TENDER FOR CONSTRUCTION AND DEVELOPMENT OF E-VEHICLES MANUFACTURING PLANT (GREENFIELD PROJECT) AT IP SEETHARAMPUR, SHABAD VILLAGE AND MANDAL, RANGA REDDY DISTRICT, TELANGANA

VOLUME - II

TECHNICAL SPECIFICATIONS

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TECHNICAL SPECIFICATION OF CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

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PART-1 (CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS)

SECTION 1

S P E C I F I C A T I O N S
FOR
C I V I L W O R K

1.0 EXCAVATION:

1. EXCAVATION AND EARTH WORK:

1.1. Examination of the Site:

The contractor shall visit and ascertain the nature of the ground to be excavated and the works to be done and shall accept all responsibility for the cost of the work involved.

1.2. Setting out:

The contractor shall set out the center line of the building or other involved works after clearing the site and get the same approved from Olectra Greentech Limited. It shall be the responsibility of the Contractor to install substantial reference marks, bench marks etc., and maintain them as long as required by the Olectra Greentech Limited. The Contractor shall assume full responsibility for proper setting out, alignment, elevation and dimension of each and all parts of the work.

1.3. Ground level and Site level:

Before starting the excavation, the requisite block levels of the entire plot shall be taken by the contractor, in consultation with the Olectra Greentech Limited, and a proper record of these levels kept, which shall be jointly signed by the contractor and the Olectra Greentech Limited. A block level plan showing all ground levels of the plot shall be prepared and shall jointly be signed by the contractor and the Olectra Greentech Limited. The levels shall be taken at intervals of 3M, or even less, as required and directed.

1.4(a) Excavation and Preparation of foundation for concreting:

Excavation shall include removal of all materials of whatever nature at all depths and whether wet or dry, necessary for the construction/foundation and sub-structure (including mass excavation for underground reservoirs, where applicable) exactly in accordance with lines, levels, grades and curves shown in the drawings or as directed by the Olectra Greentech Limited. The bottoms of excavation shall be levelled both longitudinally and transversely or sloped as directed by the Olectra Greentech Limited.

Should the contractor excavate to a greater depth or width than shown on the drawings, he shall at his own expense fill the extra depth or width in cement concrete in proportion as directed by Olectra Greentech Limited but in no case with concrete of mix leaner than 1:4:8 cement concrete, at no extra cost.

The contractor shall report to the Olectra Greentech Limited when the excavations are ready to receive concrete. No concrete shall be placed in foundations until the contractor has obtained Olectra Greentech Limited approval. In case, the excavation s done through different strata of soil and if the same are payable as per provisions in the Schedule of Quantities, the contractor shall get the

dimensions/levels/ heights of each of the strata recorded/decided by the Olectra Greentech Limited for payment. If no specific provision is made for different strata in the schedule of quantities, it will be presumed that excavation shall be in all types of soil and the contractor’s rate shall cover for the same viz., for all types of sol (only excluding hard rock, when so specifically provided for).
After the excavation is passed by the Olectra Greentech Limited and before laying the concrete, the contractor shall get the depth and dimensions of excavations and levels (and nature of strata as applicable as per Schedule of Quantities like hard rock, soft rock etc.,) and measurements recorded from the Olectra Greentech Limited.

Measurement of Excavation in Rock:

Excavated soft/disintegrated rock and hard rock should not be mixed up and shall be stacked separately for purpose of payment. (Even otherwise they shall be stacked separately, and not mixed up with soils). Minimum of the quantities arrived at from

i) Levels/pit measurements for sheet rock.

ii) Volume based on stack measurements reduced by 40% to account for voids in stacks for Builders / Over cops shall be considered for purpose of payment.

1.4(b) The contractor shall be responsible for safe custody of these stacks, till the same are taken over by the Olectra Greentech Limited or completion of work, whichever is earlier. The rates quoted for excavation shall include costs of all these and nothing extra shall be paid towards the same.

1.5 Backfilling:

All shoring and formwork shall be removed after their necessity ceases and trash/slush of any sorts shall be cleaned out from the excavation. All space between foundation masonry or concrete and the sides of excavation shall be refilled to the original surface with approved excavated materials in layers, each not exceeding 150mm in thickness, watered and rammed. The filling shall be done after concrete or masonry is fully set and done in such a way as not to cause undue thrust on any part of the structure. Where excavated materials are to be used for refilling, it shall be brought from the place, where it is temporarily stacked, and used in refilling.

No excavation of foundations shall be filled in or covered up, until all measurements of excavations, masonry, concrete and other works below ground level are jointly recorded. Black cotton soil shall not be used for back filling or in plinth filling. In case back filling is done without recording measurements of foundation work, the contractor will have to remove back filling at his cost for taking measurements. Otherwise, the foundation work will not be measured and will be paid for.

1.6 Dewatering:
Rate for excavation shall including bailing or pumping out water, which may accumulate in the excavation during the progress of work either from seepage, springs, rain or any other cause whatsoever, and diverting surface flow, if any, by bunds or any other appropriate means. Pumping out water shall be done in such an approved manner as to preclude the possibility of any damage to the foundation trenches, concrete of masonry or any adjacent structure. When water is out water shall be from auxiliary pits of adequate size, dug slightly outside the building excavations, the depth of auxiliary pit shall be more than the working foundation trench levels. The auxiliary pit shall be refilling with approved excavation materials after the dewatering is over.

The excavation shall be kept free from water:

a. During inspection and measurement.

b. When concrete and/or masonry are in progress and till they come above the natural water level and

c. Till the Olectra Greentech Limited consider that the concrete/mortar is sufficiently set.

A.1.7 Rates quoted for excavation shall include all these (A.1.1. to A.1.6) operations to the extent required for completing the work please see A.3 also, unless otherwise specifically provided for.

Surplus excavated materials:

The item of removal of surplus excavated materials shall only be undertaken by the contractor when specific instruction in this regard has been obtained from the Olectra Greentech Limited/Architect. The contractor must also secure the approval of the Olectra Greentech Limited regarding the quantity of surplus materials to be removed prior to commencement of this item of work. The contractor shall dispose of surplus excavated materials anywhere within the site as required and as directed. He will spread the same in layers of 150mm each and as directed. Contractor will take the decision of Olectra Greentech Limited for disposal of surplus excavated material and no extra will be paid for double handling of the same, if any. Wherever surplus or unsuitable material is to be disposed off outside the site, it shall be dumped and spread at the places to be specifically approved and as directed by the Olectra Greentech Limited, with all leads and lifts (unless otherwise provided for), and shall be paid as a separate item, as stated in the schedule of quantities.

d. ROCK EXCAVATION:

A.2.1 Ordinary Soft rock comprises of:

Limestones, sandstones, laterite or disintegrated rock which can be split or be quarried with crow bars or wedges. Unreinforced cement concrete, stone masonry in cement mortar.

A.2.2. Hard rock comprises of:

Any rock or cement concrete for the excavation of which the use of mechanical plant or blasting is required, or which cannot be removed with iron crow bars.

Reinforced cement concrete below ground level.

Where blasting is prohibited for any reasons, the excavation has to be carried out by chiseling, wedging or any agreed method.

Rock which requires chiseling/blasting/compressor.

A.2.3 Hard rock encountered in excavation work shall be removed by chiseling or wedging as directed by the Architects/Olectra Greentech Limited's and no blasting is permitted.

A.2.4 Rock excavation shall comply with the specifications for excavation, except that it shall be of soft or hard rock.

A.2.5 Rock excavation will be measured and paid for quantities computed from (i) pit measurement/levels or (ii) by stack measurements reduced by 40% to account for voids, whichever is less.

MODE OF MEASUREMENT:

A.3.1 Excavation for foundation of columns, beams, walls, and the like shall be measured and paid net as per drawing, dimensions of concrete (bed concrete where so specified) at the lowest level. In regard to length and breadth and depth shall be computed from the concerned excavation levels and ground level taken before excavation. Any additional excavation required for working space, formwork, planking, dewatering and strutting etc., shall not be measured and paid for separately but rates quoted for excavation shall include for all these factors. No increase in bulk after excavation shall be paid for. Excavation beyond dimensions of mass concrete for foundation as per drawing or below required depth shall not be paid for. Any excavation beyond required level shall be filled back with cement concrete of mix not leaner than 1:4:8, at his cost.

A.3.2 Measurement for general excavation/filling in roads/areas shall be made on sectional measurement by taken levels jointly before starting the work and after completion of the work and shall be worked out on average area method. This will give the total quantity of excavation. Levels shall be taken at 3m intervals or closer as required and directed by the Olectra Greentech Limited.

A.3.3. In the case of filling by morrum brought from outside, the quantities will be worked out from levels, as stated above, and shall be calculated/checked with lorry measurements, after deducting 20% for shrinkage. In case of inadequate information regarding lorry measurement and/or number of lorry trips, Olectra Greentech Limited's decision will be final and binding.

A.3.4 In case of all fillings, in exposes and open areas, 10% deduction will be made from the total quantities in the running bills, out of which 5% will be deducted permanently and balance 5% will be paid after expiry of the defects liability period of one year or one monsoon, whichever is more and after making good levels, surface etc., as required and directed.

A.3.5 In case of soft and hard rock, payments shall be limited to minimum of the quantities arrived at from levels or stack measurements (after deducting 40% for voids). The material shall be stacked on fairly level ground and places, as directed. All depressions over the required final levels will be made good by P.C.C. of mix not leaner than 1:4:8 as directed, at no extra cost.

A.3.6 The quantity of excavated materials disposed off outside the premises will be worked out on the basis of total quantity of excavation less follows:

A.3.6.1. Quantity of excavated (other than rock) materials used for filling (on the basis of levels).

A.3.6.2. Quantity of rock excavation (Stack measurements less 40% or level basis).

A.3.6.3. Quantity of excavated materials disposed of within the site (on the basis of levels).

The quantity worked out on these bases will be checked with lorry measurements, with deduction of 20% for looseness/shrinkage. In case of any discrepancy, Olectra Greentech Limited's decision will be final and binding.

A.3.7. Total quantity of excavation and filling will be finalised on the basis of levels only. The total quantity of excavation will be checked by adding quantities of the following items:

A 3.7.1. Material used for filling wherever required (on level basis).

A.3.7.2. Rock excavation minimum of quantity arrived from stack measurements with 40% voids) or based on levels.

A.3.7.3. Surplus/unsuitable material disposed within site on level basis (deducting 10% voids if consolidated, otherwise deducting 20%). In case of lock 40% voids will be deducted.

A.3.7.4. - do – disposed outside site (on lorry measurements and by deducting 20% for looseness/shrinkage if transported by lorries, otherwise on basis of levels and by deducting 10% voids if the fill is consolidated – otherwise 20% voids shall be considered.

In case of any discrepancy, the decision of Olectra Greentech Limited & Architect shall be final and binding for the above sub-divisions A.3.7.1, A.3.7.2, A.3.7.3 & A.3.7.4 as stated above.

A.3.8. Whenever the contractor is instructed to reuse the excavated rock for works such as masonry, soiling, filling etc., the measurement for such items shall be the same/equivalent as that of rock measured under excavation items earlier. The contractor will not be paid for double handling of such excavated materials.

2.0 SOIL TREATMENT:

Soil treatment for pre-construction termite control shall confirm to the following:

2.1.	Chemicals	Concentration
	ChlorophyriphosEmulsifiable	1% strength applied in oil
	Concentrate 20%	solution or water emulsion.

A daily record shall be maintained by the contractor indicating quantities of chemical brought to site, used on work with location/stage of treatment (the quantum/ area of work done) and the up to date quantity of chemical consumed for the work and up to date balance at close of work on that day. This record book shall be property of the Olectra Greentech Limited.

2.2. Method of application and treatment - All as per IS 6313 (Part – II) – 1981

2.2.1 Conditions of formations:

Barrier shall be complete and continuous under the whole of the structure to be protected. All foundations shall be fully surrounded by and in close contact with barrier of treated soil. Each part of the area treated shall receive the prescribed dosage of chemical.

2.2.2. Time of Application:

Soil treatment should start when foundation trenches and pits are ready to take mass concrete in foundations. Laying of mass concrete should start when the chemical emulsion has been absorbed by the soil and the surface is quite dry. Treatment should not be carried out, when it is raining or when the soil is wet with rain or subsoil water. The foregoing requirement applies also in the case of treatment to the filled earth surface within the plinth area before laying the sub-grade for the floor.

2.2.3. Disturbance:

Once formed, treated soil barriers shall not be disturbed. If, by chance treated soil barriers are disturbed, immediate steps shall be taken to restore the continuity and completeness of the barrier system.

2.2.4. The chemical emulsions shall be applied uniformly at the prescribed rate in all the stages of the treatment. A suitable hand

operated compressed air sprayer or watering can should be used to facilitate uniform dispersal of the chemical emulsion. On large jobs, a power sprayer may be used to save labour and time.

In the event of waterlogging of foundation, the water shall be pumped out and the chemical emulsion applied when the soil is absorbent.

2.2.5. Treatment for Masonry foundations and Basements as per clause 6.2 of IS 6313 (Part II) – 1981.

2.2.6. Treatment for RCC Foundations and Basements as per clause 6.3 of IS 6313 (Part II) – 1981.

2.2.7. Treatment of top surface of plinth filling as per clause 6.4 of IS 6313 (Part II) – 1981.

2.2.8. Treatment of junction of the wall and the floor as per clause 6.5 of IS 6313 (Part II) – 1981.

2.2.9. Treatment of soil along external perimeter of building as per clause 6.6 of IS 6313 (Part II) - 1981.

2.2.10. Treatment of soil under Apron along External perimeter of the building as per clause 6.7 of IS 6313 (Part II) – 1981.

2.2.11. Treatment for walls retaining soil above floor level as per clause 6.8 of IS 6313 (part II) – 1981.

2.2.12. Treatment of soil surrounding pipes, waster and conduits as per clause 6.9 of IS 6313 (Part II) – 1981.

2.2.13. Treatment for expansion joints as per clause 6.10 of IS 6313 (Part II) – 1981.

2.3. Guarantee: 10 years (as per form enclosed on requisite stamp paper)

In the unlikely event of any re-treatment becoming necessary subsequently during the guarantee period, necessary inspection and re-treatment, as required, shall be carried out, free of cost, by the contractor.

2.4. The rate to include:

The contractor should include in his rates given in schedule of quantities in Sq.meter area basis, all the stages of treatment, Viz., bottom of foundations, sides of trenches, underside of the floors, underside/damp proof courses, outer faces of external walls up to plinth protection, and around all pipe lines at ground level etc., and finally the back fill all around and in the building as per detailed specifications mentioned above. Where the rate of applications of the insecticide has not been specified clearly, the rates of application of chemical should be so governed that during the guarantee period, no trouble may arise. Payment will be made on the plinth area measurement of ground floor only, and the rate for the same should include all the stages of work as mentioned above and no extra on any account will be entertained.

3.0 PLAIN AND REINFORCED PRECAST CONCRETE WORK:

3.1. APPLICATION OF SPECIFICATIONS:

3.1.1 Notwithstanding what is stated in the specification herein, detailed architectural and structural drawings and notes appended there on shall be deemed to form part of the specifications and to supersede these, in case of any discrepancy.

3.2. GENERAL:

3.2.1 The structural and architectural drawings shall be studied thoroughly and any discrepancy in the dimensions on the drawings or any other point not clear to the contractor shall be brought to the notice of Olectra Greentech Limited well in advance, and got decided from them before further proceeding with the work.

3.2.2. No concrete works shall be carried out in the absence of authorised and qualified supervisor of the Olectra Greentech Limited.

3.3. MATERIALS:

3.3.1. General:

3.3.1.1. All the materials constituting the concrete shall conform to the relevant latest Indian Standard Specifications, unless otherwise indicated.

3.3.1.2. Materials shall be transported, handled and stored on the site or elsewhere in such a manner as to prevent damage, deterioration or contamination.

3.3.1.3. All the materials such as sand, coarse aggregates, cement and water shall be got tested in any approved laboratory, as directed by the Olectra Greentech Limited, before starting the concrete work. During construction also all these materials will have to be tested, as often as deemed necessary by the Olectra Greentech Limited.

3.3.2. **Cement:**

Cement shall be ordinary Portland cement 43 grade and of approved brand confirming to IS 1812 – 1989 unless otherwise specified. The contractor shall procure cement of makes – ULTRATECH/MAHA/NAGARJUNA/PENNA/

COROMANDAL/BHARATI or any other manufacturer as approved by Olectra Greentech Limited. The contractor may use ordinary Portland Cement of 53 grade of the makes specified above by obtaining written permission from the Olectra Greentech Limited. It shall be stored by the contractor in a dry, watertight and properly ventilated structure as per specified conditions. The cement shall be stacked on a dry raised platform, 1'-0" above the floor level and shall be stacked in the sequence of receipt of consignments. Not more than 10 bags should be kept in one stack. Any cement which has deteriorated, caked or which has been damaged due to any reason whatsoever shall not be used. Cement, concerning which there is any doubt, shall be got tested by the contractor at his cost and used, only if found satisfactory. Condemned/damaged cement shall be removed immediately from the site by the contractor at his cost.

Daily account of receipt and use of cement bags shall be maintained by the contractor in the proforma approved by the Olectra Greentech Limited and got checked by the Olectra Greentech Limited's Engineer at site. Cement should be used in the order in which it is received at site. Cement stored for more than three months shall be got tested, before using it in the work.

3.3.3. **Sand:**

Sand shall be well graded, coarse in texture, clean, hard and free from salt, earth, clay or any other harmful material. Before starting the work, the contractor shall get samples of sand, locally available from different sources, if required, and the same shall be got tested as per latest relevant B.I.S. codes for concrete work and to get the final approval of Olectra Greentech Limited. During the course of the construction or for any reasons it is observed that the sand, procured by the Contractor from previously approved source, is not up to the approved standard or it is not available in sufficient quantity required for the entire project, then the contractor will have to make such alternative arrangements to procure the sand of approved quality from any other source, even with longer lead at no extra cost. Sand shall be screened and washed, if required, as directed by the Olectra Greentech Limited at no extra cost. Field tests shall be carried out regularly and as directed, to ensure the suitability/quality of the same. Silt content should not exceed 8% by volume or 5% by weight, and should be free from other deleterious materials. When sand is mixed by volume, necessary allowance shall be made for bulkage, as required and directed to give correct mixture.

3.3.4. **Coarse Aggregate:**

Coarse aggregates shall consist of hard, dense, durable uncoated crushed Granite rock. It shall be free from soft, friable, thin or long laminated pieces. All aggregates should generally confirm to IS 383 – 1970. For reinforced cement concrete, the maximum size shall be not more than 20mm and minimum shall not be less than 5mm and shall be uniformly graded to the approval of Olectra Greentech Limited. If locally available coarse aggregate is not suitable or is not sufficient in quantity, the contractor shall have to procure it from any other source, even with longer leads at no extra cost. As and when directed by Olectra Greentech Limited, aggregates shall be washed by approved methods at contractor's cost. Necessary tests shall be carried out, as and when required to ascertain about the suitability and grading of the aggregated, by the contractor at his cost.

3.3.5. **Water:**

Water shall be clean, fresh and free from organic or inorganic matters in solution or suspension in such amounts, that may impair the strength or durability of the concrete. Water fit for drinking will generally be found suitable for use in concrete and plastering work. However, water shall be tested periodically for its use in construction work.

3.3.6. **Reinforcement:**

3.3.6.1. Mild steel bars:

Mild steel reinforcement bars shall conform to I.S.432 – 1982 "Part I" Fe 410 – S, other qualities of steel shall not be acceptable.

3.3.6.2. High strength deformed bars:

Where deformed high strength reinforcement bars are specified, the contractor shall use tor steel, accompanied by a test certificate from the manufacturer, conforming to IS – 1786 – 1986 and shall be Fe 500 grade. Contractor shall bet steel reinforcement tested at his cost as and when required and directed by Olectra Greentech Limited.

Steel shall be from the main manufacturers i.e., SAIL/TISCO/VSP/JSW or any other manufacturer as approved by Olectra Greentech Limited.

3.3.6.3. Cleaning of reinforcement:

Before steel reinforcement is placed in position, the surface of the reinforcement shall be cleaned of loose rust or scaling, dust, grease and any other objectionable substances as required and directed.

3.3.6.4. Bar bending schedule of reinforcement:

On receipt of structural drawings, contractor shall prepare bar bending schedules of reinforcement and shall get it approved by the Olectra Greentech Limited, in advance before starting the work.

3.3.6.5. Cutting and Reinforcement:

Before steel reinforcement bars are cut, the contractor shall study the lengths of bars required as per drawings and shall carry out cutting, only to suit the sizes required as per drawings so that the wastage is minimum.

3.3.6.6. Placing and Security:

Reinforcement bars shall be accurately placed and secured in position and firmly supported or wedged by precast cement mortar concrete blocks of suitable mix, thickness and size, at sufficiently close intervals, so that the bars will not sag between the supports or get displaced during the placing of concrete or any other operation of the work. It is most important to maintain reinforcement in its correct position without displacement and to maintain the correct specified cover. The contractor shall be responsible for all costs for rectification required in case the bars are displaced out of their correct position.

3.3.6.7. Binding wire:

The reinforcement shall be securely bound wherever bars cross/lap or whenever required with 2 strands of suitable length of 18-gauge soft annealed steel wire.

3.3.6.8. Welding:

Welding of bars, in place of splicing, shall not be carried out, unless specifically authorised in writing by Olectra Greentech Limited, and the welding shall be as per relevant I.S. code of practice. However, no extra payment shall be allowed for the same.

3.3.6.9. Bends etc.:

Bends, cranks, curves, etc., in steel reinforcement shall be carefully formed and shall strictly confirm to the drawings/requirements, care being taken to keep bends out of winding. Otherwise, all rods shall be truly straight. If any bend/crank shows signs of cracking, such rods/bars shall be removed immediately from the site. For bending of bars to any curvature, minimum radius of 9 times diameter of the bar shall be used, unless otherwise specified in the drawings. However, in respect of standard hooks, the radius of bends shall be two times the diameter of bar. Heating of reinforcement of bars to facilitate bending will not be permitted. The bars shall always be bend cold. In case of mild steel reinforcement bars of larger sizes, where cold bending is not possible, they may be bent by heating, but only with written permission of the Olectra Greentech Limited. Bars when bent shall not be heated beyond cherry red colour, and after bending shall be allowed to cool slowly, without quenching. The bars damaged or weakened in any way in bending shall not be used on the work. High strength deformed bars shall in no case be heated to facilitate bending or cranking.

3.3.6.10 Inspection of Reinforcement:

No concreting shall be commenced until the Olectra Greentech Limited have inspected the reinforcement in position and their approval obtained. A notice of at-least 72 hours shall be given to the Olectra Greentech Limited by the Contractor for inspection of reinforcement. If in the opinion of the Olectra Greentech Limited any material is not in accordance with the specification or the reinforcement is incorrectly spaced/bend or otherwise defective, the contractor shall immediately remove such materials from the site and replace with new ones and rectify any other defects in accordance with the instruction of the Architect and Olectra Greentech Limited and to their entire satisfaction.

3.3.6.11 Net Measurement:

Reinforcements shall be placed as shown on the structural drawings and payment will be made based on and limited to the net measurements, as per drawings. Only such laps, dowels, spacers, chairs etc., in reinforcement specifically shown on drawings shall be paid for. The contractor shall allow in his quoted rates for all wastages and rolling margins, which will not be paid for. The measured length of all the bars shall be converted into weight, as per standard weights given in latest I.S. Schedule. In case the weights of any bar/bars are less than the required weight (beyond rolling margins specified by B.I.S.) the same shall not be used on work. If used, the same shall be replaced with proper ones, at no extra cost.

3.3.6.12 Cover for Reinforcement:

Unless otherwise specified in drawings, cover shall be measured from outer surface of the main reinforcement and shall be as follows:

a. For beams and lintels – 25mm or dia of the bar, whichever is higher.

b. For slabs, chajjas, canopies, pardas – 15mm or dia of the bar, whichever is higher.

c. Columns – 40mm, or dia of bar, whichever is higher.

d. Footings – 50mm.

e. Cover blocks shall be of (1:1½:3) P.C.C. and of thickness, not less than the cover specified. Cover blocks of 1:2 cement mortar may be allowed, if specifically permitted by the Architect. PVC cover blocks of required cover is also allowed.

3.3.6.13. Rates quoted for reinforcement, in addition to any factors mentioned elsewhere, shall also include for:

a. Stock piling of reinforcement as described.

b. De-coiling, straightening (coiled bars, bent bars).

c. Removal of rust and every other undesirable substance, using wire brushes etc., as required/directed.

d. Cutting to required lengths, labour for bending and cranking, forming hooked ends (if required), handling, hoisting, placing in position, tying binding with binding wire and everything necessary to fix reinforcement in work as per drawings/requirements.

e. Cost of binding wire required as described.

f. Fabricating and fitting reinforcement, in any structural member, irrespective of its location, shape, dimension and level.

g. Cost of precast concrete/mortar cover blocks of proper size or nylon spacers to maintain cover and holding reinforcement in position.

h. Work at all levels.

3. 4 **FORM WORK**:

3.4.1. Materials and design:

Contractor shall get the materials, sizes/arrangements and method of supports, details of joinery, and design of formwork for beams, slabs, columns etc., approved by Olectra Greentech Limited, before starting the formwork.

3.4.2. Design of Form work:

i) Form work shall be adequately designed to support the full weight of workers, reinforcement, freshly placed concrete, effects of tamping/vibrating, etc., without yielding/settlement or deflection, and to ensure good and truly aligned concrete finish in accordance with the construction drawings.

ii) The formwork shall be so designed that the sides of the beams can be first struck, leaving the soffit of beams and supporting props in positions. Props shall be designed to allow accurate adjustment and to permit of their being struck without jarring the concrete.

iii) The design of form work shall be got approved from the Olectra Greentech Limited before starting this item of work.

