2.5 quality grade. A computer printout with vibration spectrum analysis shall be attached to the fans.
- Fan should be of G.S.S., the Steel sheet should be JFE Galvazinc (Base metal cold rolled), JIS G3302, SGCC with Z22 (minimum coating weight on both sides @ 220 g/m²) zinc coating & Zero Spangle, skinpassed, chromated and dry.

c. VANE AXIAL FLOW FANS (DIRECT DRIVE)

- Fan shall be licensed to bear AMCA seal. To achieve the minimum and equal clearance between the blade tips and casing, tube casing shall maintain its roundness by means of using one piece of sheet metal with 90 edges flanging up with Fixed Guide Vanes.

- Fan Casing should be provided with Special Designed Integral Straightening Vanes to reduced turbulence provide high performance & low noise level.
- Fan motor base support shall be properly secured (locked and sealed) to the fan housing and be of adjustable type to have precise control of motor shaft central position as well as running clearance between blade tips and casing. Motor (KW/HP) shall be able to be changed or upgraded at site without changing fan housing or ducting construction.
- Fans supplied shall be complete with factory fabricated mounting bracket (ceiling or foot /discharge matching flanges as accessories.
- All hubs shall be cast Aluminum alloy (Grade LM2) unless for Smoke Extractor Fans where high temperature (250C/2Hrs) air is expected then Aluminum alloy or steel fan impeller blades are required. Otherwise impeller blade material with Polypropylene (PP), Glass-reinforced Polypropylene (PPG) and Glass-reinforced Polyamide (PAG), to provide self-balancing, anti-static, anti-sparking characteristic is preferable.
- Impellers shall be secured to the drive shaft by a key and keyway. Axial location shall be provided by a collar or shoulder on the drive shaft together with a retaining washer and screw fitted into a tapped hole at the end of the shaft and locked in position. Blades shall be secured in place to the angle setting by setscrews, locking nuts or setting pins.
- Fans shall not exceed 1500 RPM.
- All fans after assembly shall be dynamically trim-balanced to ISO1940 and AMCA 204/3 G2.5 quality grade. A computer printout with vibration spectrum analysis shall be attached to the fans. The Fan should be AMCA Certified for Air Performance.
- Fan should be of G.S.S., the Steel sheet should be JFE Galvazinc (Base metal cold rolled), JIS G3302, SGCC with Z22 (minimum coating weight on both sides @ 220 g/m2) zinc coating & Zero Spangle, skinpassed, chromated and dry.

d. INLINE AND PROPELLER FANS

Fans shall be direct driven, three or four blade type mounted on a steel mounting plate with orifice ring.

Mounting plate shall be of steel construction, square with streamlined venturi inlet coated with baked enamel paint. Mounting plate shall be of standard size, constructed of 12 to 16 gauge steel sheet depending upon the fan size. Orifice ring shall be correctly formed by spinning or stamping to provide easy passage of air without turbulence and to direct the air stream.

Fan blades shall be constructed of aluminum or glass reinforced polypropylene. Fan hub shall be of heavy welded steel construction with blades bolted to the hub fan blades and assembly shall be statically and dynamically balanced

Shaft shall be of steel accurately ground and shall not pass through first critical speed through entire range of specified fan speed.

Motor shall be standard permanent split capacitor of shaded pole for small sizes, totally enclosed with pre-lubricated sleeve or ball bearings, designed for a quiet operation with a maximum speed of 1000 RPM for fans 60 cm dia. or larger and 1440

RPM for fans 45 cm dia. and smaller. Motors for larger fans shall be suitable for $415 \pm 6\%$ volts, 50 cycle 3-phase power supply and for smaller fans shall be suitable for $220 \pm 6\%$ volts, 50 cycles single-phase power supply. Motors shall be suitable for horizontal or

vertical service as indicated in drawing and specification. Propeller fans shall be

provided with following accessories:

- Wire guard and bird-screen
- Gravity louvers at outlet
- Regulator for controlling fan speed for single-phase fan motor.
- Single-phase preventors for 3 phase fans.
- Wiring between regulator and fan motor including termination at both ends

6.0 CHILLED WATER PUMPS (PRIMARY & SECONDARY PUMPS)

6.1 VARIABLE & CONSTANT SPEED PUMPING SYSTEM – SPECIFICATIONS (Motors Efficiency IE-3 rated with VFDs)

Split Coupled Horizontal Split Case/Vertical Inline Primary, Condenser, Secondary Water Pumps

Supply and install of Split Coupled (long coupled) Type Horizontal split case/Vertical In-Line Centrifugal pumping unit. The pumps shall be radially split, single stage centrifugal type with CI/GM casing with equal size suction and discharge flanges and having separate tapped flush line and pressure gauge connections, Gunmetal Bronze (BS1400 LG2C) dynamically balanced impeller, stainless steel shaft, lower carbon throttle bushing, Outside Balanced type mechanical seal with Resin Bonded Carbon rotating face, Sintered Silicon Carbide stationary seat and Viton secondary seal. Pump shall be PN-16 ratings

Pump shall be complete with all accessories like pressure gauge, butterfly valves at pump suction and discharge, suction guide, reducers (if reqd.) etc. All the valves and fittings shall be PN-16 at 50 Deg C and suction guide has to be sourced from pump manufacturer only.

Pump Construction: Pump Casing - Cast Iron with PN16 pump for working pressure Suction and discharge connections shall be flanged and the same size and shall be drilled and tapped for seal flush and gauge connections.

Impeller - Bronze, fully enclosed type. Dynamically balanced. Two-plane balancing is required where installed impeller diameter is less than 6 times the impeller width.

Shaft - Provide Stainless Steel pump shaft.

Coupling - Rigid spacer type of high tensile aluminum alloy. Coupling to be designed to be easily removed on site to reveal a space between the pump and motor shafts sufficient to remove all mechanical seal components for servicing and replacement without disturbing other components of the pump or motor. The coupling shall be provided with a fully enclosed guard complying with the Machinery Directive.

Mechanical Seals - Shall be Stainless Steel multi-spring outside balanced type with Viton secondary seal, carbon rotating face and silicon carbide stationary seat. Provide a 316-stainless steel gland plate.

The pump is to be fitted with a factory installed flush line. Supply in the flush line to the mechanical seal, a 50-micron cartridge filter (alternatively, a cyclone separator when pump differential pressure exceeds 30 PSIG) and floating ball type sight flow indicator suitable for the working pressure encountered. The mechanical contractor shall change the filters after the system has been flushed and on a regular basis until the pumps are turned over to the owner. The squirrel cage induction type motor, with TEFC enclosure

and shall be connected to the pump through a high tensile aluminum, split type spacer coupling to permit Servicing of the mechanical seal without disturbing pump, motor or electrical wiring. Coupling shall be protected by a guard

Integrated Variable Frequency Drive (VFD) (For Variable Pumps)

6.2 Fundamental Requirements

VFD shall be of the VVC-PWM type providing near unity displacement power factor ($\cos \phi$) without the need for external power factor Correction capacitors at all loads and speeds.

VFD shall incorporate DC link chokes for the reduction of mains borne harmonic currents to reduce the DC link ripple current thereby increasing the DC link capacitors lifetime. VFD shall be CE Marked showing compliance with both the EMC Directive 2004/108/EC and the Low Voltage Directive 2006/95/EC.

RFI filters shall be incorporated within the drive to ensure it meets the emission and immunity requirements of EN61800-3 to the 1st Environment Class C1 (EN55011 unrestricted sales class B).

6.3 VFD and Motor Protection

VFD and motor protection shall include: motor phase to phase fault, motor phase to ground fault, loss of supply phase, over voltage, under voltage, motor over temperature, inverter overload, over current. Over current is not allowed ensuring Intelligent variable speed.

Units will not overload the motor at any point in the operating range of the unit.

6.4 User Interface

VFD shall incorporate an integrated graphical user interface that shall provide running and diagnostic information and identify faults and status in clear English language. Faults shall be logged / recorded for interrogation at a later date. VFD shall display dynamic head and flow on the VFD.

It shall be possible to upload parameters from one VFD into the non-volatile memory of a computer and download the parameters into other drives requiring the same settings.

The keypad shall incorporate Hand-Off-Auto pushbuttons to enable switching between remote and manual control.

The VFD shall be multi-color 4.3" back-lit touch-screen Variable Pumps must be provided with a cloud-based subscription service that enables Active Performance Management. It must proactively track and manages pump performance and provides early diagnostic messaging, web accessible trends and analysis along with automated reports helping end customer to make performance-based decisions and take immediate action to deliver the best possible HVAC pump performance. The cloud-based subscription should deliver real-time alerts, such as Alarms & warnings on excessive vibration, Pump in hand, Dead head, Cavitation, Broken Coupling. The connectivity kit supplied by OEM/ authorized representative should have ability to connect upto 8 pumps in a single plant room

6.5 Control Algorithm

- a) Control software (Sensor-less) shall be embedded in the Integrated Variable control unit to provide automatic speed control in variable volume systems with/ without the need for differential pressure. The default operating mode under Sensor-less Control shall be 'quadratic

pressure control' whereby head reduction with reducing flow will be according to a quadratic control curve. Control mode setting and minimum / maximum head set- points shall be user adjustable via the inbuilt programming interface.

- b) If the quantity of pumps in a system is 5 to 6 maximum, including any standby, a controller shall be added to a pumping unit and set up at the factory to operate in parallel mode. The pump controls, which will be linked on site by the control contractor, will automatically stage the units, as appropriate, to maintain the best efficiency pumping and minimum operating cost. The standby unit will be brought into the rotation to exercise and equalize wear. The sequence of controls and staging points will be submitted to the engineer for approval at the time of order.
- c) Serial Communications: The VFD shall incorporate a USB port for direct connection to a PC and / or an RS485 connection with Modbus RTU protocol.
- d) Optional protocols available should include Lan works and BACnet if required
- e) Other Control Features

The VFD shall have the following additional features:

Override for BMS

Manual pump control or closed loop PID control

Programmable skip frequencies and adjustable switching frequency for noise / vibration control

Auto alarm reset

Motor pre-heat function

Minimum three
programmable digital inputs
Minimum one analogue inputs

One programmable analogue / digital output Two volt-free contacts

System Control – Sensorless Control and Multiple Pumps with Pump logic control.

6.6 Duty Pump & Standby pumps with Sensorless Control

1. Controller shall allow the design parameters to be loaded into each integrated drive, including pump flow, pump head and minimum pressure setting. The minimum pressure setting is a value similar to a remote system setting, if it were to be used. The control shall then set the pump control curve to control the pump in an identical manner as control with sensorless feedback. For Sensorless shall Control the remote system sensor is not required. The design parameters are to be entered into the integrated drive by means of the built-in graphical user interface.
2. Duty Pump & Standby pumps with sensorless system

The drive shall then control the motor speed to satisfy the system load requirement. For BMS control the BMS is to provide the signal to the duty integrated drive to control the speed of the motor. Sensorless Control is not required for either of these options and can be de-activated by means of the user interface or by making terminal connections.

3. Multiple Pump System Control

Supply a controller to control the pumps to satisfy all system settings at the minimum speed possible and at maximum efficiency under any flow conditions. Pump curves showing the staging points to maintain maximum efficiency shall be supplied with the submittal data.

6.7 Performance and Operating Logic

1. The pump logic controller shall determine the most efficient combination of operating pumps. The pump logic controller shall respond to the most dissatisfied zone by increasing either, the number of operating pumps, or the pump speed. In the case where all zones are satisfied the pump logic controller shall respond by decreasing either, the number of operating pumps, or the pump speed so as to optimize the energy efficiency of the pumping operation while meeting system demand. The pump logic controller shall continuously monitor all zone signals to determine an active control zone. To prevent unnecessary changes to the operating pump speed, to become the active control zone, the candidate zone must have a greater error from set-point than the current active control zone for greater than 5 minutes. This transition delay period, 5 minutes, shall be a field adjustable parameter that can be altered by the password protected users.

2. The pump logic controller shall sequence the pumps based on a field adjustable interval of operating hours with a "bumpless" transfer algorithm. The logic controller shall incorporate embedded logic to prevent hunting, pump flow surge, and motor overloading. The logic shall incorporate an adjustable PID control loop. PID control at the VFD is not acceptable.

Should one VFD/ pump unit fail, the appropriate alarm signal shall be activated.

3. The controller shall have hand-off-automatic (H-O-A) control and should provide the option for a remote on/off signal from a single dry type relay, or BMS communication signal.

4. The pump logic controller shall provide a data-logging feature including alarms, and events (adjustment to system parameters). The pump logic controller shall offer the option for expanded memory of 4 megabytes for a rolling record of system parameters at 10 second intervals, with a time stamp.

5. The pump logic controller shall be self-prompting. All messages shall be displayed in plain English. The operator interface shall have; Multi-fault memory and recall, On-screen help functions, and separate user screens for:

Zone setups (including calibration of
DP/T/Flow sensor range) Pump
configuration

Design set-point and
end of curve data
Alarm history and
event review

Display of zone status, pump status
and system status Factory default /
commissioning setup data

6. The controller shall be capable of serial communications with Modbus, Lon Works, Trend, and Metasys protocols. The controller shall offer the option of gateways for both BACnet and TCP/IP protocol connection for communication over the internet.

7. The pump logic controller shall automatically disable any zone DP signals that are not within limits and alert the operator of a possible transmitter failure. Should system failure be detected the pump speed will default to a pre-defined percent of full speed (factory default loaded as 90% of full speed). The pump logic controller shall have a minimum speed limit entered as a field adjustable parameter, factory loaded default set to 30% of full speed.

6.8 Pump Controller (with Parallel pump logic).

The variable pumps shall have an independent/ standalone IP-54 controller and should not be an integral part of any of the pump VFD's. The controller shall be designed to control up-to 6 pumps

6.9 Mechanical and Electrical Details

1. For Intelligent Variable Speed pumping units, Pumps operating in parallel, the pump

logic controller shall be Parallel Pump Controller. The pump logic controller shall be specifically designed for the control of multiple pumps in HVAC hot and/or chilled water systems that involve up to 6-variable speed pumps, with Control, in parallel, staged, sequenced, and standby configurations. The pump logic controller shall allow field adjustments of control parameters as described below.

2. The controller shall be capable of accepting, processing and displaying appropriate signals from the individual pump controls for the following values:

System Status

- Total flow
- Head
- Total power
- Pumps speed
- Alarm
- Wire to water efficiency (calculated)
- Number of pumps running
- Lead pump number

Individual Pump Status

- Speed Ref (%)
- Speed (%) (rpm)
- Run time (hrs)
- Fault Nbr
- Run status (running/stopped)

Individual Pump control status

- Current (Amps)
- Volts (VAC)
- Power (kW)
- Head

● Flow

3. The pump logic controller shall be suitable for indoor or outdoor applications and shall be capable of being integrated with Intelligent Variable Speed pumping units for pumping packages approved to UL 778 & CSA STD C22.2 No 108 standards and also suitable for wall mounting with separate Intelligent Variable Speed pumping units and stand-alone pump controls.
4. The controller shall have 3-levels of password security, first level to view only (No password required); the second level is for field adjustable parameters and the third level for factory/commissioning setup parameters.
5. The controller shall stage the pumping units to ensure optimum pumping energy usage and shall sequence the pumps starting order, including any standby unit.
6. The controller shall be fed with a power supply from each pumping unit controls in the control 'daisy-chain' so that a loss of power to any pump unit controls will not affect the controller pumping operation. Should the controller go off-line, all pumps in auto-mode will operate together to provide the correct system flow needs. Staging of the units will resume as the controller is brought back online.
7. The integrated controller shall be capable of being easily integrated on any other pumping unit should the need occur.

Simple mounting in pre-designed location and wiring will be all that is required.

6.10 Performance and Operating Logic

1. The pump logic controller shall determine the most efficient combination of operating pumps, and pump operating speed based from the individual pump controls input.
2. The pump logic controller shall respond to the system load flow needs by adjusting either the number of operating pumps, or the speed of the operating pumps.
3. The pump logic controller shall continuously monitor the system requirements and ensure that the operating point is maintained on the control curve to meet the system needs with optimized pumping energy usage.
4. The pump logic controller shall sequence the pumps based on a field adjustable interval of operating hours. The controls shall incorporate embedded logic to prevent hunting, pump flow surge, and motor overloading. The controller logic shall incorporate an adjustable PID control loop.
5. Should any pumping unit or pumping unit controller fail, the appropriate alarm signal shall be activated. In the place of the failed assembly, a standby pumping unit shall be operated in variable speed mode, or the next pump will start if there is no standby.
6. The controller shall have hand-off-automatic (H-O-A) control and should provide the option for a remote on/off signal by a BMS communication signal.
7. The pump logic controller shall be self-prompting. All messages shall be displayed in plain English. The operator interface shall have multi-

- fault memory and recall on-screen help functions, and separate user screens for overview, pump and setup.
8. The pump logic controller shall automatically disable any flow signals that are not within limits and alert the operator of a possible control failure.
 9. The pump logic controller shall have the system design flow, system design head and minimum head limit entered as field adjustable parameters, factory loaded. The default for the minimum head is 40% of the design head.

Operator Screens

- Source of control: local or remote.
- Controller status: on/off.
- Pump information: running/off/alarm, HOA status, pump ID 1, pump ID 2, stand-by, etc.
- Individual pump controls information: speed, amps, power, volts AC, flow and head
- Set point and error of flow and head
- Individual cumulative pump hours of operation
- System set-point and error

Alarm Screens

- Alarms with time stamp
- Alarm help
- Diagnostic indicating status (ok or bad) of PLC, memory,
- network and communication, PLC Software version

Setup Screens

- Level 0. No password, allows view only access
- Level 1. Allows modification of all parameters, except pump PID and BMS setup. Allows Restoring previously saved values
- Level 2. Allows modification of all parameters. Allows saving and restoring all parameters
- Levels 1 & 2 are password protected

BMS communication

- a. The controller shall be capable of serial communication with a BMS with either of the following protocols:
 - Modbus RTU/ BACnet MS/TP/ Lan Works
- b. The following points will be available through all protocols:
 - Flow for each pump
 - Head for each pump
 - Total real-time power consumption
 - Pump speed
 - Individual pump run status

- 0 Alarm
- 0 Wire to water system efficiency
- 0 Number of pumps operating
- 0 Lead pump ID
- 0 Remote start/stop
- 0 Controller on/off status
- 0 Pump controls information: running/off/alarm, HOA, duty 1, duty 2, stand-by, etc.
- 0 Pump controls information: speed, current, power, Volts AC, flow and head
- 0 Pump hours of operation
- 0 Head and flow Set point

6.11 CENTRIFUGAL PUMPS-DATA SHEET A

Design Parameters	S. N	Pump Designation	Primary & Secondary Chilled Water Pumps
	1	No. of Pumps	As per detailed design (with 1 standby primary pump)
	2	Design Capacity	As per detailed design
	3	Total Head	As per detailed design
	4	Location	AC plant room / As per detailed design
	5	Max. Rated Sped (AT 50 Hz)	(As per designer discretion)
Features of Construction	6	Liquid Handled	Water
	7	Type of Pump	Horizontal split case/Vertical Inline Long Coupled
	8	Seal	Mechanical
	9	Nozzle Orientation	Side Suction & Side Discharge
Materials of Constructions	10	Flange Drilling	As per ISI
	11	Parts	Material
	11.1	Impeller	Bronze
	11.2	Casing	Cast Iron
	11.3	Shaft	Steel

TECHNICAL SPECIFICATION -BUILDING MANAGEMENT SYSTEM

1. A customized Building Management System shall be provided to operate and monitor the laboratory operating parameters, critical equipments and HVAC system in the BSL-3 Laboratory & BSL-2 Laboratory, NCDC Branch Centre.
2. The function of the BMS shall be, but not limited to, as given hereunder:
 - Room/Area/zone pressure in BSL-3 & BSL-2 Laboratory
 - Room/Area/zone temperature & RH in BSL-3 & BSL-2 Laboratory
 - Ambient temperature & RH
 - AHU and Exhaust Blower operating status of BSL-3 & BSL-2 Laboratory
 - Modulate VFD's and monitor VFD status
 - Modulate VAV's and monitor VAV status
 - Pressure Drop across each HEPA Filter
 - OPEN/Close dampers operation and status at AHU Inlet
 - Supply & exhaust air quantity thru VAV in each BSL-3 Laboratory rooms/zone.
 - Chilled Water Supply and Return Temperature at each chilling unit
 - Chiller operating status and monitoring
 - Complete HVAC System Operation and Shutdown in Auto Mode through BMS
 - BSL-3 Lab Isolation damper operation and status
 - Archiving of Autoclave decontamination cycle data
 - Archiving of BLED plant decontamination cycle data
 - Operation and status monitoring of IVC
 - Allow to sequence each chilling unit through BMS to maintain equal run time
 - Enable and disable each chiller unit through BMS
3. The major components of BMS system shall include:
 - Operator and engineering workstation comprising of latest configuration desktop PC with all required hardware and software
 - Field devices (pressure, temperature & humidity sensors & transmitters etc.)
 - Power and control cabling
 - PLC based BMS control panel complete with controllers as per requirement
 - VAV devices for BSL-3 Laboratory supply air and exhaust air
 - VFD for AHU motors and Exhaust blower motors of BSL-3 Laboratory and BSL-2 Laboratory
 - Customized software
 - HMI Touchscreen panel at BSL-3 Lab entry
 - Desktop PC with colour monitor and printer
 - Any other component to complete the BMS work
4. The Building Management System shall allow START/STOP operation of the Complete HVAC system in AUTO Mode. The system shall also have the provision to over-ride the parameters (password protected).

5. The BMS shall generate alarm in case of HVAC system failure, collapse in room/zone pressure and/or disruption in other operating parameters from the set limits.
6. The HVAC system START and STOP sequence shall be interlocked to prevent reverse pressurization of the BSL-3 & BSL-2 Laboratory, at any point of time
7. The BMS control panel shall be powered through UPS. Upon restoration of power after a power failure, the BMS shall start the HVAC system automatically without any human interface and restore the normal operational set points of the system.
8. The BMS graphics shall have the ability to display real time field data and change colour of symbols based on field conditions. For example, a fan could be green when 'ON', white when 'OFF', red when 'IN-ALARM' conditions
9. All components and controllers shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable
10. The Contractor shall submit complete BMS architecture with list of I/O's and BMS system configuration for approval before proceeding with the BMS work.

TESTS AFTER INSTALLATION

1. SAFETY AND CONTROLS
 - Interlocks for compressor motor with chilled water pumps shall be checked.
 - Operation of Flow switch in chilled water lines shall be checked.
 - High pressure-stat shall be checked
 - Low pressure stat shall be tested
 - Anti-freeze thermostat shall be tested
 - Oil failure switch shall be tested
2. After Air balancing, the quantity of air through every outlet and room performance parameters for pressure and temperature shall be tested
3. Capacity Test of Chiller, Air Handling Units, Exhaust Blowers etc.
4. BMS function and operation of system through BMS
5. Any other test / check decided and directed by Engineer to ascertain the correctness of installation and verify the performance and capacity of equipment/system.

SECTION - IV

TECHNICAL SPECIFICATIONS FOR LABORATORY EQUIPMENTS AND SYSTEMS

TECHNICAL SPECIFICATIONS - EQUIPMENTS AND SYSTEMS

1.0 PASS BOX

1.1 DYNAMIC PASS BOX

Pass Boxes (Dynamic) should be provided at required locations for transfer of samples, chemicals and materials into the laboratory.

Pass box should be constructed in **SS 316 L (18 gauge)**. The corners made the Pass Box chamber should be coved for easy cleaning. The pass box chamber dimension should be approximately 610 mm x 610 mm x 610 mm, however at some specific locations and purpose, the pass box chamber dimensions may vary. The unit should be complete with HEPA filters, blower, motor, door electromagnets, door interlock, UV Lamp with timer, necessary wiring, controls and all other accessories. etc. complete.

The Pass Box doors should be interlocked by providing suitable electromagnet, so that both the door cannot be opened simultaneously. The interlock should provide visual indicator for door open/close conditions. The blower motor of Pass Box should of suitable rating and should be dynamically and statistically balanced. Magnehelic differential pressure gauge should be provided to indicate the pass box chamber pressure. The pass box should be provided with UV light and should be interlocked with the pass box doors. The UV Light operation should be provided through a 24 hour timer switch. Door glass shall be UV shielded toughened glass.

The Supply Air velocity across the terminal HEPA filter in Pass Box should be approximately 0.45 m/sec. Noise level should be less than 70 dB. The pass box should be installed flushed with the wall on BSL-3 Lab side and projected on the other side. The projected side should be provided with SS coving at the pass box and wall junction.

The Pass Box should be complete with the following filters:

Pre-filter : 95% efficiency down to 5 microns

Final Filter : HEPA Filter with 99.97 % efficiency down to 0.3 microns

The blower motor should be of suitable rating and should be dynamically and statistically balanced.

Magnehelic differential pressure gauge should be provided to indicate pressure drop across the HEPA filter

1.2 STATIC PASS BOX

1.2.1 The Static Pass Box shall be constructed in SS 304 (18 gauge). The corners inside the Pass Box chamber shall be coved for easy cleaning. The pass box chamber dimension shall be approximately 610 mm x 610 mm x 610 mm or as required. The pass box unit shall be complete with door electromagnets, door interlock and UV Lamp with timer and hour meter including necessary wiring and controls and all other accessories. etc. complete.

1.2.2 The Pass Box doors shall be interlocked by providing suitable electromagnet, so that both the door cannot be opened simultaneously. The interlock shall provide visual indicator for door open/close conditions.

2.0 DUNK TANK

Dunk tank shall be provided at approved locations in the final design. The dunk tank shall be constructed in SS 316 L (16 gauge) suitable for active use of disinfectant chemical like NaOH, Sodium Hypo-Chloride Solution. Approx. size of dunk tank shall be 550x550x900

mm. The drain outlet of the dunk tank shall be provided towards the containment side. Water supply arrangement shall be provided for re-filling the dunk tank.

3.0 SHOWER SYSTEM FOR BSL-3 LABORATORY AND BLED PLANT ROOM

- 3.1 The shower system for BSL-3 Lab should comprise of pre-fabricated cubicle and doors constructed in SS 316L (16 gauge) of approximately 1m x 1m size.
- 3.2 All the joints should be argon welded and perfectly buffed and should be free from any blurs and sharp edges. The shower cubicle should be provided with supply & return air diffusers and light fixture.
- 3.3 The shower cubicle door should be in SS 316L provided with sealable gasket. The shower drain should be seamlessly connected to the floor drain and terminated to the BLED system. The drain connections should be tested to ensure there is no leakages.
- 3.4 A water heater/calorifier should be provided for supply of continuous heated water to the showers at controlled temperature (30-35 Deg. C) during winters. With temperature indicator and ammeter.
- 3.5 The shower system should be complete with a separate shower water storage tank, insulated water distribution/recirculation piping, water distribution pumps (1W+1S), valves, flow meters, batch controllers (to set each shower cycle), hot water generator, control panel and all other necessary controls, wiring, piping etc. complete as required.
- 3.6 The shower system piping should be in AISI SS 316L grade as per JIS 3448 standards and fittings as per JWWA G116 standard.

4.0 COMPRESSED AIR SYSTEM

4.1 COMPRESSED AIR SYSTEM FOR PROCESS AIR

Compressed Air system should be provided complete with 1 nos. 5 hp Skid Mounted Air-Cooled Compressor. The air compressor should be complete with in-built compressed air reservoir, oil and particulate removal filters, starter controls, air dryer, compressed air distribution piping, pressure regulating valves, ball valves etc. complete in all respect, for supply of compressed air to pneumatic valves of Autoclaves and Effluent Decontamination system.

The compressed air piping should be done in heavy class GI pipes conforming to IS 1239 (latest version), fittings, isolation valves fitted at required location to permit uninterrupted maintenance and service of distribution line. The compressed air outlet points should be provided for supply of compressed air to pneumatic valves of Autoclave, Biological Effluent Decontamination system, inflatable gaskets of biosafety doors at all the required locations as per approved designs.

Compressor Unit should have an integrated Air-cooled Refrigeration type Air Dryer with Moisture Trap (with automatic and manual drain). Hot gas by-pass valve should be provided to maintain a stable pressure dew point and avoid freezing during extended un-load run operation.

5.0 VENTILATED TYPE GARMENT STORAGE CABINET

- a) The Garment Storage Cabinet shall be constructed in SS 316 L and shall be ventilated type.
- b) The front panel shall be constructed with SS 316 L frame and toughened glass panel
- c) The garment storage cubicle shall conform to BS 5295-76
- d) The garment storage cubicle shall be complete with motor blower assembly,

recirculatory plenum, heater with thermostat, fluorescent light, UV germicidal lamp with hour meter and 24 Hour timer switch for operation, Prefilter, HEPA filter, Activated carbon filter for odour neutralization, control switches, indications etc.

e) The garment storage cubicle shall meet the following operational requirements:

f) Approx. Dimensions (external): 1000 mm (W) x 700 mm (D) x 1800 (H)

(size shall be as per site space availability)

Air Flow : Shall be 0.45 m/sec to 0.65 m/sec

Cleanliness Level : Class M 3.5

Noise Level : Less than 70 dBA

Vibration Level : Less than 2.5 microns

Power requirement : 230 V AC, 50 Hz, 1 Phase

6.0 LABORATORY WORK STATION

6.1 The BSL-3, BSL-2 and other Laboratory rooms shall be provided with workstations, as per final approved layout and drawing. The work stations shall be planned, designed and provided with the most optimum utilization of space in the laboratories.

6.2 Hand wash sinks and emergency eye wash stations shall be provided in each BSL-3 and BSL-2 Laboratory room, integrated with the work station.

6.3 Taps shall be hands free type and elbow operated with swan neck.

6.4 The workstations in BSL-3 and BSL-4 Laboratories shall be constructed in SS 304 (16 gauge).

6.5 The workstations in BSL-2 Laboratory shall be modular type in powder coated mild steel construction and with TRESPA top in approved shade and finish.

6.6 The workstation shall have under counter storage space and drawers. Each work station shall be provided with a swivelling type laboratory chair with castor wheel. The chairs shall be in SS frame and seat (fabric and leather finish seats shall not be accepted).

7.0 BIOLOGICAL EFFLUENT DECONTAMINATION SYSTEM (STEAM SYSTEM)

7.1 Supply, installation, testing and commissioning of fully modular skid mounted biological liquid waste decontamination system, including and comprising of :

- a) Cook Tanks of 800 Ltrs Capacity – 2 Nos.
- b) Integrated Effluent Transfer and Control System
- c) Temperature Sensors for jacket steam solenoid valve and chamber – 3 Nos.
- d) Safety Valves, Rupture Disc, Vent Valve etc.
- e) Vapor Handling Skid for Vent Valve
- f) Effluent Discharge Line from Cook Tanks
- g) PLC Based Control Panel with attached printer for taking batch cycle printouts
- h) Pumps for effluent transfer from sump-2 Nos.

7.2 The cook tanks shall have chamber capacity of 1000 Ltrs, in which the decontamination cycle will start once the level of collected liquid effluent reaches ~500 Ltrs. The tank will be in heavy gauge SS 316 L. The vessel will be in horizontal/vertical design with external insulation in mineral/rock wool duly clad in aluminum finish for both tanks as well as the piping. The system shall

include interconnected piping to integrate with the cook tanks, a mild steel access platform/staircase for access and maintenance.

7.3 Integrated effluent transfer and control system shall include:

7.3.1 Automated liquid effluent release and bypass system into the cook tanks through SS 316 automated ball valve which will be closed once the effluent level reaches ~500 Ltrs. and the level sensor signal is activated. Automatically the ball valve of the second cook tank will be opened for allowing the laboratory effluent to start flowing into the empty tank.

7.3.2 Level sensor system in all the cook tanks to sense the liquid effluent on its reaching ~500 Ltrs.

7.3.3 Set of at least 3 PT 100 temperature sensors in each cook tank - 1 for control of the jacket steam solenoid valve and other 2 in the chamber to monitor the temperature at two different levels of the liquid effluent.

7.3.4 The steam, supply and discharge from the jacket will be fitted with accessories such as steam traps, non-return valve, safety valve, solenoid actuated valve etc.

7.3.5 The chamber of each cook tank shall be fitted with safety valve/s, rupture disc (both enclosed in a separate chamber) such that the vent liquid discharge is sent back through the supply piping to the adjacent cook tank. The vapor generated within the chamber during the decontamination cycle shall be piped to a common independent vapor handling mini-skid located above the cook tanks, fitted with absolute hydrophobic HEPA filters for safe exhaust of gaseous vent to the ambient. The filter skid shall be provided with provision for on-site testing of filter and in-situ filter decontamination, before removal.

7.3.6 The system shall comprise of independent filtration systems for operating vent from each cook tank and a dual relief vent system - all fitted up for safe change using filter decontamination techniques.

7.4 The common discharge line from all the cook tanks shall be fitted with an after cooler to blend the release of the effluent after decontamination cycle with raw water for cooling before being discharged into the sump to be provided in BLED plant room.

7.5 The entire system shall be controlled from an independent control panel. The control panel shall be complete with touch screen panel (Mitsubishi-Beijers/Siemens/Allen Bradley), fully programmed and wired, with full decontamination cycle function recording capability. One printer shall be provided with the control panel to take decontamination batch cycle printouts.

7.6 The Decontamination Cycle operating temperature shall be at minimum 121°C with programmable cycle duration through the PLC.

7.7 The steam supply to the BLED plant shall be from a dedicated Non IBR Electrical type Steam Boiler to be supplied along with BLED Plant. The required steam piping shall be complete with pressure reducing station, distribution piping with insulation, necessary valves and accessories as required.

7.8 The BLED System shall be provided with validation test ports for batch validation using biological indicators. The batch decontamination efficacy shall demonstrate complete kill of approved biological indicator at the maximum design capacity. Biological indicator shall be *Bacillus stearothermophilus* spores using vials or spore strips, with at least 1×10^6 spores per millilitre. At least 2 Nos. Biological indicator test port shall be provided complying with biosafety requirements without any

breach of containment.

8.0 DOUBLE DOOR AUTOCLAVE

The autoclave shall be rectangular, steam operated, high pressure high vacuum, double door & single door (requirement as per approved design) suitable for horizontal loading and unloading of materials/waste, with automated sliding doors, with Bio-Seal suitable for installation and use in BSL-3 Laboratory.

The autoclave shall be free standing type, the chamber drain shall be located on the containment side and connected to the Effluent Decontamination system.

Tentative Required Qty and Size (only for guidance). Actual quantity to be supplied shall be as per approved design:

Double Door Type Approx. Chamber Size 900x900x1000mm- 2 Nos. (BSL-3 Lab)

CONSTRUCTION

- i) The chamber shall be constructed of heavy duty SS of 316 with full argon welding. The chamber material and construction shall meet ASME standards for unfired vessels. The chamber shall be duly reinforced with carbon steel.
- ii) Doors and jacket shall be constructed of stainless steel sheet of 304 grade. Doors must be provided with automatic safety locking and unlocking devices. All doors gaskets shall provide high temperature seal.
- iii) Chamber and doors shall be designed for working under positive pressures upto 31 psig at temperature upto 135o C.
- iv) The autoclave shall be insulated with 50 mm thick resin bonded glass wool to minimise heat loss and restrict the skin temperature within reasonable limits so asnot to cause burn due to accidental touch.
- v) Pipes and fittings shall be of stainless steel and bronze.
- vi) Key locked main power switch should be provided for additional safety and security.
- vii) The autoclave shall be provided with a vacuum pump of required capacity. The vacuum break vent line shall be protected with HEPA with provision for in-situ filter decontamination of filter before removal.
- viii) The Double Door Autoclaves in BSL-3 Laboratory shall be installed flushed and provided with Bio-Seal to prevent ingress of air from autoclave sealing diaphragm due to lab operating pressure.
- ix) The autoclave chamber shall be tested to 1.5 times of the working pressure, sterilization jacket to twice the working pressure. The test pressure will be maintained for a minimum of 2 hours.
- x) The vacuum line, blow down valve, rupture disk etc. shall meet biosafety requirements with suitable protection and provided with hydrophobic HEPA filtered vent having provision for decontamination of filter before removal/change of filter. The Autoclave chamber drain shall be located towards containment side of the lab.

CONTROLS

- i) The autoclave shall be fully programmable type with microprocessor and designed to control and monitor a wide variety of sterilizing cycles, depending upon the load to be sterilized. A manual operation facility shall also be provided as a standby in case of control failure. The automatic control shall have following features (but not limited to):

- Indication Alarm in case of any cycle interruption or cycle failure
- Printer to print relevant information concerning operation during the cycle such as temperature, pressure, cycle time etc
- Cycle parameters should be adjustable with restricted access code to prevent adjustments by non-authorized persons
- Low water level in steam generator
- Following safety features to prevent the opening of door in following instances (but not limited to).
 - * When the chamber is pressurized
 - * When the decontamination/sterilization cycle has not completed

ACCESSORIES

The Autoclave shall be complete with following accessories:

- Jacket Steam Valve
- Chamber Steam Valve
- Safety Valve Exhaust to Drain
- Pressure Reducing Valve
- Jacket and Chamber Steam inlets
- Moisture separator
- Rupturing Disc
- Non return valves and strainers
- Steam Filter
- Solenoid Valve/s
- Vacuum break valve
- Vacuum break filter
- Compound Gauge
- Pressure Gauge
- Safety Valves
- Steam Trap
- Jacket drain valve
- Digital Thermometer
- Electrical Control Console/Panel with printer to record autoclaving cycle data.

Each Autoclave shall be provided with compatible capacity in-built steam generator, as per manufacturers designs and recommendation.

OPERATING AND PERFORMANCE PARAMETERS

- i) The vacuum autoclave shall give a minimum of three vacuum cycles to purge air from the autoclave chamber and leave no air pockets.
- ii) Operating temperature shall be 121o C or 135o C, as per programmed cycle parameters
- iii) The autoclave should completely kill the approved biological indicator at the

maximum design capacity. Biological indicator shall be *Bacillus stearothermophilus* spores using vials or spore strips, with at least 1×10^6 spores per millilitre. The steam condensate shall meet EU WFI Specifications.

- iv) Once the bio-contaminated waste has been loaded from the containment side, the unloading door of the Autoclave shall not open till the decontamination cycle has successfully completed.

INSTALLATION

The autoclave shall be installed/ mounted on a sturdy tubular frame of stainless steel and shall include incoming water connections, drain connection, power connection etc., complete as required.

9.0 ANIMAL TISSUE DIGESTER

The Tissue Digester shall be Alkaline Hydrolysis based System for carcass disposal. The system shall be as per the following specifications:

Capacity	:	10 Kg/batch
Chamber dimension	:	As per manufacturer
Working pressure	:	1.2 bar
Working Temperature	:	135OC
Material of Construction	:	SS 316L
Jacket	:	SS 304 (3.0 mm thick)
Insulation	:	25 mm thick Ceramic wool, 64Kg/CuM density
External cladding	:	0.8 mm Aluminium
Basket capacity	:	10 Kg
Approx. process time	:	4-5 Hrs per batch cycle
Motorized winchAccessories	:	Non return valves StrainersSteam trap Rupture diskJacket and Chamber pressure switch Jacket and chamber pressure gaugesFor precise operation, the unit shall be provided with

- a) PRS for steam for regulating uninterrupted supply of steam to chamber
- b) Steam filters for providing clean and filtered steam
- c) Safety valves to maintain desired pressure in the chamber and jacket
- d) Temperature controlled through PLC to maintain set temperature
- e) Pressure switch to maintain desired pressure in jacket
- f) Pressure transducer to maintain desired pressure and vacuum in chamber Providing all the required utilities and services shall be included in the scope.

Cycle Performance: On completion of the process cycle, only residual bones shall be left in the basket suitable for normal municipal disposal.

SECTION - V

TESTING, COMMISSIONING & VALIDATION

1.0 TESTING, COMMISSIONING AND VALIDATION

- a) After completion of the construction and installation works, all the equipment, systems and services shall be commissioned and tested by the contractor to check the operation and performance of each of the equipment and system. The contractor shall submit detailed compiled testing and commissioning report of all the equipment, systems and installations.
- b) Once all the equipment, systems and installations are found to be working satisfactory and contractor has submitted detailed onsite commissioning and testing report of all the equipment, system and installations, the contractor shall submit a request for Internal Validation of BSL-3 Laboratory and BSL-2 Laboratory. The Client/HITES shall nominate and depute a team to carry out the validation of BSL-3 Laboratory and BSL-2 Laboratory. All the required testing equipment/s and instruments along with skilled manpower and consumables shall be provided by the contractor and all the required on-site testing during the validation process shall be carried out by the Contractor.
- c) Validation of BSL-3 and BSL-2 Laboratory shall be carried out in accordance with the DBT Guidelines, as applicable. During the validation process, operation and functioning of all the equipment, systems and complete installations shall be checked to verify that the equipment and systems are delivering the desired and approved performance results. It will be checked to ensure that all the biosafety and biosecurity requirements are met, are in place and are functional.
- d) The validation of other laboratories shall be done as per the approved designs to check and verify the actual performance of equipment/s, systems and installation.
- e) Before start of the validation process, the Contractor shall submit a detailed validation document giving details of validation checks and tests to be performed, the acceptance criteria with respect to relevant guidelines and standards, as per the approved designs & drawings and the formats for recording the check and test results.
- f) After completion of the validation process, the Contractor shall compile the validation results and submit to HITES/Client.
- g) The Contractor shall provide all the test and measuring instruments, tools, tackles, consumables, manpower etc. required for the Testing, Commissioning and Validation Process.
- h) The works shall be accepted as COMPLETED only after successful completion of Validation of BSL-3, BSL-2 and Other Laboratories.
- i) The Validation Tests and Checks for BSL-3 Laboratory, BSL-2 Laboratory and Other Laboratories shall include, but not limited to, the following tests/checks at site, after completion of all installations and commissioning:
 - Testing of Containment Barrier Integrity
 - Testing of Autoclaves (Min 5 cycles)
 - Testing of BLED Plant (Min. 5 Cycles)
 - Testing and Validation of Dynamic Box
 - Testing and Validation of all the HEPA Filters

- Testing of Safe Change of HEPA Filters
- Leakage Testing of Containment Housing
- Testing of Room & Zone Pressure Gradient
 - Testing of Supply & Exhaust Air Quantity and calculation of ACPH
 - Testing of Room Temperatures
 - Testing of Access Control System
 - Testing and validation of shower system
 - Testing of Biosafety doors
 - Testing of ventilated garment cabinets
 - Operation of Decontamination cycle in Fumigation Airlock
 - Testing and validation of complete HVAC system operation
 - Testing and Validation of complete Electrical system operation
 - Testing and validation of Supply and Exhaust Fan interlock
 - Testing and Validation of Fire Alarm and Fire Fighting System
 - Testing and Validation of DG set operation
 - Testing and Validation of Normal to Emergency and Emergency to Normal power shift
 - Any other check & tests to ascertain that there is no breach in biosafety
- i) All the testing equipment/s and instruments used for on-site testing shall be calibrated and calibration reports shall be submitted by the contractor. For conducting on-site testing the contractor shall:
 - Either have ISO/IEC 17025/BIS/QCI/NABL accreditation/certification. Or
 - Shall engage ISO/IEC 17025/BIS/QCI/NABL accredited/certified agency.