3.4.2.1 The form work shall be of approved plywood (Marine or boiling waterproof) and not less than 12mm thick and with proper supports as may be approved by Olectra Greentech Limited. As an alternative sufficiently, rigid steel shuttering with appropriate supports may be used, as may be approved by Olectra Greentech Limited at no extra cost. In every case, joints in the shuttering are to be such as to prevent loss of liquid from concrete. In case of steel shuttering, the joints must be perfectly close and sealed with craft paper or any other types of approved sealing materials. If any particular material or materials are specified in the Schedule of Quantities for form work, only such particular/ specified material or materials shall be used in the work. The form work shall be constructed so as to remain sufficiently rigid during placing and vibrating/tamping of the concrete. All shuttering and framing must be adequately stayed and properly supporting the concrete during period of hardening. The forms shall have sufficient strength and rigidity to hold concrete and withstand the forces/pressure of people and machinery working ramming and vibration, and more so when the concrete is tamped/vibrated. The surface of all forms in contract with concrete shall be clean, rigid, watertight, and smooth. Suitable devices shall be used to hold corners, adjacent ends and edges of panels of other forms together in accurate alignment.

3.4.2.2. The form work shall conform to the shape, lines and dimensions to suit the RCC members, as shown in the drawings and be so constructed. A camber of 6mm in all directions, for every 5-meter span, in shuttering for all slabs and beams shall be

given to allow for unavoidable sagging, due to self-weight (including concrete, workers, machinery etc.)/compaction of other causes.

3.4.2.3. Temporary openings or windows shall be provided at the base of column forms, and at other points, where necessary to facilitate cleaning and observation, immediately before concrete is deposited. These shall be properly closed, before placing concrete in position.

3.4.2.4. Vertical centering/staging:

The vertical shuttering shall be carried down to such solid surface as is sufficiently strong to afford adequate support and shall remain in position until the newly constructed work is able to support itself. Props shall be steel tubes with extension pieces and securely braced against lateral displacement. The spacing of steel tubes shall be designed to carry loads imposed on it without undue deflection of the members, supported by the props. The spacing and sizes of props shall be approved by the Olectra Greentech Limited and any alterations suggested by them shall be carried out at contractor's expense. Pipe bracing shall be provided, as required/directed, without extra cost. The contractor shall allow in his rates for providing props and struts up to any height as shown in the working drawings issued to the contractor from time to time. Wooden props and bracing can only be allowed under special sanction of the Olectra Greentech Limited.

3.4.2. Design of form work:

i) Form work shall be adequately designed to support the full weight of workers, reinforcement, freshly placed concrete, effects of tamping/vibrating, etc., without yielding/settlement or deflection, and to ensure good and truly aligned concrete finish in accordance with the construction drawings.

ii) The form work shall be so designed that the sides of the beams can be first struck, leaving the soffit of beams and the support props in position. Props shall be designed to allow accurate adjustment and to permit of their being struck without jarring the concrete.

iii) The design of form work shall be got approved from the Olectra Greentech Limited before starting this item of work.

3.4.3. Water tightness:

It is the contractor's responsibility to ensure that the forms are checked for water tightness during progress of shuttering work and also just before concreting operation starts and to make good deficiencies, if any. If instructed by the Olectra Greentech Limited, building paper will have to be used, without any extra charge for the same, viz., to have adequate water tightness.

3.4.4. Cleaning and treatment of forms:

All rubbish, particularly chippings, shavings and sew dust, etc., shall be removed from the interior of the forms, before the reinforcement is placed in position and as well before the concrete is placed. The form work to be in contact with the concrete shall be cleaned and thoroughly wetted or treated with an approved composition before placing concrete. Care shall be taken that such approved composition is kept out of contact with reinforcements. Interior of all mould sand boxes must be thoroughly washed (water) with hose pipe or otherwise so as to be perfectly clean and free from all extraneous matter before depositing of concrete. Prior approval of the form work should be obtained from Olectra Greentech Limited, before placing reinforcement on the form work.

3.4.5. Stripping:

Form shall be left in place until their removal is authorised by the Olectra Greentech Limited and shall then be removed with due care, so as to avoid injury to concrete and or workmen. In no circumstances the forms shall be struck, until the concrete develops a strength of at least twice the stress, to which the concrete may be subjected to at the time of striking. The strength referred to shall be that of concrete, using the same cement and aggregates with the same proportions, and cured under conditions of temperature and moisture similar to these existing on the work. Where possible, the form work should be left longer, as it would assist in more effective curing.

3.4.6. Stripping time:

In normal circumstances (general where temperatures are above 20 degrees C and where ordinary Portland cement is used) forms shall be struck after expiry of the following periods, unless otherwise specifically directed at site by the Olectra Greentech Limited.

	LOCATION	STRIKING TIME IN CLEAR DAYS (OPC) (AFTER THE DAY OF CASTING)
a.	Vertical sides of walls slabs, beams and columns	4
b.	Bottoms of slabs up to 4.5m span.	7
c.	Bottom of slabs above 4.5m span/ bottoms of beams & arch rib bottoms up to 6m span.	14
d.	Bottom of beams over 6m span and arch rib bottoms above 6m span.	21

3.4.7. Form work in lifts for continuous surfaces:

Where forms for continuous surface are placed in successive units, (as for example in columns or walls) the forms shall fit tightly over the completed surface so as to prevent any leakage of water/mortar from the concrete and to maintain accurate alignment of the surface.

3.4.8. Procedure while removing the form work:

All formwork shall be removed without shock or vibration, as otherwise it would damage the reinforced concrete. Before the soffit and struts are removed, the concrete surface shall be first exposed partly, where necessary, in order to ascertain that the concrete has sufficiently hardened. Proper precautions shall be taken to allow for the decrease in the rate of hardening that occur with cement, in cold weather. Wetting the surface before stripping is preferable, to avoid spalling of corners.

3.4.9. In case of structures with two or more floors, the weight of concrete, centering and shuttering of any upper floor being cast shall be suitably supported on one floor below the top most floor already cast. The rate quoted for reinforced concrete items is deemed to have included for these arrangements/supports.

3.4.10. Tolerance:

a. All RCC work shall be executed to true lines and levels and plumb and to the final approval of Olectra Greentech Limited's representative.

b. If work is not carried out within the reasonable tolerance the cost of all rectification measures of dismantling and reconstructing or as decided by the architect and Olectra Greentech Limited shall be borne by the Contractor. In case of work dismantled, the same will not be measured and paid for.

3.5.1. **Concrete mix proportioning:**

Concrete mix proportioning for all grades of concrete shall be as per IS 456 – 2000 clauses 8 & 9 and as per SP 23 – 1982 Section 6. The constituent materials to be used for concrete making namely cement, aggregates & water shall be as per clause 4 of IS 456 – 2000. The mix proportions shall be so selected as to ensure that the workability of the fresh concrete is appropriate/suitable for the conditions of handling and placing, so that after compaction its surrounds all reinforcements and completely fills the form work. When concrete is hardened, it shall have the required strength, durability and surface finish. The determination of the proportions of Cement, Aggregates and water to attain the required strengths shall be made as follows:

a. By adopting nominal concrete mix, which is called 'nominal mix concrete'.

Batching:

In proportioning concrete the quantity of both cement and aggregate should be determined by mass. The mass of cement can be determined on the basis of mass of cement per bag. Water shall be measured by volume in calibrated containers/tanks or weighed.

In case of design mix of concrete, uniformity of the materials used for the concrete making has been established over a period of time, the proportioning may be done subsequently by volume batching, provided prior approval of Olectra Greentech Limited is obtained for same and ensured that periodic checks are made on mass/volume relationships of materials. Where weigh batching is adopted, allowance shall be made for bulking in accordance with IS 2386 (part III) 1963.

The concrete shall be mixed in a Mechanical Mixer as per IS 4791 – 1968. Workability of the concrete should be controlled by direct measurement of water content. Workability should be checked at frequent intervals as per IS 1199 – 1959. The contractor is entirely responsible for the proportioning of concrete mixes of required strengths and must submit the procedure for such proportioning of concrete mixes for the prior approval of Olectra Greentech Limited & Architect, whose decision shall be final in the matter.

b. Alternatively, contractor may use suitable ready mix concrete at no extra cost and after obtaining written permission from Architects/Client.

3.5.2. Transporting and placing concrete:

3.5.2.1. Immediately prior to placing the concrete, the shuttering shall be well watered and any water and rubbish lying removed.

3.5.2.2. The concrete shall be transported from mixer to the position of placing as rapidly as possible and in a manner that would prevent separation or bleeding or impair the quality of concrete. Equipment for transportation, pumping or pneumatically conveying concrete shall be of such size and design as to ensure a practically continuous flow of concrete at the delivery end, and without any separation of the materials. The chute shall be of metal or metal-lined wood with slopes neither less than 1 vertical to 3 horizontal nor more than 1:2. The discharge end of the chute shall be provided with baffle plates to prevent segregation.

3.5.2.3. Concrete shall not be dropped from a height in a manner, which will cause segregation. It shall be placed directly in its permanent position to avoid segregation due to re-handling. Rate of placing concrete shall be such as to avoid formation of planes of weakness in concrete being placed. No partly set or re-tempered concrete shall be used on the job.

3.5.2.4. Each layer of concrete being placed shall be consolidated by mechanical vibration supplemented by hand spreading, rodding and tamping as directed, to form dense concrete with all surfaces free from honeycombing and tolerably free from water and air holes or other blemishes. Vibrators shall in no case be used to work along the forms. Duration of vibration shall be so limited to reduce time necessary for satisfactory consolidation, without causing objectionable segregation. The vibrator shall not be inserted into a lower course, that has already been vibrated/compacted and begun to set.

3.5.2.5. The contractor shall be responsible for the co-ordination with sub-contractors or other contractors for incorporating necessary inserts, electrical conduit pipes, fixing boxes, blocks, chase holes, etc., as required. The contractor shall obtain approval from the Architect/Client as regards the above, before casting of the concrete. No holes or chases shall be made in the concrete, without prior approval of the Olectra Greentech Limited.

3.5.2.6. Concrete shall be placed continuously until completion of the work.

3.5.2.7. Accumulation of set concrete on the reinforcement shall be avoided. Before fresh concrete is deposited upon or against any concrete which has already hardened, the surface of the hardened concrete shall be well roughened, if necessary by chipping, and all lattice removed. The surface shall then be swept clean with wire brushes, thoroughly wetted and covered with a thin layer of rich cement mortar and or chemical additives, as may be directed by Architects.

3.5.2.8. In foundation trenches or in like positions, concrete shall be carefully laid and poured from less than over 1 meter height. If the height exceeds 1 meter, the concrete must be deposited through inclined spouts. The trenches shall be maintained free of water during concreting by proper diversion of water flow with dewatering as required and directed, at no cost and without washing over freshly deposited concrete.

3.5.2.9. Concrete footing shall be placed upon undisturbed clean and hard surfaces of specified bearing capacity.

3.5.2.10. Contractor's authorised Engineers/Supervisors/Foremen shall always be present for all concreting work carried out at site.

3.5.3. Protection of Concrete:

Newly placed concrete shall be protected by approved means from rain, sun and drying winds. Exposed vertical/inclined/curved faces of concrete shall be kept wet continuously for not less than a fortnight by covering with a layer of sack curing, invariably horizontal surfaces shall be kept covered with water pounded by means of bunds. Concrete placed below the ground shall be protected from falling earth during and after placing. Approved means shall be taken to protect immature concrete from damage due to debris, excessive loading, vibration, abrasion, ground-water, mixing with earth or other materials, flotation and other influences that may impair the strength and durability of the concrete.

3.5.4. Consistency:

Only minimum and sufficient water shall be added to the cement and aggregate during the mixing to produce a concrete

having sufficient workability to enable it to be well consolidated and to be worked into the corners of the shuttering and around reinforcement, to give the specified surface finish, and to have the specified strength. When suitable and appropriate amount of water has been determined, the resultant consistency shall be maintained through the corresponding parts of the work and approved tests shall be conducted from time to time to ensure the maintenance of this consistency.

The exact determination of the slump for various members and water cement ratio shall be as directed by the Olectra Greentech Limited.

Slumps tests shall be made in accordance with the details given in IS 456 – 1978.

3.5.5. Finishing:

3.5.5.1. As soon as possible after the form work has been struck holes left by clamping bolts, air and water holes and other rough patches shall be filled in with cement and sand mortar 1:1 mix (sand passing 1/8" sieve) by working into the surface with a wooden float. Excess water shall be avoided. This should be done within 72 hours after removal of form work.

3.5.5.2. Unless instructed to the contrary the face of exposed concrete placed against shuttering shall be rubbed down immediately upon removal of the shuttering to remove fine or other irregularities. All surfaces which are required to be plastered shall be hacked properly.

3.5.5.3. All exposed faces of concrete members for which shuttering is not provided, shall be smoothened with a wooden float, when the concrete is green and setting has not started, to give a finish equal to that of rubbed down face where shuttering is provided. The top face of a slab, which is not intended to be covered with other materials, shall be levelled and floated while unset to a smooth finish to the levels of falls/slopes shown on the drawings or as instructed. The floating shall be done so as not to bring an excess of mortar to the surface of the concrete. Dentations in the surface of the concrete shall be formed, if specified/ordered, by approved implements to the depths and patterns described. The top face of a slab intended to be surfaces with mortar, granolithic or any other materials shall be finished rough (to receive final finish) and to the approval of the Olectra Greentech Limited.

3.5.5.4 Honey Combing:

i) Where honey combed surfaces are noticed in the concrete, the contractor shall not patch up the same, until examined by the Olectra Greentech Limited and decision given regarding accepting the work with rectifications or rejections of the same. If the contractor patches up such defects without the knowledge of the Olectra Greentech Limited, the Olectra Greentech Limited will be at liberty to order demolition of the concerned concrete members to the extent they consider necessary. In such cases, the contractor shall reconstruct the demolished work. The cost of demolition and demolished work and disposal of debris shall not be measured and paid for.

ii) If in the opinion of the Olectra Greentech Limited the honey combing is harmful to the structure and where so directed by the Olectra Greentech Limited, the full structural members affected by honey combing, as decided by Olectra Greentech Limited, shall be dismantled and reconstructed to Olectra Greentech Limited's approval. The cost of demolished concrete and as well cost of demolishing and disposing the debris will not be measured and paid for.

iii) Where in the opinion of the Olectra Greentech Limited the structural members containing honey combing can be allowed to be retained with rectification, the rectification shall be carried out as directed by the Olectra Greentech Limited by gunitting (with cement mortar 1:3 proportion) or epoxy bonding and plastering the areas concerned at the contractor's expense.

iv) If such honey combed areas are not severe in the opinion of the Olectra Greentech Limited and where so directed shall be patched up with dry-pack cement mortar consisting of 1 part of cement and 3 parts of sand after removing defective concrete down to sound concrete to the satisfaction of Olectra Greentech Limited all at the expense of the contractor. Such works should be completed within 72 hours from de-shuttering.

v) Concrete faces to be finally concealed shall be left as from the shuttering, except that honey combed surface shall treated as above (i), (ii), (iii) & (iv). Faces of concrete that are to have finished other than specified shall be prepared in an approved manner and as instructed.

vi) The patched-up areas shall be kept moist for 7 days and prevented from drying out too soon. Wherever required or instructed by the Olectra Greentech Limited, patching work shall be done using part white cement up to 30% of the total quantity of cement specified.

3.5.6. Construction joints:

Concreting shall be carried out continuously up to construction joints, if any, the position and details of which shall be predetermined by the Architects/Olectra Greentech Limited's. Construction joints shall be provided as directed by the Architect. They shall be rebated and or of an approved shape for slabs, beams etc., and shall be provided in the positions described on the drawings or as directed by the Architects/Olectra Greentech Limited. Inclined "Feather" joints shall not be

permitted. Shear keys not less than 2" deep and equal to 50% of the cross-sectional area shall be provided to all construction joints. Reinforcing bars shall extend by not less than 60 times dia of respective bars for M:150, 50 times dia, for M:200, beyond construction joints, unless otherwise indicated.

The joints shall be kept only at places, where the shear force is minimum and these shall be at right angles to the direction of main reinforcement. In case of columns, the joints shall be horizontal and about 3" below the bottom of the deepest beam framing into the columns.

3.5.7. Structural joints:

Expansion joints, construction joints, hinges or other permanent structural joints shall be provided in the position and of the form described in the drawings or as directed by the Architects/Olectra Greentech Limited's and shall be got approved before casting.

In no case shall the reinforcement corner protecting angles or other fixed metal items, embedded in or bonded into concrete, run continuously through the expansion joints. The placing of concrete or either side of the expansion joint shall be separated by suitable filler materials during continuous construction or alternately adequate space left during construction and filler materials placed in position later after an interval of at-least seven days.

3.5.8. Cutting into concrete:

No concrete shall be neither cut into, nor shall it be interfered with in any way, without the prior approval in writing by the Olectra Greentech Limited.

3.5.9. No portion of the structure shall be subjected to any loading in excess of design loads, except with prior written permission of Architect.

3.6.0. Strength of Concrete:

3.6.1. The concrete mix shall be so made to produce the desired grade concrete having the required workability and characteristic strength not less than values given below:

Grade Definition	Specified Minimum Characteristic compressive strength at 28 days
M – 15	150 Kg/Sq.cm
M – 20	200 Kg/Sq.cm
M – 25	250 Kg/Sq.cm
M – 30	300 Kg/Sq.cm

Strength of concrete required for various situations have been clearly stipulated in the relevant item of the schedule of quantities and/or in the drawings. As required by the Architect, the water content and the water/cement ratio shall be determined from the results of tests of the materials proposed for use, in advance of construction. It is important to maintain constant water cement ratio at its correct value.

If the concrete produced at site does not satisfy the above strength requirements, the Olectra Greentech Limited will reserve the right to require the contractor to improve the method of batching, the quality of the ingredients and the mix with increased cement contents, if necessary. The contractor shall not be entitled to claim any extra cost for the extra cement used or for the modifications, for fulfilling the strength requirements as specified. The able guide for the quality and for durability of concrete. It must also have an adequate cement content and as well a low water – cement ration, as given below, which is applicable for moderate weather conditions, as specified in I.S. 456 – 2000.

MINIMUM CEMENT CONTENT	MAXIMUM WATER – CEMENT RATIO
Moderate conditions 290 Kg/Cum	0.55

The minimum cement contents is based on 20mm aggregates. For 40mm aggregate it should be reduced by about 10% and for 12.5mm aggregate it should be increased by about 10%.

3.6.2. Strength tests during the work:

Samples should be taken from each 20 cum of concrete made during the progress of the work, or when a day's concrete work does not amount to 20 cum, then from each day's quota, and as required by Architects/Olectra Greentech Limited's. Six samples of cubes of size 150 x 150 x 150mm shall be taken jointly each time in steel moulds, 3 of which shall be tested for 7 days strength and the remaining 3 shall be tested for 28 days strength on 7th and 28th day respectively, after the day of casting. Proper curing arrangements, as directed by Olectra Greentech Limited, shall be made at site by the contractor. Each cube shall be marked and numbered, and dated by the contractor.

The contractor shall maintain a register at site as directed by the Olectra Greentech Limited, showing all particulars (date of casting, mix of concrete, location of concreting, water cement ratios, approximate concrete quantity represented by samples, no of cubes cast, date and results of testing, and remarks) and all the entries should be signed jointly by the contractor with Olectra Greentech Limited. 7 days strength shall not be less than 2/3rds of the 28 days strength. The results of the tests in any of the recognised laboratories and/or contractor's laboratory at site shall be taken as final and binding on the contractor. The average strength shall be higher than the prescribed strength. The average strength of the specimens taken at a time, may be assumed as the compressive strength of concrete, provided the difference between the maximum and minimum strength of the three specimens does not exceed 15% of the average strength. Concrete test cubes shall be taken out and got tested as per time schedule for knowing 7 days and 28 days crushing strength, at no extra cost, either at site or at an approved laboratory. Whenever for any set of cubes, if the 7 days crushing strength is found satisfactory, 28 days tests are not necessary. In cases, where 7 days strength is not satisfactory, tests for 28 days strength must be gone done WITHOUT ANY EXCEPTION.

In case the compressive strength obtained from the test samples of concrete at 28 days is less than the minimum specified characteristic compressive strength, the work is liable to be rejected at the sole discretion of Olectra Greentech Limited.

Olectra Greentech Limited's & Architect's decision regarding dismantling of such works or suitable rectifications or any alternative assessment by load test for allowing the corresponding work to be retained, shall be final and binding on the contractor. These shall be carried out at contractor's cost only. The condition of any test does not guarantee acceptance of concrete covered by the test final decision regarding finally accepting/rejecting such works even after conducting those tests shall be made by the Olectra Greentech Limited only.

In case of concrete showing test results lower than the specified strength and in the opinion of the Olectra Greentech Limited such works could be allowed to remain, after due and satisfactory rectifications, if any, ordered and or load tests or even otherwise, then the rates quoted by the contractor, corresponding to those items, shall be reduced suitably for paying for that part of work. The Olectra Greentech Limited/Architect shall have full power in their absolute discretion to fix the actual rate payable after deduction, and it shall be binding on the contractor. If the strength is so low that in the opinion of Olectra Greentech Limited, the work has to be dismantled, then the contractor shall do so as directed at his own cost irrespective of the amount of loss, inconvenience and difficulties involved. Rejected/dismantled work shall not be paid for.

If in the opinion of the Olectra Greentech Limited/Engineer any load test or hammer test or any other test is necessary, the same shall be carried out by the contractor as directed and he shall bear the cost of the same. Based on the results of the tests, the Architect shall reduce rates/accept after rectification or modification/reject and order dismantling of concrete, and the decision shall be final and binding on the contractor.

The contractor shall pay all costs incurred in supplying the material for and in making, maturing, delivering and testing the cubes.

3.7. RECORD OF CONCRETING

3.7.1 The contractor shall keep a daily record showing the date when each portion of concrete is poured in slab, beam, column footing etc., curing period, removal of formwork and test cubes results at 7 days and 28 days period and observations on the same.

3.8. The rates for concrete shall also include, apart from any other factors specified elsewhere in the tender, as follows:

3.8.1. All materials required for design/ nominal mix concrete, getting the designs for the design mix from an approved agency, labour, use of tools and plants, scaffolding, mixing, conveying, placing, ramming, vibrating, formwork, finishing, curing, hacking etc., complete as required and directed.

3.8.2. Rates for concrete items shall cover

a. Any shape and size, and for doing at any height and depth (all lifts) as per drawings, providing cover blocks or nylon spacers etc.

b. Fixing all inserts such as pipes, plugs, forming holes/pockets etc.

c. Providing dowel bars, etc., through shuttering and forming drip molds to chajjas, sills etc., or at any other places as directed.

3.9.0 MODE OF MEASUREMENT:

3.9.1. Length of columns will be measured up to top of the slab.

3.9.2. Length of main beams will be measured between columns and depth below the top of the slab. For secondary beams length will be between main beams.

3.9.3. Slabs to be measured in Cum between beam to beam.

3.9.4. Chajjas will be measured in CUM. Width to be measured beyond lintel width.

3.9.5. For staircase, RCC steps, waist slab, beams will be measured in Cum.

3.10. PRECAST CONCRETE:

3.10.1. All provisions in the specifications for concrete shall apply to precast concrete except for the specific variations given herein below:

3.10.2. Aggregate:

For maximum size of aggregate shall not be larger than one third of the minimum dimension of the member.

3.10.3. Concrete Cover:

For all surfaces not exposed to weather, all reinforcement shall be protected by concrete equal to the nominal diameter of bars but not less than 15mm.

3.10.3. Concrete Cover:

For all surfaces not exposed to weather, all reinforcement shall be protected by concrete equal to the nominal diameter of bars but not less than 15mm.

3.10.4. Care:

The concrete in one precast piece shall be placed in one operation. No piece shall be removed from the mould or erected until sufficiently natured to ensure that no damage may occur to the piece.

3.10.5. Details:

All details of jointing, inserts, anchors and bearing widths etc., shall be as shown in the drawings.

3.10.6. Identification and Marking:

All precast concrete members shall be properly marked to indicate the top of the member and its location.

3.10.7 Transportation, Storage and Erection:

While handling, including loading/unloading, the members shall be supported/hung at such suitable points, so that the member may safely withstand all the loads/stresses etc., that may occur/develop. For this, suitable hooks/markings etc., shall be provided, while casting itself, as may be necessary and or as directed.

3.10.7.1. Units shall be stored, transported and placed so that they will not be over stressed/pressed or damaged.

3.10.7.2. Precast concrete units shall be adequately braced and supported during erection to ensure proper alignment and safety and such bracing and supports shall be maintained until there are adequate permanent connections.

4.0 VACUM DEWATERED FLOORING

4.0.1 SCOPE

This specification covers the method and procedure to be adopted for vacuum dewatering of the concrete floor and finishing the floors with power trowels.

The process consists of mixing and placing concrete of the required grade, levelling and compacting using double beam screed board vibrator and vacuum dewatering the concrete floors using vacuum pump, suction mats, filter pads and finishing with power floater, power trowel and other required accessories. The sequence of operations shall be as follows:

placing of concrete, levelling, vibration, vacuum treatment, floating, and finishing. The operations shall follow each other to get the best results.

4.0.2 GENERAL REQUIREMENTS

All concrete work, reinforcement and formwork shall be done as per specifications provided in other relevant sections. **All concrete work in floor inside and outside will be executed with double wash sand only as approved by the Owner / Engineer in charge**.

The Contractor shall furnish all skilled and unskilled labour, plant, tools, tackles, equipment, men, materials, etc., required for complete execution of the work in accordance with the drawings and as described herein and / or as directed by the Engineer-in-Charge.

The Contractor shall deploy skilled workmen well experienced in the vacuum dewatering process, and in the operation of all related equipment. All process equipment to be used shall be maintained in good working condition and shall be subject to the approval of the Engineer-in-Charge. The trowel operators shall be sufficiently experienced to give the required finish to the floor.

The Contractor shall strictly follow, at all stages of work, the stipulations contained in the Indian Standard Safety Code and the provisions of the safety rules as specified in the General Conditions of the Contract to ensure safety of men and materials.