2.0 EXTERNAL VALIDATION

After successful completion of Internal Validation, HITES/Client may appoint an Expert Committee for Validation of BSL-3 Laboratory, BSL-2 Laboratory and Other Laboratory. The contractor shall provide all the required assistance (test equipment, manpower and consumables) for carrying out the validation by the Expert Committee, at no extra cost.

The Contractor shall extend full cooperation and provide the validation instruments, tool, tackles, consumables and manpower etc., as required and asked by the HITES/Client during the External Validation.

3.0 DOCUMENTS TO BE SUBMITTED ON COMPLETION

- a) On Completion of the works, the Contractor shall submit the following documents to HITES/Client in three sets:
 - o Complete Set of 'AS BUILT DRAWINGS'
 - o Operation and Maintenance Instructions & Manuals for individual Equipment and Systems
 - o Recommended List of Spares and Consumables

o Preventive Servicing and Maintenance Schedule

- b) The Contractor shall submit the Technical Specifications and Data sheet for all the equipment/s and systems supplied and installed.
- c) The Contractor shall submit a written undertaking that spares and after sales services for all the equipment, systems and services installed in the facility shall be made available for a period of at least five years from the date of handing over the facility. The after sales services may be availed by the Employer from the executing Contractor under a separate Operation and Maintenance Contract.

End of Vol 5 : Technical Specification

(Make List Attached)

(Furniture Specifications attached)

(BSL3 Scientific Equipment Technical Specifications attached)

LIST OF APPROVED MAKES

I. CIVIL & PLUMBING WORKS:

Sl. No	Details of equipment/ material	Make/ Manufacturer
A. CIVIL WORKS		
1.	Acoustical Panelling	Armstrong/ Anutone/ Hunter Douglas
2.	Adhesive for Ceramic tiles/ Stone/ Stone Sealers	Pidilite / Fosroc/ Cera-Chem/ Sealix/ BASF
3.	Adhesive for Wood Work	3M/Pidilite/Basf/ Zerodrip /Fosroc/ Mapei
4.	Adhesive Tape	3M/ Norton/Ceilux/Appolo industries
5.	Aluminium Door & Window System	Windfall/ Fenesta/ Encraft/ Aluplast / Hindalco
6.	Aluminium Accessories and Hardware	Windfall/ Fenesta/ Encraft/ Aluplast
7.	Aluminium Glass Facade & Structural Glazing Systems	Saint Gobain/ RAC Extrusion / Hunter Douglas/ Schuco
8.	Aluminium Composite Panels	Eurobond / Viva / Alstrong / Alstone / Reynobond
9.	Aluminium Die-Cast handles & two point locking kit	Dorma/Saint Gobain/ Windfall / Hunter Douglas/ Schuco
10.	Aluminium Extrusion/ Sections	Hindalco / Jindal/ Bhoruka / Nalco
11.	Anchor Fastner/Dash Fastner	Hilti / Fischer /Bosch/ Mapei
12.	Anti – Termite Treatment	It should be done by permanent members of IPCA as approved by Engineer-in-Charge.
13.	APP Polymeric Polyethylene Felt	BITUMAT/ STP/ Bengal Bitumen
14.	Backer rod	Supreme Industry/ SYSTRANS Polymers/ Backer Rod Mfg. Inc.
15.	Batch Mix Concrete (BMC) / Ready Mix Concrete (RMC)	The contractor to install his own computerized batching plant of suitable capacity and arrange for Transit Mixers, pumps etc. as per approval of Engineer – In- Charge. OR The RMC shall be procured from the source as approved by Engineer- In- Charge. RMC producing

Sl. No	Details of equipment/ material	Make/ Manufacturer
		plants of the main Cement producers shall be preferred.
16.	Bitumen	Indian Oil, Hindustan Petroleum, Bharat Petroleum
17.	Cement	ACC / Ultra tech / JK Cement / Ambuja / Shree/ Dalmia For Kerala Projects: Refer GoK Circular No.24/2022-Fin dtd 19.03.2022. BIS mark with IS code No. and License number (CM/L.no) is insisted in Cement and to be approved by Engineer-in-Charge.
18.	White Cement	Birla White / JK / Ultratech/ Sealix/ ACC
19.	Cement bonded particle board	Century/ Greenglam/ Duro / Bison Panel
20.	Clean Room Wall Panels with/ without return air risers, Doors/ windows etc.	CLESTRA/ NICOMAC / HEMAIR / GMP / E-PACK Saint Gobain/ Hunter/Douglas/ Schuco
21.	Concrete Additive/ Admixture	Pidilite / Fosroc / STP Ltd / Cera Chem/ Basf/ Zerodrip
22.	Cover /Spacer Block	Fosroc / Astron/ KK
23.	Curtain Rod/ Drapery Rod/ Venetian Blinds/ Blinds	Decorex/Coopers/ Meta Door/ Window Tech
24.	Curing Compound	Pidilite / Fosroc / Sika/ STP Ltd./ Zerodrip / Mapei / BASF
25.	Crash Guard/ Corner Guard	Great Effects/ Window Tech / JDB Healthcare / Decorex
26.	Coupler (mechanical)	Dextron/ Sanfield/ Usha Martin/ G- Tech Splicing/ Ascon/ Halfen/Svaas infra max /SNTF Rebar
27.	Carpet Flooring & Skirting (Flotex)	Krone/ Milliken/ Standard Carpet/ EGE/SUMINOE
28.	Compressed Chequered tiles	Somany / Kajaria /Nitco / Orient/ Johnson & Johnson

Sl. No	Details of equipment/ material	Make/ Manufacturer
29.	Door closer / Floor spring	Godrej/ Dorma/ Hafele/ Kalos
30.	Door Locks & Latches	Godrej / Dorma/Hafele/ Hettich / Kalos
31.	Door Seal	Anand Reddiplex/ Enviroseal / STP
32.	Door (Automatic Sliding Glass Doors with complete mechanism)	Godrej/ Dorma/ Kalos/ Hafele
33.	Door Shutters- Flush & Factory Hot Pressed Laminated Door Shutters	Godrej/ Dorma/ Kalos/ Hafele
34.	Doors & Windows Fixtures / Fitting.	Godrej/ Hafele/ Dorma/Hormann/ Dorma/ Kalos
35.	Epoxy Flooring	Fosroc/ STP/Mapei/Cera-Chem/ BASF/ Saint Gobain/Tessella
36.	Epoxy Mortar	Fosroc/ Sika/ / BASF/ Pidilite/Dr. Fixit/ Saint Gobain/Tessella/Mapei
37.		
38.	Extruded Polystyrene Board	Styrofoam by DOW Chemical's / Insuboard by Supreme Industries /STP Ltd. / Iso board ND,
39.	False Ceiling - Calcium Silicate Boards & Tiles	Armstrong / Saint Gobain (Gyproc)/Aerolite/ /Knauf/ Ceilux / Hunter Douglas
40.	False Ceiling – Metal	Armstrong / Hunter Douglas / Knauf/ Saint Gobain/ /Aerolite /Ceilux
41.	False Ceiling - Mineral fibre	Armstrong / Knauf/ Saint Gobain / Ceilux/ Usg Boral/ Hunter Douglas
42.	False Ceiling – GRG Ceiling Tiles	Saint Gobain /Armstrong/ Ceilux/ Knauf / Hunter Douglas
43.	False Ceiling/ Dry wall partition system (ceiling/hanging sections)	Gyproc/ Knauf/Armstrong/ Western /DEXUNE/ Hunter Douglas/ Saint Gobain (Gyproc) /Ceilux
44.	Fire Rated Doors & Frames with accessories	Shakti-Hormann /Minimax/Cease fire/Newage

Sl. No	Details of equipment/ material	Make/ Manufacturer
45.	Fire Rated Glass	Asahi India Safety Glass Ltd./ Saint Gobain/, Pyroguard/ Modi Glass
46.	Fire Retardant Paint	STP / / Juton/ Soudal/ Nippon Paint/ 3M India/ Dow Corning
47.	Fire Seal	Soudal/ Nippon Paint/ 3M India/ Dow Corning
48.	Fire: Door Closures, Mortise Dead locks, D- Type Pull Handles, Hinges, Panic Exit Devices, Tower Bolts	Dorma/ Godrej/ Hafele/ Shakti- Hormann/Kalos
49.	Fire: Sealant	3M/ Hilti / Soudal/ Nippon Paint/ Dow Corning
50.	Floor Hardener	Pidilite / Sika/BASF/STP Ltd./ Fosroc/Saint Gobain/Tessella/Mapei
51.	Flooring -Synthetic Acrylic (as per ITF Specifications)	Rebound/ PACE Court/Nova Cushion/ Sports Master/ Mapei
52.	Glass : Float / Mirror /Structural Glazing/Toughened Glass	Modiguard / Atul / Saint Gobain/ Asahi India Safety Glass Ltd / Sisecam (HNG)/ Pilkington/ Firelite / Glaverbel
53.	Glass Wool / Insulation Boards	Rockwool / UP Twiga / Lloyd Insulation/ Pidilite/ Berger/ Dexune /Rockfon/ Owens Corning/ Gyptech
54.	GRC Jali	Asian GRC / Nexxstruct GRC / GRC Bangalore
55.	Grout: Non-Shrink	Fosroc / Sika/ Pidilite / Mapei/BASF/ Cera Chem/ STP/Zerodrip /Fosroc
56.	Grouting Compound	Pidilite/ STP/ /Cera Chem / Ultratech/ BASF/ Zerodrip /Fosroc/ Mapei/ JK Tylo / Vura / Tikidan
57.	Gypsum Board / Gypsum False Ceiling/ Gypsum Partitions	Knauf / Saint Gobain (Gyproc)/ Armstrong / / Usg boral/ Ceilux/ Hunter Douglas
58.	Gypsum Plaster	Ultratech/ Saint Gobain/ Asian Paints /USG Knauf / Sealix
59.	Laminates/ Veneers	Century/Greenlam/ Duro

Sl. No	Details of equipment/ material	Make/ Manufacturer
60.	Lead Lined Door	Shakti-Hormann/ Metaflex / Tata Pravesh/ Supreme
61.	Modular Grab bars and Disabled Hardware	Dorma / Jaquar/ Hindware/ Kohler / Hife
62.	Modular SS Railing System	Metallica India / /KICH/ / Dorma/Kalos
63.	Modular Kitchen Chimney	Hindware/ Elica/ Glen/ Faber/ Sleek.
64.	Neutron Shielded Door	Ray-Bar Engineering Corp / A-Fabcoln/ A&L shielding INC/ Accurate Radiation Shielding
65.	OT: Conductive Tile Flooring: ESD-Control Tile Flooring	Tarkett/ Armstrong / Responsive/ Gerflor
66.	Paints - Cement Based	Berger/ Nerolac/ Asian Paints/ STP Ltd./ Dulux/ Jotun / Kamdhenu
67.	Paints - Epoxy paint	DULUX/ Nerolac / Berger / Asian /Pidilite/ STP Ltd./ Fosroc / Jotun/ Mapei / / Kamdhenu
68.	Paints - Oil Bound Distemper / Acrylic Washable Distemper /Plastic Emulsion Paint	DULUX/ Asian Paints/ Berger / Nerolac / Jotun/ Nippon/ / Kamdhenu
69.	Paints - Plastic Emulsion Paint (exterior)	Asian Paints (Apex Ultima)/ Berger (Weathercoat all Guard)/ Jotun/ Nerolac (Excel), Dr. Fixit/ DULUX / Kamdhenu
70.	Paints - Synthetic Enamel Paints	DULUX (Gloss), Berger (Luxol Gold), Asian Paints (Apolite), Jotun/ Nerolac / Kamdhenu
71.	Paints - Texture paint	Berger / /Asian Paints / DULUX/STP Ltd./ Jotun / Nerolac / / Kamdhenu
72.	Paint: Anti-Fungal	Sika by Liquid Plastic/ / STP Ltd./ Berger/ Cera-Chem / Kamdhenu
73.	Paint-Wood Finish (Melamine & PU)	Nippon /Asian Paints / Berger / Nerolac / DULUX / / Kamdhenu
74.	Putty (Wall)	JK/ Birla/ Berger/ Asian Paints/ Sealix

Sl. No	Details of equipment/ material	Make/ Manufacturer
75.	Paver blocks / Tiles (All Types)/ Grasscrete pavers	KK / Uni Stone Products (India) Pvt. Ltd/ Hindustan Tiles/ Nitco/ Pavit/ Ultra/ Duracrete/ Ntc Tiles.
76.	Plywood/Block board/Ply board	Greenply/ Archidply/ Century/ Kitply/ National / / Merino /
77.	Polycarbonate Sheets	Greenpro/ GE Laxan- SABIC /PolyAlloy / AmeriLux International
78.	Pre-coated Galvanised Steel Sheet/ Pre- coated Puff Sheet roofing	Tata BlueScope / Llyod Insulations India Ltd / S.R. Metals/Interarch / Bhushan/ Essar/Everest Jindal Steel / JSW Steel
79.	Pre-Laminated Particle Board	Novapan /Century / Greenlam / Archidply Merino/Greenply/Everest / Kitply/ National
80.	PVC continuous fillet for periphery packing of glazings / Structural/ Glazing	Roop / Anand / Forex Plastic/ Nagalia/ Trading Company
81.	PVC Doors	Sintex/ Polyex/ Rajshri / Rushil
82.	PVC Flooring	Tarkett Floors / Gerflor /Armstrong / Responsive/ Wonderfloor
83.	Powder Coating Material pure Polyester	Jotun / Berger / Goodlass Nerolac/ Akzo nobel (Interpon)/Valspar/ Asian PPG
84.	PVC Water Stops	Prince /Supreme/ Finolex/ /
85.	RF Shielded Door	ETS Lindgern/ Synchrony Agency/ Huaming EMC India
86.	Reinforcement Steel / Structural Steel	SAIL/ RINL/ TATA Steel Ltd./ Jindal Steel & Power Ltd./ JSW Steel Ltd./ ESL Steel Ltd. / Electrotherm ET TMT/JSW One TMT For Kerala Projects: Refer GoK Circular No.24/2022-Fin dtd 19.03.2022. BIS mark with IS code No. and License number (CM/L.no) is insisted in reinforcement and to be approved by Engineer-in- Charge
87.	Structural Steel (Hollow Sections)	SAIL/ RINL/ TATA Steel Ltd./ Jindal Steel & Power Ltd./ JSW Steel Ltd./ Apollo Tubes / Parkash Steel

Sl. No	Details of equipment/ material	Make/ Manufacturer
88.	Restroom Cubicles	Merino/ Century/ Greenlam /Dorma/ Trespa/ Aica / Wilsonart
89.	Sealant: Poly-sulphide	Pidilite / FOSROC / CICO / Sika / Dr. Fixit/ / BASF/ NIPPON PAINT / MAPEI
90.	FRP Manhole Covers & Grating	Greenpro/ Everlast/ Polyalloy/ Rawji
91.	SFRC / RCC Manhole Covers/ Perfect RCC Grating	KK Manholes / SK Precast Concrete/ Advent concrete vision / Daya concrete/ Dalal Tiles,/ Tokas concrete product, / Nimco precast
92.	Silicon sealants /Weather Sealant / Structural Glazing Sealant	Pidilite / Fosroc//Dow Corning / Sika/ STP/ Cera-Chem/ Ferrouscrete /Soudal/ Nippon Paint/ 3M India
93.	Stainless Steel	Salem Steel/ Jindal / TATA Steel/ SAIL
94.	Outdoor Sports Flooring	Great Sports Infra/PORPLASTIC/Sunflex/ Rebound/ Herculan/ Mapei
95.	Stainless Steel bolts, Screws, Nuts & Washers	Atul/ GKW/Alloy/ Kalos/Hilti
96.	Stainless Steel Clamps	Hilti / Dorma / Fischer / KALOS
97.	Stainless Steel CP Grating	Chilly / Atul/Alloy/Kalos/Hilti
98.	Stainless Steel D-handles	D-line /Dorma/ Hormann/ Cotswold / Schuco/ SAPA / Kalos
99.	Stainless Steel Friction Stay	Schuco/ Kich/Hafele/Kalos/Godrej
100.	Stainless Steel Hinges/Handles/Door Window Fixtures	Godrej/ Dorma/ Hafele/ KICH/ Hormann/ Kalos
101.	Sunken Portion Treatment	Sika / BASF/ Dr. Fixit/ Endura/ Cera- Chem/ STP/ Zerodrip/Mapei
102.	Super plasticizer	Pidilite / Berger/ Asian Paints/ Cera- Chem/ Dr. Fixit/ STP LTD/ Ferrouscrete koster, Fosroc, sika, Zerodrip/Mapei
103.	Tiles: Glass Mosaic Tiles	Mridul/ Bizzare/ Bisazza/Opto/Musaica
104.	Tiles: Glazed /Ceramic Tiles (Manufactured in own Mother Plant Only)	Kajaria / Somany/ RAK/ Johnson / Simpolo/Orient (Bell), / Tessella

Sl. No	Details of equipment/ material	Make/ Manufacturer
105.	Tiles: Heat Resistant Terrace Tiles	Johnson/ Kajaria/ Tessella/ Somany
106.	Tiles: Vitrified Tiles (Double / Multi Charged)/ Germ free/Full body) (Manufactured in own Mother Plant Only)	Kajaria / Somany/ RAK/ /Johnson/ Simpolo/ Orient (Bell) / Oasis / Tessella
107.	Extruded Hollow Terracotta Tile for façade	Clayton/Hunter Douglas/ Tempio/Moeding as approved by E-I-C
108.	Vacuum Dewatered Flooring	Tremix / Sun Build / Avcon technics
109.	Veneered Particle Board	Duro / Greenply / Century /Action Tesa
110.	Water Proofing Materials	BASF/ Fosroc / Sika / STP /Pidilite/ Cera-Chem/ Mapei/ Dr. Fixit/ Ferrouscrete / Zerodrip
111.	Water Proofing Compound (Crystalline)	Pidilite/ /Mapei/ / Fosroc/ Sika / Ferrouscrete /BASF/Zerodrip
112.	Wooden Laminated Flooring	Pergo/ Armstrong/ Tessella/ Kronotex/ Greenply
113.	Auditorium Chairs	Godrej / Wipro/ Durian/ BP Ergo
114.	Hospital Beds	Godrej/Midmark/Huntleigh/ Niyanta
115.	Expansion Joints	Ferrouscrete / INPRO/ Veda France/ KRON/ Construction speciality
116.	Raised/ False Flooring	Unifloor / Unitile / Camflor
117.	uPVC door & window system	Fenesta, Duroplast/ Windfall/ Encraft/ Aluplast
118.		

Sl. No	Details of equipment/ material	Make/ Manufacturer
	uPVC Door and windows Hardwares	WINDFALL/ FENESTA/ ENCRAFT/ ALUPLAST
119.	Wood Plastic Composite	Wonder Alu/ Ontech /Floresta
120.	High Pressure Laminates	Greenlam/ Merino/ /Trespa / Century
121.	AAC Block	Ultratech/ Ferrouscrete/Renacon/Birla Aerocon
122.	AAC Block adhesive	/Ultratech/ Ferrouscrete/Renacon/ United/Fosroc,/ Sika, / Chryso/Mapei/Vura
123.	Ready Mix Plaster	Ardex Endura/ Ferrouscrete/MYK Arment/ Pidilite/FOSROC/Sika/
124.	Ready Mix Mortar	Ardex Endura/ Ferrouscrete/MYK Arment/ Pidilite/FOSROC/Sika/
125.	Zinc composite panel/Cladding	Reynoarch/Virgo/Aludecor
B. PLUMBING & SANITARY WORKS		
1.	Automatic variable temperature control /fixed temperature control faucets	Jaquar / Parry / / Euronics / Kohler/ Hife
2.	Central Control	Rain Bird, USA/ Toro/ Nelson,
3.	Ball Cock	/ L&T/Audco/ /Advance/ Prop
4.	Ball valves with floats	Zoloto / Leader/ Audco/ honeywell /Advance / Prop
5.	Butterfly valves	Zoloto/ / Audco/ Honeywell/ Kirloskar /Advance/ Prop
6.	C. I Pipes & Fittings	Electrosteel/ NECO / SKF/ Kapilansh
7.	Centrifugally Cast Iron Hubless Pipes & Fitting	NECO/SKF/Kapilansh/RPMF/Hepco
8.	C.I Sluice Valve & Non Return Valve	Kirloskar /Leader /Zoloto/ Audco/Honeywell/ Prop / Advance
9.	Brass Valves (Full way, Check and Globe Valves)	Advance/ /Audco/ L&T / Prop
10.	C.I Valves (Full way, Check and Globe Valves)	Leader / Kirloskar / SKF / Zoloto / NVR/ L&T
11.	C.I. Manhole Covers	NECO/B.I.C./R.I.F/HEPCO/SKF/ KAJECO/ RPMF.

Sl. No	Details of equipment/ material	Make/ Manufacturer
12.	C.P. Fittings: Mixer / Bib Cock/Stop Cock/ Pillar taps/ Angle valve/ Valves Washers / Waste/ Urinal / Spreaders / Accessories etc.	Jaquar / Kohler/Grohe/Hife
13.	Chlorinator	Thermax Ltd/ Watcon, Ion exchange/ Sigma DH Combine Inc./ Siemens/ Techcon/ JUSCO / Prominent Heidelberg
14.	Cockroach Trap	Chilly/ Player/ Camry/ Viking/cardin/ XEN
15.	Copper Pipe/Fittings (Capillary)	Yorkshire Imperial, U.K./ Rajco Metal Works Mumbai / IBP Conex Ltd.
16.	Disc Filter	Azud, Spain/ Amaid / Arkal,
17.	Drainage Pumps	KSB/ Grundfos/ Kirloskar/ Crompton/ KCJ
17.	Ductile Iron Fittings (IS:9523) / Ductile Iron Pipes (IS:8329)	Electrosteel/ Kesoram/ Tisco/ Jindal/ HEPCO/ Electrotheram
18.	E.P.D.M Gaskets	Anand Reddiplex / Enviro Seals / HANU
19.	Forged Steel Fittings & Flanges (For Welded joints)	Rohini /Kanwal/ Vijay Cycle & Steel (VS)
20.	DI-UL/FM & Flanges (For Welded joints)	Audco/ / Unique/ Vijay Cycle & Steel (VS) / Prop
21.	Geyser	Racold /Bajaj/ Havells/Jaquar
22.	Groove Coupling and fittings	Victaulic/ Amith cooper /Anvil
23.	Hand Drier	Euronics/ Automat/ Toshi/Jaquar/ Hife
24.	HDPE Pipes / Moulded Fittings	Jain Irrigation / / Supreme/ Oriplast/ Finolex / Prop
25.	HDPE Solution tank	Watcon / Ion Exchange / Water Supply Specialist Pvt. Ltd.
26.	Inbuilt Drip Line	Azud/ Rainbird/ Netafim
	Insulation of Hot water pipes	Vidoflex insulation / Superion insulation Kaiflex – Kaimann/Armoflex/Thermafex /Tikidan
	Liquid Level Controllers / Indicators	Advance Auto / Sridhan International / Minilec / Radar / Switzer / 21st Century/ Auto pump/Cirrus,

Sl. No	Details of equipment/ material	Make/ Manufacturer
		engineering/ Technika/Pumptrol/ Pune techtrol/ Lehry
27.	Liquid Soap Dispenser	Euronics/Utec/Kopal// Toshi /Jaquar / Hife
28.	MS Saddle with G.I. Riser	Harvel/Alprene/Rain Bird
29.	PVC flushing cistern	Kajaria Sanitary ware/ Somany/ Jaquar/ Hife
	Concealed cistern	GABREIT/ Grohe/ Cera/Hife/Jaquar / Hindware
30.	P.R.S. Dials	Rain Bird/ Toro/ Nelson,
31.	P.T.M.T. Fitting	Prince India / Symet/ Prayag/ Cera
32.	Pipe coat material (pipe protection)	RPG Raychem/ Pypkote/ Makphalt/ Tikidan/IWL
33.	Pipe Fittings: G.I.	Unik/ Zoloto/ Jainsons / /Bhart Forge /
34.	Pipe:- G.I.	Jindal (Hissar) / Tata / SAIL/ APL-Apollo/ Bhushan power steel /
35.	Pipes & fitting: PVC for SWR Soil, Waste & Vent Pipes and fittings, Type B PVC Casing & Screen Pipes	Prince / Supreme / Finolex/ Astral / Prop
36.	Pipes & Fittings: CPVC	Prince/ Astral / Supreme / Finolex / Prop
37.	Pipes & fittings: UPVC	Finolex / Prince / Supreme / Astral / Prop
38.	Pipes & Gully Trap: Stone ware	Perfect / S.K.F/ R.K/ Hind / Anand/ Burn
39.	Pipes and Accessories: PE-AL-PE	Kitec/ Jindal/ Kissan/Vista
40.	Pipes: Copper	Rajco Metal works, Mumbai / IBP Conex Ltd.
41.	Pipes: M.S.	Jindal / Prakash – Surya /TATA /SAIL/ Prop Steel
42.	Pipes: PP-R (PN – 16)	Amitex Polymers Pvt. Ltd./Prince/ Supreme
43.	Pipes: R.C.C	Indian Hume Pipe / Pragati Concrete /Udyog Daya/ lakshmi/ / jain & co./ usha/
	Pipes: Triple Layer Low Noise (Polypropylene) PP Pipe	Ostendorf-Skolan Safe/aquapro-safe/poloplast

Sl. No	Details of equipment/ material	Make/ Manufacturer
44.	Plastic seat cover of W.C	Jaquar /Kerovit/Duravit/ Kohler/Grohe/ Hife/ Hindware / Cera / Parryware
45.	Polyethylene Storage Tank	Sintex/ Polycon/ Supreme / Polyplast
46.	PVC Floor trap	Platinum/ Khodiyar/ Supreme/ Finolex
47.	Pop up Connecting Assembly	Rain Bird/Dura/Lasco,
48.	Popup Spray Head	Rain Bird/Toro, USA/Nelson,
49.	RQRC Hydrant	Harvel/Alprene/Rain Bird, USA
50.	RQRC Key	Harvel/ Aqua/ Drip& Drip
51.	Sensor Operated Auto Flushing System Urinals	Jaquar /Kerovit/ Euronics/ ASIAN/ Duravit/ Kohler/Grohe/ Hife
52.	SS Gratings/ Soap Dish/Towel Rail etc.	Jaquar/ Grohe/ Asian/ Hife
53.	Stainless Steel Sink	Hindware / Cera/ ASIAN /Hafele/ Kalos
	Bed Pan Sink	CMP Metal/Vijay metal or equivalent as approved by E-I-C
	Stainless Steel Pipe & Fittings of Grade AISI 304 as per JIS Standard 3448 for Water Supply Line and Fittings	Sail (Salem Steel)/ Jindal / J-Press/ alfa Press
54.	Safety foot Steps	MCP/ GP/ Surabh
55.	Valve Box	Rain Bird USA/Carson Brook, USA/Dura,
56.	Valve: Air Release	Zoloto/Audco/Kirloskar/Advance/ Venus / Honeywell/ Drp/ Prop
57.	Valve: Butterfly	Zoloto/Audco/Kirloskar/Advance/ Venus / Honeywell/ Drp/ Prop
58.	Valve: Flush /Flushometer	Jaquar / Marc/ Asian/ Prop
59.	Valve: Mainline Isolation	Leader /Zoloto, Kirloskar/ Audco/ Advance/ Prop
60.	Valve: Pressure Relief	Leader/ Zoloto / Audco/ Honeywell/ Advance/ Prop
61.	Valve: Sluice / NRV	Kirloskar/ /Zoloto/ Leader / L&T/ Audco/ Honeywell / DRP /
62.	Valve: Solenoid	Audco/ Advance /Honeywell/ Prop

Sl. No	Details of equipment/ material	Make/ Manufacturer
63.	Valves: Gunmetal / C.P brass angle	Zoloto/ Leader / Audco/ Kirloskar/ Jaquar/ Drp Advance / Prop
64.	VFD Pump	Crompton/ Kirloskar/ KSB/ Grundfos/ /KCJ
65.	Vibration Eliminator Resisto-flex Pads & Connections	Relay Corpn./ Kanwal/ Dunlop /flexionics
66.	Vitreous China Sanitary wares & White Glazed Fire Clay Sink	Jaquar /Kerovit/Duravit/ Kohler/Grohe/ Hife / Hindware / Parryware
67.	Water Cooler	Voltas/ Usha/Godrej/ Aquaguard/ Blue Star
68.	Water Meter	Capstan / Kant/ Aristo/ Chambal/ Crescent/ Prince/
69.	Water supply pumps	KSB/ Grundfos/ Kirloskar/ Crompton/ KCJ
70	Modular Rain water harvesting pits	Atharva Energy/Retas Enviro Solution Pvt. Ltd/Nugreen Energy pvt Ltd/Bantair India Pvt. Ltd.

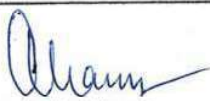


NATIONAL CENTRE FOR DISEASE CONTROL

SHAMNATH MARG, NEW DELHI
Dte. GHS, Ministry of Health & Family Welfare, Govt. Of India

LIST OF PROPOSED MAKES/MANUFACTURERS FOR ELECTRICAL & ASSOCIATED WORKS

S. No.	Materials	Manufactures
1	11 KV VCB Panel Board	Siemens/ Areva/ ABB/ Crompton Greaves/ Kirloskar / L&T/ Andrew Yule
2	11 KV XLPE Cable	Incab/ Universal/ NICCO/ CCI
3	Compact or Unitized Substation	Areva/ Crompton Greaves/ Kirloskar/ ABB
4	Bus Duct/rising mains	L&T/ Siemens/ ABB/ GE/ Schneider
5	Diesel Engine	Cummins/ Kirloskar/ Caterpillar/ Greaves Cotton
6	Alternator	Stamford/ Kirloskar/ Leroy Somer & Control/ Crompton Greaves/ Caterpillar
7	Battery	Exide / Standard Furukawa/ Amar Raja
8	L.T. Cables	Universal/ ICC/ NICCO/ INCAB/ KEI
9	PVC insulated Wires/ Telephone wires & cables, axial cables	Finolex/ Havells/ Polycab/ KEI/ L&T/ Batra Henlay
10	Telephone Tag Blocks	Krone Type
11	Switch & sockets	CLIPSAL (Schneider) IP 66 rated for BSL-3 Lab, Modular - Legrand/Schneider/Crabtree
12	Industrial Sockets & Plugs	Siemens/Schneider/Crompton/MDS/ BCH/ Havell's
13	PVC Conduit	BEC/ AKG/ Polycab
14	Lighting fixtures (LED)	Philips/ GE/ Crompton /Wipro For BSL 3 IP 65 or better
15	Ceiling Fan/ Exhaust fan	Crompton Greaves/ Alstom/ Usha/ Bajaj
16	Main LT Panel & MV Panels	CPRI approved Manufacturer
17	UPS & Inverter	Tata Emerson/APC/Sukam/Luminous/Microtec
18	Air Circuit Breakers	L&T/ GE Power Controls/ Siemens/ ABB/ Schneider
19	MCCB	L&T/ GE Power Controls/ Siemens/ ABB/ Schneider
20	MCB-DB's, MCB, ELCB RCCB / MCB-Isolator etc	L&T/ GE Power Controls/ Siemens/ MDS/ Schneider
21	SDFU	L&T/ GE Power Controls/ Siemens/ Schneider
22	Power Contactors	L&T/ GE Power Controls/ Siemens/ Schneider/ ABB
23	LIFTS	OTIS/ Kone/ Scheindler/ Mitubshi./ Johnson
24	EPABX	Siemens/ Ericsson/ Alcatel/ Avaya
25	FDA System	Honeywell/ Edwards/L&T/ Siemens
26	P.A. System	BOSCH/ Bose/ Honeywell/ Harman


(Er. A.H. Khan)


(Er. Ajay Khare)



NATIONAL CENTRE FOR DISEASE CONTROL

SHAMNATH MARG, NEW DELHI
Dte. GHS, Ministry of Health & Family Welfare, Govt. Of India

27	CCTV System	Hikvision/ CP Plus/ LG
28	Lamps & Push Buttons Relays Current Transformer/ Ammeter/Voltmeter	L&T/GE/ Siemens/ Schneider

LIST OF PROPOSED MAKES/MANUFACTURERS FOR HVAC & ASSOCIATED EQUIPMENT WORKS

S. No.	Materials	Manufactures
1	Chilling Units (Air Cooled)	Voltas / Blue star/ Carrier /Hitachi/Daikin
2	Double skin type AHU	Carrier/ Caryaire/Blue Star/ZECO/Saiver AHU
3	Cooling Coils	Bluestar/Voltas/Zeco/Hitech/Caryaire/Carrier
4	Centrifugal fan of double skin type AHU	Nicotra/ Comefri/Flakt/Kruger/GEC
5	Humidifier	Rapid cool/Emerald/Khokar
6	Exhaust Fan Sections	Hitech/ Edgetech/Flowel
7	FCUs	Hitech/Blue Star/Carrier/Zeco/Voltas
8	Ductable Split(Air Cooled)	Voltas / Blue star/ Carrier /Hitachi
9	Window /Split type Air conditioners	Voltas / Blue star/ Carrier/Hitachi
10	Extruded Aluminium Air terminals	Dynacraft /Caryaire /Ravistar /opella /Servex /Mapro
11	Fire damper with controls	Caryaire/ Dynacraft/ Ravi star
12	Centrifugal Exhaust Blower	GEC/ Swent / Flakt/Nadi / Divine
13	Inline Fan	Kruger/ Flakt/ Comefri/Nicotra
14	Propeller Fan	GEC(Alsthom)/Crompton Greaves/ Khaitan/Usha/Polar
15	Axial Fan	Kruger/ Flakt/ Comefri
16	GI Pipes	ITC/ Jindal/Tata/SAIL/HSL
17	MS pipe upto 150 mm dia	ITC/ Jindal/Tata/SAIL/HSL MS
18	MS pipe 200 to 300 dia	ITC/ Jindal/Tata/SAIL/HSL
19	GI Sheets	TATA/SAIL/Jindal/Bhushan Steel
20	SS Sheet	TATA/SAIL/Jindal
21	Grilles/Diffusers	Ravistar/ Caryaire/ Mapro/Dynacraft
22	Fire dampers (Motorized)	Caryaire/Dynacraft / Ravistar Electric
23	Hot Water Generator	Rapid cool/Emerald/Khokar
24	Gate Valve	Leader/ Divine/Sant/Bankim Sarkar
25	Butterfly Valves	Advance/ Castle / Audco / Intervolve / Arrow / C&R
26	Balancing Valves	Advance/ Castle/ Audco/ Arrow/ C&R
27	Non-return Valves	Advance/ Castle/Kirloskar/C&R/ Arrow
28	Pot & Y- Strainer	Emerald/Sant/Rapid cool
29	Three way mixing valves	Stafea/Johnson/Honeywell/Danfoss/ Anergy/Rapid controls

(Er. A.H. Khan)


(Er. Ajay Khare)

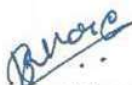


NATIONAL CENTRE FOR DISEASE CONTROL

SHAMNATH MARG, NEW DELHI
Dte. GHS, Ministry of Health & Family Welfare, Govt. Of India

30	Two way motorized valve	Staefa/Johnson/Honeywell/Danfoss/Anergy / Rapid controls
31	Actuating motor for 3 way & 2 way valve	Staefa/Johnson/Honeywell/Danfoss/Anergy
32	Ball Valve with & without strainer	Rapid Control/Sant/Leader
33	Fibre glass	FGP Ltd./UP Twiga/Kimmco / Owens Corning
34	Expanded Polystyrene	Beardsell Ltd./ BASF/Styrene Packing/ Indian Packaging Industries / Lloyd
35	Thermometers/Pressure Gauge	Fiebig/Emerald/H Guru/Japsin
36	Thermostats/Humidistats	Honeywell/Penn /Staefa/Johnson/ Anergy / Rapid Controls
37	Electric Strip Heaters	Escorts/Daspass
38	Controls	Honeywell/ Johnson / Staefa
39	Electric Panels	CPRI approved make
40	Electric Motors	Siemens/ Kirloskar / ABB/ Bharat Bijlee / Crompton Greaves
41	Starters/Contactors	L&T/ GE Power/ Siemens/ ABB
42	ACB/MCCB	L&T/ GE Power/ Siemens/ ABB Switch
43	Fuse/ Fuse Switch Unit	L&T/ GE Power/ Siemens/ ABB
44	Isolation Damper	Trox/Camfil/YIT/Greenheck
45	VAV	Trox/ Aldes/Celmec/Tek-Air (Accutrol)
46	HEPA Filters	AAF/Camfil/Klenzaid/Thermadyne
47	Containment HEPA Filter housing	Camfil/YIT/Klenzaid
48	VFD	ABB/Seimens/AllenBradley/Danfoss
49	Pressure sensor & transmitter	Honeywell/Dawyer/Danfoss/Siemens
50	Temperature sensor & transmitter	Honeywell/Dawyer/Danfoss/Siemens
51	Humidity sensor & transmitter	Honeywell/Dawyer/Danfoss/Siemens
52	BMS system	AllenBradley / Siemens / ABB
53	PLC	AllenBradley/Siemens
54	Magnehelic Gauges	Dawyer
55	Prefabricated wall and ceiling panels	Nicomac/I-Clean/GMP
56	View Panels	Nicomac/I-Clean/GMP
57	Laboratory Doors	Nicomac/I-Clean/GMP
58	Biosafety Cabinet	Esco/Nuaire/Thermo/Klenzaid
59	Autoclave	Pharmalab/Klenzaid/Machinfabrik


(Er. A.H. Khan)


(Er. Ajay Khare)



NATIONAL CENTRE FOR DISEASE CONTROL

SHAMNATH MARG, NEW DELHI
Dte. GHS, Ministry of Health & Family Welfare, Govt. Of India

60	Dynamic Pass Box	Esco/Klenzaidis/I-Clean
61	Fire Alarm System	Honeywell/System Sensor/GST/Siemens
62	Door Interlock & Access Control	HID/LG/ESFL
63	LED for CCTV display	Samsung/LG/Sony/Panasonic
64	Air Compressor	Atlas Copco / Ingersoll Rand
65	CAT6 cables	AT&T/KABEL/LUCENT/LAPP/Digilink
66	Protection Relays	ABB/L&T/Seimens/Schneider
67	Single phase preventor	L&T / Mirulec
68	View Panels	Nicomac/I-Clean/GMP
69	Laboratory Doors	Nicomac/I-Clean/GMP
70	Epoxy Coating	Dr. Beck / Apurva / Fosroc

Any item not included above should conform to the relevant BIS specifications, wherever applicable.