Any approval, instruction, permission, checking, review, etc. whatsoever by the Engineer-in-Charge, shall not relieve the Contractor of his responsibility and obligation regarding adequacy, correctness, completeness, safety, strength, and workmanship.

4.0.3 MATERIALS

Generally, the materials shall be in accordance with their respective Indian Standard Codes and as specified for similar works, which shall be deemed to form a part of this section of specifications.

4.0.3.1 **Cement** - Ordinary Portland Cement of 43 Grade conforming to IS 8112 or 53 grade conforming to IS: 12269 and as specified under MATERIALS.

4.0.3.2 **Fine aggregates** - As specified under MATERIALS and conforming to IS 383.

4.0.3.3 **Course aggregate** - As specified under MATERIALS and conforming to IS 383

4.0.3.4 **Water**- As specified under MATERIALS and conforming to IS 456- Clause 4.3.

4.0.3.5 **Concrete** - Manufacture, conveying, placing etc. as specified under CONCRETE WORK.

4.0.3.6**. Reinforcement** - Fabricating, placing, binding etc. as specified under REINFORCEMENT.

4.0.4 PROCEDURE

4.0.4.1 General

The work shall be planned well in advance with a view to determine areas to be concreted daily. The required number of equipment, size of vacuum mats, length of vacuum hoses, arrangement of rails, screeds etc. shall be reviewed with the Engineer-in-Charge well in advance.

The area to be concreted shall be thoroughly cleaned; the reinforcement shall be checked and got approved by the Engineer-in-Charge. Then the specified grade of concrete shall be placed in position without any segregation and properly vibrated. Suitable pathways shall be provided to prevent any disturbance to the reinforcement placed in position.

4.0.4.2 PREPARATION OF SUB-BASE

Soil below the floor shall be properly compacted with approved compaction equipment and the soil shall be tested for 98% laboratory maximum dry density before laying of hard core sub-base layer. Hard core layer shall be properly laid and compacted. Polythene sheet of 200 microns shall be laid before placing of concrete.

4.0.4.3 REINFORCEMENT

Reinforcement shall be laid as per the drawings or as specified by the Engineer-in-Charge. Specified spacing and cover shall be maintained while laying.

4.0.4.4 FORMWORK

M.S Channels shall be used as formwork for casting. Straight channels shall be placed carefully on the ground and accurately levelled one day in advance to ensure flatness of the floor. Bottom edge of the channel shall be sealed properly. The channel shall be removed after 24 hours of casting. Removal of the channel shall be done carefully so that the edge of the concrete floor is not damaged.

4.0.4.5 COMPACTING AND LEVELLING

Immediately after placement of concrete, the vibrating screed (fixed at the proper position to achieve the required/ specified finished level,) shall be allowed to run over the concrete on a true surface to level the concrete. For better consolidation proper surcharge of concrete should be maintained in front of the leading edge of the screed and the vibrating screed shall be allowed to move forward rapidly. The concrete surface shall be screened high by 2% of the slab's thickness to compensate for the compaction caused by the Vacuum dewatering process. (Slabs that have an aggregate hardener shall have compensation made to maintain elevation.)

4.0.4.6 DEWATERING

Immediately after levelling, the concrete shall be covered with filter pads and suction mats in strict accordance with the recommendations of the manufacturer, to have the slab fully dewatered. The suction mat shall extend 100 mm beyond the edge of the filter pad on all sides. The pads shall extend to within 100 mm of the edges of concrete slab, and the mats shall cover entire slab. Before connecting the hose of the suction mat to the vacuum pump, the edges of the mat shall be smoothened to enable an airtight seal to be created. Vacuum suction shall then be applied to the mat. After a minute the gauge on the vacuum pump should indicate a minimum vacuum of 0.70 atmospheres (24.0 in HG) and if not, the mat must be checked for leakage. For concrete that dewaters readily, the vacuum should then be maintained at 0.70- 0.80 atmosphere (24.0 - 25.5 in Hg). For concrete which dewaters less efficiently (e.g., air-entertained concrete), the vacuum shall then be reduced to 0.50 - 0.60 atmospheres (15.0 - 18.0 in Hg). After approximately 10 minutes the vacuum can be increased to 0.80 atmospheres.

The vacuum shall be maintained for at least 5 minutes per 25 mm of concrete thickness at 0.80 atmospheres. (Where aggregate hardeners are specified, sufficient moisture shall be maintained to meet Manufacturer's requirements). The suction mats and filter pads shall then be removed and moved to the next section in a leapfrog manner.

Vacuum dewatering shall be stopped when light footprints only are left in the concrete when stepped upon. A suitable suction time can also be checked with a Proctor-apparatus, which should show 1.5 - 2 Kp/cm^2.

4.0.4.7 FLOATING

Upon removal of the suction mats and filter pads, the concrete shall be power floated without delay until all imprints from the vacuum process is removed. If crusting occurs, the floating operation must be delayed till the concrete carries the machine.

Higher speed is recommended for the floating operation. The passes with the floating disc should be made in the junction of two mats in order to avoid risk of cracking. The waiting time after the floating operation depends on concrete temperature and humidity and varies from 10 minutes to 2 hours. Suitable time shall be determined at the site.

4.0.4.8 NON METALLIC SURFACE HARDENER FOR FLOORING

To improve abrasion resistance of dewatered concrete floor, a non - metallic and monolithic surface hardening compound shall be used. It shall have the ability to improve the abrasion resistance of concrete by not less than 225% when measured in accordance with the requirement of BS 784 - 1953, against controlled concrete.

Hardener compound shall be applied, at the recommended dosage of the manufacturer, to freshly laid concrete by dry shake-on method. It shall be applied at the point where the light foot traffic leaves an imprint of about 3 to 6 mm. It shall be broadcast over green concrete surface evenly in 2 stages as per the manufacture's specifications to achieve a uniform application over the entire floor surface. The surface shall be brought to the required level of finish by repeated power

troweling.
Coloured hardener shall be used as per the directions of Engineer-in-Charge and during the application of the coloured hardener adequate care shall be taken to check the uniform quantity and proper mixing to achieve a uniform shade throughout. Contractor shall be responsible to provide for high quality supervision during the mixing and finishing of the floor with the coloured hardener.

4.0.4.9 FINISHING

The trowelling operation shall not take place before the concrete has hardened enough to carry the machine i.e., the trowelling blades shall not leave any marks on the concrete. Repeated trowelling, with intervals between the passes which are adapted to the setting of the concrete, greatly improves the surface characteristics. The surface will be more wear resistant and less dusty. The trowelling shall continue till a smooth continuous surface, free from undulations and blemishes is obtained. At least two passes are recommended for floors that are not to be covered. The tolerance for finished floor shall be ± 2 mm in 3 meters. However, the total variation in the finished surface at any point shall not be more than ± 4 mm.

4.0.5 CURING

Vacuum dewatered concrete should be cured like other concrete in order to achieve good final result. Curing by water ponding or by curing compounds may be adopted.

The Contractor shall be responsible for achieving the smooth and good quality of concrete finish specified by controlling the placing, vacuum process, finishing and curing. The concrete technician in charge must be present at the site when work is in progress. The Contractor shall be responsible for performing necessary tests, correcting deficiencies and trouble shooting in general. The Contractor shall be required to maintain individual test results for aggregate gradation, slump etc.

4.0.6 GROOVES & CONTROL JOINTS

The Contractor shall provide grooves of size 4 mm wide and 10 mm deep, with groove cutting machine on floor surface at every 40 m^2 area (panel of 10 m x 4 m) or as specified or as shown drawings and / or as directed by the Engineer-in-Charge.

The grooves shall be cut positively within 48 hours after laying of concrete. The groove shall be vacuum cleaned by removing dust and dirt, chipping of projected mortar / concrete using chisel etc. The concrete joint shall be sound and clean, free from oil, dirt and debris etc. The groove shall be filled after applying masking tape besides the joint, in two layers with epoxy polysulphide semi rigid sealant EUCO 700 of STP limited or any other equivalent make as approved as per manufacturer's recommendations and drawings and direction of the Engineer-in-Charge. All the edges of the grooves shall be finished neatly with epoxy based floor hardener mortar.

4.0.7 MODE OF MEASUREMENT

Measurement of vacuum dewatered floor shall be in cum meters (Cum) of Cement Concrete. The unit rate shall include cost of all materials, equipment, labour, and shall include all work described above.

The construction / control joints shall be including in cement concrete price. The rate shall include cutting of groove of specified size with a groove cutting machine, vacuum cleaning of groove and filling of groove with epoxy polysulphide semi rigid sealant EUCO 700 of STP limited using masking tapes (fixing and removal) etc. as per manufacturers recommendations and drawings and direction of the Engineer-in-Charge and complete in all respect.

4.0.8 SAMPLE REQUIREMENT

The Contractor shall provide a sample of vacuum dewatered floor as described below for approval from the Engineer-in-Charge before commencing the work without any extra cost to the Main-Contractor.

a) Floor Finish Sample - 10 Sqm or 1 Panel size of floor whichever is larger including non – metallic hardener (coloured if required or specified by the Engineer-in-Charge) and grooves complete in all respect.

5.0 BRICK MASONRY:

5.1. BRICK MASONRY:

5.1.1. Bricks:

a. The bricks shall be of best locally available quality, and having the specified crushing strength, and shall be of quality

approved by the Olectra Greentech Limited & Architect before placing orders for the same.

b. They shall be sound, hard and well burnt. They must give a ringing sound when struck with a metal piece and shall have frog.

c. They shall be free from cracks, flaws and nodules and also free from lime or stone pieces.

d. All bricks when dry, shall have an average compressive strength not less than 35 Kg/Sq.cm, unless otherwise specified.

e. The bricks wherever specified as wire cut and or machine made, shall have compressive strength not less than 75 Kg/sq.cm, unless otherwise specified. The crushing strength bricks of bricks which vary by more than 15% of average strength of that group of samples, must be omitted and average strength of balance bricks only shall be considered as representative of that lot of bricks.

f. The contractor shall produce different brands of locally available bricks for approval by the Olectra Greentech Limited & Architect. If during the execution of the work, it is observed that the bricks of approved brand/quality are not sufficient in quantity or Manufacturers have not maintained the same approved quality, then the contractor shall make alternate arrangements to procure bricks from any other source even with longer leads without any extra cost, after getting same approved in advance by the Olectra Greentech Limited, as done earlier.

g. If the contractor executes the work, without approved quality of bricks, the same shall be liable for rejection or paid at reduced rates, at the sole discretion of the Olectra Greentech Limited & Architect, which shall be final and binding.

5.1.2. Mortar:

The sand should be only of approved quality and 'Coarse' unless otherwise specified. It will be screened and/or washed, if required and directed, without extra cost. Unless otherwise stated, cement mortar for brick work shall be of 1:6 (1 cement: 6 sand) proportion for walls of one brick thick and above. While for half brick walls or brick on edge work cement mortar shall be of 1:4 (1 cement :4 sand) proportion.

5.2. WORKMANSHIP:

5.2.1. Proportion and mixing of cement mortar:

Cement and sand shall be mixed in the specified proportion by volume by emptying cement bags on measured quantity of sand and thoroughly turning over the mixture in a dry state, till uniform colour is obtained. The mixture is made into the form of a frustum of a cone with a hollow at top Centre, and then water added to it. The whole material is then thoroughly turned and mixed till mortar is homogeneous; and shall be mixed only for such quantities, which can be readily used. Not more than 30 minutes should pass between adding of water to the dry mixture and the actual placings of mortar in position.

5.2.2. Construction:

5.2.2.1. All brick work shall be set out and built to lines, levels, batters, curves and to any shape or position to dimensions, thickness and heights shown upon the drawings, and a good bond shall be preserved throughout the work both laterally and transversely. English bond shall be used throughout.

5.2.2.2. All bricks shall be thoroughly wetted before use in the manner that water penetrates to the full depth of brick stock, and every brick is fully soaked.

5.2.2.3. Single or double scaffolding of adequate strength shall be provided for all types of loads likely to come on them during construction. In case of single scaffoldings all the scaffolding holes shall finally be filled with cement concrete 1:3:6 (1 cement :3 coarse sand: 6 graded stone aggregate, 20mm nominal size) at contractor's cost.

5.2.2.4. All courses shall be laid truly horizontal and all vertical joints made truly vertical.

5.2.2.5. Where water is met within foundations, work space shall be kept free of water by the contractor while the brick work is in progress and until the mortar, pointing, plastering has properly set.

5.2.2.6. No half or quarter brick shall be used except as closures. The closures shall be horizontal and the walls shall be raised plumb. Not more than ten courses shall be raised in a day and no part of the work shall be raised more than one meter above another at any time.

5.2.2.7. Joints shall be uniform in thickness. All joints shall be adjusted to its final position in the wall while the mortar is steel soft and plastic. All vertical joints shall be full of mortar and well compacted with trowel and just sufficient water (so that

cement/mortar does not flow out of the joints). No looseness/hollows in the mortar (in the joints) shall be permitted. Any unit, which is disturbed after mortar has stiffened or the mortar in the joints is loose or has hollows, shall be removed and re-laid with fresh mortar.

5.2.2.8. All joint shall be raked out, while the mortar is still green, to a depth of 10mm (minimum) to ensure a good key for plastering.

5.2.2.9. Half brick walls shall be reinforced at every 4th bedded course with 25 x 1.5mm hoop iron reinforcement well in mortar, properly lagged etc., and as directed by the Architect. Alternatively, two 6mm dia bars be embedded in cement mortar in same locations.

5.2.2.10. In brick arches or other circular work, the bricks shall be shaped to slope, joints radiating outward and correctly from the center, front to back of walls and joints shall be not more than 12mm thick.

5.2.2.11. All brick work shall be adequately watered atleast for three times as day, for ten days continuously.

5.2.2.12. During the rains and frosty weather, the work shall be carefully covered, without extra charge, so as to prevent any mortar being washed away etc. Should any brick work be damaged, the same shall be removed and rebuilt at the contractor's expense.

5.2.2.13. Chases and raked out joints shall be kept free from mortar or other debris. Spaces around door frames and other built-in items shall be solidly filled with cement mortar 1:3 (1 cement :3 coarse sand) or cement concrete 1:3:6 (1 cement :3 coarse sand: 6 hard stone aggregate of suitable size). Anchors, wall plugs, accessories, flashings and other items required to be built in with masonry shall be built in as masonry work progresses. Unfinished work shall be stepped back for jointing with new work. Tooting may be resorted to, only when specifically approved by the Architect. Before new work is started, all loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

5.3. RATES TO INCLUDE:

Apart from other factors mentioned elsewhere in this contract, the rates for brick masonry shall also include following:

5.3.1. All materials, labor, tools/equipment used and other items intended for the satisfactory completion of brick masonry at all heights and depths.

5.3.2. Erecting and removing of all single or double scaffolding, (as may be directed/specified), ladders required for the execution of the work at any height and depth and shape as shown in drawings or as directed by the Olectra Greentech Limited, and as well cleaning every day the surface of masonry executed on that day.

5.3.3. Cutting of brick work, raking out joints to received plaster, removing stains and mortar lumps, making required chases and openings and filling the chases with cement mortar not leaner than 1:4 (1 cement :4 coarse sand), all as specified/directed.

5.3.4. Reinforcement embedded in cement mortar, including cost of reinforcement, in half brick walls and brick on edge work.

5.3.5. Dewatering, wherever required.

5.4 MODE OF MEASUREMENT:

All brick work, except half brick work and brick on edge, shall be measured in cubic meters. Half brick and brick on edge will be measured in Sq. Meters. Deductions shall be made for all openings, lintels, beams, chajjas/shelves bearings, and the like and columns etc., occupying full thickness of the walls. No deductions will be made for ends only of

i. Dissimilar materials like girders, beams, lintels, rafters etc., up to 500 Sq.cm. cross section, and for

ii. Openings up to 0.1 Sq.m. in face area.

6. RUBBLE MASONRY:

6.1. MATERIALS:

6.1.1. Stones:

6.1.1.1. They shall be blue granite stones from an approved quarry.

6.1.1.2. They shall be tough, hard, dense, durable, sound, uniform in colour and texture and free from flaws, cracks, unjuries, veins, crystals, minerals, salt, cavities, skins (weathered surfaces) and other defects.

6.1.1.3. The stone shall not absorb water more than 5% of its dry weight, when immersed in water and tested as per I.S. 1224.

6.1.1.4. The contractor shall furnish a sample of stones which he intends to use on the works and get the same approved by the Architects, well before start of masonry.

6.1.1.5. All Royalties, Compensations, Taxes, Octroi, duties, etc., payable for securing stones shall be paid by the contractor and

included in the rates quoted for respective items.

The mortar shall be as specified in the item or as shown on drawing. The sand shall be coarse and of approved quality and may be screened or washed, if required, without extra cost.

6.2.0. WORKMANSHIP:

6.2.1. Masonry:

6.2.1.1. The stones shall be hammer dressed, unless otherwise specified in the item, before they are laid in position. For masonry to be plastered, bushes on surfaces shall not exceed 12mm in thickness and for other (exposed) faces not more than 25mm.

6.2.1.2. The masonry shall consist of large stones flat bedded, properly selected for their places and carefully laid, with a suitable proportion of smaller stones and chips to fill up the interstices (but not on faces). No face joint shall exceed 20mm and shall also be not less than 10mm in width. The stones shall be wetted before laying in mortar. The work shall be hand set and solidly bedded in and surrounded with mortar fully and properly on every side except the face.

6.2.1.3. Flat stones shall not be less in breadth than in height and its length shall not be less than 1½ times its height.

6.2.1.4. Through stones or headers shall be laid in every course at a distance not exceeding 1.0 meter apart and shall be staggered. They shall be in one piece for walls up to 600mm width and shall be lap jointed (laps not less than 150mm) in case of greater thickness, if laps are desired by the contractor. In no case length of these stones shall be less than 400mm. Alternately headers may be of precast cement concrete blocks of cement concrete 1:3:6 (1 cement: 3 coarse sand: 6 hard stone aggregate 20mm nominal size) and in cross section, height shall be equal to the height of that course in the masonry. The face area of each header shall not be less than 0.05 sq.m. They shall be distinctly marked on their face

6.2.1.5. Quoins shall have the same height as that of the course. They shall be laid header and stretcher alternatively. Faces of quoins shall be fair dressed. No quoin stone shall be less than 0.03 cum in content. Jambs or doors, windows and openings be formed with quoins only. They shall have uniform chisel draft of 40mm at the corner edges.

6.2.1.6. The masonry shall be laid to lines, levels, curves, and shapes as shown in the plans. The face of all masonry work shall be strictly in plumb. In the case of battered walls, the courses on the battered surface side shall be at right angles to the batter. All joints shall be raked out to a depth not less than 20mm, and unless otherwise stated shall be flush pointed for all exposed surfaces with cement mortar of proportion (1 cement :3 fine sand). The width of pointing shall be uniform and constant.

6.2.1.7. The fixtures, plugs, frames etc., if any, shall be built in places as shown on plans, while laying the masonry, and not afterwards, by removing the stones already laid.

6.2.1.8. Bad work shall be pulled down, as directed by the Architect, and shall be rebuilt at the contractor's cost.

6.2.1.9. All masonry shall be washed down on completion and all stains and mortar removed from the faces as scaffolding is removed, on each day.

6.2.1.10. Holes of the required size and shape shall be preferably left during construction alone for fixing pipes, service lines etc. After the pipes are fixed in position the hollows if any, shall be filled in with 1:3 (1 cement : 3 coarse sand) cement mortar or 1:3:6 cement concrete (1 cement: 3 coarse sand: 6 graded stone aggregate 20/12.5mm nominal size as required). The face shall be neatly finished with matching stones. Iron and steel fixtures shall be embedded in cement mortar 1:5 91 cement :5 coarse sand).

6.2.1.11. In wet foundations, work space shall be kept free from water, while the masonry is in progress and until the mortar has sufficiently set.

6.2.1.12. Adequate single/double scaffolding as required and or directed for constructing masonry shall be provided and scaffolding holes filled with cement concrete (1 cement : 3 coarse sand : 6 graded stone aggregate 20mm nominal size) and finished to have surfaces matching with adjacent stones by the contractor at his expenses.

6.2.2. Coursed Rubble – Stone Masonry – Second Sort:

6.2.2.1. Exposed face stones shall be khandki dressed to have the vertical and horizontal sides perfectly straight, parallel at right angles to the adjacent sides. Where the interior face is to be plastered, the backing stones and hearting shall be as specified for uncoursed rubble masonry, chisel drafts of 37mm dia shall be provided at the external corners, when stone face is not chisel dressed.

6.2.2.2. Height of each course shall not be less than 150mm and all the stones in any course shall be of the same height. Unless otherwise stated, height of all courses shall be uniform. In no case the height of any course shall be more than any of the courses below it. The bed and joints shall be hammer or chisel dressed back from the face for 3" and 1½" width respectively. The faces of the stones shall be hammer dressed and bushings shall not be more than 10mm. Thickness of the joints shall not exceed 10mm. Stones shall break joints atleast half of the height of the course.

6.2.2.3. Quoins shall be atleast 0.5m long (limited to thickness of wall when single piece placed across the jamb), laid square on their levels and beds shall be fair dressed to a depth of atleast 10mm.

6.2.2.4. Face joints shall not exceed 15mm.

6.2.3. Uncoursed Rubble Masonry:

Rubble stones shall be uncoursed blue granite stones from an approved quarry. They shall be tough, hard, dense, durable, sound, uniform in colour and texture and free from flaws, cracks, injuries, veins, crystals, minerals, salts, cavities, skins and other defects.

If ordered by the Olectra Greentech Limited, 75 x 75mm or of specified size weep holes shall be provided in the masonry without any extra cost, at spacings as directed by the Architect.

During the progress of the work, if necessary, diversion of the nalla shall be provided and maintained by the Contractor at his own cost.

In wet foundations, work space shall be kept free from water while the masonry is in progress and until the mortar has sufficiently set in. Dewatering shall be done bailing out water or pumping out water by the contractor at his own cost.

Adequate scaffolding required for constructing masonry walls shall be provided by the contractor at his expenses.

Flush cement pointing shall be done in cement mortar 1:3 (1 cement: 3 fine sand) unless otherwise specified. The width of pointing shall be constant and not varying.

Stones shall be hammer dressed. Nearly half the stones shall not be less than 0.01 cum each in content and 25% of stones shall tail back into the masonry by 40mm or more. The stones shall be so arranged to break horizontal joints atleast by 50mm and long vertical joints being carefully avoided.

Cement mortar shall be of (1:6) proportion, unless otherwise specified.

For masonry to be plastered, bushes shall not exceed 12mm, in thickness.

Flat stones shall not be less in breadth than in height and its length shall not be less than 1½ times its height.

The masonry shall consist of large stones flat bedded, properly selected for their places and carefully laid with a suitable proportion of smaller stones and chips to fill up interstices (hearting). The stones shall be wetted before laying in mortar. The whole work shall be hand set and solidly bedded and surrounded well with compacted mortar on all sides, except the face.

Through stones or headers shall be laid in every course at a distance not exceeding 1m. apart and shall be staggered. They shall be in one piece for walls, up to 600mm width and shall lap atleast 150mm for thicker walls. Face area shall not be less than 0.05 Sqm. They shall be distinctly marked less than 400mm. Alternately headers may be of precast cement concrete blocks of cement concrete 1:3:6 (1cement: 3 coarse sand: 6 hard stone aggregate 20mm nominal size) and in cross section, height shall be equal to the height of that course in the masonry.

Quoins shall have same height as courses and shall be laid alternatively header and stretcher. They shall be fair dressed and shall be less than 0.03 cum in content. Jambs of doors, windows and openings shall be formed with quoins. They shall have uniform chisel draft of 40mm at the corner edges.

The masonry shall be laid to lines, curves, levels and shapes as shown in drawings. The face of masonry shall be in plumb. In case of battered walls the courses on the battered side shall be at right angles to the batter.

All face joints shall be raked out for a depth not less than 20mm, and unless otherwise stated, shall be pointed sunk/raised/flush (as may be decided by the Architect) with cement mortar 1:3 (1 cement : 3 fine sand) in case of all exposed surfaces. The pointing shall be of uniform and constant width. The masonry shall be shaded from the sun and watered well for 10 days.

For the days work, all masonry shall be washed down, on completion of days work, of all stains; and mortar splashes removed from the face for the days work and before the scaffolding is removed.

The joints shall be uniform on the face and be not more than 20mm in width.

6.2.4. Random Rubble – First Sort:

6.2.4.1. Stones shall be roughly chisel dressed. They shall be so arranged as to break joints as much as possible, avoiding continuous lines of joints horizontal and vertical. Quoins shall be same as for coursed rubble second sort.

6.2.4.2. All stones shall be carefully fitted with uniform thickness of joints not exceeding 20mm. Face joints shall be chisel dressed for a depth not less than 25mm for fitting in position properly.

6.2.4.3. All other details shall be same as for coursed rubble stone masonry 2nd sort.

6.3.0 MODE OF MEASUREMENT:

Masonry work will be paid in Cu.m. All deductions shall be made specified for brick masonry work.

7.0 CEMENT PLASTERING/CEMENT POINTING:

7.1.0. MATERIALS:

7.1.1. Cement, sand and water constituting the materials for the work shall conform to the specifications laid down for the concrete work. Fine sand shall be used as per IS Code.

7.1.2. Lime required for neeru finish shall be of approved variety fat lime.

7.1.3. Mortar shall be in proportion s specified in the bills of quantities.

7.2.0. WORKMASHIP:

7.2.1. General:

7.2.1.1. Adequate single scaffolding (if specifically permitted) shall be provided by the contractor at his expense and the scaffolding holes shall be filled in with cement concrete 1:3:6 (1 cement : 3 coarse sand: 6 hard graded stone aggregate 20mm size) compacted well and plastered over before lowering the scaffolding just below, if any, without any extra cost. In case double scaffolding is done, nothing extra shall be paid.