Er. A.H. Khan,
Former Engineer with HSCC,
ICMR-NTV Pune and ICAR

Er. Ajay Khare,
In-Charge, Engineering Support Group
ICMR-NTV, Pune

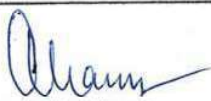


NATIONAL CENTRE FOR DISEASE CONTROL

SHAMNATH MARG, NEW DELHI
Dte. GHS, Ministry of Health & Family Welfare, Govt. Of India

LIST OF PROPOSED MAKES/MANUFACTURERS FOR ELECTRICAL & ASSOCIATED WORKS

S. No.	Materials	Manufactures
1	11 KV VCB Panel Board	Siemens/ Areva/ ABB/ Crompton Greaves/ Kirloskar / L&T/ Andrew Yule
2	11 KV XLPE Cable	Incab/ Universal/ NICCO/ CCI
3	Compact or Unitized Substation	Areva/ Crompton Greaves/ Kirloskar/ ABB
4	Bus Duct/rising mains	L&T/ Siemens/ ABB/ GE/ Schneider
5	Diesel Engine	Cummins/ Kirloskar/ Caterpillar/ Greaves Cotton
6	Alternator	Stamford/ Kirloskar/ Leroy Somer & Control/ Crompton Greaves/ Caterpillar
7	Battery	Exide / Standard Furukawa/ Amar Raja
8	L.T. Cables	Universal/ ICC/ NICCO/ INCAB/ KEI
9	PVC insulated Wires/ Telephone wires & cables, axial cables	Finolex/ Havells/ Polycab/ KEI/ L&T/ Batra Henlay
10	Telephone Tag Blocks	Krone Type
11	Switch & sockets	CLIPSAL (Schneider) IP 66 rated for BSL-3 Lab, Modular - Legrand/Schneider/Crabtree
12	Industrial Sockets & Plugs	Siemens/Schneider/Crompton/MDS/ BCH/ Havell's
13	PVC Conduit	BEC/ AKG/ Polycab
14	Lighting fixtures (LED)	Philips/ GE/ Crompton /Wipro For BSL 3 IP 65 or better
15	Ceiling Fan/ Exhaust fan	Crompton Greaves/ Alstom/ Usha/ Bajaj
16	Main LT Panel & MV Panels	CPRI approved Manufacturer
17	UPS & Inverter	Tata Emerson/APC/Sukam/Luminous/Microtec
18	Air Circuit Breakers	L&T/ GE Power Controls/ Siemens/ ABB/ Schneider
19	MCCB	L&T/ GE Power Controls/ Siemens/ ABB/ Schneider
20	MCB-DB's, MCB, ELCB RCCB / MCB-Isolator etc	L&T/ GE Power Controls/ Siemens/ MDS/ Schneider
21	SDFU	L&T/ GE Power Controls/ Siemens/ Schneider
22	Power Contactors	L&T/ GE Power Controls/ Siemens/ Schneider/ ABB
23	LIFTS	OTIS/ Kone/ Scheindler/ Mitubshi./ Johnson
24	EPABX	Siemens/ Ericsson/ Alcatel/ Avaya
25	FDA System	Honeywell/ Edwards/L&T/ Siemens
26	P.A. System	BOSCH/ Bose/ Honeywell/ Harman


(Er. A.H. Khan)


(Er. Ajay Khare)



NATIONAL CENTRE FOR DISEASE CONTROL

SHAMNATH MARG, NEW DELHI
Dte. GHS, Ministry of Health & Family Welfare, Govt. Of India

27	CCTV System	Hikvision/ CP Plus/ LG
28	Lamps & Push Buttons Relays Current Transformer/ Ammeter/Voltmeter	L&T/GE/ Siemens/ Schneider

LIST OF PROPOSED MAKES/MANUFACTURERS FOR HVAC & ASSOCIATED EQUIPMENT WORKS

S. No.	Materials	Manufactures
1	Chilling Units (Air Cooled)	Voltas / Blue star/ Carrier /Hitachi/Daikin
2	Double skin type AHU	Carrier/ Caryaire/Blue Star/ZECO/Saiver AHU
3	Cooling Coils	Bluestar/Voltas/Zeco/Hitech/Caryaire/Carrier
4	Centrifugal fan of double skin type AHU	Nicotra/ Comefri/Flakt/Kruger/GEC
5	Humidifier	Rapid cool/Emerald/Khokar
6	Exhaust Fan Sections	Hitech/ Edgetech/Flowel
7	FCUs	Hitech/Blue Star/Carrier/Zeco/Voltas
8	Ductable Split(Air Cooled)	Voltas / Blue star/ Carrier /Hitachi
9	Window /Split type Air conditioners	Voltas / Blue star/ Carrier/Hitachi
10	Extruded Aluminium Air terminals	Dynacraft /Caryaire /Ravistar /opella /Servex /Mapro
11	Fire damper with controls	Caryaire/ Dynacraft/ Ravi star
12	Centrifugal Exhaust Blower	GEC/ Swent / Flakt/Nadi / Divine
13	Inline Fan	Kruger/ Flakt/ Comefri/Nicotra
14	Propeller Fan	GEC(Alsthom)/Crompton Greaves/ Khaitan/Usha/Polar
15	Axial Fan	Kruger/ Flakt/ Comefri
16	GI Pipes	ITC/ Jindal/Tata/SAIL/HSL
17	MS pipe upto 150 mm dia	ITC/ Jindal/Tata/SAIL/HSL MS
18	MS pipe 200 to 300 dia	ITC/ Jindal/Tata/SAIL/HSL
19	GI Sheets	TATA/SAIL/Jindal/Bhushan Steel
20	SS Sheet	TATA/SAIL/Jindal
21	Grilles/Diffusers	Ravistar/ Caryaire/ Mapro/Dynacraft
22	Fire dampers (Motorized)	Caryaire/Dynacraft / Ravistar Electric
23	Hot Water Generator	Rapid cool/Emerald/Khokar
24	Gate Valve	Leader/ Divine/Sant/Bankim Sarkar
25	Butterfly Valves	Advance/ Castle / Audco / Intervolve / Arrow / C&R
26	Balancing Valves	Advance/ Castle/ Audco/ Arrow/ C&R
27	Non-return Valves	Advance/ Castle/ Kirloskar/ C&R/ Arrow
28	Pot & Y- Strainer	Emerald/ Sant/ Rapid cool
29	Three way mixing valves	Stafea/ Johnson/ Honeywell/ Danfoss/ Anergy/ Rapid controls

(Er. A.H. Khan)


(Er. Ajay Khare)

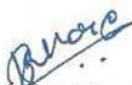


NATIONAL CENTRE FOR DISEASE CONTROL

SHAMNATH MARG, NEW DELHI
Dte. GHS, Ministry of Health & Family Welfare, Govt. Of India

30	Two way motorized valve	Staefa/Johnson/Honeywell/Danfoss/Anergy / Rapid controls
31	Actuating motor for 3 way & 2 way valve	Staefa/Johnson/Honeywell/Danfoss/Anergy
32	Ball Valve with & without strainer	Rapid Control/Sant/Leader
33	Fibre glass	FGP Ltd./UP Twiga/Kimmco / Owens Corning
34	Expanded Polystyrene	Beardsell Ltd./ BASF/Styrene Packing/ Indian Packaging Industries / Lloyd
35	Thermometers/Pressure Gauge	Fiebig/Emerald/H Guru/Japsin
36	Thermostats/Humidistats	Honeywell/Penn /Staefa/Johnson/ Anergy / Rapid Controls
37	Electric Strip Heaters	Escorts/Daspass
38	Controls	Honeywell/ Johnson / Staefa
39	Electric Panels	CPRI approved make
40	Electric Motors	Siemens/ Kirloskar / ABB/ Bharat Bijlee / Crompton Greaves
41	Starters/Contactors	L&T/ GE Power/ Siemens/ ABB
42	ACB/MCCB	L&T/ GE Power/ Siemens/ ABB Switch
43	Fuse/ Fuse Switch Unit	L&T/ GE Power/ Siemens/ ABB
44	Isolation Damper	Trox/Camfil/YIT/Greenheck
45	VAV	Trox/ Aldes/Celmec/Tek-Air (Accutrol)
46	HEPA Filters	AAF/Camfil/Klenzaid/Thermadyne
47	Containment HEPA Filter housing	Camfil/YIT/Klenzaid
48	VFD	ABB/Seimens/AllenBradley/Danfoss
49	Pressure sensor & transmitter	Honeywell/Dawyer/Danfoss/Siemens
50	Temperature sensor & transmitter	Honeywell/Dawyer/Danfoss/Siemens
51	Humidity sensor & transmitter	Honeywell/Dawyer/Danfoss/Siemens
52	BMS system	AllenBradley / Siemens / ABB
53	PLC	AllenBradley/Siemens
54	Magnehelic Gauges	Dawyer
55	Prefabricated wall and ceiling panels	Nicomac/I-Clean/GMP
56	View Panels	Nicomac/I-Clean/GMP
57	Laboratory Doors	Nicomac/I-Clean/GMP
58	Biosafety Cabinet	Esco/Nuaire/Thermo/Klenzaid
59	Autoclave	Pharmalab/Klenzaid/Machinfabrik


(Er. A.H. Khan)


(Er. Ajay Khare)



NATIONAL CENTRE FOR DISEASE CONTROL

SHAMNATH MARG, NEW DELHI
Dte. GHS, Ministry of Health & Family Welfare, Govt. Of India

60	Dynamic Pass Box	Esco/Klenzaidis/I-Clean
61	Fire Alarm System	Honeywell/System Sensor/GST/Siemens
62	Door Interlock & Access Control	HID/LG/ESFL
63	LED for CCTV display	Samsung/LG/Sony/Panasonic
64	Air Compressor	Atlas Copco / Ingersoll Rand
65	CAT6 cables	AT&T/KABEL/LUCENT/LAPP/Digilink
66	Protection Relays	ABB/L&T/Seimens/Schneider
67	Single phase preventor	L&T / Mirulec
68	View Panels	Nicomac/I-Clean/GMP
69	Laboratory Doors	Nicomac/I-Clean/GMP
70	Epoxy Coating	Dr. Beck / Apurva / Fosroc

Any item not included above should conform to the relevant BIS specifications, wherever applicable.

Er. A.H. Khan,
Former Engineer with HSCC,
ICMR-NIV Pune and ICAR

Er. Ajay Khare,
In-Charge, Engineering Support Group
ICMR-NIV, Pune

1. Horizontal Laminar Air flow/ Laminar Air Flow
(GeM Nomenclature: Laminar Air Flow Cabinets or Stations)

Product Description	
UMDNS Name and Code	Cabinets, Biological safety, Class II: 20-653
Other Names	Laminar Flow (Horizontal)
Purpose	A laminar airflow workstation is a closed cabinet fitted with HEPA filtered airflow system
Certifications	
Confirmity to Certifications	CE/USFDA/CE & USFDA/CSDSCO
Confirmity to Manufacturing Standards	ISO 9001 & ISO 13485/ISO 90001 & ISO 13485
Confirmity to Safety Standards	IEC 60601-2-18 / BIS equivalent
Technical Specifications	
Type of configuration	Freestanding/ benchtop
Type of air flow direction	Vertical/Horizontal
Type of air cleanliness	Class 100
Material used for the work bench	Stainless steel 304/Powder coated MS/GI/Stainless steel 316
Type of Sash (front door)	Manual sliding
Material used for the front door	Acrylic transparent
Material used for the Side panels	Acrylic
Thickness of the floor or side panels	2-8 mm
Door and Frames should be hermetically sealed	Yes
Laminar air flow Velocity (m/s)	0.4- 0.45
Air changes per Hours, Min	30
Type of light	LED
Number of LED lamps	1/2
Noise level (± 5) in DB	Less than 65
Availability of Pre-Filter (washable) for air filtration with 10 microns	Yes
Availability of HEPA filter (Microns)	0.3
Availability of air/gas cock	Mains switch
Availability of motorized sliding door	No
LCD display for velocity, time & lamp on/off	Yes
UV Hour meter	Yes
UV Germicidal lamp	Yes
DOP HEPA filter testing	Yes
Digital Pressure Gauge with Alarm	Yes
Availability of display	Yes
Type of display	LCD/LED
Power Requirements	
Power supply	100- 240, 50-60 Hz
Purchase Information	
User/Technical/Maintenance manuals to be supplied in English in hard and soft copy	Yes

Installation, Demonstration and training to be provided at consignee end	Yes
The Principal Manufacturer Must Have Direct Presence/approved service centre In India	Yes
Warranty (year)	≥5
Copies of all certifications and reports to be provided to buyer on demand at time of supplies	Yes

2. PCR Workstation/ PCR Cabinet (Not available in GeM Portal)

1. Bench top model, require no duct work
2. Inner chamber dimension: LXWXH (1.5-2 ft X 1-1.5 ft X 1.5 -2 ft) or better
3. Outer chamber should be made up of mild steel/GI sheet with powder coated body.
4. Working chamber with the three-stage filter- prefilter, carbon filter, HEPA filter of 99.9% efficiency or better, UV radiation and SS 304 or better body and work surface, chemical resistant.
5. Working chamber with 2 inbuilt short wave UV tubes (254nm, 25 W or better) and 1 UV tube in UV air circulation (250±30nm, 8 W or better) and 1 white light tube (15 W or better) fitted with UV timer minimum 01 to 59 minutes with automatic UV cut-off switch when sash is opened. Functional indicator for UV air circulating tube.
6. Sash should be made up of clear, UV resistant and Chemical resistant acrylic glass.
7. Working chamber may have built-in Pipettes holder.
8. CE IVD/USFDA/BIS certified or manufacture ISO certified.

3. Micro-fuge/ Microfuge (minicentrifuge/Tabletop Centrifuge) (GeM Nomenclature: Refrigerated Micro Centrifuge)

SET 1	
Microprocessor controlled High speed Micro centrifuge	Yes
Maximum permissible Speed (RPM)	13000 to 15000
Relative Centrifugal Force (RCF), Max	20,000 ×g to 22,000 × g
Temperature Range	-10 degree C to +40 degree C
Refrigeration System	NA
Display for Speed, RCF, Temperature and Time parameters	Yes
Type of Display	LCD display/ LED display/Full colour touch screen interface display
Facility for short run operation	Yes
Imbalance System and Selectable acoustic Alarms	Yes
Running Modes available: soft/fast accelerate, decelerate and break off mode	Acceleration/Deceleration rates 9/10
Operation of equipment	By keypad operations/ By Touch screen
Angle rotor Polypropylene/metallic 24 x (15/10) ml or Dual row rotor with same capacity/volume	With angle rotor 24×1.5/2.0mL rotor with Click seal bio containment lid

Lid	Click seal bio containment lid
Certification:	US FDA/ CE(European)/ICMED 13485 plus/CDSCO/BIS
Adopter for PCR tube sizes	0.2ml to 0.5ml
Time Selection:	1-99min or continuous

4. Vortex Mixer

Warranty	
Warranty on machine	≥ 5 Years
Discretion	
Type of Drive Motor	Brushless DC Motor
Display Option/Output Read out Option	Digital
Material of Mixing Head/vortex cup	Rubber
Type of Vortex Mixer	Mini Vortex Mixer/Standard Vortex Mixer
Type of Controller	Microprocessor Controlled
Timer setting increment steps	1 minute
Base material	Die cast aluminium
Number of Sample tubes testable simultaneously	Multi-tube
User Interface	Digital Front panel without Glove mode/ Digital Front panel with Glove mode
Largest Volume of the tube testable	≥200 millilitre
Finish of Body material	Powder coated/Electro plated
Body material	Die cast Aluminium
Maximum Load capacity	should be ≥0.1 kg
Features	
Activation mode	Press Activated and Continuous run
Speed mode	Variable Speed
Number of Programmable/Programmed modes	1
Maximum speed (RPM)	≥3000
Minimum Speed (RPM)	≥300
Timer Provided	Yes
Pulse mode	Yes
In built Counter balance	Yes
Programmable Pulse mode	Yes
Speed control Accuracy (+/-) (RPM)	0-50
Suction Cup in the base	Yes
Auto Cutoff	Yes
Dimensions	
Orbital Diameter	2-6 millimeter
Power	
Input Voltage (V) with number of Phases	AC 100-240 volts single phase
Certifications	

Availability of test report (to be furnished to Buyer by Seller on demand of the former) from NABL/ILAC/Govt laboratory	Yes
Test Report Number and date	As Applicable
Name and address of the Lab issuing test report	As Applicable
Product CE certified	Yes
Firm certified to ISO9001:2008 or latest	Yes
If CE certified, EN/IEC directives	-
Operating Parameters	
Ambient operating Temperature (0 to 50 Degree Celsius)	Yes

5. Deep Freezer-20°C

STANDARDS	
Conformity to Certifications	BIS/CE/USFDA
Certification date and number	As applicable
Conformity to electrical safety	IEC 61010-1,2 /IS13450
Performance parameters	
Purpose	For storage of biological products including ATCC cultures, enzymes, vaccines, chemicals or material testing components for a longer period of time
Capacity in Litres (range)	200 or more
Type of cabinet	Vertical/Upright /Chest
Ground Clearance in mm (range)	50 mm or more
Cooling type	Forced air cooling
Freezer body	Galvanized steel body with tough powder coated exterior finish
Castors	Heavy duty (lockable)
Lockable outer doors and lids	Yes
Material of internal cabinet	Stainless steel
Freezer should use CFC-free, HCFC-free non-flammable refrigerants	Yes
Refrigeration system must be energy efficient	Yes
Pull down time in hrs	2.5 to 5.2 hrs
Operating Temperature in degree Celsius	-20°C to - 40°C
Increment variation setting	1°C or better
Number of corrosion resistant racks	Not less than 4

Control	Fully programmable microprocessor controlled with membrane keypad and eye level control panel & digital temperature display LEC with 0.1°C graduation/ Microprocessor digital electronic controller cum indicator, PID controller
Number of inner storage compartments with insulated doors	Not more than 5
Digital temperature display	Yes
Should have battery backup for the display and security lock for the display	Yes
Alarms	Audible and visible alarm systems for unwanted temperature rise, sudden power failure, system failure and low battery, high and low temperature, hot condenser, open door, clean filter indicator, there should be a method to check alarm system
Noise level in dB Value	≤ 60
Stabilizer should be capable to run any voltage between 190V - 270 V	Yes
Warranty of Stabilizer in Years	≥5
Warranty of Freezer in Years (from the date of installation)	≥5
Additional Parameters	
Freezer must have washable condenser filter indicator which should keep fins free of dust to maintain peak cooling efficiency	Yes
One 5KVA servo stabilizer to be supplied with freezer	Yes
CO ₂ cylinder should be supplied with freezer for backup	No
Temperature Chart recorder to be provided	Yes
Reports	
Manufacturer should have ISO certification	Yes
ISO certification date and number	As applicable
Copies of all certifications and reports to be provided to buyer on demand at time of supplies	Yes

Additional specifications-

- Hermetically sealed dual compressor with 5 years or more warranty and online UPS with at- least 1 hour backup.

6. Micropipette/ Single channel Micropipettes

(Gem Nomenclature: Manual Single Channel Air Displacement Pipettes)

Features and Sizes	
Type of Micropipette	Variable volume single channel
Material of Piston	Chemically Resistant
Micropipette with spring loaded tip cone	Yes
Autoclavable	Yes
Capacity of Fixed Volume Single Channel Micropipette	NA
Locking Mechanism	Yes
Availability of Digital Volume Indicator	Yes/No
Minimum Volume of Variable Volume Pipette (Hint: Type NA in Case of Fixed Volume pipette, ul = µl)	0.1 µl /1.0µl/ 10 µl/100 µl
Maximum Volume of Variable Volume Pipette (Hint: Select NA in Case of Fixed Volume pipette, ul = µl)	1.0µl /10 µl/100 µl/1000 µl
Volume increment (in Ul)	0.1 µl /1.0µl/ 10 µl/100 µl
Calibration Certificate with traceability	Yes
Warranty & CAMC including annual Calibration	Yes

ote: The volume (Minimum and Maximum) *of the pipette has to be selected based on approved **“List of Equipment for State NCDC Branches/ BSL-3 Laboratory”** enclosed at **Annexure I**.

7. Multichannel Micropipettes

(GeM Nomenclature: Manual Multi Channel Air Displacement Pipette)

Features and Sizes	
Type of Micropipette	Variable volume multichannel
Material of Piston	Chemically Resistant
Micropipette with spring loaded tip cone	Yes
Autoclavable	Yes
Capacity of Fixed Volume Single Channel Micropipette	NA
Locking Mechanism	Yes
Availability of Digital Volume Indicator	Yes/No
Minimum Volume of Variable Volume Pipette (Hint: Type NA in Case of Fixed Volume pipette, ul = µl) *	0.1 µl /1.0µl/ 10 µl/100 µl
Maximum Volume of Variable Volume Pipette (Hint: Select NA in Case of Fixed Volume pipette, ul = µl) *	1.0µl /10 µl/100 µl/1000 µl
Volume increment (in Ul)	0.1 µl /1.0µl/ 10 µl/100 µl
Calibration Certificate with traceability	Yes
Warranty & CAMC including annual Calibration	Yes

Note: The volume (Minimum and Maximum) *of the pipette has to be selected based on approved **“List of Equipment for State NCDC Branches/ BSL-3 Laboratory”** enclosed at **Annexure I**.