7.2.1.1. Dewatering the foundation if required, shall be done by the contractor at his own cost.

7.2.1.2. The surfaces to be plastered shall be first cleaned and watered well in advance and thoroughly wetted before plastering.

7.2.1.3. Smooth surfaces of concrete, old plaster etc., shall be suitably roughened or removed to provide necessary bend for the plaster. All dirt, sports, oil paint etc., which prevents proper bond with plaster, shall be removed.

7.2.1.4. Patches of plaster 150 x 150mm shall be put on about 3 meter apart as gauges, to ensure even plastering in one plane.

7.2.1.5. All plaster work will be done to lines levels and plumb and to the satisfaction of Olectra Greentech Limited.

7.2.1.6. For walls, columns and beams, thickness will be minimum 20mm for external faces and 15mm thick for internal faces, while for ceiling it shall be average 10mm, unless otherwise specified in bill of quantities.

7.2.1.7. The thickness specified shall be average and measured from the proudest part of the surface.

7.2.1.8. Unless otherwise stated in Bill of Quantities, cement mortar shall be in 1:4 (1 cement :4 fine sand) proportion.

7.2.2. Plaster with Neeru Finish:

7.2.2.1. The surface thus rendered shall then be finished with good quality of lime neeru. Neeru may be prepared at site out of the best quality of fat lime slaked at site with fresh water and sifted as specified. The slaked and sifted lime shall be reduced to a fine paste by grinding in a mortar mill (150 turns). Only sufficient quantity which can be used within 10 days only, shall be prepared at a time. Chopped hessian or jute fiber in the required quantity may also be added to neeru, if directed by the Olectra Greentech Limited. Otherwise readymade neeru of approved quality can be used. If required, plastered surfaces should be finished smooth with junction of skirting and plaster, if any, shall be finished as directed at no extra cost. All door/window jambs shall be finished as directed.

7.2.2.2. Plaster work shall proceed from top to bottom. An entire unobstructed surface shall be plastered in one operation. All exposed angles and junctions of walls and doors etc., shall be carefully flushed so as to furnish a neat and even surface. Before the base coat sets the neeru finish shall be applied and finished smooth. The entire plaster shall be surfaced truly vertical and horizontal. In case thickness item, no extra will be paid to the contractor.

7.2.2.3. All mouldings as shown on drawings or as directed shall be worked true to the template and drawn neat, clean and level, at no extra cost.

7.2.2.4. Bad work shall be pulled down as directed by the Architects/clients and shall be rebuilt by the contractor at his cost.

7.2.2.5. All plaster work shall be cured atleast for 7 days and to the entire satisfaction of the Olectra Greentech Limited. The curing shall be so done that damage to plaster with the impact of splashing water is avoided.

7.2.2.6. The contractor shall be responsible for making good any portion of plaster, which requires redoing, at his cost.

7.2.3. Rough cast Cement plaster:

7.2.3.1. The surface shall be cleaned as specified under cement plaster with neeru finish.

7.2.3.2. First coat comprising of cement and sand mortar 1:4 (1 cement :4 fine sand) with approved water proofing compound as per manufacturer's instruction, shall be applied uniformly with a trowel and flat board to exact plumb with thickness not less than 15mm and allow it to set for not less than half an hour.

7.2.3.3. While this is still green, the surface shall be roughened with wire brush. The surface shall be cured for 4 days.

7.2.3.4. All loose particles shall be dusted and a second coat of average 6mm thick cement mortar 1:3 (1 cement :3 fine sand) shall then be applied. Sand used shall be screened through a mesh not less than 1/16" and not more than 1/8" size and thoroughly washed, if required. The finished surfaces shall be lightly pressed with close pricked wooden board or a wet sponge to bring the sand particles into prominence.

7.2.3.5. General workmanship, curing etc., shall be all as specified for cement plaster with neeru finish.

7.2.4. Water proof cement plaster:

This shall be all as specified herein before for cement plaster work except for the following:

a) No neeru finish shall be applied over the rendered surface, but the rendered surface itself shall be finished smooth by steel trowelling.

b) In the preparation of cement sand mortar, cement shall be mixed with an approved waterproofing compound such as pudlo, CICO No.1 water lock, impermo, composeal or of any other standard manufacturer as per the manufacturer's instructions and as directed by the Architects.

7.2.5. Rate to include:

Apart from other factors mentioned elsewhere in the contract, rates for plastering shall also include following:

7.2.5.1. All materials, labour, use of tanks/implements for satisfactory completion of the work.

7.2.5.2. Erection, dismantling and removing single/double scaffolding.

7.2.5.3. Preparing all the surfaces to secure plaster.

7.2.5.4. Providing cement plaster of specified average thickness (measured from the proudest part of BB/stone work) and proportion at all heights and depths and to any shape as directed.

7.2.5.5. Curing for 7 days.

7.2.5.6. Chicken mesh of approved gauge shall be provided at all the junctions of concrete, masonry, timber and grouting of chases made for electrical/plumbing or other purpose as directed at no extra cost. Prover V-grooves must be made at all junctions of walls and slabs/beams/columns etc., at no extra cost.

7.2.5.7. Any moulding, bends, arisers, groves/drip mould, rounding/Vatas, chamfering, soffits of arches, and also making good damaged plaster after their (Contractor's) all the sub-contractor or nominated sub-contractors have done their work.

7.2.6. Mode of Measurement:

All plastering will be measured in square meter, unless otherwise described, as per relevant I.S. code.

Walls:

The measurement of walls plastering shall be taken between the walls or partitions for the length and from top of floor or skirting up to the ceiling bottom for the height. The dimensions before plastering shall be taken.

Ceiling:

Ceiling shall be measured between walls or partitions and the dimensions before plastering shall be taken. Ceilings with projected beams shall be measured over beam and the plastered side of the beam shall be measured and added to plastering on ceiling.

For jambs, soffits, sills, etc., for openings not exceeding 0.5 sq.m. each in area, ends of joists, beams, posts, girders, steps etc., not exceeding 0.5 sq.m each in area and openings not exceeding 3 sq.m each., deductions and additions shall be made in the following manner.

7.2.6.1. No deduction shall be made for ends of joists, beams posts etc., and openings, not exceeding 0.5 sq.m. each, and no addition shall be made for reveals, jambs, soffits, sills, etc., of these openings no for finishing the plaster around ends of joists, beams, posts, etc.

7.2.6.2. Deductions for openings exceeding 0.50 sqm but not exceeding 3 sqm each shall be made as follows and no addition shall be made for reveals, jambs, soffits, sills, etc., of these openings.

7.2.6.3. Deductions for openings exceeding 0.50 sqm but not exceeding 3 sqm each shall be made as follows and no additions shall

be made for reveals, jambs, soffits, sills, etc., of these openings.

When both faces of wall are plastered with the same plaster, deduction shall be made for one face only.

When two faces of wall are plastered with different plasters or if one face is plastered and the other pointed, deduction shall be made from the plaster or pointing, on the side of frames for doors, windows, etc., on which the width of reveals is less than that on the other side, but not deduction shall be made on other side.

7.2.6.4. In case of openings of area above 3 sq.m each, deductions shall be made for the openings, but jambs, soffits and sills shall be measured.

8.0 FLOORING:

8.1. GRANITE FLOORING SKIRTING AND FACING:

8.1.1. Materials:

8.1.1.1. Granite stone slabs shall of the thickness and type mentioned in the item and of the colour and quality approved by the Architects. Slabs shall be hard, dense, uniform and homogeneous in texture. They shall have even crystallized grain and be free from defects and cracks. The surface shall be mirror polished to an even and perfectly plain surface and edge machine cut, true and square.

8.1.1.2. No slab shall be thinner than the specified thickness, at its thinnest part. The dimensions of the slab shall be as specified in the item. A few specimens of approved finished slabs shall be deposited by the Contractor in the Architect's office for reference.

8.1.1.3. All the Granite slabs brought to site shall be got approved by the Olectra Greentech Limited, before using them in the work. Sizes of Granite slabs for floorings, steps/raisers and dado etc., shall be got approved by Olectra Greentech Limited, before ordering for the same.

8.1.2. Workmanship:

8.1.2.1 They shall be laid to the pattern shown in the drawings or as directed by the Architects.

8.1.2.2. The surface on which the Granite slabs are to be laid shall be cleaned of all dust and saturated with water.

8.1.2.3. The Granite slabs shall be set in cement slurry over cement mortar bedding as specified and tamped with wooden mallet. The joints shall not exceed 1mm. In thickness and shall be grouted/flushed with white cement mixed with pigment of suitable colour, if required, to match the shade/colour of slabs, and cured for 10 days.

8.2. GLAZED TILE IN FLOORS, DADOS & SKIRTING:

8.2.1. Materials:

8.2.1.1. glazed tiles shall be of first quality and of approved make and 5.5 mm in thickness. They shall be sound, hard and well and evenly glazed with fine and sharp edges, and free from twists. The rear face shall be grooved and recessed or suitably moulded, in parts, to provide necessary dressed or suitably moulded, in parts, to provide necessary key for mortar. They shall generally confirm to I.S.777:1988 (Second revision). The tiles shall be of sizes 150mm x 150mm or 100mm x 100mm or as specified/directed.

8.2.2. Workmanship:

8.2.2.1. The tiles to be used for floor and dado shall be of the same manufacture and of first quality, as per approved sample.

8.2.2.2. Tiles shall be immersed in water for atleast 6 hours prior to their end use.

8.2.2.3. Cement sand mortar 1:4 (1 cement :4 coarse sand) bed (average 20mm thick for flooring and 12mm thick for skirting finished to proper levels and falls. After the surface has hardened sufficiently, it shall be roughened, cleaned and well set to receive a thin cement slurry of honey like consistency. Tiles with their underside also smeared with cement slurry of honey like consistency shall then be laid over the bedding and tamped into position properly to have the top surfaces in a true plane and level or to falls as directed.

8.2.2.4. For skirting/dado, the surfaces shall be plastered with cement mortar 1:4 (1 cement: 4 coarse sand) to make the surface even and in plumb. The surface of the plaster shall be scarified with brush for getting a good bond between the back of the tiles shall be battered with cement paste and pressed on the plastered surface as per flooring and tapped in position.

8.2.2.5. Joints shall be thin, uniform, even and straight. The joints shall be cleaned off gray cement and pointed with white cement paste with pigment, if required, to match the shade of the tiles. The work shall be cured for 7 days. After curing, the surface shall be washed clean with water and oxalic acid. The finished floor skirting/dadoo shall not sound hollow, when tapped with a wooden mallet.

8.3. MODE OF MEASUREMENT:

All flooring work will be measured in Sqm basis and shall be measured between un-plastered wall surfaces. Skirting and dado will be measured in Sqm and the height above flooring will be measured, length between the finishes of adjoining walls, if any.

F.7. The ceramic flooring shall be of first quality and of approved make and 7.5mm in thickness. They shall be sound, hard and tough as per manufacturers specification. The rear face shall be groove and recessed (or) suitably man holed in part to provide necessary key for mortar. The tiles shall be of sizes 12” x 12”, 8” x 8” (or) as specified/directed.

9.0 WOOD WORK:

9.1. MATERIALS:

9.1.1. Unless otherwise stated the timber used in this project will be second class teakwood and shall be got approved from the Olectra Greentech Limited & Architect before using it in work. The timber shall be well seasoned and free from shakes, fissures, cracks, large/loose knots or other major defects. It shall also be free from spongy, brittle, flaky wood, sapwood and all such defects, which will affect its strength, durability, appearance or usefulness for the purpose for which it is required. Any effort such as plugging, painting or using any adhesives, to hide any defects, shall render the timber liable to rejection by the Olectra Greentech Limited & Architect. No individual hard and sound knot shall be more than 40mm dia and the aggregate area of all the knots shall not exceed 1.5% of area of the piece for purposes of acceptance. It should confirm to relevant I.S.I003.

9.1.2. Any timber rejected for any reason whatsoever, shall at once be removed from the site of work.

9.1.3. Glue: Organic type shall comply with specification I.S. 852 –1957 and synthetic type shall comply with I.S.851 – 1957 in all respects.

9.1.4. Nails, screws, ties, straps, bolts, etc., shall be of the material, make and pattern as approved by the Architect. Unless otherwise specified, they must be of mild steel and be of such sections and design, such that they serve the purpose adequately.

9.1.5. The Contractor shall get all the wood approved by Olectra Greentech Limited, before taking permission of the Architect to apply paints, oils or otherwise treats wood work in anyway whatsoever.

9.1.6. All embedded parts of wood work shall be well painted with two coats of hot boiled tar or creosoted, as approved by the Architects /Olectra Greentech Limited’s.

9.2. WORKMANSHIP:

9.2.1. All the wood work shall be neatly and truly finished as per tender item dimensions with not more than 3mm, planning margin. Unless otherwise specified, the exposed wood work shall be accurately planned to the required dimensions, within planning tolerance, smooth and to lines, planes, curves or shapes as required.

9.2.2. All the necessary joinery work shall be carefully done as per normal standard practice and Architects instructions. All framed joinery for external work shall be put together with white lead and joints pinned with hardwood or Fevicol. For internal work, unaffected by moisture, the joints may be glued and pinned or joined with Fevicol as directed.

9.2.3. Framed/Fabricated wood work includes all sawing, cutting, panning, jointing, framing, supply and use of all straps, bolts, holdfasts, nails, tensile, spikes, screws, etc., as may be necessary to complete the work and for fabricating/framing and

or fixing. Fabricating/framing and trussing shall be done in the best possible manner and as shown on the drawings or as directed by the Architects/Olectra Greentech Limited's.

9.2.4. The contractor shall provide labour, scaffolding, ladders and tackle necessary for hoisting and fixing wood work in position and afford facilities for its inspection during construction. The contractor shall be responsible for the safety of the work, workmen and for any action or compensation that may arise in this connection.

9.2.5. All iron work connected with wood work and going to be embedded in masonry shall, before erection, receive 2 coats of solignum/creosote. If it is to be painted, it shall be given one coat of red oxide primer and one coat of finishing panned on the ground, before being fixed in position and afterwards second coat of finishing paint.

9.2.6. All wood shall be got inspected and passed by the Olectra Greentech Limited before being put into work. The architect defective quality, despite his having previously passed the same before it was worked upon. In no case the wood work shall be painted or otherwise, before it is inspected and approved by the Architect.

9.2.7. After fixing the wood work in position, if any defects, including damaged edges of the frames, are notices by the Olectra Greentech Limited during the execution of work or in the defects liability period, the contractor shall have to rectify the same or remove and replace the defective work, as directed and to the satisfaction of Olectra Greentech Limited, at no extra cost.

9.2.8. Any cutting and waste of timber, that may be incidental in carrying out an item, shall not be paid for extra, but shall be included in the rate for the item.

9.3. T.W.DOORS AND WINDOWS:

9.3.1. Timber used for this work, shall be locally available second class teakwood, unless otherwise specified, and of approved quality and as per the sample approved by the Olectra Greentech Limited and Architect. As specified in the item, all the doors shall have teakwood door frames or pressed steel frames of approved make, quality and size, with three numbers holdfasts on each leg. Teakwood beading/cover moulding will be provided wherever necessary and at no extra cost. Hold fasts shall be embedded in concrete blocks, as shown in drawings or as directed.

9.3.2. For flush doors, shutters to be used shall be solid core of best approved make (BWP quality) with ISI mark, 30mm thick (unless otherwise specified) inclusive of either commercial ply, veneer or Formica of approved shade and design/pattern on one or both sides as specified and shown in the drawings and shall be bonded with phenol Formaldehyde synthetic resin. If so specified, all flush shutters shall have teak wood lipping on all four sides, as directed, which shall be fixed at site. All solid core shutters shall generally confirm to IS 2202 (Part I) & (Part 2) :1983.

9.3.3. For full panelled doors, the shutters shall be of best quality factory made with ISI marking and to be approved by the Olectra Greentech Limited and Architect and having panels of 19mm thick best approved make and quality marine ply, unless otherwise specified, and as shown in drawings or as directed.

9.3.4. The fixtures and fittings required for all the doors and windows shall be got approved from the Olectra Greentech Limited and Architect before placing the order. Any fixture found damaged or missing at the time of handing over shall be replaced by the contractor and surface of joinery made good as directed at no extra cost.

9.3.5. All the timber work including pressed steel frames shall be painted with 3 coats of synthetic enamel paint (including primer coat) of best approved make and shade as directed. In case of teak ply or decorative ply veneered shutters, they shall be French polished/wax polished, as per specifications and as directed.

9.4. GLASS:

9.4.1. All glass used in the doors, windows and ventilators etc., shall be of the best quality, free from specks, bubbles, smoke, veins, airholes, blisters and other defects. The kind of glass and its thickness shall be as mentioned in the item or a shown in detailed drawings or as ordered by the Architect. The glass shall generally confirm to I.S.1765.

9.4.2. Sheet glass shall be best quality of approved make plain/ground/frosted, and either 4mm or 5.0mm thick, as specified. For Bath/W.C. windows 3.8 to 4mm thick frosted glass shall have to be used as directed.

9.4.3. Plate glass shall be polished patent plate glass of best quality. It shall have both surfaces flat and parallel and polished to give clean undistorted vision. All mirrors shall be of plate glass and give clear undistorted reflection. The thickness of the glass shall be as mentioned in the item or shown in the detailed drawings or as directed by the Architect. Minimum thickness

of plate glass shall be 4mm to 5.5mm.

9.4.4. Float glass, wherever specified shall be “Bronze tinted” manufactured by FLOAT GLASS INDIA LIMITED to thickness as specified.

9.4.5. Obscured or ground glass:

This glass transmits lights, but the vision is partially or almost completely obscured. Principal types are plain, rolled, double rolled, figured, ribbed, fluted, frosted (on one or both sides) and rough cast. The thickness shall be as specified in the item or as mentioned in the drawings or as directed by the Architect.

9.5. MODE OF MEASUREMENT FOR DOORS AND WINDOWS:

Payment will be made for the area of opening in the masonry as per relevant ISI. The height of the door shall be measured from finished floor level to the bottom of lintel on the top.

10.0 ALUMINIUM DOORS, WINDOWS & VENTILATORS:

10.1. All aluminum doors shall be procured from approved manufacturer. Aluminum section shall be extruded tubular hollow sections confirming to latest I.S. specifications. All sections shall be approved by the Olectra Greentech Limited before placing the order. All extruded sections shall have minimum 1.8mm wall thickness. The aluminum sections shall be anodised in natural matt finish and the anodize film shall be 15 microns, unless otherwise specified.

Openable windows shall be double weather-stripped. One weather-strip shall be provided in the outer frame and the other weather-strip in the shutter frame. The weather-strip shall be of extruded neoprene and of a size to make the windows completely weather tight. The weather strip shall be dovetailed into the window section. The hinges of openable windows shall be strong. Pin of the hinges shall be of stainless steel with nylon/PVC washers. In case the windows are projected type, the hinges shall be provided with brass pivots sliding on stainless steel guides. Concealed type friction stays shall be provided to keep the windows open in any desired position. The window shall be provided with handle for two-point locking or single point 4mm thick or 5.5mm thick float glass of first quality and approved make, free from scratches, waviness, bubbles etc., all as shown in drawing or as specified and directed.

SLIDING WINDOWS: As per latest specification of CPWD

All sections of aluminum doors windows & ventilators shall be as per standard sections as approved by the Olectra Greentech Limited/Consultant.

11.0 PAINTING/POLISHING WORK:

11.1 LIME WASHING AND COLOUR WASHING:

11.1.1. The materials for preparing the lime wash shall be freshly burnt fat lime of good quality free from unburnt stone and other foreign matter.

This shall be dissolved in sufficient quantity of water (about 4-5 liters/Kg of lime), stirred thoroughly and strained through a clean coarse cloth. Alternately, readymade whiting, complying with I.S.63-1950, may also be used. Clean gum dissolved in hot water shall then be added in suitable proportion of 2 gm. of gum-Arabic to a liter of lime, to prevent lime wash coming off easily when rubbed.

11.1.2. Colour wash shall be lime wash prepared as above, to which a solution of water, lime and fast pigment, boiled if directed, shall be gradually added and stirred until the required shade/tinge is obtained.

11.1.3. As required, single or double scaffolding or ladder shall be used, without damaging or scratching the wall/plastered surfaces/floors.

11.1.4. The surfaces to be painted shall be prepared by removing all mortar droppings and foreign matter and thoroughly cleaned with wire or fiber brush. All holes or depressions shall be stopped with mortar and cured and surfaces made even and smooth before painting.

11.1.5. Colour/lime wash shall be applied with a brush. The first stroke of brush shall be from top downwards, next from bottom upwards over the first stroke and further a stroke over the earlier brushing before it dries. This will form one coat.

Each coat must be allowed to dry and shall be subject to inspection before the next coat is applied. When dry, the surface shall not show signs of cracking and shall present a smooth and uniform finish, free from brush marks, and it shall not come off easily, when rubbed with a finger. Patchy or streaky work will be rejected and shall have to be re-executed at the contractor's own expense. Unless otherwise specified, 3 coats of lime wash or colour wash shall be applied.

11.1.6. Doors, windows, floors and other articles of furniture etc., shall be protected from being splashed upon. Splashing and droppings, if any, shall be removed and surfaces cleaned.

11.2. CEMENT WASH:

11.3.1. Dry Distempering:

11.3.1.1. Material:

Powdered dry distemper shall be of approved make, colour and shade and manufactured by approved manufacturers. It shall generally confirm to IS:427 – 1965.

11.3.1.2. Scaffolding:

This shall be double or single as required and directed.

11.3.1.3. Preparing the surface:

The surface to be distempered shall be cleaned well and all cracks, holes and surface defects shall be repaired with gypsum and allowed to set hard. All irregularities shall be sand papered smooth and wiped clean. The surface so prepared must be completely dry and free from dust before distempering is commenced. In the case of newly plastered walls, special care shall be taken to see that it is completely dry before any treatment is at tempted. For old surfaces, which has earlier been distempered, the surface shall be cleaned well of grease, dust etc. The flaking of previous coating, if any, shall be removed/ taken off. All cracks, holes and surface defects shall be repaired with gypsum and allowed to set hard and then sand papered and wiped clean. But in case the surfaces were colour or white washed, the wash must be removed thoroughly first.

11.3.1.4. Priming Coat:

The priming coat shall be applied over complete dry surface in the manner recommended by the manufacturer in cast of patent distemper. When no priming coat is specified by the manufacturer, finely powdered chalk mixed with a thin solution of glue shall be applied to prepare a good hard background. This coating, when dry, shall be sand papered as close and smooth as possible.

11.3.1.5. Application of Distemper:

The instructions of the manufacturer shall be followed, regarding the preparation of the surface and application of priming and finishing coats. Distemper shall not be mixed in quantities larger than is actually required for a day's work. Hot water may be used to prepare the mixture. Distempers shall be applied in dry weather with broad stiff brushes in long parallel strokes. The treated surface shall be allowed to dry and harden. Second or succeeding coats shall not be applied until the preceding coat has passed by the Olectra Greentech Limited & Architects. Two more coats of distemper shall be given in exactly the same manner as the first one but only after the earlier coat laid has thoroughly dried. All the operations (strokes of brush) for one coat of white/colour wash will give two coats in case of distempering.

11.3.1.6. Rates to be inclusive of:

The rates shall include all labour, materials, equipment and tools for carrying out the following operations:

i) Providing and mixing the primer and distemper separately.

ii) Scaffolding.

iii) Preparing the surface to receive the priming and finishing coats.

iv) Applying the priming coats.

v) Each coat to be completed in all parts of one building and got approved, before starting next coat in that building, and shall not be done room wise or floor wise.

vi) Applying the distemper in 3 coats minimum, including primer coat. If a proper even surface is not obtained to the satisfaction of the Olectra Greentech Limited & Architects in 3 coats contractor shall carryout additional coats of distemper to approval, at contractor's own expense.

11.4. ACRYLIC WASHABLE DISTEMPER:

11.4.1. Washable acrylic distemper shall be conforming to IS 2395 – 1 – 1966 and shall be of approved make and shade.

11.4.2. As required, single or double scaffolding shall be used. Ladders, if used, shall be tied with old gunny bags at top to prevent damage or scratches to the walls/floors etc.

11.4.3. The instructions of the manufacturer shall be followed regarding preparation of the manufacturer shall be followed regarding preparation of the surface and application of priming and finishing coats.

11.4.4. Where the specifications of the manufacturer are not available, the following instructions shall be carried out:

11.4.5. The surface shall be cleaned and all clears, holes and surface defects shall be repaired with gypsum and allowed to set hard. All irregularities shall be sand papered smooth and wiped clean. The surface so prepared shall be completely dry and free from dust before distempering is commenced. In case of newly plastered surfaces/walls, special care shall be taken to see that it is completely dry before treatment is attempted.

The old surfaces which had earlier been distempered, shall be cleaned of grease and dust etc. All cracks, holes and surface defects shall be repaired with plaster of Paris and allowed to set hard and then sand papered smooth and wiped clean. The flaking's of previous coatings, if any, shall be taken off. But in case the surfaces are colour or white washed, the wash must be removed thoroughly first.

11.4.6. The priming coat shall be applied over complete dry surfaces as recommended by the manufacturers or patent distemper.

11.4.7. Distemper shall be applied in dry weather with a broad stiff brush in long parallel strokes. This shall be allowed to dry thoroughly before the next coat is applied. All the operations (strokes of brush) for one coat of white colour wash will give tow coats in case of distempering.

Rates to be inclusive of: The rates shall include all labour, materials, equipment and tools for carrying out the following operations:

i) Providing and mixing the primer and distemper separately.

ii) Scaffolding.

iii) Preparing the surface to receive the priming and finishing coats.

iv) Applying the priming coats.

v) Each coat to be completed in all parts of one building and got approved, before starting next coat in that building, and shall not be done room wise or floor wise.

vi) Applying the distemper in 3 coats minimum, including priming coat. If a proper even surface is not obtained to the satisfaction of the Olectra Greentech Limited and Architects in 3 coats contractor shall carryout additional coats of distemper to approval, at contractor's own expense.

11.5. WATERPROOF CEMENT PAINT:

The waterproof cement paint shall be of Super Snowcem or of any approved manufacture and it shall be of approved colour and shade. It shall be brought to site in original air tight containers with seals intact.

Double scaffolding and ladders shall be provided, if necessary, without damaging the wall surfaces to be painted.

The preparation of surface, mixing of paint and application shall be done as specified by the manufacturer. In the absence of manufacturer's specifications, the following shall be followed:

The surfaces shall be thoroughly cleaned free from dirt, dust, etc., by brushing and washing down with clean water. Any grease, oil paint or other foreign material shall be removed by approved method.

Colour/Lime wash and or distemper shall be thoroughly removed by washing, brushing and if necessary the accumulated coats of oil paint shall be removed by thoroughly brushing or scraping and washing and a clean even surface obtained.

Rough cast plaster and pebble dash surfaces shall be thoroughly brushed and washed to remove dust and dirt.

Dry cement paint shall be thoroughly mixed with clean fresh water to produce paint of required consistency. It shall be strained through a paint strainer. The paint shall be kept stirred thoroughly and applied within the specified time. Hardened or damaged paint shall not be used.

The paint shall be applied by brush. Each paint coat shall be properly cured and got inspected and approved by the Architects/Olectra Greentech Limited before the next coat is applied. Minimum 2 coats will be applied but if the work is not satisfactory, more coat/coats shall be applied as directed at no extra cost.

Absorbent surfaces shall be evenly damped so as to give even suction in dry weather, freshly painted surfaces shall be kept damp for atleast two days.

For smooth surfaces one coat of primer shall be applied as per manufacturer's specifications and three more coats of cement paint of approved shade shall be applied. All operations (strokes of brush) for one coat of white (colour wash will give two coats of cement painting).

Rates to be inclusive of: The rates shall include all labour, materials, equipment and tools for carrying out the following operations:

i) Providing and mixing the primer and waterproof cement paint distemper separately.

ii) Scaffolding.

iii) Preparing the surface to receive the priming and finishing coats.

iv) Applying the priming coats.

v) Each coat to be completed in all parts of one building and got approved, before starting next coat in that building, and shall not be done room wise or floor wise.

vi) Applying the waterproof cement paint in 3 coats minimum, including primer coat. If a proper even surface is not obtained to the satisfaction of the Olectra Greentech Limited & Architect in 3 coats, contractor shall carryout additional coats of work to approval, at contractor's own expense.

vii) Water repellant silicon liquid paint:

Multipurpose protective coating.

PIDICOTEW – 100 is a protective coating system designed for vertical walls, and acts as a one-way membrane, allowing moisture to escape to the surface but prevents moisture ingress into the treated structure.

Application Areas:

External wall surface for durable insulation effect.

For wall surfaces, can be used as protective coating in the desired colour.

For protecting industrial as well as residential structures from weathering effect.

Coverage:

10 to 12 Sqm/lit of PIDEBIND P – 100 on smooth surface once the area is covered properly with primer coat then, apply one coat of PIDICOTEW – 100 with a coverage rate of 5 sqm/lit.

After 1 hour of drying of first coat, second coat of PIDICOTEW – 100 shall be applied with the coverage rate of 5 sqm/lit.

11.6. MODE OF MEASUREMENT (FOR J1 TO J5):

For all the above painting items, Mode of measurement shall be same as that of plastering and shall be in Sq. Meters. No extra payment shall be made for painting rough cast surfaces or sand faced surfaces.

11.7. ENAMELLED PAINTING:

11.7.1. Materials:

11.7.1.1. The paint shall be of the specified colour and shade and of an approved make by the Olectra Greentech Limited. The paint shall comply in all respects with relevant Indian Standard Codes.

11.7.1.2. The make and brand of the paint to be used on the work shall first be got approved by the Architects/Olectra Greentech Limited. The material shall be obtained directly from the approved manufacturers or authorized dealers and brought to the site in the manufacturers drums etc., with seals unbroken.

11.7.1.3. Paint for undercoating and finishing coat shall be ready mixed. Mixing by contractor is not permissible except with prior written approved of the Architects/Olectra Greentech Limited, in which case the preparations of ingredients and their quality shall be strictly maintained as per manufacturer's instructions and relevant I.S. codes.

11.7.1.4. All the materials shall be kept properly protected when not actually in use. Lids of containers shall be kept closed and surfaces of paint in open shall be covered with a thin layer of turpentine to prevent formation of a skin.

In case of doubt regarding the quality, the paint supplied by the contractor shall be got tested in an approved laboratory as described in I.S. 101 – 1964, if considered necessary by the Architect. The cost shall be borne by the client, if the results are satisfactory, and by the contractor if otherwise. The rejected paint shall be removed from the site of work forthwith.

11.7.2. PREPARATION OF SURFACE:

11.7.2.1. Plastered Surfaces:

New plaster shall not be primed or painted till it is completely dry and hard. The surface shall be carefully rubbed smooth and thoroughly cleaned. The surface shall be dry, smooth, clean and free from dirt.

11.7.2.2. Steel work (NEW):

Degreasing shall be done by either proprietary brands of approved solvent cleaner or by mineral turpentine or petroleum and other petroleum solvents, like trichloroethylene alkali solutions or detergents as directed by the architects.

The de-rusting shall be done by manual scraping (by wire brushes, fine steel wool scraper, sand paper etc.) and/or mechanically by sand blasting, shot blasting or flame cleaning or chemical methods as approved by the Architects.

11.7.2.3. Steel work (Old):

For repainting necessitated due to any specified reason the relevant instructions given in I.S. 1447:1966 shall be followed. If necessary and ordered by the Architect, the surface shall be cleaned completely as for new steel.

11.7.2.4. Wood Work:

The surface to be painted shall be thoroughly dry, clean and smooth. It shall be sand papered with coarse medium grade sand papers and the finished surface shall be free from scratches.

11.7.2.5. Before applying primer, knots, if any, shall be covered with preparation of red lead made by grinding red lead in water and mixing with glue sized and used hot. The surface prepared for painting shall be dry before paint is applied. The holes and indentation on the surface shall be stopped with putty. Stopping shall not be done before the priming coat is applied.

11.7.3. Application:

11.7.3.1. All brushes, tools, etc., used shall be cleaned of all foreign matter at the beginning of different operations being undertaken.

11.7.3.2. Paint may be applied by spraying or brushing. Unless otherwise specified, paint shall be applied with brushes. Brushes of appropriate size shall be either round or oval shaped and they shall be maintained carefully throughout the work so as to be pliable and free from bristles.

11.7.3.3. The contents of the drum and tins shall be well stirred with a small clean and smooth stick before using and occasionally during use to prevent sedimentation at the bottom of the container.

11.7.3.4. Painting shall be carried out as far as possible in dry and warm weather.

11.7.3.5. Single or double scaffolding shall be used as necessary, by the contractor at his cost. Ladders, if used, shall be tied with old gunny bags at top to prevent damage or scratches to the walls, floors etc.

11.7.3.6. The primer coat shall be applied as soon as the surface has been cleaned and before deterioration of surface by rust and contamination of the surfaces by dust, dirt or any other foreign material.

11.7.3.7. Sufficient time shall be allowed for each coat of paint to dry before the next is applied.

11.7.3.8. Painted surface, shall be protected from sun, rain, condensation, contamination or surface damage, till it is completely dry. 'Wet paint' shall be put, when necessary.

11.7.3.9. Preparation of surfaces, priming coat, undercoat and finishing coats shall be applied as specified or recommended by the manufacturer. Where no specifications are available, the following specifications will be followed.

11.7.3.10. Primer Coat: Plastered surface:

Priming coat shall consist of equal parts of white and red lead mixed in boiled linseed oil to the required consistency applied uniformly over the surface. When this coat is dry, all cracks, holes and other such defects shall be filled with a mixture of one part of white lead and 3 parts of ordinary putty. After drying, the surface shall be rubbed with sand paper and dusted clean. An undercoat shall be applied thinly so that plaster may be thoroughly saturated. One or more undercoats with putty shall be applied as required and directed to obtain thoroughly saturated surface to the satisfaction of Olectra Greentech Limited.

Steel Work:

The primer coat be of red lead conforming to I.S.102 – 1962. Undercoating and puttying shall be done, if necessary. For old painted surfaces and new surfaces already primer with red lead/red oxide, the surface shall be cleaned thoroughly and primed with red lead/ red oxide, at some places, where necessary or over the whole surface as directed by the Architects.

Wood Work:
The primer coat shall consist of red lead, white lead, raw and boiled linseed oil and patent driers.

After priming coat, all small holes, cracks, open joints and other minor defects shall be stopped with putty made from whitening mixed to proper consistency with raw linseed oil and little white lead to help hardening of putty. The surface shall then be lightly rubbed down smooth with sand paper. One or more undercoats, with putty shall be applied as required and directed to obtain thoroughly saturated surface to the satisfaction of Olectra Greentech Limited.

11.7.3.11. Finishing coats:

Unless otherwise specified in the item, the finishing shall be done with atleast two coats of paint of approved made and shade confirming to the latest I.S. codes. The last coat of paint shall give a matt/flat, semi-glossy or glossy finish as specified for each item of painting or as directed by the Olectra Greentech Limited. Striped finish shall be given at no extra cost, if required, by the Olectra Greentech Limited. The finished surface shall be of the required shade and present an even appearance. It shall not show any brush marks. If required, final coat will be applied with rollers at no extra cost.

11.8. ENAMEL PAINT:

General specifications, preparation of surface and priming coat shall be same as specified for oil painting. Finishing shall be done in two coats or more as required with synthetic enamel paint of approved make and shade and shall generally conform to relevant I.S.codes.

11.9. RATE FOR ALL PAINTING WORKS TO INCLUDE:

Apart from other factors mentioned elsewhere in this contract, the rate for painting shall also include.

11.9.1. Providing all the materials/labour and equipment that is required to execute the work as specified.

11.9.2. Scaffolding (single/double) erection and removal.

11.9.3. Preparing the surfaces before painting.

11.9.4. Applying three cots of approved paint including priming coat. If proper & even surface or shade is not acquired, then extra cost/coats shall be applied as directed and to the final approval of the Olectra Greentech Limited, at no extra cost.

11.9.5. Applying additional priming coat/coats to obtain thoroughly saturated surface and filling the putty as required and directed.

11.9.6. No extra coat shall be paid for painting smooth/rough surfaces such as precast concrete pardis, rough cast plaster, sand faced plaster etc.

11.9.7. Curing the cement paint as directed for minimum 7 days.

11.9.8. Doors, windows, floors and other materials of furniture etc., shall be protects from being splashed upon. Splashing and droppings, if any, shall be removed and the surfaces cleaned as directed.

11.9.9. If any cracks develop in the plaster, before or after final painting, the same will have to be filled in by suitable putty and the surface painted again as directed to give an even surface to the approval of Olectra Greentech Limited at no extra cost. If neeru surface is damaged due to any reason before painting, then the surface shall be redone by using plaster of paris as directed, at no extra cost.

11.10. MODE OF MEASUREMENT FOR OIL, ENAMEL PAINT, POLISHING ETC:

11.10.1. Measurement of painted/polished surfaces shall be in Sq.m and as per plaster work.

11.10.2. For measurement of polishing/painting to joinery and steel work etc., multiplying coefficients, as in standard table shall, be as follows:

S.No	DESCRIPTION OF WORK	HOW MEASURED	COEFFICIENT
1	Wood work - Doors and Windows ect.,		
	Panelled doors / windows	Measured flat including frame	1.30 (for each side)
	Flush doors	- Do –	1.20 (for each side)
	Partly panelled and partly glazed or glazed doors/windows (for glazed portions only – for panelled portions as per 1 above).	- Do –	1.00 (for each side)

	Fully venetioned or louvered doors/windows	- Do –	1.80 (for each side)

S.No	DESCRIPTION OF WORK	HOW MEASURED	COEFFICIENT
1	Steel Work – Doors and Windows	Measured flat including frame.	0.50 (for each side)
	Fully glazed doors & windows.	- Do –	1.10 (for each side)
	Plain sheeted steel door, windows, Collapsible gate.	Measured flat	1.50 (for each side)
	Rolling shutters of interlocked laths	Jamb guides bottom rails, locking, arrangement included (top cover shall be measured separately)	1.10 (for each side)
2	General Work:		
	Expanded metal, M.S grill work, grating in guard bars, balustrades, railing and partitions.	Measurement flat	1(for painting all over)
	R.C.C grill	- Do –	1.10 (for each side)

The table given above is as per C.P.W.D. specification.

11.11. FRENCH SPIRIT POLISHING:

11.11.1. Materials:

French spirit polish shall be of an approved make conforming to I.S.348:1968 and shall be approved by the Architects. If it is to be prepared, the polish shall be made by dissolving 0.7 Kgs of best shellac in 4.5 liters of spirit or wine without heating. To obtain required shade, approved pigment shall be added and mixed in required proportions.

11.11.2. Workmanship:

11.11.2.1. Preparation of Surface:

The surface shall be cleaned. All unevenness shall be rubbed down smooth with sand paper and well dusted. Holes and indentations of the surface shall be filled with putty made of whiting and linseed oil. The surface shall be given a coat of filler made of 2.25 Kg of whiting and 1.5 liter of methylated spirit. When it dries, the surface shall again be rubbed down perfectly smooth with sand paper and wiped clean.

11.11.2.2. Application:

A piece of clean fine cotton cloth or cotton wool made into the shape of a pad shall be used to apply polish. The pad shall be moistened with polish and applied sparingly but uniformly and completely over the entire surface. It shall be allowed to dry and then only another coat is applied in the same way. To finish off, the pad shall be covered with a fresh piece of clean fine cotton cloth, slightly damped with methylated spirit and rubbed lightly and quickly with a circular motion. The finished surface shall have a uniform texture and high gloss. Irrespective of number of coats, this will be carried out to the entire satisfaction of Olectra Greentech Limited.

11.12. POLISHING:

11.12.1. Materials:

This shall be of approved quality and make and brought to site in sealed containers as marketed by the manufacturers.

11.12.2. Workmanship:

11.12.2.1 Preparation of Surface:

Woodwork to be treated, shall be finished smooth. It shall then be stopped and rubbed down perfectly smooth with different grades of sand paper. (The final rubbing shall be done with sand paper which has been slightly moistened with linseed oil and rubbed one over the other for a few seconds).

11.12.2.2. Application:

The mixture of the polishing shall be applied evenly, with a clean cloth pad in such a way that no blank patches are left, and rubbed continuously for half an hour. When the surface is quite dry, a second coat shall then be applied and rubbed for two hours or more if necessary, until the surface has assumed a uniform glass and is quite dry, showing no signs of stickiness when touched. Irrespective of number of coats, this will be carried out to the entire satisfaction of Olectra Greentech Limited.

11.13. MEASUREMENT:

Measurement for French/wax polishing and or polishing with readymade polish will be as per schedule stated herein before and the explanatory note on coefficient shall be as per C.P.W.D. specifications.

11.14. For all painting and polishing works (11.1. to 11.12):

(i) Detailed register shall be maintained, by the contractor, showing daily account of receipts, consumption and balance of different materials showing materials received and their consumption with location, and shall be checked by Olectra Greentech Limited & Architect as their discretion.

(ii) Each coat of work shall be done in one building at a time and got approved before starting next coat in that building; and shall not be done room wise or floor wise.

SECTION 2

S P E C I F I C A T I O N
FOR
PRE-ENGINEERED BUILDING

1.0 CONNECTION DETAILS:

1.0.1 All flanges and webs of primary members can be welded on one side of the web.

1.0.2 All connections shall be bolted unless otherwise specified. No building connection should be designed to have any slip critical joints.

1.1 PITCH OF ROOFING:

A slope of 1 in 10 shall be considered for the roofing system unless otherwise specified.

1.2 FIXING ARRANGEMENT FOR SERVICES:

1.2.1 Necessary fixing of supports from the primary members such as rafters will be indicated during the approval of the drawings stage.

1.2.2 Fixing of the electrical/lightning conductors shall be made as per the drawing at the time of the fixing of the roof sheet.

1.3 MATERIAL SPECIFICATIONS

1.3.1 GENERAL

The specifications mentioned in this chapter are indicative purpose only. The manufacturer shall give specifications for all the materials as per the statement which has been listed in the design brief.

1.3.2 FINISH OF THE MEMBERS

1.3.2.1 All framing members shall be cleaned and remove all dirt, grease, oil, loose mill scale, weld slag, flux deposit and other foreign matter, and given two shop coat of zinc rich chromate primer (2 x 25 micron) conforming to IS: 104-1962: After application of the primer, two coat of synthetic enamel paint (2 x 35 microns) shall be applied as per IS: 1477 (Part II) – 1971: Code of Practice for Painting of Ferrous Metals in Buildings. The total film thickness shall not be less than 120 microns. All the painting shall be factory applied. No site painting shall be allowed, only touch up painting shall be allowed if required.

1.3.2.2 All secondary members such as purlins, wall girts shall be coated with zinc coating to the standard of 275 g/sqm.

1.3.2.3 All fixing clamps for the down spouts shall have the paint finish with enamel painting which the coating thickness shall not be less than 120 microns.

1.3.3 PRIMARY MEMBERS

1.3.3.1 Primary members (Built up Sections) shall be fabricated from hot rolled steel plates Grade 345 with minimum yield strength of 345 Mpa. Flanges shall be machine welded.

1.3.3.2 Members fabricated from hot rolled structural shapes shall have minimum yield strength as per relevant IS code and shall conform to the physical specifications.

1.3.3.3 The finish of the primary members shall be with zinc rich chromate primer and enamel painting as specified.

1.3.3.4 The Rafters & Columns should be fabricated considering full plate length for the entire rafter & column length as practicable.

1.3.4 SECONDARY MEMBERS

1.3.4.1 All secondary members such as purlins, girts shall be pre galvanized and shall be fabricated from cold formed steel coils conforming to IS or equivalent with zinc coating to Z275 designation (275 g/Sqm) having minimum yield strength as per relevant IS code. The vendor shall give the coating thickness as per the material consumption specified. The vendor shall provide Manufacturer's test certificate and Test certificate from an independent laboratory for the Galvanization on the cold formed materials.

1.3.4.2 Rod bracing shall have minimum yield strength as per relevant IS code and shall conform to the physical specifications of

relevant IS Code and the paint finish shall be with two coats of zinc chromate primer and synthetic enamel painting as per the painting specification.

1.3.4.3 All other miscellaneous secondary members except purlin and girts shall have minimum yield strength of relevant and the paint finish shall be with the zinc rich chromate primer and synthetic enamel painting as per the painting specification.

1.3.4.4 All sag rods shall have bolting arrangements to ensure the alignment of the purlins.

2.3.5 CONNECTIONS

a. All field connections shall be bolted. (Unless otherwise specified)

b. All primary bolted connections, as shown on drawings, shall be furnished with electro galvanized high strength bolts of 8.8 grade, washers, nuts conforming to the physical specifications of relevant IS codes.

c. All secondary bolted connections, conforming to grade 4.6, as shown on drawings shall be furnished with machine bolts conforming to the physical specifications of relevant IS codes.

d. All shop connections shall be welded using either submerged or shielded arc process, and welding shall be in accordance with the applicable sections, relating to design requirements and allowable stresses, of the latest editions of the relevant IS codes.

2.3.6 ANCHOR BOLTS

a. Electro galvanized black painted Mild steel bars s conforming to Grade A of IS: 2062 are used for anchor bolts.

2.3.7 WALL PANELS

a. Color coated Wall panels shall be roll formed with 0.47 mm BMT and should have a total coating thickness 0.5 mm having minimum yield strength of 550Mpa.

2.3.8 HI RIB ROOF SYSTEM

a. Roof panels

1. Structural Hi Rib bare galvalume roof sheet shall be used, requiring no end closures. Only factory profiled sheets to be laid.

2. Panel ends shall be sufficiently lapped located at supporting members, and sealed with butyl mastic. Factory rib notching shall be furnished on panels requiring end laps. Panel end shall occur at structural members.

3. Standard panels shall be with minimum thickness of 0.47mm bare metal, 550Mpa yield strength and coatings specifications.

4. Batten cleats shall be also of same material as panels and shall come with factory applied mastic.

b. Fastening and joining

1. The panels shall be fastened with self-tapping fasteners including sealing washer assemblies at eave members and fab lock fasteners at end lap locations.

2. All other structural fastening of panel to sub structural members shall be by concealed clip. Thermal contraction and expansion of the roof panel is to occur within panel ends independently of the structure frame.

c. Trims and accessories:

1. Location of trims and accessories shall be as shown on shop drawings. Materials used for trim and accessories shall correspond with roofing materials unless other materials are specified.

2.3.9 FASTENERS

a. Standard fasteners shall be metallic polyester coated, heat treated carbon steel conforming to relevant IS Code, hex head, self-drilling screws, assembled with galvanized steel washers bonded with EPDM seals.

b. The wall fasteners cap shall match the color of the panels.

2.3.10 DECKING SHEET

a. Galvanized Metal Deck sheet shall be of suitable thickness, in trapezoidal profile of suitable depth. The deck sheet shall have yield strength of minimum 250 Mpa.

b. The decking sheet shall be fixed to the steel beams with suitable self-drilling and self-tapping screws at suitable distance.

c. The Vendor has to provide Manufacturers Test Report as well as Test report from an independent laboratory for the Galvanization of the sheets.

2.3.11 SEALER

a. Sealer for side laps, end laps and windows shall be extruded elastomeric butyl rubber based sealant or equivalent. The sealer shall be non-asphaltic, non-shrinking, nondrying, and nontoxic and shall have adhesion to metals, plastics and painted surfaces.

b. The vendor shall give the complete technical specifications at the time of submitting the offer.

c. Special grade silicone sealants shall be used at side laps and end laps wherever required.

2.3.12 FLASHING, TRIM AND CLOSURES

a. Flashing and/or trim shall be furnished at the rake, corners, and eaves, framed openings, and wherever necessary to provide weather tightness and finished appearance matching with wall finish or as approved by **Engineer-in-charge.**

b. Color coated steel for flashing, metal closure, trim and other miscellaneous uses shall be of the same specification as the roof and wall covering material. 150mm flashing is to be considered for the masonry wall & sheet joint locations for the inside of all buildings with the flashing top matching the profile of the roof sheet.

c. Foam closures shall be used additionally to match the panel profile made up of polyurethane or similar material.

2.3.13 EAVE GUTTERS AND DOWN SPOUTS

a. Gutters shall be of Color coated Galvalume sheet of 0.50mm thick TCT which shall be designed based on the rain water and catchments area calculations and accordingly, the size and thickness shall be calculated. The outside face of the gutters shall be supported with galvanized steel clamps suitably designed for fixing to the eave members. The vendor shall provide Manufacturer's test certificate and Test certificate from an independent laboratory for the Galvanization and coating.

b. The sealant filling shall be considered around the downspouts cutouts.

c. Down spouts shall be PVC and shall have a 45 degree elbow at the bottom and shall be supported by attachment to the steel columns with color coated galvanized steel clamps at a designed spacing.

2.3.14 VALLEY GUTTER AND DOWN SPOUTS

a. Valley Gutter shall be of Galvanized steel sheet, with a yield strength of minimum 250 Mpa, which shall be designed based on the rain water and catchments area calculations and accordingly, the size and thickness shall be calculated. The vendor shall provide Manufacturer's test certificate and Test certificate from an independent laboratory for the Galvanization on the sheet.

b. The Gutter shall be provided in places shown in the Tender drawing.

c. The gutter shall be suitably supported from bottom by providing suitable steel member support.

d. The Gutter segments shall be welded together to form one impermeable gutter. The welded joints shall be treated by applying suitable cold galvanization paint from approved vendors.

e. Down spouts shall be PVC and shall be supported by attachment to the steel columns with color coated galvanized steel clamps at a designed spacing.

2.3.15 SKY LIGHT PANELS

a. All skylights shall be provided with 2mm thick opal white, UV resistant polycarbonate sheet to match to the profile of the roof sheeting with necessary sealants and tapes etc. complete. The polycarbonate sheet shall have the light transmitting property of 60%+/5%. The sheets shall be one side UV coated, 40 to 50 microns conforming to ASTM standards and the color of the panel shall be Opal white with smooth surface finish. Polycarbonate sheet shall be Baffle type as shown in the drawing and provided with ACST Butyl tape for sides and end laps to guarantee water tightness.

b. The area of the skylights shall be 3% of roof area. The tenderer shall indicate the area in the attached Bill of Materials. The location indicated in the drawings is tentative only and subject to be changed.

c. Continuous bend of polycarbonate sheet shall be provided of 3.00m height all two side of building as per tender drawings. The tenderer shall indicate the area in the attached Bill of Materials. The location indicated in the drawings is tentative only and subject to be changed.

d. The skylight panels shall be designed to take care of the live load of 75 Kg/Sqm and accordingly, the tenderer shall provide the detailing of the skylight panels. Specification Sheets for the above to be submitted by bidder.

e. Protective galvanized weld mesh of eye size 25*25mm, 12 gauge is to be provided for safety against man fall underneath the skylights.

f. Unless otherwise specified, the polycarbonate sheets shall have 2.4 kgs/sqm as weight, tensile strength at break > 65 Mpa, U /value not exceeding 5 W/sq.m./K and impact strength > 200 J as per IS 14443-1997. End overlaps shall be at least 150mm with one crest covered in side overlap.

2.3.16 GRAVITY VENTILLATOR/GRAVENT (CONTINUOUS RIDGE VENTILATOR)

a. All Opening to be fitted with insect proof mesh.

b. Gravent of throat opening shall be considered as per the design drawing. The gap shall be closed with 20 wires per linear inch with 30 gauge SS wire mesh as per relevant IS code bird proof mesh. The vendor shall give the proposal drawing along with the offer.