8. Laboratory Refrigerator

Generic	
Capacity of Refrigerator (In Litres)	300 - 350
Lower of Temperature Range (± 0.5 Degree Celsius)	2
Higher of Temperature Range (± 0.5 Degree Celsius)	8
Cooling Method	forced air cooling system
Refrigerant	CFC free refrigerant gas
Refrigerant Type	Non-CFC
Temperature Controller	Microprocessor based digital controller (temperature, on/ off switch, digital thermometer and power on indicator.
Insulation Type	PUF
Display Type	LCD/LED
Wheels Availability	YES/No
Number of Wheels	4 or more
Wheels Type	Castor/NA
Wheels With Brakes	Yes/No
Type of Chamber Light	LED
Hermetically Sealed Refrigeration Compressor	Yes/No
Alarm	Yes
Energy Star Rating	Minimum 3 Star
Power Supply	230 V Single Phase (50 Hz)
Power Consumption of Refrigerator	Approx-125 -250 Watts
Dimension and Constructions	
Number of Shelves/Drawers/Trays	4 or more
Shelves/Drawers/Trays Type	Solid
Shelves/Drawers/Trays Material	Toughened glass
Outer Body Material	Mild Steel
Inner Body Material	Mild Steel/SS 304/SS 316
Number of Doors	1
Door Type	Single Glass Door
Corrosion Resistant Shelves/Drawers/Trays	Yes
Certification, Testing & Warranty	
Warranty for complete unit (Excluding Compressor)	≥ 5 years
Warranty on Compressor	≥ 5 years
Conformity to Standard(s)	CE (With 4 Digit Notified Number) compliant with IEC 61010 with latest amendment (suitable and working with voltage stabilizer)

availability Of Test Report from Central Govt/NABL/ ILAC Accredited Lab to Prove Conformity to Specification	
Test Report Number and Date	
Copies of reports and certifications to be furnished to buyer on demand at time of supplies	
Insulated Doors	
Door Lock	Yes
Chamber Lightning	Yes

9. Refrigerated Centrifuge

(GeM Nomenclature: Refrigerated Centrifuge for General and Research Purpose)

Standards	
Conformity to standards	European CE (Notified Body) With 4 Digit Notified Body No./ BIS/ ICMED 13485 plus/ EN/UL/IEC 61010-02-020 and 61010-2-101
Certificate date and number	As applicable
Performance Parameters	
Purpose	To Centrifuge different kinds of samples in different testing laboratories and research labs at Room temperature/ Research and routine purpose
Centrifuge design	Bench top
Maximum RPM with no load	20000
RPM setting accuracy	Plus, minus 5%
Type of Motor	Brushless (without carbons)
Accessories	Spanner to tight or loose Nut of Rotor on Motor shaft head puller, spare rotor nuts, fuse-2, Instruction Manual Book, installation CD printed English user manual corrosion resistance oil (70009824) power cord declaration of conformity
Type of lid lock	Electronic lid locking with automatic lid opening at end of run
Maximum Noise level when working at 1 meter distance in dB	≤ 60db
Ambient operating Temperature range in Degree centigrade Celsius and humidity range	0 to 50 and Relative Humidity 15 to 90%
Rotor imbalance diagnostics and automatic stop if required	Yes

No of acceleration and deceleration profiles in built for rotor speed while automatic braking	Acceleration and deceleration profile- 9/10
Maximum timer set point	60 minutes
Parameters to be displayed by the digital display	RPM/RCF/Set time/ Run time/ Rotor running indication, imbalance if any
Display Type	LCD
Speed controller	Microprocessor controlled pre-programmed speed controller which can control RPM as well as RCF
Temperature controller	Microprocessor controlled based PID digital temperature controller cum indicator, (with LCD display) to control the temperature
Configuration of Rotor supplied with centrifuge machine	Swing out and Angle rotor
Rotor Feature with reference to Autoclavability	Autoclavable rotor at 121 °C
Type of Tubes which can be used with centrifuge machine	Polypropylene centrifuge tubes and glass centrifuge tubes
Size of rotor supplied with centrifuge in ml	(two rotors)"24x1.5ml (for angle rotor) RPM 16000"or "24X2 ml (for angle rotor) RPM 16000"and 2 micro plates of 96 wells each (for swing out type or angle rotor RPM 3500)
Power supply	220 – 240 Volts 50 Hz
Length of Power cord in meters	3 meters or more
Refrigerant should be CFC free	Yes
Temperature of refrigerator in degree Celsius	Upto -20°C
Cooling arrangement	Compressor cooling
Temperature control accuracy	±2°C

Warranty period for equipment & Rotor (on site and comprehensive warranty) in years	≥5Years
Maximum Noise level when working at 1 meter distance in db	≤ 60
Material Parameters	
Assembly Material for manufacture of Centrifuge	Die cast aluminium, aluminium sheet, stainless steel, CRC steel, Plastic and Rubber
Lid Material of Centrifuge	CRC steel finish with powder coating or stove painting or ABS plastic of injection moulding
Body material of Centrifuge	CRC steel finish with powder coating or stove painting

Front Panel of centrifuge	CRC steel finish with powder coating/ stove painting or ABS plastic of injection moulding
Centrifuge Bowl material in Centrifuge	Double walled with PUF insulation to avoid loss of cooling. Inner chamber of 304 quality stainless steel moulded
Material of Rotor	Aluminium
Additional Parameters	
Condensed Water Drainage System	Yes
The Equipment shall be installed and demonstrated before Acceptance	Yes
Servo Controller Voltage Stabilizer supplied with Item	Yes
Servo stabilizer ratings in KVA	2 KVA
Warranty of stabilizer in years	≥5 years
Auto cut off	Yes
Timer provided	Yes
Reports	
Certifications of Manufacturer	ISO 9001:2015
ISO Certificate date and number	As applicable
Copies of all certifications and reports to be provided to buyer on demand at time of supplies	Yes

10. Dry Block Heater

Block Specifications	
Block Capacity	1
Set up Block Material	Aluminium alloy/ SUS304
Block Type	Full
Tube Specifications	
Diameter of probe tube	≥1.5 millimetre
Coating of probe tube	Safe coat
Tube Types	
PCR tubes	Yes
Standard Test Tubes	Yes

Conical Bottom Centrifuge Tubes	Yes
Operating Specifications	
Temperature Range, (+/-)	Ambient 5°C to 120°C
Heating Up Time, (Minute)	10-20 minutes or better

Temperature Accuracy, (+/-) (Deg C)	0.5°Cor Better
Power Supply	120-240 V; 50-60 Hz
Relative Humidity Tolerance,	20% - 80%, Non condensing
Temperature Uniformity at 37 Deg C,) (+/-) (Deg C)	0.5°C
Technical Specifications	
Protection class according to DIN EN 60529	IP 21, EN 61326-1
Additional Parameters	
Applications	DNA extractions and analysis, Melting point determination, Boiling point determination, Immunoassays, Enzyme reactions and processes, Enzyme activity studies, In situ hybridization, Blood-urea-nitrogen determinations, Nucleic acid hybridization, Coagulation studies, Biochemical processes, Incubation and activation of cultures, Blood examinations, Biopharm, Life Science or Cancer research
Accessories Included	Dry bath, Block lifter
Features	Digital controls and display of time and temperature
Generic	
Warranty, (Select 0 if NA)	≥ 5 Years
Certification, Standards and Test Reports	
Certifications	CE
Test report to be submitted to the buyer on demand	Yes
Availability of Test Report from Central Govt/NABL/ILAC accredited lab to prove conformity to specification	Yes/No
Name and Address of the lab (Please write NA if not applicable)	As applicable
Test Report Date and Numbers (Please write NA if not applicable)	As applicable
Standards	EN 61010-1

11. **Real Time PCR Equipment/RT-PCR**

GENERAL INFORMATION	
Product -Name	Real time PCR Machine
Purpose	Real- time PCR (Polymerase Chain Reaction) machine is an advanced laboratory instrument used to amplify and simultaneously quantify DNA or RNA in real-time.
PRODUCT INFORMATION	
System Type	Open
Capacity of Blocks	96 well
Number of channels (minimum)	5 or more
Maximum Heating ramp rate in degree per second	4 or more
Maximum cooling ramp rate in degree per second	4 or more
Adjustable heating / cooling ramp rate	Yes
Operating Temperature range (degree Celsius)	4-105 ° C
Hot Lid Temperature (degree Celsius)	30-110 ° C
Sample volume range in micro litre	5-100 microlitre
Programmable Steps and cycles	Yes
No of USB ports	2 or more
Pause/start function	Yes
Input power supply	Single phase (230 V, 50Hz)
Auto restart after power outages	Yes
Boot up time	≤ 1 minute
Type of chemistries that can be run on system	Taqman, SYBR green, Molecular beacon and all other fluorescent dye based
Compatibility for well strips	8
Compatibility for Individual PCR tubes	0.1-0.2 ml tubes
Source of Excitation	Tungsten/ Xenon/ LED/ Halogen
Detection	Cooled CCD/ Photo diode/CMOS/PMT

Number of excitation filters	≥ 5
Number of emission filters	≥ 5
Multiplexing ability dyes in a single run	≥ 5
Pre calibration with at least 7 commonly used dyes	FAM/ SYBR Green/ VIC/ HEX/NED/ TAMRA/ROXD/TEXAS RED/ JOE/Cy5/Quasar 670/Cy5.5/ Quasar 705/Cy3

Addition of new dyes should be possible without hardware change	YES
Analysis performed	Gene expression+Plusminus assay+ SNP+Allelic Discrimination and Dissociation curve analysis+ DNA Quantitation+ Gene Expression Analysis+ Comparative analysis curve+ Standard Curve+Relative Standard curve+Capability for calculating dilution & reaction set up for HID kits+Sample Quality Assessment
Instrument software should not restrict number of assay or target that can be run on a single 96 well plate in parallel	Yes
Suitable software for Data Acquisition, analysis of run and also for Gene Expression analysis by relative quantity or normalized expression	Yes
Software should have the capacity to analyse data of minimum 10 different runs at a time	Yes
The instrument software must be capable of detecting and analysing a different gene, SNP or pathogen target in every well of the 96-well plate	Yes
Temperature setting accuracy (degree Celsius)	± 0.3 or better
Well to well temperature uniformity (degree Celsius)	± 0.4 or better
DATA MANAGEMENT SYSTEM	
Computer system with latest licensed operating system and antivirus provided	Yes
PC monitor type	LCD/LED
Minimum PC monitor size (inches)	15 inches or more
PC hard disk	500GB or more
UPS with power backup (Minutes) (minimum)	60 minutes or more
CERTIFICATIONS	
Compliance to Medical Device Rules (MDR) 2017 as amended till date	Yes
Availability of valid Medical Device license for the product issued from the competent authority defined under Drugs and Cosmetic Act 1940 and Rules made there under as amended till date	Yes
Valid Medical Device License Number	As applicable
Certification for manufacturing unit	ISO:13485 (Latest)

Availability of Test Report for each supplied batch/product as per Medical Device Rule (MDR) 2017 as amended till date	Yes
Submission of all necessary certifications, licenses and test reports to the buyer at the time of bid submission or along with supplies as per buyer requirement	Yes
Electrical Safety Compliance Standard	IEC 60601 or Equivalent BIS
WARRANTY	
Warranty in Years (Option of comprehensive warranty is available through bidding only, which if opted will supersede normal warranty in the catalogue)	≥5 Years

Additional specifications-

- Minimum 5 years warranty for machine and PC separately.
- One start up kit and consumable of each parameter and all other accessories required for training and IQ, OQ and PQ compliance to be provided by the bidder free of cost.

12. Microwave Oven

Conformity to Standards	
Conformity to Indian Standard IS 11676 (Latest)	Yes
ISI Marked hrs)	Yes
CML No	To be provided by the seller
Dimension	
Capacity / Volume (Litres)	20
Diameter of turntable (mm)	226-250 Litres
Usable Shelf Area in m2	20 L
Parameter	
Grill Heating Power (Watts)	501-550
Operating AC voltage (Volts)	231-240
Heating time adjustment Pitch(seconds)	5
Microwave frequency	1400
Maximum heating time	30 minutes
Microwave heating power (Watt)	651-700
Power Levels	5
Warranty	
Unit Warranty	≥5 Years
Magnetron and Cavity Warranty	≥5 Years

Performance	
Convection heating	No
Touch control panel	Yes
Oven glass window	Yes
Adjustment of microwave power	Yes
Finish of heating chamber	Stainless steel
Display of power on/Off	Yes
Grill heating	No
Display for set heating time, present time and power	Yes
Rotisserie rack	No
Door safety lock system	Yes
Uniform Heating/Rotating Plate	Yes
Generic	
Colour	White / Black
Additional Features	
Auto Cook Menus	Yes
Multistage Cooking	No
Door Type	Side Swing
Control Types	Feather Touch Membranes
Display Type	LED
Defrost	Yes
Oven Mode	Yes
Quick Start	Yes
Pre Heat	Yes
Grill Rack	No
Starter Kit	Yes
User manual	Yes
Moisture retention	Yes
Front Panel Material	Glass
Child Lock	Yes
Door Open Type	Hinge

13. **A. BOD Incubator (Entomology)/ Incubator BOD**

Item	BOD Incubator
Design	
Features available in BOD Incubator	
Toughened glass window	Yes
Air circulation fan	Yes
Removable tray	Yes
Temperature sensor	Yes
Door hinges	Yes
Door handle with lock & key	Yes

Pilot lamp	Yes
PID temperature controller	Yes
PID temperature controller	Yes
Safety thermostat	Yes
Caster wheels	Yes
Power cord	Yes
Solid door	Yes
Heater	Yes
Temperature High/Low Safety alarm	Yes
Digital Ampere Meter	Yes
On/Off Switch	Yes
UV tube	Yes
Optional Features available in BOD Incubator	
Digital event timer	Yes
Illumination with 3 florescent lights	Yes
Stainless steel	Yes
Perforated trays	Yes
Humidity system (for Entomology purpose)	Yes
IQ, OQ & PQ Documentation, Caster wheels with brake	Yes
No of Trays	≥ 3
Air Circulation	Motorized blower
Material	
Exterior body material	Mild steel and Painted in Epoxy Powder Coating/ Stainless Steel
Interior body material	Stainless steel
Insulation material	Glass wool, used for thermal and acoustic insulation
Outer door material	Stainless steel
Inner door material of removable tray	Acrylic sheet
Material of removable tray	Perforated Stainless steel tray
Dimension	
Chamber Capacity (in litre)	300±50
Thickness of Toughed Glass/Acrylic Sheet (in MM)	7-15
Diameter of Stainless-Steel wire in mesh (in MM)	3-6
Wire Length (in metre)	≥2
Power	
Temperature Range	5°C - 60°C
Temperature Accuracy	+/- 0.5°C
Temperature Uniformity	+/- 1°C
Power supply	230 volts 50 Hz
Warranty	
Warranty (in year)	≥5 Years

B. BOD Incubator (Serology)/ Incubator BOD

Item	BOD Incubator
Design	
Features available in BOD Incubator	
Toughened glass window	Yes
Air circulation fan	Yes
Removable tray	Yes
Temperature sensor	Yes
Door hinges	Yes
Door handle with lock & key	Yes
Pilot lamp	Yes
PID temperature controller	Yes
PID temperature controller	Yes
Safety thermostat	Yes
Caster wheels	Yes
Power cord	Yes
Solid door	Yes
Heater	Yes
Temperature High/Low Safety alarm	Yes
Digital Ampere Meter	Yes
On/Off Switch	Yes
UV tube	Yes
Optional Features available in BOD Incubator	
Digital event timer	Yes
Illumination with 3 florescent lights	Yes
Stainless steel	Yes
Perforated trays	Yes
Humidity system	Yes
IQ, OQ & PQ Documentation, Caster wheels with brake	Yes
No of Trays	≥ 3
Air Circulation	Motorized blower
Material	
Exterior body material	Mild steel and Painted in Epoxy Powder Coating/ Stainless Steel
Interior body material	Stainless steel
Insulation material	Glass wool, used for thermal and acoustic insulation
Outer door material	Stainless steel
Inner door material of removable tray	Acrylic sheet

Material of removable tray	Perforated Stainless steel tray
Dimension	
Chamber Capacity (in litre)	300±50
Thickness of Toughed Glass/Acrylic Sheet (in MM)	7-15
Diameter of Stainless-Steel wire in mesh (in MM)	3-6
Wire Length (in metre)	≥2
Power	
Temperature Range	5°C - 60°C
Temperature Accuracy	+/- 0.5 °C
Temperature Uniformity	+/- 1 °C
Power supply	230 volts 50 Hz
Warranty	
Warranty (in year)	≥5 Years

14. **Electric Sterilizer for Inoculation Loop**

Mechanical Parameters	
Should Provide uniform and constant heat for perfect sterilization	Yes
Material	Stainless steel
Dimensions	
Diameter of Sterilizing Tube	12-15 (in millimetres)
Length	140-150 (in millimetres)
Number of Angular adjustments	5-7
Temperatures	
Sterilization time	5-7 sec
Heating-up time	700°C /15minutes
Sterilization temperature	900-950°c
Electrical Parameters	
Power supply	240 volts Single phase AC supply
Input Frequency	50 Hz
Power consumption	250 Watt or Higher
Additional Parameters	
Should be compact enough with a height, width and diameter should not be more than 300mm	Yes
Warranty (Years)	≥ 5 Years
Should have GMP compliance	Yes
Should have a long-Lasting Sterilizing Tube	Yes
The system Should Have Temperature Indicating Controller	
	Yes
Safety features	

Residual heat display	Yes
Certifications and Approvals	
Safety Standards	EN 61326-1/EN 61010-1/EN 61010-2-010
Test Report Details	
Test Report Number	As Applicable
Availability of Test Report from Central Govt/ State Govt/NABL/ILAC accredited lab	Yes/No
Address of the Lab	As Applicable
Test Report date	As Applicable
Test Report to be furnished to the Buyer on demand	Yes
Name of the Lab	As Applicable

15. Analytical Weighing Balance

(GeM Nomenclature: Micro/Semi-Micro/Analytical Weighing balance)

Group: Type/ Application	
Governing Specification	General Confirming to IS 9281-[Latest]
Intended Application	The products covered in this category are-electronic weighing system/ electronic weighing machine are generally
Scope of Supply	Weighing system consists of Load sensor (EMCF)/Load cells, closed weighing chamber/associated electronic display
Category of weighing Scale	Analytical weighing scale having least count 4 digits after decimal and above
Electronic Display/ Processing unit/ Generic	
Nominal Rated Load Capacity of weighing scale (in gm) [Better capacity is considered higher than the nominal capacity meeting required resolution]	200 gm or more
Resolution	0.1mg
Weighing System Accuracy and Class {As per Governing IS} [Percentage of Rated Output (RO))	+/- 0.1 % of RO (Class 2)
Maximum Measurement Time in second	5-10 sec
Electronic display	LCD/LED display with keypad/touchpad
Sensitivity Drift (10 to 30 degree Celsius)	+/- 2ppm
Safe Overload cell Capacity [Percentage of Rated Load (RL)]	150 % of Rated Load
Ultimate Overload	200 % of Rated Load
Linearity	+/- 3 times of Resolution

Repeatability	+/- 1%
Close weighing chamber type	Glass shield with manual operation
Rigid frame and Weighing Platform/Pan	
Shape	Circular/Square/Rectangular
Nominal Weighing Platform/Pan Size (Diameter/Side, in mm)	80-90mm
Material of Rigid frame	SS
Other features of Rigid frame and Weighing Platform/ Pan	NA
Calibration Certificate	
Calibration Certificate issuing authority (Issuing date should be more than 3-month prior, at the time of invoicing)	OEM Certificate NABL/ILAC Approved Agency
Valid Calibration Certificate Provided for Each weighing scale Supplied	Yes
Features	
Connectivity/port	USB/ RS 232/ Ethernet/Wi-Fi
Operating Temperature Range and humidity	15 to 35°C & up to 90% RH
Power Requirements	Automatic environmental compensation/ levelling assistance/ electable Multi unit display
Power Requirement	Mains operated
Power supply/ Battery Type	230V +/- 10%/Single phase AC
Buyer Specific Requirement	
Software Features	Should provide a user-friendly interface to input various process parameters
Installation and commissioning	Yes- provided onsite (at consignee location)
Seller Declared Value	
Link of product / product brochure	Yes
Warranty	
Comprehensive Warranty	≥ 5 Years
TEST REPORT & Certification	
Availability of Test Report from type of Lab, to prove the conformity of product to the specification	OEM NABL Accredited lab ILAC Accredited Lab

Agree to provide all relevant documents including supporting document / reports etc, if applicable, to the buyer at the time of bidding or on demand	Yes
Agreed to provide Model approval certificate for each model from Director Legal Metrology at the time bidding or on demand by buyer [Hint: Valid model approval certificate shall be available with the OEM/ Manufacturer/ Seller at the time of product	Yes

16. Water Purification System (for laboratory use)

(Gem Nomenclature: Water Purification System with UV (Ultra-Violet Process) Or UV (Ultra-Violet Process) +UF (Ultra-Filtration Process))

Description and Purpose of Machine	The purpose of this machine is to purify water using <u>UV (Ultra-Violet Process) Or UV (Ultra-Violet Process) +UF (Ultra-Filtration Process)</u>
Construction	Aesthetically designed, water purification system having all the necessary components such as UV light and requirement
Features and Performance	
Method of Mounting	Wall mount
Rate of Flow (In LPH) of purified water	50 and above
Input Water Source Connection	Plumber in/ Faucet-Mounted
Type of Water Purification Technology	Generally, Conformity to IS 14724 for Ultraviolet (UV)/Generally Conformity to IS 14724 for Ultraviolet (UV)) +Ultrafiltration (UF)
Maximum Feed Water TDS (ppm) at which the machine LPH and Guaranteed output water quality is ensured	Up to 500
Guaranteed output water quality	As per IS 10500 or better
Water Storage	Yes
Storage Tank (inclusive in the scope of supply)	Yes
Type of Water Tank / Location	In-built storage tank/external storage tank
Storage Tank Material	ABS/PP Food Grade
Storage Tank Capacity (in Liter)	20 litres - 50 litres
Power Supply	
Power Supply	230V+-10% single phase
Type of Controller	Fully automatic
Controller and Display Features	Auto cut-off
Service, Warranty, Installation and Commissioning	Yes
Comprehensive warranty for complete unit	≥5years from the date of satisfactory commissioning of the machine