2.3.17 WALL CLADDING ENDS

a. 20 wires per linear inch with 30 gauge SS wire mesh as per relevant IS code is to be provided at the cladding ends for the gap between the masonry wall and cladding sheet if the gap is up to 200mm. The necessary frame work for fixing the mesh is to be provided by the vendor. The tenderer shall specify the frame work design will all technical specifications. If the gap is more than 200mm, the opening to be closed with wall sheeting material with adequate flashings.

2.3.18 LOUVERS

a. Color coated galvalume sheet material fixed S/Z type louvers are to be provided as per the locations shown in the drawing. The tenderer shall specify the complete technical specifications along with the drawing.

b. 20 wires per linear inch with 30 gauge SS wire mesh as per relevant IS code is to be provided for inside of the building and accordingly necessary frame work is to be designed by the PEB vendor.

2.3.19 ROOF ACCESS

a. Roof access cage ladders shall be provided as per the locations shown with 750*750mm platform at the top with suitable handrails.

b. All Insect Proof mesh and Mosquito proof mesh to have 20 openings per square inch.

1.4 STRUCTURE:

1.4.1 Reinforced Cement Concrete Pedestals are to be constructed as per tender drawings by the contractor. Pre Engineered Building Columns are to be considered from RCC pedestal top level up to the required heights of the buildings as shown in the drawings. The clear height of the building is as per drawings. The rafters are to be positioned above the PEB columns. The cladding of the building is with brick masonry as per Architectural drawing by the civil contractor and above the masonry height, the rest is to be cladded with color coated galvalume sheeting.

1.4.2 The gap between the wall and the cladding sheet is to be provided with 26 gauge galvanized steel 20 openings/square inch with necessary frame work at required level as per the elevations shown in the Architectural drawings.

1.4.3 Flashings are to be provided for the openings of rolling shutters if the girt is coming less than 500mm or otherwise, cladding is to be provided with flashings. Suitable steel box section to be provided for fixing of the Rolling shutter. For openings within PEB area necessary framed openings to be provided with necessary trims and flashings.

1.4.4 Eaves gutter and down spouts shall be considered for the as per the locations shown in the drawings.

1.4.5 Valley gutters and down spouts shall be considered for the as per the locations shown in the drawings.

1.4.6 Hangers can be considered by the tenderer for supporting the canopies as shown in the drawings

1.4.7 Foam closures, mastic taps, and sealants shall be considered for all areas wherever applicable.

1.4.8 Ridges, gable end flashings, corner flashings and apron flashings shall be considered wherever applicable.

1.4.9 Double sided flashings shall be considered at the eaves level i.e. on both sides of the gutter beam wherever applicable. All the inside ledges are to be covered with double sided flashings. The columns positions at the base plates will be encased in the concreting after completion of alignment at the concrete gutter locations.

1.4.10 Cage ladders shall be provided as per architectural drawing for the maintenance provision from the finished ground level to the roof level with necessary handrails/guard rails.

1.4.11 Pre-punched holes shall be provided for the Rafters and secondary members such as purlins for supporting the services. However, the exact location of the pre punched holes will be indicated during the approval of the shop/GA drawings.

1.4.12 Jack beams are to be provided for the support wherever applicable. The clear height for soffit of jack beams will be as per drawings.

1.4.13 Roof loading shall be considered for future solar panel installation. (Refer DBR for Loads)

1.5 QUALITY TESTING PLAN

1.5.1 Factory Inspection

Factory test certificates shall be furnished for all the lots of material required for the specific project before shipment from the manufacturer. Independent testing in, a client approved laboratory shall be carried out for the mechanical properties verification by the vendor after procurement of the material, as per instruction by Engineer-in-charge.

1.5.2 Raw Material (Steel Plates and sections):

The following tests shall be done for both raw material and critical consumables before proceeding with any fabrication work as per applicable standards.

1.5.2.1 Visual Inspection

1.5.2.2 Dimensional Inspection

1.5.3 Welding Procedure:

1.5.3.1 This shall apply for welding procedure specifications and the qualification of the welders. The vendor shall take the approval of the welding procedure specification before proceeding with any fabrication work, in case it varies from the codal references as stated in the document.

1.5.3.2 All welding with electrodes shall be in accordance with IS 814 for thickness up to 20 mm and AWS E 7018 for thickness above 20 mm and as approved. Welding and cutting is not allowed at site. All welding, cutting etc. operations to be done at the factory. Machine welding has to be done.

1.5.4 Fabrication of beams, rafters:

1.5.4.1 This shall apply for checking of weld preparation of flange to web prior to full welding and dimensional check of fit up components and holes marking etc.

1.5.5 Non-destructive testing for the welding:

This shall apply for the welded joints which shall be minimum of 10%. Test reports are to be furnished.

1.5.6 Surface preparation and painting:

1.5.6.1 This shall apply to the inspection of the surfaces before commencement of the priming of the members and after completion of the painting such as inspection of DFT (Dry Film Thickness). This shall be minimum 10% of the area.

Test reports are to be furnished

1.5.6.2 Painting to all steel components of structure for all steel works should be carried out including preparation of surface confirming to IS specifications, as specified in the bills of materials. Samples and mock-ups are required to be planned and submitted to Engineer-In-Charge approval before commencement of respective layers of work, to meet the agreed schedule. Testing equipment, calibrated in approved Institution shall be made available at site for in-situ

measurement of coating thicknesses anti-corrosive treatment to all steel components of structure with specialized painting for all steel works should be carried out including preparation of surface confirming to IS specifications, as specified in the bills of materials.

1.5.7 Packaging and shipping Inspection:

This shall apply before commencement of the protective packaging and before shipment to the site.

1.5.8 INSPECTION SCHEDULE

1.5.8.1 The inspection will be made after giving 7 (Seven) days prior notice to the vendor.

1.5.8.2 The vendor shall follow the following inspection schedule for carrying out the work.

- At the time of testing of the welding
- At the time of process of the painting
- Before shipment

1.5.9 SITE INSPECTION

This shall apply to all the materials unloading at site to complete erection and handing over to Engineer-in-charge. Tests on materials shall conform to IS Specification and the test shall be carried out as directed either at site Laboratory or at any approved test laboratory and documented to ensure the quality as well as the workmanship. No additional cost shall be paid on this account.

Sl.	Description	Type of test	Minimum requirement
1	Welding works	Ultrasonic test to be done as per IS 3664 ,Dye penetration test as per IS 3658	Welding quality test done at factory it self-10% of welding to be tested.
2	Painting works	Coating thickness	Required thickness of coating to be checked by using Elcometer.
3.	Sheet thickness	Testing of sheet thickness	Sheet thickness verification by using Digital Micro meter.
4	Self-drilling Screws	Pull over test	Test to be done for pull out capacity of screws in the laboratory.
5.	Anchor bolts and fasteners	Steel quality test	Test to be done for elongation, yield strength, maximum tensile strength etc. at laboratory (minimum one for every diameter).

Apart from the above tests necessary Manufacturers certificate for all the materials to be given

Damage during transit: while opening of the protective packaging, any damaged materials (found either visually or otherwise, during transit or unloading) shall be replaced by the vendor

Damage during erection: Any damage during erection (found either visually or otherwise) shall be replaced by the vendor.

Water leakage test: after completion of the execution of the roofing system, water leakage test shall be carried out as per the standards, and if any leakage is found, same shall be rectified.

1.6 MTC AND WARRANTY CERTIFICATES

The vendor shall give the following certificates during the construction / after handing over the project (whichever applicable) to the **Engineer-in-charge** along with close out documentations as per the following.

- Material Testing certificate
- Warranty certificate
- As Built Drawings

1.7 LIST OF CODES

LIST OF BUREAU OF INDIAN STANDARDS CODES		
Sl. No.	***Code No.***	***Subject***
1	IS63	Whiting for paints and putty
2	IS 198	Varnish gold size
3	IS228	Structural steel (Standard quality)
4	IS277	Specification for galvanized steel sheets (Plain and corrugated)
5	IS 419	Putty for use on window frames
6	IS800	Code of practice for use of structural steel in general in steel construction
7.	IS806	Code of practice for use of steel Tubes in general building construction
8.	IS808	Dimensions for Hot rolled steel beams, columns, channel and angle sections
9.	IS 812	Glossary of terms relating to welding and cutting metals
10	IS 813	Scheme of symbols for welding
11	IS 814	Covered electrodes for manual metal arc welding of carbon and carbon manganese steel
12	IS816	Code of practice for use of metal arc welding for general construction in mild steel
13	IS 817	Code of practice for training and testing of metal arc welders
14	IS818	Code of practice for safety and healthy requirements in electric and gas welding and cutting operations
15	IS822	Code of procedure for inspection of welds
16	IS823	Manual for metal arc welding in mild steel
17	IS 1038	Steel doors, windows and ventilators
18	IS 1081	Code of practice for fixing and glazing of metal (Steel and aluminum) doors, windows and ventilators
19	IS 1148	Hot rolled steel rivet bars (up to 40 mm diameters) for structural purposes
20	IS1161	Steel tubes for structural purposes
21	IS 1182	Recommended practice for radiographic examination of fusion welded butt joints in steel plates
22	IS 1200- (Pt. VIII)	Method of measurements of steel work and iron works
23	IS 1363 Part I	Hexagon head bolts, screws, and nuts of product grade C (Hexagon Head bolt)
24	IS 1363 Part II	Hexagon Head Bolts, screws and nuts of product Grade 'C'
25	IS 1363 Part-III	Hexagon Head Bolts, screws and Nuts of product grade 'C'
26	IS 1367	Technical supply conditions for threaded steel fasteners
27	IS 1568	Wire cloth for general purposes
28	IS 1599	Method for bend test
29	IS 1608	Metallic materials - Tensile Testing at Ambient Temperature.
30	IS 1730	Dimensions for stainless steel plates, sheets strips and flats for general engineering purposes
31	IS 1821	Dimensions for clearance holes for bolts and screws
32	IS 1852	Rolling and cutting tolerance for hot rolled steel products
33	IS 1894	Method for tensile testing of steel tubes
34	IS 1977	Structural steel (ordinary quality)
35	IS 2062	Hot Rolled low, medium and high tensile structural steel
36	IS 2074	Ready mixed paint, air drying red oxide zinc chrome priming
37	IS 4351	Specification for steel door frames
38	IS 4454 (Part I)	Steel wires for mechanical springs. Cold drawn unalloyed steel wire.

39	IS 4711	Methods for sampling of steel pipes, tube and fittings.
40	IS 4736	Hot - dip zinc coating on mild steel tubes
41	IS 4923	Hollow Steel Sections for Structural Use - Specification
42	IS 6248	Metal rolling shutters and rolling grills
43	IS 6911:2017	Stainless steel plate, sheet and strip
44	IS 7452	Specification for hot rolled steel sections for doors, windows and ventilators.

SECTION 3

S P E C I F I C A T I O N S

S A N I T A R Y W O R K S

SPECIFICATION - GENERAL SCOPE

1.0.1 These specifications establish and define the material and constructional requirements for Public Health Engineering Services works.

1.0.2 Methods of measurements are indicated in these specifications. Where not so specified, latest revision of IS: 1200 shall be applicable.

1.0.3 Providing and operating necessary measuring and testing devices and materials including all consumables are included in the scope of work. No separate measurement or payment for testing the work shall be made and the rates quoted by the Contractor for various items shall be deemed to include the cost of such tests, which are required to ensure achievement of specified quality.

1.0.4 All materials shall be of standard quality, manufactured by renowned concerns conforming to Indian Standards or equivalent and shall have IS mark as far as possible unless otherwise approved by the Engineer-in-Charge. The Contractor shall get all materials approved by the Engineer-in-Charge prior to procurement and use or placing orders in bulk supply. The Contractor shall furnish manufacturer's certificates for the materials supplied by him. Further to that he shall get the materials tested from an approved test house if asked for by the Engineer-in-Charge. The cost for conducting all the tests and submitting test certificates shall be borne by the Contractor. No separate payment shall be made for the testing. The Engineer-in-Charge shall have the right to determine whether all or any of the materials are suitable. Any materials procured or brought to site and not conforming to specifications and to the satisfaction of the Engineer-in-Charge shall be rejected and the Contractor shall have to remove the same immediately from site at his own expense and without any claim for compensation due to such rejection. The decision of Engineer-in-Charge in this regard shall be final and binding to the Contractor.

1.0.5 Wherever referred to in this tender document, only the latest revision of specifications, Codes of Practice and other publications of Bureau of Indian Standards shall be applicable.

1.0.6. Preparation of "as built" drawings of structural foundations, equipment foundations etc. indicating designed and achieved levels, center lines and dimensions of pockets, position and level of anchor bolt etc. for all drawings prepared by the Contractor.

1.0.7 The provisions of schedule of rates, specifications and drawings shall be in conjunction with each other and in case of conflict amongst them, the clarification shall be obtained from the Engineer-in-Charge whose decision shall be final and binding on the Contractor.

1.0.8 Order of precedence shall be:

a.) Drawings
b.) Specifications
c.) B.O.Q.
d.) Relevant IS a code, IS a specification and IS handbooks.

1.0.9 For each item of work, a work sequence permitted by the Engineer-in-Charge shall be followed by the Contractor. Various check cards to be used for each item of works shall be prepared by the Contractor at his own cost as per the instructions of the Engineer-in-Charge.

1.0.10 **Technical Specification of DSR items of Public health works (Based on DSR 2021) mentioned in SOQ shall be as per CPWD specification 2021 VOLUME I AND VOLUME II** (corrected up to the last date of submission/uploading of bid).

1.0.11 For Non-scheduled item mentioned in SOQ shall be installed as per manufacturer's direction approved by the Engineer-in-Charge.

2 Scope of work

2.1.1 Work under this section shall consist of furnishing all materials & labour necessary and required to completely install all sanitary fixtures, chromium plated fittings and accessories as required by the drawings specified hereinafter and given in the Schedule

of Quantities.

2.1.2 Without restricting to the generality of the foregoing the sanitary fixtures shall include the following: -

a) Sanitary fixtures
b) Chromium plated fittings
d) Accessories e.g., toilet paper holders, soap dish, coat hooks etc.
e) Connections to all kitchens, equipment, pump headers and other equipment requiring water and drainage connections.

2.1.3 Whether specifically mentioned or not all fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required.

2.2 All exposed pipes within toilets and near fixtures shall be chromium plated brass or copper unless otherwise specified.

2.3 General requirements

2.3.1 Sanitary fixtures and C.P. fittings in manufacturer's packing as specified in the schedule of quantities shall be supplied by the Contractors.

2.3.2 All fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the Schedule of Quantities, specifications, drawings. Accessories shall include proper fixing arrangement, brackets, nuts, bolts, screws and required connection pieces, WC flexible connectors etc.

2.3.3 Fixing screws shall be half round head chromium plated brass screws with C.P. washers where necessary.

2.3.4 Contractor shall furnish without cost all such accessories and fixing devices that are necessary and required but not supplied along with the Plumbing Fixtures & CP Fittings by the manufacturers as a part of the original and standard supply.

2.3.5 All fittings and fixtures shall be fixed in a neat workmanlike manner true to level and heights shown on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at Contractor's cost.

2.3.6 Contractor shall seal all fixtures fixed near wall, marble and edges with an approved type of poly-sulphide sealant appropriate for its application.

2.4 Accessories

2.4.1 Contractor shall install all chromium plated and porcelain accessories as shown on the drawings or directed by the Project Manager.

2.4.2 All C.P. accessories shall be fixed with C.P. brass half round head screws and cup washers in wall with crawl plugs or nylon sleeves and shall include cutting and making good as required or directed by Project Manager.

2.4.3 Recessed porcelain accessories shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand) and fixed in relation to the tiling work as per Interior Designer's drawings.

2.5 Measurement

2.5.1 Sanitary fixtures and accessories shall be measured by numbers in the unit given in the Schedule of Quantities.

2.5.2 Rates for all items shall be inclusive of cutting holes and chases and making good the same, C.P Brass screws, nuts, bolts and any fixing arrangements required and recommended by manufacturers, testing and commissioning.

2.6 <u>Sanitary item</u>

2.6.1 Coat hook shall be of brass material and chrome color double hook type of approved quality.

2.6.2 Handicap Grab bar 600 mm of non-slipping grip type for handicap toilet.

2.6.3 WC Pan connector shall be of with integral single mould sealing fins made of flexible EVA body to be fixed with manufacture supplied grease, including rubber bush / adaptor for use with uPVC pipe as supplied with the pan connector.

SOILS, WASTE, VENT PIPES & FITTINGS

3 Scope of work

Work under this section shall consist of furnishing all labour, materials, equipment's and appliances necessary and required to completely install all soil, waste, vent pipes and fittings as required by the drawings and as given in the Schedule of Quantities.

3.1 Without restricting to the generality of the foregoing, the work shall include the following:-

a) Vertical and horizontal soil, waste, vent, and fittings, joints, clamps and connections to fixtures.
b) Soil & waste pipes to external sewers line.
c) Connection of all pipes to sewer lines as shown on the drawings at the ground floor.
d) Floor and urinal traps, cleanout plugs, inlet fittings.
e) Testing of all pipe lines.

3.2 General requirements

3.2.1 All materials shall be new and best quality conforming to Latest IS Code and specifications and subject to the approval of the Project Manager /Architect.

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

3.2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

3.2.4 Pipes shall be securely fixed to walls and ceilings by suitable clamps an interval specified.

3.2.5 Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

3.3 Piping System

3.3.1 Soil, Waste & Vent Pipes

a) The Soil & Waste pipe system above ground has been planned as a "two pipe system" as defined in IS: 5329, having separate pipes for waste from showers, washbasins and floor drains and is approved by the local authority. Waste stacks have been provided with a "P" trap.

b) Vertical soil & waste stacks shall be connected to a common horizontal drain pipe at basement floor ceiling as shown on the drawings.

c) All Floors of toilets and other areas located on structural slab are SUNK by 450 mm to accommodate all soil & waste pipes.

d) All soil and waste from areas below general ground level will be collected in sumps and pumped into sewer lines.

e) Anti-siphonage pipe (ASP) shall be provided for soil fittings on vertical stacks. It may also be provided for waste lines where shown on the drawings.

3.4.1 Soil & Waste Pipes

3.4.2 All pipes shall be straight and smooth and inside free from cracks and other manufacturing defects. Pipes shall uPVC SWR Type- B confirming to IS 13592.

3.5. Fittings

3.5.1 Fittings shall conform to the Indian Standard recommended for the pipes. Pipes and fittings must be of matching as per manufacturer specification. Interchange of pipes of one standard with fittings on the other standard will not be permitted.

3.5.2 Fittings shall be of the required degree of curvature with or without access door.

3.5.3 Connection from a vertical stack or position to a horizontal line shall be made only by a “Y” junction.

3.6 Fixing

3.6.1 All vertical pipes shall be fixed truly vertical to walls with approved type of GI clamp. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard). However, shaft where more vertical pipes run, the pipes may be fixed to the slotted angle/channel supports fixed to walls at intervals specified here under: -

3.6.2 Horizontal pipes running on the floor shall be covered with cement concrete grade M-10, 75mm thick in bed and 75mm thick all-around soil and waste pipes under floor

3.6.3 Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the Project Manager/Building Contractor for making such provisions in the structure as necessary. All damages shall be made good to restore the surfaces at no extra cost.

3.7 Clamps

3.7.1 Holder bat clamps shall be of standard design and fabricated from **galvanized MS standard flats** 40x3 mm thick and 12 mm dia MS rod and 6 mm nuts and bolts. Holder bat clamps shall be fixed in cement concrete 1: 2: 4 mix blocks 10x10x10 cm deep.

3.7.2 Where holder bat clamps are to be fixed in RCC column or slotted angles, walls or beam they shall be fixed with **galvanized** 40x3 mm flat iron "U" type clamps with anchor fasteners of approved design or 6 mm nuts and bolts.

3.7.3 For CI pipes shall be clamped to wall with approved type of GI saddle clamp/U-clamp or as given in the Bill of quantities.

3.7.4 Structural clamps shall be fabricated by electro-welding from MS structural members e.g. rods, angles, channels flats as per detailed drawing. Contractor shall provide all nuts & bolts, welding material. All fabricated clamps, nuts, bolts and washers shall be not dipped galvanized.

3.7.5 Galvanized slotted angle/channel supports on walls shall be provided wherever shown on drawings. Angles/channels shall be of sizes shown on drawings or specified in schedule of quantities. 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.

3.7.6 Wherever MS clamps are required to be anchored directly to brick walls, concrete slabs, beams or columns, nothing extra shall be payable for clamping arrangement and making good with cement concrete 1 : 2 : 4 mix (1 cement : 2 coarse sand : 4 mm stone aggregate 20 mm nominal size) as directed by the Project Manager.

3.7.7 For sleeves, anchor fasteners and clamp spacing chart shall be as follows:

MARKINGS:

All pipes shall carry the following markings: Time and date of manufacture; company name; dimension, application class, barcode and material details.

INSTALLATION: The piping system must be clamped properly as required, pipes passing through walls, beams, slabs, columns should pass through sleeves which are padded with insulation material internally (between pipe and sleeve) covering the pipe to avoid transfer of body and structural borne sounds (refer manufacturer’s installation guide lines). The piping must not touch any wall, structure, paneling, false ceiling etc.

3.8.0 Traps

3.8.1 Floor traps

Floor traps shall be siphon type full bore P or S type cast iron having a minimum 50 mm deep seal. The trap and waste pipes in sunken area (where required) 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.

3.8.2 Floor trap inlet

Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type inlet fitting fabricated from uPVC pipe without, with one, two or three inlet sockets fixed on side to connect the waste pipe. Joint between waste and hopper inlet socket of the trap shall be joined with solvent cement recommended by the manufacturer. Inlet shall be connected to an uPVC. P or S trap. Floor trap inlet hoppers and the traps if set in cement concrete blocks as specified in para above without extra charge. UPVC multi-inlet trap can be used where ever possible to be decided by the project Engineer.

Trap & Seals

All traps shall be self-cleaning design and the seal depth shall be as specified below wherever the traps are not integral with the appliances:

Appliance or ware	Material	Trap Type	Seal depth(mm)
Lavatory /wash basin	C.P. cast brass	40 mm dia Bottle	75 mm
Sink	C.P. cast brass	40 mm dia Bottle	75 mm
Kitchen floor drain of fabricated drain boxes	uPVC	75/100 mm dia 'P' or 'S'	50 mm
Urinals	uPVC	100 mm dia 'P' or 'S'	50 mm

3.8.3 Floor Gratings

Floor and urinal traps shall be provided with 100-150mm square or round CP/stainless steel grating, with rim of approved design and shape. Minimum thickness shall be 4 mm or as specified in the Schedule of Quantities

3.8.4 Jointing

Pipe to pipe and pipe to fitting (SWR) joint shall be with 'O' rubber ring as recommended by the manufacturer. Jointing with solvent cement shall be applied to uPVC waste pipes (confirming to I.S. 4985) and fittings or as recommended by the manufacturers.

3.9 Cleanout Plugs

3.9.1 CI Clean out pipe for Soil, Waste pipes laid under floors shall be provided near pipe junctions bends, tees, "Ys" and on straight runs at such intervals as required as per site conditions. Cleanout pipe shall terminate flush with the floor levels.

3.9.2 Cleanout on Drainage Pipes

a) Cleanout pipe shall be provided on starting point of each drain and in between at locations indicated on plans or directed by the Project Manager. Cleanout pipe shall be of size matching the full bore of the pipe but not exceeding 150 mm OD.

b) Cleanouts at ceiling level pipe shall be provided with a bend terminating at floor level above. The cap of the cleanout pipe shall have a cap flush with floor.

3.10 Waste pipe from appliances

3.10.1 General

a) Waste pipe from appliances e.g. wash basins, sinks and urinals shall be of GI pipe complete with GI fittings 32,40, 50 mm OD as given in the Schedule of Quantities.

b) All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings. Where required pipes may be run at ceiling level in suitable gradient and supported on galvanized structural clamps. Spacing for clamps for such pipes shall be as per the pipe spacing chart given in section

3.11 Encasing pipe in Cement Concrete

CI soil and waste pipes and drainage under floor in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1: 2: 4 mix (1 cement: 2 coarse sand: 4 stone aggregate 12 mm size) 75 mm in bed and all-round. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height at intervals of one meter. Rate for concreted round pipes shall be inclusive of pillars, supports, shuttering and centering.

3.12 Cutting and making good

3.12.1 Contractor's rate shall include for providing all necessary holes, sleeves, cut outs and chases in structural members as building work proceeds. Wherever holes are cut or left originally, they shall be made good with cement concrete 1 : 2 :

4 (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size) or cement mortar 1 : 2 (1 cement : 2 coarse sand) and the surface restored as in original condition.

3.13 Testing

3.13.1 Testing procedure specified below apply to all soil, waste and vent pipes above ground including pipes laid along basement ceiling.

3.13.2 Entire drainage system shall be tested for water tightness during and after completion of the installation. No portion of the system shall remain untested. Contractor must have adequate number of expandable rubber/bellow plugs, manometers, smoke testing machines, pipe and fitting work test benches and any other equipment necessary and required to conduct the tests. All testing equipment/motors etc. shall be certified for its calibration by an approved laboratory.

3.13.3 All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site.

3.13.4 Testing soil, waste and rainwater pipes

a) Apart from factory test all pipes and fittings shall be hydraulically tested for a head of 3 m preferably on a specially set up work bench. After applying pressure, strike the pipe with a wooden pallet and inspect for blow holes and cracks. Pressure may be applied for about 2 minutes. Reject and remove all defective pipes.

b) After installation all connections from fixtures, vertical stacks and horizontal drains including pipes along ceiling shall be tested to a hydraulic pressure not exceeding 3 m. Such tests shall be conducted for each floor separately by suitable plugs.

c) After the installation is fully complete, it should be tested by flushing the toilets, running at least 20% of all taps simultaneously and ensuring that the entire system is self-draining, has no leakages, blockages etc. Rectify and replace where required.

3.13.5 Contractor shall maintain a test register identifying date and time of each area. All tests shall be conducted in presence of Project Manager and signed by both.