Number of Visits per Year	2 Nos
Installation and commissioning inclusive in the scope of supply	Yes
Training and Demonstration	The installation and demonstration of the machine at the consignee place shall be carried out as part of installation and commissioning
Certification / Test Report	Yes
Agreed to the STC of the category	Yes
Type of lab which carried out Test of Complete Product to prove the conformity of product as per Governing Specification	OEM/Govt. Lab/NABL Accredited Lab
Agree to provide all relevant documents Test Report/supporting document /reports etc. if applicable to the buyer at the time of bidding or on demand	Yes

17. Magnetic Stirrer with Hot Plate

CERTIFICATIONS	
Firm Certified to ISO9001:2008 or latest	Yes
Product is CE certified (Seller to furnish supporting document to Buyer on demand)	Yes
EN/IEC directives	As applicable
Name and Address of the Lab	As applicable
Availability Of Test Report (to be furnished by Seller to Buyer on demand) from Central Govt/NABL/ILAC accredited laboratory to prove conformity to specifications	Yes/No
Test Report details; Number, date of issue, name and address of issuing laboratory	Yes/No
CONFIGURATION AND FEATURES	
Number of stirring Positions	1
Calibration	Automatic
Type of Drive Motor	Brushless motor DC
Display Option/Output Read out Option	Digital
Magnetic stirrer is	With hot plate or some other means for heating the liquid
Magnetic stirrer Type	Variable type
Controller type	Microprocessor controlled
IP rating or Ingress protection rating	≥ IP 60
Programmable	No
Direction change feature	No
Speed Control Accuracy of set speed (+/-) (RPM)*	≤5

Maximum Stirring capacity per position	≥3000 millimeter
Top plate Material	Ceramic
Timer Provided	Yes
User Interface	Digital front panel
Pulse mode	Yes
Slip Detection	Yes
Accessories and spares included in standard pack	Yes
WARRANTY	
Warranty on Machine	≥5 years
MISC (Miscellaneous)	
In built-in multi-step safety system to continuously monitor device operation and protect against damage should the operation exceed the pre-determined parameters	Unsafe hot plate temperature- temperature exceeds parameters/Vessel Breakage – Should the Vessel Have a Crack and the Solution Begins to Leak, provision for preventing liquid from damaging equipment
Ambient operating Temperature range 0 to 50 degree and RH 80%	Yes
POWER SUPPLY	
Input Voltage with Phase (V)	220 V, 50 Hz AC, Single phase
Power consumption	250 watt or more
SPEED	
Speed Mode	Variable speed
Speed (RPM)	100-150
DIMENSIONS	
Body Material	Metal alloy
Finish of Body material	Powder coated
STIR BAR	
Stir bar cover material	PTFE Coated Alinico Magnet
Stir Bar length	10-15 millimetre
TOP PLATE	
Top plate area shape	Circular
Circular Top plate diameter	≥150 millimetre
Top plate Finish	Ceramic coated

18. pH Meter

Warranty	
Warranty (Year)	≥ 5 Years
Impact Resistant	Yes
Ingress Protection, Water Tight	Yes/ IP 56
Storage pocket for pH electrode	Yes

System to be supplied with Measuring electrode combined & glass calomel, temperature probe, Electrode Stand, calibration buffer and maintenance kit, operation manual, power cable and plug	Yes
Configuration	
Type	Microprocessor Based/Microcontroller Based
Display	LED/LCD/Touch screen, 3 digits
Calibration	Up to 3 points with auto buffer
pH Range	0.00 to 14.00
Accuracy	± 0.05
Corrosion resistant	Yes
Power requirements	230 V+- 10,50 Hz AC/Battery operated
Modes	pH mV-C
Parallel temperature indication	Yes
Temperature Compensation Type	Manual or automatic with ATC probe
Temperature Accuracy (Degree C)	± 0.3
Temperature Compensation Range (Degree C)	0 to 100° C
Resolution (pH)	0.01
Operating Humidity: RH in (%)	0-100
Operating Temperature (Degree C)	-20 to 50
Certifications	
Availability Of UL/CE Certification as Per EN 61010-1:2010 Safety Requirements for Electrical Equipment for Measurement, Control, And Laboratory Use General Requirement	Yes
Test Reports For EMC/EMI As Per EN 61326-1:2013 Electrical Equipment for Measurement, Control and Laboratory Use EMC Requirements General Requirements (Test Reports Are to Be Furnished When Demanded by Buyer)	Yes
Availability Of Test Reports from Central Govt / NABL Approved / ILAC Accredited Lab to Prove Conformity to the Specification (Test Reports Are to Be Furnished When Demanded by Buyer)	Yes
Test Report Number and Date	As Applicable
Name and address of the Lab	As Applicable

19. Vertical Autoclave

GENERAL FEATURES	
Product Name	Vertical Autoclave

Purpose	For sterilization/disinfection/pre-treatment of medical, laboratory and surgical wastes
PRODUCT INFORMATION	-
All piping material	SS 304/SS 316/ SS 316 L or better
Sterilizer chamber capacity (usable volume) (Litres)	100 or more
Wall type	Double walled
Sterilizer chamber material	Double walled made of SS 304/SS 316/ SS 316 L
Working Pressure of Chamber (PSI)	15 to 20
Type of Sterilizer Chamber Door	Radial locking
Sterilizer Chamber door material	SS 304/SS 316/ SS 316 L
Sterilizer Chamber door locking facility	Yes
Sterilizer Chamber door operation	Manual
Door sealing suitable to withstand temperature up to 140 degree Celsius & pressure up to 20-30 PSI	By Neoprene Rubber gasket
Controller type	Digital timer controller with end cycle buzzer/ Microprocessor PID Controller
Digital pressure display	LCD/LED/TFT
Minimum Display Size (Inches)	≥5 inches
Temperature sensor range (degree Celsius)	100 to 300
Audio - visual Alarm facility available for notifying	Low water alarm system as well as steam release valves and safety valves Cut off automatically when the autoclave is dry
Working temperature (degree Celsius)	121- 135
Working pressure (PSI)	15 to 22
Power supply	220 to 240V, three phase
Print records facility	Yes
Water level indicator	Yes
Water inlet & outlet	Yes
Automatic pressure control switch	Yes
Manual Water Filling & Removal	Yes
Unit having a heater fitted at the bottom and with capacity	≥ 3KW
CERTIFICATIONS	
Compliance to Medical Device Rules (MDR) 2017 as amended till date	Yes
Availability of valid Medical Device license for the product issued from the competent authority defined under Drugs and Cosmetic Act 1940 and Rules made there under as amended till date	Yes

Valid Medical Device License Number	Yes
Certification for manufacturing unit	ISO:13485 (Latest)
Availability of Test Report for each supplied batch/product as per Medical Device Rule (MDR) 2017 as amended till date	Yes
Submission of all necessary certifications, licenses and test reports to the buyer at the time of	Yes
bid submission or along with supplies as per buyer requirement	
Electrical Safety standards	IEC 60601 or equivalent to BIS
Autoclave (Vertical) design and manufacturing conform to IS 3829	Yes
WARRANTY	
Warranty in years (Option of comprehensive warranty is available through bidding only, which if opted will supersede normal warranty in the catalogue)	≥ 5 years
Calibration including thermal mapping and pressure gauge	Annually

20. **Weighing Machine (for BMW)**
(GeM Nomenclature: Electronic Weighing Scales)

Type/ Application	
governing Specification	Generally confirming to IS 9281-(Part-III) [Latest]
Intended Application	The products covered in this category are- electronic weighing system/ electronic weighing machine are generally used for weighing general purpose products /goods commonly sold/ purchased in the market. It includes Electronic postal weighing scale, Electronic Platform type weighing Scale (General Purpose), Electronic Hanging/ Crane weighing scale, etc. The products such as spring type weighing scales, personal weighing scale, mechanical/ Lever type weighing scales, precision weighing scales or micro weighing scales, other scales that are specially used in laboratories/Medical or for weighing precious metals, etc. are NOT covered in this category.
Type of Weighing Scale (Based on Intended Application)	Electronic Platform type Weighing Scale (General Purpose)
Scope of Supply	Weighing system consist of load sensor/cells, associated electronics display, rigid frame and weighing platform etc

Electronic Display/ Processing unit/ Generic	
Rated Load Capacity of weighing scale	Upto 50 Kg or more
Resolution	25-50 gm
Weighing System Accuracy and Class {As per Governing IS} [Percentage of Rated Output (RO)]	± 0.25 % of RO (Class 3)
Maximum Measurement Time in second	1 sec
Electronic display character size	0.5 inch or better LCD/LED display
Other feature of Electronic Display/ Processing unit	Tare provision Internal Calibration External Calibration Alarm for overload & Malfunctioning
Load Sensor/ Cell	

Load Cell Accuracy and Class (As per the Governing IS)	0.1 % of RO (Class 3)
Safe Overload cell Capacity [Percentage of Rated Load (RL)]	150% of Rated Load
Ultimate Overload	200% of Rated Load
No of load cell	1

Rigid frame and Weighing Platform	
Shape	Square/ Rectangle
Weighing Platform Size	300mm \times 300mm or better
Material of Rigid frame	SS
Material and Thickness of Weighing platform sheet	SS 304 (2mm or better)

Calibration Certificate	
Calibration Certificate issuing authority (Issuing date should be more than 3-month prior, at the time of invoicing)	OEM Certificate NABL/ILAC Approved Agency
Valid Calibration Certificate Provided for Each weighing scale Supplied	Yes

Features	
Salient Features	Error/Out of Range Indication, Connectivity with computer along with Ethernet TCP/IP/USB Connectivity module
Operating Temperature Range and humidity	10 to 35 °C & up to 90% RH

Power Requirements	
Power Requirement	Mains operated along with Battery
Power supply/ Battery Type	230V \pm 10%, Single phase AC with Rechargeable battery of 6 Ah or better
Power feature	Overcharging protection

Buyer Specific Requirement	
Weighing system with dimensioning Feature	No- Weighing system is only capable of weighing
Other Buyer specific requirements	Type Test Certificate as per governing specification for given Class including Environment conditions from Regional
Installation and commissioning	Yes provided-Onsite (at consignee location)
Seller Declared Value	
Link of product / product brochure	Yes
Warranty	
Comprehensive Warranty	≥5 Years

TEST REPORT & Certification	
Availability of Test Report from type of Lab, to prove the conformity of product to the specification	OEM Certificate/ NABL Accredited Lab/ILAC Accredited Lab
Agree to provide all relevant documents including supporting document / reports etc, if applicable, to the buyer at the time of bidding or on demand	Yes
Agreed to provide Model approval certificate for each model from Director Legal Metrology at the time bidding or on demand by buyer	Yes
Each weighing machine shall be supplied with calibration certificate under weights and measures ac	Yes

21. Hot Air Oven
(Not Available on GeM Portal)

1. Capacity of 90L-120L.
2. Dual digital display with Microprocessor based PID controller.
3. Temperature range: ambient temperature plus 10°C to 250°C.
4. Temperature accuracy of 1°C controlled by thermostat.
5. Temperature heating up time 20 min. at 150°C.
6. Double walled, inner chamber should be made up of stainless steel.
7. Outer chamber should be made up of mild steel with epoxy powder coating.
8. Heating Element placed in the ribs of the bottom & 3 sides for uniform heating.

9. Temperature is controlled by thermostat with an accuracy of $\pm 1^{\circ}\text{C}$.
10. Mineral wool/ceramic wool insulation.
11. Door should also be insulated and fitted with heavy hinges.
12. Motorized blower for forced air circulation.
13. Blower motor should be at least 1/35 HP, totally enclosed and should be air cooled.
14. At least 3 removable shelves.
15. Should work in ambient temperatures $>40^{\circ}\text{C}$ and 15-90% humidity.
16. Should have over heating protection.
17. Audio-visual safety alarm should be provided.
18. Shelves should be made up of wire mesh sleeves of stainless steel.
19. Should have ergonomic handle design with two-point door lock.
20. Should conform to electrical safety standards IEC 60601/ IS 13450 with latest amendments.
21. CE, /ISO 9001:2015/ ISO 13485:2016 Certified.

22. Deep Freezer -80oC

(GeM Nomenclature: Ultra Low Temperature Laboratory Deep Freezer-80°C)

STANDARDS	
Conformity to Standards	CE /USFDA/ BIS
Certification number and date	As applicable
Conformity to standard conforms to standards IEC- 61010 for electrical safety latest amendment	Yes
Performance parameters	
Purpose	Used for storage of various samples, sensitive stem cells, plasma, semen, virus, bone grafts and other biological samples
Capacity in litres	300L or more
Freezer body	Freezer should have galvanized steel body with tough powder coated exterior finish constructed on steel
Material of inside chamber	Stainless Steel
Type of Cabinet	Vertical/ vertical with four adjustable compartments
Ground Clearance in mm	minimum 100 mm
Should have heavy duty lockable castors and levelling for adjustments and installation	Yes
Refrigerants	Hermetic sealed compressor with CFC free refrigerant
Refrigeration system must be energy efficient with pull down time in hrs	Less than 5.5 Hr

Operating Temperature with 1°C increment	-55°C to -86°C
Freezer must attain -80°C while operating at ambient temperature of 32°C	Yes
Number of holding racks	0 to 30
Control System	Fully programmable microprocessor controlled with membrane keypad and eye level control panel
Number of inner storage compartments with insulated doors and adjustable height	Minimum 4
Freezer should have heated air vent and easily accessible front panel air filter	Yes
Digital temperature display	Yes
Alarms	Audible and visible alarm systems for unwanted temperature rise, power failure, system failure and low battery
Noise level in dB	≤60
Stabilizer should be capable to run any voltage between 190V - 270 V	Yes
Double door with locking lids	Yes
Availability of decompression valve facility to lower air pressure inside freezer for easy door opening	Yes
Panels	VIP (Vacuum insulated panel) with Green PUF (poly urethane foam)
Number of compressors	2
Temperature uniformity	+/- -3°C or less
temperature stability of system	+/- 3°C or less
Warranty of Stabilizer in Years	≥5
Warranty of Freezer (except compressor) in Years (from the date of installation)	≥5
Warranty of compressor in years	≥5 years
Additional Parameters	
Vacuum insulation panel	Yes
Freezer must have washable condenser filter indicator which should keep fins free of dust to maintain peak cooling efficiency	Yes
One 5KVA servo stabilizer to be supplied with freezer	Yes
CO ₂ cylinder should be supplied with freezer for backup	NA

Number of corrosion resistant racks	≥3
Pairs of Cryogloves to be provided	1 or more
Number of Ice scraper to be provided	1 or more
Temperature Chart recorder to be provided	Yes
Availability of USB port to download event log and freezer setting	Yes/No
Reports	
Manufacturer should have ISO certification	Yes
ISO certification date and number	As applicable
Copies of all certifications and reports to be provided to buyer on demand at time of supplies	Yes

Additional specifications-

Hermetically sealed dual compressor with 5 years or more warranty and online UPS with at- least 1 hour backup.

20. Magnetic Stirrer (Repeated)

21. Laminar Air Flow (Repeated)

22. Deep Freezer -80 Degree Celcius (Repeated)

23. Compound Light Microscope

CONFORMITY / TYPE / EYE PIECE - OBJECTIVE DETAILS	
Microscope Type	Pathological binocular non-hinged with built in Light with Light Intensity regulator
Conformity to Indian Standard	Pathological IS:4381 latest / Research IS: 5204 latest
ISI MARKED	Yes/No
C/ML No (BIS License No)	As applicable
Eye piece Type	Compensating
Binocular Eye pieces Confirming to the requirements of IS: 8275/1976 (latest)	Yes
Eye Piece with magnification	Set of Two for Binocular 10X
Objective Type	Plan Achromatic Infinity/ Apochromatic
Objective Magnification	4X,10X,40X,100X
Numerical Aperture of Objective	1.25
Type of lamp for Illumination	LED type with battery backup
GENERIC	
Plano Concave mirror attachment	Yes

Stage	Rectangular
Coarse and Fine Movement of stage	Yes (on both sides)
Co-axial focussing	Yes
Micrometre Arrangement	Yes/No
ACCESSORIES	
Extra eyepieces (inclusive in the scope of supply)	Yes, set of two 10X
Carrying case, Dust cover, Immersion Oil, Lens cleaner & Spare fuse (inclusive in the scope of supply)	Yes
WARRANTY	
Warranty	≥5 Years
CERTIFICATIONS	
Availability of Test Report from Central Govt/NABL/ILAC accredited lab to prove conformity to specification	Yes / No
Test Report No and Date	As applicable
Name and Address of the Lab	As applicable

Additional specifications-

- Binocular ergonomic tilting observation head 0-35 degree with FOV 25mm and inter pupillary distance 48-75mm.
- Swing out ABBE condenser with a NA 0.9/1.25 and Quintuple inward coded nosepiece with auto intensity manager.
- 5W, minimum 20,000 hours Life LED with KOHLER System Illumination, Intensity control, Inbuilt SMPS (Switching Mode Power Supply) with a worldwide range, Field diaphragm, Rechargeable battery backup.
- 270° rotatable stage with a capacity to hold 2 standard microscope slides (75X25 mm) stage, hard coated surface with size minimum 153 x 135 mms (we should discuss).
- **Certifications:** ISI/ ISO13485 / ISO14001/ USFDA / CE / IS 5204 standards.




24. Small Incubator up to 25° C




Specification Name	Values
Conformity to Standards	CE
Certification number and date	-
Conformity to standard for for electrical safety latest amendment	IEC - 61010
Purpose	Microbiological incubator is used for the incubation of biological products under controlled conditions.
Type of Incubator	BOD Incubator
Capacity in liters	40-50
Material of Inner Chambers	SS 304
Material of Outer Chamber	SS
Ambient Temperature in °C	5°C to 60°C (BOD Incubator)
Temperature Accuracy in °C	±0.5°C
Temperature Uniformity in °C	±2°C




Insulation	PUF
Controller	Microprocessor based PID control
Digital Display of temperature in °C	Yes
Type of Display	LED
Type of Temperature sensor	PT100
Power supply	220 V, 50 Hz Single Phase
Door	Insulated door and fitted with heavy hinges and should have double glass window
Dimension	
Interior Dimension (W×D×H)	34× 34× 34 cm to 40× 50× 50 cm
Exterior Dimension (W×D×H)	40× 48 × 52 cm to 60 × 60 × 72 cm
Type of Shelves	Fixed
Material of Shelves	SS wire mesh
Number of shelves	2
Size of incubator (L x W x H) in mm x mm x mm	500 ×550×650 mm to 600 ×580×750 mm
Weight in kgs	20-60
Auto power break off	Yes
Over temperature protection	Yes
Safety alarm system	Yes
Instruction manual to be provided	Yes
Warranty in Years	5
Manufacturer should have ISO certification	Yes
ISO certification date and number	-
Copies of all certifications and reports to be provided to buyer on demand at time of supplies	Yes



Additional Terms and Conditions

- Authorized Service Centre within the state of Odisha, along with a dedicated contact person with telephone number for technical solution in a fast track basis at this institution as and when required basis.
- Experience Certificate for the supply of the same to any Govt/ PSU/ any renowned private organization along with Supply/ Purchase Order.
- If the agency is registered under MSME or NSIC, then EMD exemption certificate needs to be enclosed.
- Make in
- India specific authorization certificate needs to be enclosed.
- IMPORTED PRODUCTS: In case of imported products, OEM or Authorized Seller of OEM should have a registered office in India to provide after sales service support in India. The certificate to this effect should be submitted.