3.14 Measurements

3.14.1 General

a) Rates for all items quoted shall be inclusive of all work and items given in the specifications and Schedule of Quantities.

b) Rates are applicable for the work in basements, under floors, in shafts at ceiling level area for all heights and depths.

c) Rates are inclusive of cutting holes and chase in RCC and masonry work and making good the same.

d) Rates are inclusive of pre testing, on site testing, of the installations, materials and commissioning of the works.

e) Pipes (unit of measurement. Linear meter to the nearest centimeter)

3.14.2 Pipes shall measured per running meter correct to a centimeter for the finished work which shall include fittings e.g. bends, tees, crosses, etc. The length shall be taken along center line of the pipes and fittings. All pipes and fittings shall be classified according to their diameter, method of jointing and fixing substance, quality, and finish. The diameters shall be nominal outer diameter.

3.14.3 Cement concrete around pipes shall be measured along the center of the pipe line measured per linear meter and include any masonry supports, shuttering and centering cutting complete as described in the relevant specifications.

3.14.4 Slotted angles/channels shall be measured per linear meter of finished length and shall include support bolts, nuts and clamps embedded in masonry walls with cement concrete blocks and nothing extra will be paid for making good the same.

3.14.5 Fittings

Unit of measurement shall be the number of pieces. Pipe fittings are included in the rate for pipes. Urinal traps, trap gratings, hoppers, cleanout plugs shall be measured by number per piece and shall include all items described in the relevant specifications and Schedule of Quantities.

3.14.6 Excavation for soil pipes

No payment shall be admissible with respect to excavation, refilling and disposal of surplus earth for soil and waste pipes laid below ground, in sunken slabs or over basement rafts.

3.14.7 Project Manager's decision with respect to the correct interpretation regarding mode of measurement shall be final and binding on the contractor.

SECTION 4

S P E C I F I C A T I O N
FOR
WATER SUPPLY SYSTEM

4. WATER SUPPLY SYSTEM

4.1 Scope of Work

4.1.1 Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the Schedule of Quantities.

4.1.2 Without restricting to the generality of the foregoing, the water supply system shall include the following: -

a) Distribution system from main supply headers to all fixtures and appliances for cold/hot water.
b) Cold water supply lines from municipal to underground water tanks.
c) Garden irrigation system
d) Excavation and refilling of pipes trenches.
e) To all the water required for WC, Urinal, wash basin, and kitchen should be done by the cold-water supply by gravity system.
f) Pipe protection and painting.
g) Control valves, masonry chambers and other appurtenances.
h) Connections to all plumbing fixtures, tanks, appliances and Municipal mains

4.2 General Requirements

4.2.1 All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Project Manager.

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

4.2.3 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.

4.2.4 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.

4.2.5 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.

4.2.6 Clamps, hangers and supports on RCC walls, columns and slabs shall be fixed only by means of approved made of expandable metal fasteners inserted by use of power drills.

4.2.7 All pipe clamps, supports, nuts, bolts, washers shall be galvanized MS steel throughout the building. Painted MS clamps & MS nuts, bolts and washers shall not be accepted.

4.2.8 Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

SECTION 5

S P E C I F I C A T I O N
FOR
SEWAGE & STORM WATER DRAINAGE

5. Sewer & Storm Water Drainage work

5.1 Scope of work

5.1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install all the drainage system as required by the drawings and specified hereinafter or given in the Schedule of Quantities.

5.1.2 Without restricting to the generality of the foregoing, the drainage system shall include:-

a) Sewer lines including excavations, pipelines, manholes, drop connections and connections to the bio digester.

b) Storm water drainage, excavation, pipelines, manholes, catch basins, drain channels and connections to rain water harvesting the overflow to the existing storm water drain.

5.2 General requirements

5.2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of the Project Manager.

5.2.2 Drainage lines shall be pipe drain laid to the required gradients and profiles.

5.2.3 All drainage work shall be done in accordance with the local municipal bye-laws.

5.2.4 Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority.

5.2.5 Location of all manholes, etc. shall be got confirmed by the Contractor from the Architect / Landscape Architect. As far as possible, no drains or sewers shall be laid in the middle of road unless otherwise specifically shown on the drawings or directed by the Project Manager.

5.2.6 In sewer line pipe DWC HDPE SN8 confirming to IS 16098 Part II pipe will be used.

5.2.7 In storm line pipe RCC NP2 confirming to IS 458 pipe will be used as per CPWD specifications 2019

5.3 DWC HDPE Pipes (SN 8): IS 16098 Part II

5.3.1 DWC pipes shall be of first class quality and free from rough texture inside or outside and straight. All pipes shall have the manufacturers name marked on it and shall comply with IS-16098 Part II and shall be of approved makes.

5.3.2 <u>Laying and Jointing of DWC HDPE Pipes</u>

a) Pipes are liable to be damaged in transit and notwithstanding tests that may have been made before dispatch each pipe shall be examined carefully on arrival at site. Each pipe shall be rung with a wooden hammer or mallet and those that do not ring true and clear shall be rejected. Sound pipes shall be carefully stacked to prevent damage. All defective pipes should be segregated, marked in a conspicuous manner and their use in the works prevented.

b) The pipes shall be laid with sockets leading uphill and should rest on solid and even foundations for the full length of the barrel. Socket holes shall be formed in the foundation sufficiently deep to allow the pipe jointer room to work right round the pipe and as short as practicable to admit the socket and allow the joint to be made.

c) Where pipes are not bedded on concrete the trench bottom shall be left slightly high and carefully bottomed up as pipe laying proceeds so that the pipe barrels rest on firm ground. If excavation has been carried too low it shall be made up with cement concrete 1:5:10 mix at the Contractor's cost and charges.

d) If the bottom of the trench consists of rock or very hard ground that cannot be easily excavated to a smooth surface, the pipes shall be laid on cement concrete bed of 1:5:10 mix to ensure even bearing.

5.3.5 Jointing of Pipes

a) Tarred gaskin shall first be wrapped round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid, the pipe shall then be adjusted and fixed in its correct position and the gaskin caulked tightly home so as to fill not more than one quarter of the total length of the socket.

b) The remainder of the socket shall be filled with stiff mix of cement mortar (1 cement: 1 clear sharp washed sand). When the socket is filled, a fillet should be formed round the joint with a trowel forming an angle of 45 degrees with the barrel of the pipe. The mortar shall be beaten up and used after it has begun to set.

c) After the joint has been made any extraneous materials shall be removed from inside of the joint with a suitable scraper or “Badger”. The newly made joints shall be protected until set from the sun, drying winds, rain or dust. Sacking or other materials, which can be kept damp, shall be used. The joints shall be exposed and space left all rounds the pipes for inspection by the Project Manager. The inside of the sewer must be left absolutely clear in bore and free from cement mortar or other obstructions throughout its entire length, and shall efficiently drain and discharge.

5.4 Testing

- All lengths of the sewer and drain shall be fully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole to manhole. All pipes shall be subjected to a test pressure of at least 1.5 meter head of water. The test pressure shall, however, not exceed 6 meter head at any point. The pipes shall be plugged preferably with standard design plugs with rubber plugs on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head.

- Sewer lines shall be tested for straightness by: (i) inserting a smooth ball 12 mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball should roll down the invert of the pipe and emerge at the lower end. (ii) means of a mirror at one and a lamp at the other end. If the pipeline is straight the full circle of light will be seen otherwise obstruction of deviation will be apparent.

- The Contractor shall give a smoke test to the drains and sewer at his own expense and charges, if directed by the Project Manager.

  A test register shall be maintained which shall be signed and dated by Contractor.

SECTION 6

S P E C I F I C A T I O N
FOR
SEWAGE TREATMENT PLANT

6.1. Scope

6.1.1 Work under this contract consists of:

6.1.1.1 Detailed engineering design of all plan areas, section, mechanical, electrical and piping systems according to the current and applicable BIS codes as applicable. The proposed plans of the STP shall be subject to the approval of the Architect / Consultant.

6.1.1.2 The execution of the Civil & Structural Works shall be done by a civil engineering contractor separately as per plan, section & details submitted by vendor.

6.1.1.3 Design, manufacture, assembly, installation, testing and commissioning of the Equalization tank in Civil, main treatment units in MSEP, Electro mechanical equipment for the Sewage Treatment Plant (STP) of capacity and design parameters given in BOQ & specifications broadly comprising of: -

a) Diffused aeration system comprising of non-metallic piping floating diffusers to be provided in the equalization tank, main aeration unit, settling tank and sludge holding tank.

b) Twin lobe air blowers with belt drive, electrical motors, piping headers, piping connections to all units.

c) Pumping sets from equalization tank to STP, effluent, post filtration and final effluent disposal pumps as per design requirements.

d) Final effluent disposal through Dual Media Filter (MGF) and final use in Gardening.

e) Motor control centers, cabling from MCC to all units, all instrumentation, and measuring devices and earthing of equipment. All electrical works to be carried out guidelines as per detailed annexure enclosed.

f) Instrumentation and chemical test kit as specified.

6.1.1.4 Submersible pump (1 working + 1 standby) with pipe work, valves and discharge pipe up to nearest tank.

6.1.1.5 Provide water meter on outgoing treated effluent for measuring the outflow.

6.1.2 The work includes:

a) Mechanical & Electrical works

b) Piping as specified.

c) Testing, commissioning and operation of plant with water and under load conditions.

6.2. Work by other agencies

6.2.1 Construction of all architectural, civil and structural works related to the construction of the building, its internal lighting, mechanical and ventilation.

6.2.2 Incoming power connection, electrification of pump house.

6.2.3 Incoming sewer / rising main connection to the plant.

6.2.4 Connection from final effluent tank / pump to point of use for reuse or for disposal in accordance with approval of the State Board for Prevention and Control of Pollution.

6.2.5 Battery limits of the contractor's works are within the plant room.

6.3. Power supply

6.3.1 Power will be available at 410/220 V, 3/single phase, 4 wire 50 cycles earthed neutral system. All equipment shall be suitable for a variation of ±10%. Any equipment /component operating at other than the above power supply shall be provided with necessary transformers and related accessories.

6.4. Specifications

6.4.1 The specifications lay down minimum standards of equipment and workmanship. Should the tenderer wish to depart from the specifications either on account of manufacturing practices, their own patented process or for any other reasons, he should submit a deviation statement to clearly draw attention to the proposed departures and submit such complete information, drawings and specifications to enable the relative merits of the deviations to be fully understand on a separate annexure.

6.4.2 In the absence of any deviations, it will be deemed that the tenderer accepts the tender specifications and accept the compliance with all statutory provisions and local codes.

6.5. Shop Drawings & design calculation

The contractor shall submit shop drawings along with design calculation as follows:

6.5.1 On award of the work, he shall submit GA drawing, PIB diagrams, plant layout with basic dimensions, flow diagram with levels of elements.

6.5.2 Location of equipment layout piping, valves and all other information required for installation.

6.5.3 Electrical layouts, detail of all MCC, cable sizing and system diagrams and earthing system.

6.5.4 Piping layout with pipe dia. slopes, fixing arrangements.

6.5.5 Three copies of the shop drawings shall be submitted for initial scrutiny. On approval of the same contractor shall submit six copies of the same incorporating corrections etc. Two sets will be stamped "GOOD FOR CONSTRUCTION" by the Consultant and returned to the contractor.

6.6. Other Submittals

6.6.1 Contractor shall furnish four sets of folders giving:

a) Catalogues and technical information sheets of equipment to be installed.

b) Performance curves, foundation details and fixing arrangements.

6.6.2 Contractors proposal for testing procedures for individual equipment and for overall testing of the plant.

6.6.3 Submittals shall be separate for:

a) Mechanical and Piping works

b) Electrical Works

6.6.4 All shop drawings and submittals mentioned above shall be approved by Architect and two sets duly stamped shall be returned to the contractor for execution of the works.

6.7. Execution of Work.

6.7.1 All work shall be executed only in accordance with the approved shop drawings and other submittals. Contractor shall ensure that all inserts, support plates, puddle flanges and other items required to be incorporated during execution shall be placed in position as per his own requirements during execution of the works.

6.7.2 All special tools and tackle required for erection and assembly of the equipment covered by the contract shall be obtained by the contractor himself. All other materials such as foundation bolt nuts, etc. required for the installation of the plant and equipment shall be supplied by the contractor and are part of the contract.

6.8 Testing & Handing Over

6.8.1 The contractor shall carryout tests on different equipment as required in the presence of the Consultant or his representative in order to enable him to determine whether the plant, equipment and installation comply with the specifications, local codes and in accordance with the letter and intents of the specifications.

6.8.2 The installation shall be handed over to the Engineer in Charge only on successful completion, operational tests and acceptance of the effluent quality by the municipal/ pollution control and statutory authorities.

6.9. Statutory Permissions

6.9.1 Contractor shall submit a write-up of process of the plant, drawings, design parameters flow and PIB diagrams as necessary and required for submission to the State pollution control authority.

6.9.2 Contractor shall furnish at his own cost, analysis of influent at source (for evaluation) as well as that of influent at the holding tank of the STP and the effluents from the STP for submitting to State Pollution Control Board and any other statutory authority whose approval is required.

6.9.3 Contractor shall perform all testing and operation of the plant in presence of the Pollution Control Board if so stipulated by them.

6.9.4 Contractor to obtain all statutory approval as required for PCB or any other approval. Only official fee will be reimbursed to contractor by the Owner.

6.10. Completion documents

On successful completion of the entire work, the contractor shall submit 4 sets of following documents to Architect.

6.10.1 A brief write-up of process, day to day operating and maintenance Instructions.

6.10.2 List of approved chemicals and procedure for storage and safety norms.

6.10.3 Completion drawing and data, catalogues, performance charts, technical data sheets and equipment's installed.

6.10.4 Manufacturer's maintenance and operating instructions for mechanical and electrical equipment.

6.10.5 Laminated and framed "As Built" drawings with plans, section, process flow diagrams, pipe runs, levels and final disposal point schedule of equipment installed with all their model Nos. plate data and date of installation.

6.10.6 Test readings of Influent & Effluent parameters taken at final handing over time

6.10.7 NOC (No Objection Certificate) from State Pollution Control Board and any other statutory authority whose approval is required.

6.11. Performance Guarantee

6.11.1 Equipment supplied and installed shall be guaranteed to yield the specified effluent standards which must meet and accepted with the requirements of local authorities.

6.11.2 The guarantee implicitly includes replacement of the entire plant on failure to meet desired effluent parameters, replacement of individual equipment or repairs as warranted. Decision on each and every aspect on this matter shall rest with the Consultant and shall be final and binding on the contractor.

6.11.3. Defects Liability

All equipment and the entire installation shall be guaranteed against defective materials and workmanship for a **period of 12 months** reckoned after taking over of system by Owner along with the documentation. During the defects liability period, the contractor shall replace defective parts and components free of cost. Rectification or repair may be permitted in case the defect is of minor nature.

6.12. Deviations from tender specifications

6.12.1 Tenderer may indicate their comments only as deviations from the conditions stipulated herein. Wholesale submission of their own conditions and/or printed conditions in disregard of the conditions stipulated herein shall not be binding on this tender.

6.12.2 All deviations technical and commercial shall be clearly given in Section VIII including any alternate design offered by the contractor.

6.12.3 No corrections, erasure etc. of this document shall be accepted.

6.13 Design Parameters

6.13.1. Project Description

6.13.1.1	Project	:	Construction and Development of E-Vehicles manufacturing Plant
6.13.1.2	Usage	:	Factory Building
6.13.1.3	Location	:	IP Seetharampur
6.13.1.4	Level	:	Site plan (Refer plumbing layout)

6.13.2 Design Consideration

6.13.2.1	Capacity (Max).	:	80 KLD
6.13.2.2	Area Available	:	25 sqm as per layout available
6.13.2.3	Operation	:	Around the clock

6.13.2.4 CHARACTERISTICS OF SEWAGE AT INLET

PH	:	5.5 - 8.5
BOD	:	250-300 Mg/L
S. Solids	:	150 Mg/L
COD	:	300-500 Mg/L
Oil & grease	:	< 20 mg/L
Inlet Coliform	:	10^{6} - 10^{7} counts / 100 ml

6.13.2.5 TREATED EFFLUENT CHARACTERISTICS

PH	:	6.5 – 8.0
BOD5	:	Less than 30 Mg/L
Total suspended Solids	:	Less than 10 Mg/L
COD	:	Less than 30 Mg/L
Oil & Grease	:	Less than 10 Mg/L
NH4-N	:	5 PPM
N-Total	:	10 PPM
Outlet Coliform	:	< 100 counts / 100 ml (at CCT outlet)

6.13.3 Salient Features

6.13.3.1 The plant should be suitable for low/peak flow in line with office uses usage.
6.13.3.2 The plant should not create any noise, with no nuisance on fly or mosquito and no foul odours.
6.13.3.3 The plant should work without the use of in-organic chemical additives
6.13.3.4 The plant should be provided with territory treatment in form of duel media to provide zero bacteriological standard for reuse on:
a) Gardening Purpose.

6.13.4 Offer

6.13.4.1 Quotation with breakdown price on items to be listed as per design parameter for technology and as per BOQ.
6.13.4.2 List of equipment with sizes of tank/other items, plan, section and schematic flow diagram.
6.13.4.3 Electrical load demand, with operational hours on daily basis, operational cost of system including cost of one year of maintenance with consumables, spares etc.

6.13.5 General

6.13.5.1 The plant should be eco friendly
6.13.5.2 Approval from local/pollution control board authority shall be obtained by the contractor.

6.14 Technical Specifications

6.14.1. Basis of Design

6.14.1.1 The capacity/ rating of pumps and equipment etc. shall hold good for the capacity of 80 m^3/day and shall be good for meeting the treated parameters requirement as follows:

a. Permissible limit as prescribed in IS: 2490 (Part-I)-1974 and environment (Protection) Rules 1986.
b. Water (Prevention and Control of Pollution) Act, 1977 & 1978.
c. Environment (Protection) Act, 1986.
d. Environment (Protection) Rules, 1986.
e. Hazardous Wastes (Management & Handling) Rules, 1989.
f. Manufacturer, Storage and Import of Hazardous Chemicals Rules, 1989.
g. Manufacturer, use import and storage and hazardous Micro-Organizers, Genetically Engineered organizations or Cell Rules, 1989.
h. Manual on sewage & sewage treatment - CPHEEO
i. The Public Liability Insurance Act, 1991.
j. All standards as laid down by Central Pollution Control Board and any other relevant statutory authority.
k. 100% recycle of waste water and removal of sludge in cake from, no water to be discharged outside the premises.

6.14.2 General

The sewage treatment plant (STP) system outlined in this section specifies the system design, manufacture, supply and installation of a standard FAB / MBBR based plant.
The work shall be carried out in a manner consistent with good practice in the local market.
A qualified and experienced Engineer shall be engaged for site supervision.
The Contractor shall submit analytical test reports of effluent water samples after the commissioning or after the system is put into operation or as required by the Consultant.
First 2 months – 30 days
The report shall contain analysis of all data related to those requirements laid down by the local Authorities.
The effluent from the Sewage Treatment Plant shall be suitably treated and the effluent water recovered shall be used for irrigation purposes/ flushing system/ etc.

6.14.3 Description of Process

The treatment process shall comprise the following stages:

- Physical treatment :Fine bar-screening / Oil & Grease Chamber
- Equalization / Collection tank: flow equalization with air mixing
- Biological treatment :anoxic tank / MBBR based
- Final sedimentation :Settler tank
- Water reclamation :tertiary filtration
  Sterilization for Gardening purpose.
- Sludge disposal :In cake form through Filter Press

or

(Transfer through a screwed type pump to municipal tanker)

6.14.4 Performance Criteria of the Plant

Raw sewage will be brought into the Sewage Treatment Plant. The Contractor shall receive sewage from this point to the treatment plant for treatment process.

The treatment plant shall be designed to treat the above basic characteristics expected in the raw sewage.

Treated effluent shall be connected to a tertiary filtration & softening plant to treat and shall be use for irrigation, Flushing water purpose.

6.14.5 Process Description

6.14.5.1 Inlet Screen Chamber / Oil & Grease Chamber

Raw sewage shall flow into the inlet screen chamber by gravity. Large solids particles shall be intercepted by a fine screen. Then there shall be Oil & Grease Tank. Sewerage will then flow into Equalization / Collection Tank The incoming sewage shall be mixed in the EQT and fine bubble aeration shall be maintained.

6.14.5.2 Equalization / Collection Tank

The equalization tank shall be designed to provide a minimum storage of 2 hours at peak flow while pumping. Submersible pumps as per schedule shall be provided with level switch control and automatic cut-in of the standby unit.

An aeration system similar to the FAB tank shall be provided for mixing and aerating the sewage.

6.14.5.3 Anoxic tank

The Anoxic tank shall be designed to provide a minimum storage of 1 to 3 days at peak flow while pumping. Depending on the carbon source used, nitrogen removal ranging from 30 to 100% can be achieved. Anoxic Mixers are designed to: Suspend solids which include waste sludge and provide complete basin control. Promote bacterial breakdown of nitrate so the nitrogen can escape. Eliminate air (i.e. oxygen) incorporation from the liquid surface.

6.14.5.4 FAB / MBBR Tank

Sewage shall be retained in the FAB/MBBR tank for a minimum of 7-8 hours and subjected to biochemical oxidation by fine bubbles aeration. The FAB/MBBR Bio deck media shall be installed in the form of rectangular blocks & shall be float in the form of layers not more than 600 mm vertical height. The media shall be corrugated type & shall facilitate cross flow for better air distribution. The media shall be duly glued as per manufacturer's recommendations.

6.14.5.5 Tube Settler Tank

The sewage after bio-oxidation shall enter the hopper bottom sedimentation tank where the sludge effectively settles to the tank bottom. The clear effluent shall weir into the Intermediate Tank for UV treatment.

The activated sludge collected in the sludge tank shall be returned to the FAB tank for further oxidation of the incoming organic matter. Excessive sludge shall be wasted in the sludge holding tank.

PVC tube deck media is to be installed in Tube Settler Tank. The media shall installed at 60^0 angle with the horizontal and the total vertical height when installed should be 750 mm. The media shall be duly glued using recommended material and shall be installed as per the drawing to be given by the vendor as per manufacturer's recommendation.

6.14.5.6 Intermediate Tank

The effluent shall be retained in the baffle walled cleared water tank for a minimum of 30 minutes for effective disinfection prior to discharge through UV system.

6.14.5.7 Then will be Treated Water Tank (TWT).

6.14.6 EQUIPMENT

The following give the minimum requirements of the different components of the system.

All equipment and components of the system shall be of top quality construction and shall be corrosion resistant.

6.14.6.1 Fine Screening Equipment

Bar screen shall be of 304 stainless steel constructions. Drip trays shall be provided for holding and drainage of the screenings. A manual by-pass screen of 30mm opening with stainless steel drip tray shall be provided. An isolation valve shall be provided to divert the flow to the bypass screen when the screen requires service.

6.14.6.2 Air Blowers

Air blowers shall be provided with standby arrangement. Blowers shall be either of positive displacement or centrifugal with pressure vessel type complete with motor, base-plate, inlet filter, intake silencer and off-load starting system outlet silencer, anti-vibration damper, flexible coupling, filter restriction indicator, non-return valve, pressure relief valve, V-belt system or direct drive coupling. The casing rotor shall be of cast iron construction. Bearings and gears shall be grease lubricated.

6.14.6.3 Air Diffusers

Air diffusers shall be made to provide a uniform distribution of fine bubble air release performance in the system. The air diffuser shall be either made of elastomic rubber membrane or composed of crystalline fused aluminum oxide with a suitable ceramic bonding material.

Membrane endurance shall be more than 180,000 expansion/contraction cycles.

The Contractor shall submit calculation to justify the diffuser selection and air requirement during the detailed design.

6.14.6.4 Sewage Pumps

Working and standby sewage pumps shall be provided.

Each shall be of submersible type c/w guide base to facilitate case of removal, lift chain and automatic discharge connection.

6.14.6.5 Settling Tanks

Settling tanks shall include baffles to prevent short circuiting.

6.14.6.7 Tertiary Treatment

This tertiary treatment shall be provided for the effluent used for irrigation and flushing of tower make-up water tank/flushing system.

The tertiary treatment plant shall comprise of the pressure sand filters and activated carbon filters. This shall be sized to accommodate 100% of the effluent discharge flow rate and shall achieve the performance as outlined and described in Design Criteria.

6.14.6.8 Electrical Control

The operation of the treatment process shall be fully automatic.

A completely assembled and pre-wired control panel consisting of weatherproof cabinet shall be furnished. The control panel shall contain all metering and status indicators, motor starters, program timers, on-off-auto change-over switches and duty selectors for equipment.

6.14.6.9 Other Equipment

Any other necessary accessories, such as buffer, riser, scrum removal devices, partition, control panel, collection devices, etc. for all the tanks and pumps (where necessary) shall be provided in order to provide a fully working systems.

6.14.6.10 Piping Materials

Upvc	:	Submerged air piping
MS epoxy	:	Air piping and pumped effluent riser (Non Submerged)
uPVC piping	:	Pumped effluent (submerged) & tank Overflow pipe line.

6.14.6.11 Valves

The Contractor shall supply and install all isolating valves and control valves as indicated on the drawings and as required for the proper and efficient operation and maintenance of the entire systems.

All valves supplied shall be suitable for the working pressure and test pressure of the system as specified elsewhere in this specification.

All valves shall be full line size.

Furnish all valves and accessory materials necessary in the piping whether or not shown on drawings as flows.

Plastic or metal plates (rustles) shall be provided to indicate the open / close status as well as the use of each valve in the pump and tank rooms.

6.15 PIPE SUPPORTS

6.15.1 GENERAL SUPPORT

Tender drawings indicate schematically the size and location of pipes. The Contractor, on the award of the work, shall prepare detailed working drawings, showing the cross-sections, longitudinal sections, details of fittings, locations of isolating

and control valves, drain and air valves, and all pipe supports. He must keep in view the specific openings in buildings and other structure through which pipes are designed to pass.

Piping shall be properly supported on, or suspended from, on stands, clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchor, clamps and hangers, and be responsible for their structural stability.