Item No.	Item Name	Item Description	Ref Image
1	cabin Table	<p>The Overall size of the Cabin Table shall be 1500 mm L x 750 mm D x 750 H & Side unit shall be 900 x 450 x 750ht. The worktop shall be made up of 25mm thick PLPB E1 norms duly finished with 2mm pvc edge band. The Modesty shall be made of 18mm thick pre laminated partical boards with E1 norms and all visible side 2mm pvc edge bending. Modesty height shall be 450mm . The understructure shall be made up of MS powder coated legs having enhanced look trapezoidal cross section size 52mm x 52mm x 52mm x 26mm with chamfered corners and thickness of 1.6mm. Edges of the leg should not have sharp edges. For safety of users a radius of R3.20 mm should be provided. The Trapezoidal tube shall be connected with die cast connectors at top, leg shoe & levelers at bottom. High pressure aluminum die cast connectors shall of ADC-12 material confirming to ASTM E 1251-2011, IS 7658-1990 & IS 11035 – 1190. The vertical legs shall be connected by horizontal beams with the help of aluminum die cast connector that joints the legs vertically and horizontally with pipe of cross section 50 x 25 mm x 1.6 mm thickness. The die cast connect size shall be L shaped having angle of 10 degrees for vertical leg side. The Diecast connector will have same shape as of Trapezoidal vertical leg at one side and another side matching to horizontal cross section 50x25. Wire Management: 350 mm anodised flip up made of anodised aluminum finish, that shall have soft closure and three way wire access & PVC cable tray for entry of cables from the floor into the cable tray. Side unit shall be 900 x 450 x 750 (WDH) mm. Top & sides shall made up of 18 mm thick PLPB E1 norms & back 9 mm thick PLPB with 2mm PVC lipping, Shutters & drawer front shall be 18 mm thick PLPB. Lock shall be provided. The hinged doors top and drawer top shall be provided with finger groove handle-less design created by providing a reverse tapered profile edge of 6mm straight surface & 12 mm tapered towards inside at 45 degree & then sealed with minimum 2mm thick PVC lipping on automatic machine. Suitable lock shall be provided. The OEM shall have ISO 9001, BIFMA Level 2, Green Guard UL Gold Certification, AIOTA, IGBC Gold rated factory certification and India Design Mark.</p>	
2	cabin HB Chair	<p>The overall size of Chair shall be : width 600 +/-5mm, depth 640 +/-5mm. Total height 1170 to 1270 +/-5 mm, Back Width 425 mm at Top and 500mm at bottom, Seat Width 500 +/-5 mm, Seat Depth 470+/-5 mm and Seat height 470mm to 570 mm +/-5mm range. Seat made up of foam pre moulded at 55 kg/m3 density. hardness of 25+ 3kgf at 50% deflection conforming to IS 3400. Seat shall be upholstered with micro fabric 100% polyster 180 GSM abrasion > 50000 cycles. Fire rated fabric confirming to BS EN 1021 (match) should be used. The chair shall be supplied with Mesh Back rest. The back frame shall be made up of Injection molded PPGF 20%. PU Adjustable Lumbar Support full length of size 365 mm, 110 mm height and 25mm thickness. The Chair should be provided with Self Calibrating Multilock Mechanism that should adjust the tension of the back sensing weight of the user. The mechanism shall allow 360 degree revolving feature along with height adjustability. One Way Adjustable Arms (Height) to be provied with height adjustment button of size 73mm x 18mm made of Delrin P 500. The mechansim shall possess seat to back recline ratio of 3:7. The Gas Lift used shall be class 4 tested as per ANSI BIFMA standards. Nylon base shall be provided.Twin castors 50 mm dia with PA6 material complying to ANSI/ BIFMA X 5.1 2017 standards. The base shall be 660 mm PCD (26 inches) five pronged bases made up of PA6, 30% glass filled reinforced with bottom ribbing for additional buttress and strength.Tolerance of +/- 5mm to be considered for product sizes i.e Length, Depth & height and tolerance of 5% to be considered in pipe thickness & Pipe sizes. The OEM shall have ISO 9001, BIFMA Level 2, Green Guard UL Gold Certification, AIOTA, IGBC Gold rated factory certification and India Design Mark.</p>	
3	cabin MB Chair	<p>The overall size of Chair shall be height 870 to 970 +/-5 mm, Back Width 415 mm at Top and 470mm at bottom, and 450mm at the lumber support. Seat Width 480 +/-5 mm, Seat Depth 440+/-5 mm and Seat height 420mm to 520 mm +/-5mm range. over all chair width should be 540 +/-5mm and Overall chair depth should be 610 +/-5mm. Seat should be made up of foam pre moulded at 55 kg/m3 density. hardness of 25+ 3kgf at 50% deflection conforming to IS 3400. Seat shall be upholstered with micro fabric 100% polyster 180 GSM abrasion > 50000 cycles. No flamming or progressive smoldering within one hour of placement of the cigarettes. Fire rated fabric confirming to BS EN 1021 (match) should be used. The back frame shall be made up of PPGF and the injection molded in black color, armrest also in black color. The chair shall be supplied with Mesh Back rest. The Chair should be provided with center tilt two position lock Mechanism.The mecahinsm plate shall be attached to seat with 2.5mm thick plate. The mechanism shall allow 360 degree revolving feature along with height adjustability. Fixed arms connected to seat and back in the same colour.Armrest shall be Single peice die casted trapezium shaped arm rest overall size of 280 L x 230 H x 11mm thick at user side. The mechansim shall possess seat to back recline ratio of 1:1. The Gas Lift used shall be class 4 tested as per ANSI BIFMA standards. Nylon Base to be provied. Twin castors 50 mm dia with PA6 material complying to ANSI/ BIFMA X 5.1 2017 standards. the axle pin shall be rust protected zinc passivated. The base shall be made up of nylon glass filled black color.Tolerance of +/- 5mm to be considered for product sizes i.e Length, Depth & height and tolerance of 5% to be considered in pipe thickness & Pipe sizes. The OEM shall have ISO 9001, BIFMA Level 2, Green Guard UL Gold Certification, AIOTA, IGBC Gold rated factory certification and India Design Mark.</p>	

4	Conference Table	<p>The Overall size of the Table shall be 4500LX1200DX750. The worksurface of the table shall be made up of 25mm thick Pre-laminate particle board as per E1 norms and its edges duly sealed with 2mm PVC Lipping on automatic machine at visible sides. Two Long sides of the work surface shall be provided with reverse tapered edge design created by chamfering the board at 45 degree inside for 17mm length & keeping 8mm straight & then edges sealed with 2mm thick PVC Lipping on automatic machine. Leg: shall be made up of high pressure aluminum die casted 20 degree tapered, number "7" shape & oblong cross section of about 55mm on top, 45mm at bottom and of 725mm length to get 750mm table height, it shall acts as vertical structural support member, connected by a horizontal cross beams 50x25x1.6thk (16g) ERW tube & connected to the Aluminium diecast vertical legs through a high pressure Aluminium diecast 90deg – 02 way connectors. The Intermediate leg: Two Verticals of Intermediate leg will have to be with 60x40mm rectangular ERW tubes and both legs are joined using a beam section of 40x40x1.6mm thk at the top side. The 60x40 verticals to have through "U" notch or through cut out of 40x41mm size at the top side to locate 40x40 cross beam. Understructure shall powder coated upto 40 to 60microns. Wire Management: 450mm Aluminium Flip Up and provision to mount swiches and sockets on PVC cable dump and Vertical wire entry cover made up of steel sheets. The OEM shall have ISO 9001, BIFMA Level 2, Green Guard UL Gold Certification, AIOTA, IGBC Gold rated factory certification and India Design Mark.</p>	
5	Conference HB Chair	<p>The overall size of Chair shall be : width 600 +/-5mm, depth 640 +/-5mm. Total height 1170 to 1270 +/-5 mm, Back Width 425 mm at Top and 500mm at bottom, Seat Width 500 +/-5 mm, Seat Depth 470+/-5 mm and Seat height 470mm to 570 mm +/-5mm range. Seat made up of foam pre moulded at 55 kg/m3 density. hardness of 25+ 3kgf at 50% deflection conforming to IS 3400. Seat shall be made up of foam pre moulded at 55 kg/m3 density. hardness of 25+ 3kgf at 50% deflection conforming to IS 3400. Seat shall be upholstered with micro fabric 100% polyester 180 GSM abrasion > 50000 cycles. Fire rated fabric confirming to BS EN 1021 (match) should be used. The chair shall be supplied with Mesh Back rest. The back frame shall be made up of Injection molded PPGF 20% in light grey shade, armrest support also in light grey shade. PPGF Frame thickness shall be minimum 4.8mm. Adjustable Lumbar Support made up of PU having size 365 mm x 110 mm x 25mm thick shall be provided for better comfort. Lumbar Support material Integrated one-piece Molded PU. The Chair should be provided with Self Calibrating Multilock Mechanism (Bio Snchyro mechansim) that should adjust the tension of the back sensing weight of the user. The mechanism shall allow 360 degree revolving feature along with height adjustability. One Way Adjustable Arms (Height) to be provied with height adjustment button of size 73mm x 18mm made of Delrin P 500. Armrest Height shall be 170mm to 260mm adjustable from Seat The mechansim shall possess seat to back recline ratio of 3:7. The Gas Lift used shall be class 4 tested as per ANSI BIFMA standards. Metal base shall be provided of light grey color matching the chair back & armrest.The base shall be made up of mild steel powder coated in grey shade to match the entire grey theme of chair.Metal base powder coated made up of sheet thickness 2mm.Tolerance of +/- 5mm to be considered for product sizes i.e Length, Depth & height and tolerance of 5% to be considered in pipe thickness & Pipe sizes. The OEM shall have ISO 9001, BIFMA Level 2, Green Guard UL Gold Certification, AIOTA, IGBC Gold rated factory certification and India Design Mark.</p>	
6	Conference MB Chair	<p>The overall size of Chair shall be width 600 +/-5mm, depth 640 +/-5mm. Total height shall be 980 to 1080 +/-5 mm, Back Width 425 mm at Top and 500mm at bottom, Seat Width 500 +/-5 mm, Seat Depth 470+/-5 mm and Seat height 470mm to 570 mm +/-5mm range. Seat shall be made up of foam pre moulded at 55 kg/m3 density. hardness of 25+ 3kgf at 50% deflection conforming to IS 3400. Seat shall be upholstered with micro fabric 100% polyester 180 GSM abrasion > 50000 cycles. Fire rated fabric confirming to BS EN 1021 (match) should be used. The chair shall be supplied with Mesh Back rest. The back frame shall be made up of Injection molded PPGF 20% in light grey shade, armrest support also in light grey shade. PPGF Frame thickness shall be minimum 4.8mm. Adjustable Lumbar Support made up of PU having size 365 mm x 110 mm x 25mm thick shall be provided for better comfort. Lumbar Support material Integrated one-piece Molded PU. The Chair should be provided with Self Calibrating Multilock Mechanism (Bio Snchyro mechansim) that should adjust the tension of the back sensing weight of the user. The mechanism shall allow 360 degree revolving feature along with height adjustability. One Way Adjustable Arms (Height) to be provied with height adjustment button of size 73mm x 18mm made of Delrin P 500. Armrest Height shall be 170mm to 260mm adjustable from Seat The mechansim shall possess seat to back recline ratio of 3:7. The Gas Lift used shall be class 4 tested as per ANSI BIFMA standards. Metal base shall be provided of light grey color matching the chair back & armrest.The base shall be made up of mild steel powder coated in grey shade to match the entire grey theme of chair.Metal base powder coated made up of sheet thickness 2mm.Tolerance of +/- 5mm to be considered for product sizes i.e Length, Depth & height and tolerance of 5% to be considered in pipe thickness & Pipe sizes. The OEM shall have ISO 9001, BIFMA Level 2, Green Guard UL Gold Certification, AIOTA, IGBC Gold rated factory certification and India Design Mark.</p>	

7	Reception Table	<p>Reception table : The overall size of the reception table shall be 2400 mm length, 750 mm depth & 1050 mm height. On the front side both ends shall be provided with groove design strips to enhance the overall look. At the centre of the front side L shape surface shall be provided fixed up with hinges to paste logo of the University. The entire table shall be made up of 25mm / 18mm thick pre laminated particle board of E1 norms. Inside of table a working height shelf should be provided or height 750 mm to keep desktop/ laptop and normal working with sitting. the edges of the visible surface shall be sealed with 2mm thick PVC lipping on automatic machine. Unless specified tolerance of +/- 5mm to be considered for product dimensions Length, Depth & height and tolerance of 5% to be considered in thickness & size of material & components used. The OEM shall have ISO 9001, BIFMA Level 2, Green Guard UL Gold Certification, AIOTA, IGBC Gold rated factory certification and India Design Mark.</p>	
8	Reception MB Chair	<p>The overall size of Chair shall be height 1020 to 1120 +/-5 mm, width should be 595 +/-5mm and depth should be 640 +/-5mm. Back Width 435 mm at Top and 490mm at bottom, Seat Width 500 +/-5 mm, Seat Depth 465+/-5 mm and Seat height 450mm to 550 mm +/-5mm range. Seat should be made up of foam pre moulded at 55 kg/m3 density. hardness of 25+ 3kgf at 50% deflection conforming to IS 3400. Seat shall be upholstered with micro fabric 100% polyester 180 GSM abrasion > 50000 cycles. No flammability or progressive smoldering within one hour of placement of the cigarettes. Fire rated fabric confirming to BS EN 1021 (match) should be used. The chair shall be supplied with Mesh at the back rest. The back frame shall be made up of injection molded nylon GF 3. Adjustable Lumbar Support of size 300 mm length, 150 mm height and 3mm thickness travel upto 65mm. The Chair should be provided with Synchro mechanism with single lever with one position lock. The mechanism shall allow 360 degree revolving feature along with height adjustability one Way with height adjustment button made of Delrin P 500 & arm top shall be PU material. The mechanism shall possess seat to back recline ratio of 3:7. The Gas Lift used shall be class 4 tested as per ANSI BIFMA standards. Nylon Base to be provided. Twin castors 50 mm dia with PA6 material complying to ANSI/ BIFMA X 5.1 2017 standards. The base shall be 660 mm PCD (26 inches) five pronged bases made up of PA6, 30% glass filled reinforced with bottom ribbing for additional buttress and strength. Tolerance of +/- 5mm to be considered for product sizes i.e Length, Depth & height and tolerance of 5% to be considered in pipe thickness & Pipe sizes. The OEM shall have ISO 9001, BIFMA Level 2, Green Guard UL Gold Certification, AIOTA, IGBC Gold rated factory certification and India Design Mark.</p>	
9	Workstations	<p>The overall size of workstation shall be 1200L x 600D x 750H. The worktop shall be made of 25mm thick pre laminate particle boards with E1 norms fully finish with 2mm pvc edge band all the side of worktop. Modesty shall be made of 18mm thick pre laminate particle boards with E1 norms with 2mm pvc edge band all the visible side and connected with 2 nos L-shape pressure aluminium die casted connector. The height of the modesty shall be 450mm. The understructure shall be made up of MS powder coated legs having enhanced look trapezoidal cross section size 52mm x 52mm x 52mm x 26mm with chamfered corners and thickness of 1.6mm. Edges of the leg should not have sharp edges. For safety of users a radius of R3.20 mm should be provided. The Trapezoidal tube shall be connected with die cast connectors at top, leg shoe & levelers at bottom. High pressure aluminum die cast connectors shall of ADC-12 material confirming to ASTM E 1251-2011, IS 7658-1990 & IS 11035 – 1190. The vertical legs shall be connected by horizontal beams with the help of aluminum die cast connector that joints the legs vertically and horizontally with pipe of cross section 50 x 25 mm x 1.6 mm thickness. The die cast connect size shall be L shaped having angle of 10 degrees for vertical leg side. The Diecast connector will have same shape as of Trapezoidal vertical leg at one side and another side matching to horizontal cross section 50x25. The Intermediate leg: Two Verticals of Intermediate leg will have to be with 60x40mm rectangular ERW tubes and both legs are joined using a beam section of 40x40x1.6mm thk at the top side. The 60x40 verticals to have through "U" notch or through cut out of 40x41mm size at the top side to locate 40x40 cross beam. Understructure shall powder coated upto 40 to 60microns. The spacers shall be made of Polycarbonate (PC). The Raceways shall provided below the work surface for carrying wires from one end to other end of the cluster, Size offered shall 250mm Ht, Thickness 70mm. Provided with separator for data and power cables. Designed to accommodate 50-60 CAT-6 cables. The "Hook on" raceway covers shall provided with opening from either side. The cover shall made of MS Powder coated metal/prelam particle board. The switch/sockets shall mounted on the Raceway covers as per the client requirement Switches. For entry of cables from the floor into the cable tray, Wire Entry covers shall provided between the intermediate legs with separator for entry of power and data. 65mm dia grommet hole for wire access. The front fabric screen shall be provided of size 1050 mm L x 350 mm ht. made up of 18 mm thick prelam particle board of grade E1 upholstered by fabric, having aluminum extrusion at all three sides having cross section size of 12mm x 5mm & joined at all 4 corners with Zinc mazak5 die cast connector of size 15 L x 15 H x 12mm W. The OEM shall have ISO 9001, BIFMA Level 2, Green Guard UL Gold Certification, AIOTA, IGBC Gold rated factory certification and India Design Mark.</p>	

10	Wks Chair	<p>Overall size : Width 560 +/-5mm and Depth 670 +/-5mm. Total height 990 to 1090 +/-5 mm, Back Width 415 mm at Top and 450mm at bottom, Seat Width 480 +/-5 mm, Seat Depth 460+/-5 mm and Seat height 460mm to 560 mm +/-5mm range. Seat should be made up of foam pre moulded at 55 kg/m3 density. hardness of 25+ 3kgf at 50% deflection conforming to IS 3400. Seat shall be upholstered with micro fabric 100% polyester 180 GSM abrasion > 50000 cycles. No flaming or progressive smoldering within one hour of placement of the cigarettes. Fire rated fabric confirming to BS EN 1021 (match) should be used. The chair shall be supplied with Mesh Back rest. The Chair should be provided with Synchro tilt Mechanism. The mechanism shall allow 360 degree revolving feature along with height adjustability. The mechanism shall possess seat to back recline ratio of 1:1. The Gas Lift used shall be class 4 tested as per ANSI BIFMA standards. One Way Adjustable Arms (Height) to be provided with height adjustment button made of Delrin P 500. Nylon Base to be provided. Twin castors 50 mm dia with PA6 material complying to ANSI/ BIFMA X 5.1 2017 standards. the axle pin shall be rust protected zinc passivated. The base shall be 660 mm PCD (26 inches) five pronged bases made up of PA6, 30% glass filled reinforced with bottom ribbing for additional buttress and strength. Tolerance of +/- 5mm to be considered for product sizes i.e Length, Depth & height and tolerance of 5% to be considered in pipe thickness & Pipe sizes. The OEM shall have ISO 9001, BIFMA Level 2, Green Guard UL Gold Certification, AIOTA, IGBC Gold rated factory certification and India Design Mark.</p>	
11	Meeting Table	<p>The Overall size of the Table shall be 4500LX1200DX750. The worksurface of the table shall be made up of 25mm thick Pre-laminate particle board as per E1 norms and its edges duly sealed with 2mm PVC Lipping on automatic machine at visible sides. The understructure shall be made up of MS powder coated legs having enhanced look trapezoidal cross section size 52mm x 52mm x 52mm x 26mm with chamfered corners and thickness of 1.6mm. Edges of the leg should not have sharp edges. For safety of users a radius of R3.20 mm should be provided. The Trapezoidal tube shall be connected with die cast connectors at top, leg shoe & levelers at bottom. High pressure aluminum die cast connectors shall of ADC-12 material confirming to ASTM E 1251-2011, IS 7658-1990 & IS 11035 – 1190. The vertical legs shall be connected by horizontal beams with the help of aluminum die cast connector that joints the legs vertically and horizontally with pipe of cross section 50 x 25 mm x 1.6 mm thickness. The die cast connect size shall be L shaped having angle of 10 degrees for vertical leg side. The Diecast connector will have same shape as of Trapezoidal vertical leg at one side and another side matching to horizontal cross section 50x25. The Intermediate leg: Two Verticals of Intermediate leg will have to be with 60x40mm rectangular ERW tubes and both legs are joined using a beam section of 40x40x1.6mm thk at the top side. The 60x40 verticals to have through "U" notch or through cut out of 40x41mm size at the top side to locate 40x40 cross beam. Understructure shall powder coated upto 40 to 60microns. Wire Management: 450mm Aluminium Flip Up and provision to mount switches and sockets on PVC cable dump and Vertical wire entry(Intermediate Leg) cover made up of steel sheets. The OEM shall have ISO 9001, BIFMA Level 2, Green Guard UL Gold Certification, AIOTA, IGBC Gold rated factory certification and India Design Mark.</p>	
12	Meeting MB Chair	<p>The overall size of Chair shall be width 600 +/-5mm, depth 640 +/-5mm. Total height shall be 980 to 1080 +/-5 mm, Back Width 425 mm at Top and 500mm at bottom, Seat Width 500 +/-5 mm, Seat Depth 470+/-5 mm and Seat height 470mm to 570 mm +/-5mm range. Seat shall be made up of foam pre moulded at 55 kg/m3 density. hardness of 25+ 3kgf at 50% deflection conforming to IS 3400. Seat shall be upholstered with micro fabric 100% polyester 180 GSM abrasion > 50000 cycles. Fire rated fabric confirming to BS EN 1021 (match) should be used. The chair shall be supplied with Mesh Back rest. The back frame shall be made up of Injection molded PPGF 20% in light grey shade, armrest support also in light grey shade. PPGF Frame thickness shall be minimum 4.8mm. Adjustable Lumbar Support made up of PU having size 365 mm x 110 mm x 25mm thick shall be provided for better comfort. Lumbar Support material Integrated one-piece Molded PU. The Chair should be provided with Self Calibrating Multilock Mechanism (Bio Synchro mechanism) that should adjust the tension of the back sensing weight of the user. The mechanism shall allow 360 degree revolving feature along with height adjustability. One Way Adjustable Arms (Height) to be provided with height adjustment button of size 73mm x 18mm made of Delrin P 500. Armrest Height shall be 170mm to 260mm adjustable from Seat The mechanism shall possess seat to back recline ratio of 3:7. The Gas Lift used shall be class 4 tested as per ANSI BIFMA standards. Metal base shall be provided of light grey color matching the chair back & armrest. The base shall be made up of mild steel powder coated in grey shade to match the entire grey theme of chair. Metal base powder coated made up of sheet thickness 2mm. Tolerance of +/- 5mm to be considered for product sizes i.e Length, Depth & height and tolerance of 5% to be considered in pipe thickness & Pipe sizes. The OEM shall have ISO 9001, BIFMA Level 2, Green Guard UL Gold Certification, AIOTA, IGBC Gold rated factory certification and India Design Mark.</p>	