Pressure gauges shall be provided as shown on the approved drawings. Care shall be taken to protect pressure gauges during pressure testing.

6.15.2 INSTALLATION

The Contractor shall check the associated civil work prior to the installation of any item of machinery and advise the Consultant, in writing, of any deviation of such work from the specified details.

The machinery shall be accurately installed to correct dimensions, alignments, levels, etc., all as indicated on the final drawings. The machinery shall be mounted on flat steel packing pieces of thickness suitable to take up variations in level of the concrete foundations. Suitable packing pieces shall be located adjacent to each holding down bolt and shall be properly bedded by grinding the concrete surface to a smooth, level finish. The machinery shall be aligned and levelled and the nuts of the holding down bolts tightened with a spanner of normal length. The base plates shall be packed with grout after the machinery has been run and checked by the Consultant for stability and vibration.

Installation shall include the provision and fixing of all necessary holding down bolts, washers, nuts etc.

6.15.3 TESTING

The performance of the system shall be demonstrated by taking hourly samples of the raw sewage and final effluent over a twelve-hour period. The sample shall be taken at periods approximately the flow rates specified by the plant. The sample shall be combined and a 5-day BOD shall be run, the results of which must verify the capacity of the treatment plant prior to acceptance.

6.16 ELECTRICAL INSTALLATION

6.16.1 SCOPE

The scope of this section comprises of fabrication, supply, erection, testing and commissioning of Motor Control Centre (MCC), wiring and earthing of all Sewage Treatment Plant equipment, components and accessories.

6.16.2 MOTOR CONTROL CENTRES

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

a) Incoming MCCB of required capacity.

b) MCCB / MPCB – one for each motor.

c) Fully automatic DOL/Star Delta starters suitable for motor DOL up to 7.5 H.P.; Star / Delta for 10 H.P. and above H.P. with push buttons one for each motor and On / Off indicating neon lamps.

d) Single phasing preventer of appropriate rating for each motor.

e) Rotary duty selector switch

f) Panel type ampere meters one for each motor shall be with rotary selector switch to road line currents.

g) Panel type voltmeter on Incoming main with rotary selector switch to read voltage between phase to neutral and phase to phase.

h) Neon phase indicating lamps and indicating lamp for each motor and on incoming mains.

i) Rotary switch for manual or auto operation for each pump.

j) Fully taped separate aluminum bus bar of required capacity for normal and emergency supply where specified.

k) Space for liquid level controllers and other equipment specified separately in the contract / given in the schedule of quantities.

l) The panel shall be pre-wired with colour-coded wiring. All interconnecting wiring from incoming main to switchgear, meters and accessories within the switchboard panel. Wiring shall have suitable copper or aluminum ferrules.

6.16.2.2 Switchboard cubicle shall be floor or wall mounted type as directed by the Engineer-in-charge.

SECTION 7

S P E C I F I C A T I O N
FOR
WATER TREATMENT PLANT

TECHNICAL SPECIFICATIONS:

7.0 GENERAL DESCRIPTION:

7.1 SCOPE:

7.1.1 The scope of this work covers the complete, Domestic Water Treatment Plant Works for **complete** in all respects as indicated BOQ and approved shop drawing.

7.2 DOMESTIC WATER TREATMENT PLANT:

7.2.1 Design Criteria:

WTP Plant should be able to perform and generate the following outlet parameters. Contractor should tested the raw water

WTP- INLET AND OUTLET PARAMETERS			
S. No.	**Parameter**	**Inlet (Raw Water)**	**Outlet Parameters**
1	Colour (Hazen unit)		Less than 5 (Not Noticeable)
2	Odour		NIL (Not Noticeable)
3	Total Suspended Solids		100 Microns
4	Total Dissolved Solids		Should not increase
5	Organics		90 to 99% Removal
6	Turbidity		1 NTU
7	Total Coliform		Nil

7.3 Scope:

7.3.1 Scope of this section covers the design, manufacture, supply, erection, testing and commissioning of the complete Domestic Water Treatment Plant complete with all necessary equipment's and inter-connecting pipe work etc.

7.3.2 The supply of equipment and their erection including related electrical works and interconnecting pipe work shall be complete in all respects and any equipment or component not covered in this specification but considered essential by the Contractor in order to guarantee the proper operation of the plant shall be included in the quotation. The necessary equipment, their expected performance and disposition in the plant are all indicated in the specifications and drawings. However, if the Contractor desires he may suggest alternative equipment and their layout capable of meeting the requirements of final water quality as well as the area and head room restrictions within the plantroom.

7.4 Water Filtration Plant:

7.4.1 Capacity:

The proposed filtration plant capacity rating shall be 15 m^3 /hr or as given quality as given in in BOQ within a maximum of 6 hrs operation period. Backwash time of filter (15 minute or as or manufacturer recommendation) shall be included in operation period.

7.4.2 Location:

The water filtration plant shall be located in the underground tank water tank pump room

7.4.3 Standards:

The components of all equipment shall be designed assembled and tested in accordance with the latest standards of Bureau of Indian Standards.

7.4.4 Equipment:

The equipment to be supplied and erected for the plant shall be constructed from first class material with first class workmanship to the satisfaction of the Consultant/Project Manager/ Client.

The items listed below are for the general guidance of the Contractor. The Contractor shall include all items essential for the complete water filtration plant and shall revise or modify the list and submit his tender along with the list which he considers suitable for guaranteeing the performance of the plant.

The above scheme as mentioned in clause no. 2.2.2 shall broadly include the following equipment as given below. All major/minor components necessary for completion of the system shall be deemed included in each item.

a) Raw water feed pumps comprising of:

   i) 2 Nos. (One set). Mono block & centrifugal type for fresh water application.

   ii) Discharge side isolation valves on each pump (C.I. butterfly valve not less than discharge size of pump).

   iii) Discharge side N.R.V's on each pump (C.I. wafer type or dual plate type not less than discharge size of pump).

   iv) All pipes and fittings, specials etc. as required making common suction and common discharge. The M.O.C. of pipe shall be G.I. class 'C' only.

b) Chlorine solution dosing on source inlet supply before fire tank if Coliform is more than 10.

c) Multi-grade pressure sand filters.

d) Activated carbon filter.

e) Chlorine dosing system with electronic dosing pump in bypass from activated carbon filter.

7.5 Technical Specifications:

7.5.1 Dual Media Filter/ Multi grade pressure sand filter

Dual Media filter shall be vertical types of required diameters. The shell and dish end shall be fabricated from M.S. plates conforming to relevant IS standard suitable for withstanding the working pressure given in schedule of quantities. The minimum thickness of shell shall be 6mm and dished ends shall be 8mm and working pressure 3kg/sq.cm and inner surface shall be food Grade FRP. The min. free board at the top of vassal shall be 600mm or as per manufacturer recommendation. The filter shall have at least one pressure tight manhole cover and at least one side hole with cover for maintenance purposes. Outer surface shall be painted of approved quality and colour.

Filters shall be provided with an efficient under drain system and raw water distributor.

Filter shall be provided with frontal piping comprising of inlet, outlet, backwash and rinse complete with valves, piping shall be of GI (Heavy Class), 100mm dia dial burden type gunmetal pressure gauges with forged brass isolation cock and connection piping on inlet and outlet, sampling cock on raw water inlet and filtered water outlet, drain connection with valve.

7.5.5 Chlorine Dosing System:

Chlorine dosing system shall be electronic diaphragm type dosing pump both stroke length and frequency controls, foot valves, dosing valve and interconnecting tubing. The pump shall be mounted on virgin chemical grade HDPE tank.

7.6 Control Panel:

Control panel shall be provided with suitably rated incoming feeder to receive power from the Electrical Panel outdoor type near pump. Distribution using starter or space for starter as required for various pumps etc. for the system. The panel shall

be fully integrated with seated instrument and shall house control logic scheme inter locking and annunciation including operation and complete with control wiring including connection/ interconnection earthing etc. as required for normal running of the equipment.

7.7 Pump operation philosophy

The filter feed pump shall be run automatically when filtered water domestic tank level reaches predetermined low level, and upper level a Audio-visual automatic alarm sound in case of over flow /dry condition. The alarm will have a switch which will enable the operator to switch it off. Domestic water transfer pump to the overhead water tank based on pressure switch with manual on off facility. Vendor shall be provided the arrangement in shop drawing.

7.7.1 Pumping operation philosophy

When the water reaches high level in filtered water storage tank and audio-visual automatic alarm will sound and filtered water pump will stop automatically. The alarm will have a switch which will enable the operator to switch it off. When the water reaches predetermined low level in filtered water storage tank, an audio visual automatic alarm will sound and the filtered water booster pump will start automatically. Provision shall be made in the system to protect the filtered water booster pump from dry run protection.

7.8 TECHNICAL DATA:

Contractor shall fill in the following Technical data for each pump:

7.8.1 Filter Feed Pumps:

Description:

Pump:

Make :

Model :

No. of Stages :

Head/Stage :

Power Requirement :

Efficiency :

Discharge in l.p.s. each pump :

Total Head :

Suction end I.D. :

Delivery end I.D. :

Material:

Body :

Impeller :

Shaft :

Type of impeller :

Motor:

Make :

Model :

R.PM :

Rating :

Over Load Capacity :

Class of Insulation :

Details of Additional protection in winding :

Motor Efficiency :

Size and type of cable for connections :

7.8.2 Garden Irrigation Pump:

Description:

Pump:

Make :

Model :

No. of Stages :

Head/Stage :

Power Requirement :

Efficiency :

Discharge in l.p.s. each pump :

Total Head :

Suction end I.D. :

Delivery end I.D. :

Material:

Body :

Impeller :

Shaft :

Type of impeller :

Motor:

Make :

Model :

R.PM :

Rating :

Over Load Capacity :

Class of Insulation :

Details of Additional protection in winding :

Motor Efficiency :

Size and type of cable for connections :

7.8.3 Domestic water transfer pumps:

Description:

Pump:

Make :

Model :

No. of Stages :

Head/Stage :

Power Requirement

Efficiency :

Discharge in l.p.s. each pump :

Total Head :

Suction end I.D. :

Delivery end I.D. :

Material:

Body :

Impeller :

Shaft :

Type of impeller :

Motor:

Make :

Model :

R.PM :

Rating :

Over Load Capacity :

Class of Insulation :

Details of Additional protection in winding :

Motor Efficiency :

Size and type of cable for connections :

7.8.4 Dual Media Filter

a) Type of pressure filter :

b) Quantity :

c) Filtration Rate ($m^3/hr./m^2$)

d) Dimensions. Dia x H.O.S. (mm) :

e) Maximum flow rate through filter :

f) Minimum flow rate through filter :

g) Average flow rate through filter :

h) Backwash flow rate :

i) Duration of Backwash :

j) Minimum pressure for backwashing :

k) Maximum pressure for backwashing :

l) Material of construction :

m) Working weight of filter :

n) Total turbidity in treated water :

o) Maximum pressure drop across the filter at the end of filter run (kg/cm^2) :

p) Filtering Media :

q) Depth of Media :

7.8.5 Chlorine Dosing System:

a) No. of Tank :

b) Capacity of Tank :

c) M.O.C. of Tank :

d) No. of Dosing Pump :

e) Max. dosing flow rate (LPH) :

f) Min. dosing flow rate (LPH) :

g) Operating pressure (kg/cm^2) Max. :

h) Material of construction (Liquid End) :

i) Type of the pump :

j) Make of the pump :

TECHNICAL SPECIFICATION OF FIRE FIGHTING WORKS

Index

PART-3 (FIRE FIGHTING WORKS)

SECTION 1
S P E C I F I C A T I O N S
G E N E R A L

1. SCOPE OF WORK

1.1 The form of Contract shall be according to the "Conditions of Contract". The following clauses shall be considered as an extension and not in limitation of the obligation of the Contractor.

1.2 Work under this Contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the Firefighting system and other specialized services as described hereinafter and as specified in the schedule of quantities and/or shown on the Firefighting system drawings.

1.3 Without restricting to the generality of the foregoing, the Fire Fighting system installations shall include the following: -

i) Fire Pumps.
ii) Hydrant system installation
iii) Sprinkler system installation
iv) Firefighting piping installation
v) Getting Approval of Fire system installation from local fire authority for Fire hydrant, Sprinkler and Fire Alarm system.
vi) Co-ordination with other agencies during process of NOC for fire approval from Local fire authority.

1.4 Services rendered under this section shall be done without any extra charge.

1.5 **Technical Specification of DSR items of Fire Fighting works (Based on DSR 2019) mentioned in SOQ shall be as per CPWD General Specification for electrical works Part V (WET RISER AND SPRINKLER SYSTEM) 2020.** (Corrected up to the last date of submission/uploading of bid).

2. SPECIFICATIONS

2.1 Work under this Contract shall be carried out strictly in accordance with specifications attached with the tender.

2.2 Items not covered under these specifications due to any ambiguity or misprints or additional works, the work shall be carried out as per latest specifications of the Central Public Works Department with up to date amendments as applicable in the Contract.

2.3 Works not covered under para 2.1 and 2.2 shall be carried out as per relevant Indian Standards specifications and Code of Practice as applicable (TAC, NFPA and NBC).

3. EXECUTION OF WORK

3.1 The Contractor should visit and examine the site of work and satisfy himself as to the nature of the existing roads and other means of communication and other details pertaining to the work and local conditions and facilities for obtaining his own information on all matters affecting the execution of work. No extra charge made in consequence of any misunderstanding or incorrect information on any of these points or on grounds of insufficient description will be allowed.

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

3.3 The Contractor shall cooperate with all trades and agencies working on the site.

3.4 On award of the work, Contractor shall submit a schedule of construction in the form of a pert chart or bar chart for approval of the Engineer-in-Charge. All dates and time schedule agreed upon shall be strictly adhered to, within the stipulated time of completion/commissioning along with the specified phasing, if any.

4. DRAWINGS

4.1 Firefighting drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the architectural and other services drawings.

4.2 Architectural drawings shall take precedence over firefighting system or other services drawings as to all dimensions.

4.3 Contractor shall verify all dimensions at site and bring to the notice of the Engineer-in-Charge all discrepancies or deviations noticed. Decision of the Engineer-in-Charge shall be final.

4.4 Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small scale drawings.

4.5 Any drawings issued by the Architects/Consultant for the work are the property of the Architects/Consultant and shall not be lent, reproduced or used on any works other than intended without the written permission of the Architects/Consultant.

5. INSPECTION AND TESTING OF MATERIALS

5.1 Contractor shall be required, if requested, to produce manufacturers test certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Indian Standards.

5.2 For examination and testing of materials and works at the site Contractor shall provide all testing and gauging equipment necessary and required at site for such tests.

5.3 All such equipment shall be tested for calibration at any approved laboratory, if required by the Engineer-in-Charge.

5.3.1 Samples of all materials shall be got approved before placing order and the approved samples shall be deposited with the Engineer-in-charge. Any materials declared defective by Engineer-in-Charge shall be removed from the site within 48 hours.

6. METRIC CONVERSION

6.1 All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.

6.2 Any weights or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost.

7. REFERENCE POINTS

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

7.2 All such reference points shall be in relation to the levels and locations, given in the architectural and Firefighting drawings.

8. REFERENCE DRAWINGS

8.1 The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site. All important drawings shall be mounted on boards indexed and placed in racks no drawings shall be rolled.

8.2 All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporations in the completion drawings. All changes to be made shall be initialed by the Engineer-in-Charge.

9. SHOP DRAWINGS

9.1 The Contractor shall submit to the Engineer-in-Charge four copies of the shop drawings.

9.2 Shop drawings shall be submitted under following conditions: -

a) Showing any changes in layout in the firefighting system drawings.
b) Equipment layout, piping and wiring diagram.
c) Manufacturer's or Contractor's fabrication drawings for any materials or equipment supplied by him.

9.3 The Contractor shall submit four copies of catalogues, manufacturer's drawings, equipment characteristics data or performance charts as required by the Engineer-in-Charge.

10. COMPLETION DRAWINGS

10.1 On completion of work, Contractor shall submit one complete set of original tracings and two prints of "As Built" drawings to the Engineer-in-Charge. These drawings shall have the following information.

a) Run of all piping, diameters on all floors, vertical stacks and location of external services.

b) Ground and invert levels of all fire pipes together with location of all manholes and connections up to outfall.

c) Run of all fire pipe lines with diameters, locations of control valves, access panels.

d) Location of all mechanical equipment with layout and piping connections.

NOTE: No completion certificate shall be issued unless the above drawings are submitted.

10.2 Contractor shall provide four sets of catalogues, service manuals, manufacturer's drawings, performance data and list of spare parts together with the name and address of the manufacturer for all electrical and mechanical equipment provided by him.

10.3 All "Warranty Cards" given by the manufacturers shall be handed over to the Engineer-in-Charge.

11. CONTRACTOR'S RATES

Refer to relevant clause of General Conditions of contracts.

12. TESTING

12.1 Piping and drainage works shall be tested as specified under the relevant clauses of the specifications.

12.2 Tests shall be performed in presence of the Engineer-in-Charge.

12.3 All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.

12.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet municipal or other bye-laws in force.

12.5 Contractor shall provide all labour, equipment and materials for the performance of the tests.

13. SITE CLEARANCE AND CLEANUP

13.1 The Contractor shall, from time to time, clear away all debris and excess materials accumulated at the site.

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

13.3 On completion of all works, Contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done at Contractor's risk and cost.

14. LICENSE, PERMITS AND AUTHORITIES

14.1 Contractor must hold a valid any other license as required by the municipal authority or other competent authority under whose jurisdiction the work falls.

14.2 Contractor must keep constant liaison with the municipal /statutory authority and obtain approval of all firefighting system and other works carried out by him.

14.3 Contractor shall obtain, from the municipal and other authorities on completion of his work No Objection Certificate with respect to his work, as required for occupation of the building. Engineer-in-Charge shall reimburse the fees paid to the authorities towards the statutory fee charges on production of receipts for money paid.

15. RECOVERY OF COST FOR MATERIALS ISSUED TO CONTRACTORS FREE OF COST

15.1 If any materials issued to the Contractor, free of cost, are damaged or pilfered, the cost of the same shall be recovered from the Contractor on the basis of actual cost to owner which shall include all freight and transportation, excise duty, sales tax, octroi, import duty etc, plus 100%. The decision on the actual cost given by the Engineer-in-Charge shall be final and binding on the Contractor.

16. CUTTING OF WATER PROOFING MEMBRANE

16.1 No walls or terraces shall be cut for making any opening after water proofing has been done without written approval of Engineer-in-charge. When permitted cutting of water proofing membrane shall be done very carefully so that other portion of water proofing is not damaged. On completion of work at such place the water proofing membrane shall be made good and ensured that the opening/cutting is made fully water proof as per contract specifications and details of water proofing.

17. CUTTING OF STRUCTURAL MEMBERS

17.1 No structural member shall be chased or cut without the written permission of the Engineer-in-Charge.

18. MATERIALS SUPPLIED BY OLECTRA GREENTECH LIMITED

18.1 The Contractor shall verify that all materials supplied by the Olectra Greentech Limited conform to the specifications of the relevant item in the tender and approved technical datasheet. Any discrepancy found shall be brought to the notice of the Engineer- in-Charge.

19. MATERIALS

19.1 The contractor shall submit technical datasheets of all materials before procurement at site for approval by Consultant/ Engineer-in-Charge. No material will be inspected/ acceptable without duly approved technical datasheet by the consultants.

19.2 Unless otherwise specified and expressly approved in writing by the Engineer-in-Charge, only materials of makes and specification as mentioned in the list of approved makes attached with the specifications shall be used.

19.3 If required, the Contractor shall submit samples of materials proposed to be used in the works. Approved samples shall be kept in the office of the Engineer-in-Charge and returned to the Contractor at the appropriate time.

SECTION 2
S P E C I F I C A T I O N S FOR
PUMPS AND ANCILLARY EQUIPMENT

1. SCOPE OF WORK

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

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

a) Electrically operated pumps with motors, base plate and accessories.
b) Pump suction and delivery headers, valves, air vessel and connections.
c) Pressure gauges'/Pressure switch
d) Electrical switch board, wiring, cabling, cable tray, control panel and properly connecting to earthing system of the Factory.

2. GENERAL REQUIREMENTS

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

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

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

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

3. FIRE AND JOCKEY PUMPS

3.1 Pump Sets

a) Centrifugal, split casing, horizontal pump should be selected as per IS. Pump should have following specification.

Materials of Construction

PARTS	
CASING	CAST IRON
IMPELLER	BRONZ IS:318, GR.LTBJ/LTB 2
CASING WEARING	CAST IRON
SHAFT	STAINLESS STEEL
SHAFT SLEEVE	SS-410
SHAFT SEAL	MECHANICAL (FACTORY FITTED)
THRUST BEARING	ANTI-FRICTION OF TITLING PAD TYPE

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

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

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

4. FIRE PUMPS

4.1 Wet riser hydrant shall be pressurized through a set of pumps driven by electric motors. Desired pressure shall be created

and maintained in the systems by means of main and Jockey pump sets. The working of the pump sets shall be as under:

4.2 Main pump for Hydrant

a) Automatic start on reduction in the pressure in the system at pre-determined level through pressure switches. Also manual start arrangement shall be made in case of failure of automatic start system.

b) Pump set shall stop by manual operation only.

4.3 Stand-by main pump (Diesel Engine Driven)

a) In the event of failure in the operation of main pump sets for hydrants, the stand-by main pump shall come into operation when the pressure in the system is reduced to a pre-determined level. Also manual start arrangement shall be made in case of failure of automatic start arrangement.

b) Pump set shall stop by manual operation only.

5. JOCKEY PUMP

5.1 Starting and stopping of Jockey pump set shall be automatic at pre-determined levels through pressure switch. However, arrangements for manual start and stop of the pump shall also be made. Jockey pump shall take care of small leakages in the piping system and pumps cushion tanks.

6. ELECTRIC DRIVEN MOTOR

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

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

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

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

7. DIESEL ENGINE

7.1 Diesel Engine shall be of 4/6 cylinders with individual heat assemblies. The engine shall be water cooled and shall include heat exchanger and connecting piping strainer, isolating and pressure reducing valves, bye-pass line, exhaust pipe, silencer, day tank for fuel all interconnected piping etc. complete in all respects.

7.2 Engine shall be direct injection type with low noise and exhaust emission levels.

7.3 The speed of engine shall match the pump speed for direct drive.

7.4 The engine shall be capable of being started without the use of the wicks, cartridge heater plugs or either at engine room temperature of 4 deg. C and shall take full load within 15 seconds from the receipt of the signal to start.

7.5 The engine shall effectively operate at 46 Deg.C ambient temperature at 150 meter above mean sea level.

7.6 Noise level of the engine shall not exceed 105 db. (Free sound pressure) at 3 meters' distance.

7.7 The engine shall be self-starting type up to 4 deg.C shall be provided with one 24 volts' heavy-duty D.C. battery, starter, cut out, battery leads complete in all respects. The battery shall have a capacity of 200 ampere hours and 640 amperes cold cranking amperage.

Pump Control Panel should have visual and audio alarm and indication for battery failure.

The battery should have output amperage capacity for at least 3 consecutive cranking/starting of the Engine.

7.8 Provide a battery charger of 20 amperage capacity of fully charge the batteries in 20 hours with tickle and booster charging facility and regulators.

7.9 Arrangement for starting shall be automatic on receiving the signal. But shut-off shall be manual.

7.10 The engine shall be provided with an oil bath or dry type air cleaner as per manufacturer's design.

7.11 Engine shall be suitable for running on high speed diesel oil.

7.12 The system shall be provided with a control panel with push button starting arrangement also wired to operate the engine on differential pressure gauge.

7.13 The entire system shall be mounted on a common structural base plate with anti-vibration mounting, Dunlop make, and flexible connections on the suction and delivery piping.

7.14 Contractor provide one fully mounted and supported day oil tank fabricated from 6mm thick MS sheet electrically welded of 8 hours working load but not less than 200 ltrs. Provide level indicators - low level and full level in the day oil tank on the control panel through float switches and an air breather. Day oil tank shall also be provided with filling connection (threaded) with cap, gauge glass indication & cocks, drain cock, inspection/cleaning cover with gasket and nuts/bolts. M.S. dyke to hold 150% of the Day Tank capacity to be built around the Day Tank.

7.15 Contractor to provide one exhaust pipe with suitable muffler (residential type) to discharge the engine gasses to outside in open air as per site conditions (contractor to check the site).

7.16 Contractor to provide all accessories, fittings, and fixtures necessary and required for a complete operating engine set. The exhaust pipe shall be taken outside the building with minimum number of bends (approx. length 30 mts.) and shall be duly heat insulated with 50 mm thick glass wool covered with 24-gauge aluminum cladding.

7.17 Contractor shall indicate special requirements, if any, for the ventilation of the pump room.

8. BASE PLATE

8.1 Pumps and motors shall be mounted on a common structural base plate and installed as per manufacturer's instructions.

9. VIBRATION ELIMINATORS

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

10. CUBICLE TYPE SWITCH BOARDS/L.T. PANEL

10.1 Cubicle type switch boards and components shall conform to the requirements of the latest revision including amendments of the following codes and standards.

IS:8623	: Specification for factory built assemblies of switch- gear and control gear for voltage up to and including 1000-V AC/1200 V-DC.
IS:4237	: General requirements for switch-gear and control-gear for voltage not exceeding 1000-V.
IS:2147	: Degree of protection provided by enclosures for low voltage switch-gear and control-gear.
IS:1018	: Switchgear and control-gear selection/installation and maintenance.
IS:6005	: Code of practice for phosphating of iron and steel.
IS:13947-1993/ IEC947-1989	: Air circuit breaker/Moulded case circuit breaker.
IS:1248	: Direct acting indicating analogue electrical measuring instruments and testing accessories.
IS:2705 Part I, II & III 1964	: Current transformers for metering & protection with classification burden & insulation.

The board shall be metal enclosed single front, indoor, floor mounted free-standing type or wall mounting type as mentioned in BOQ. The panel shall be designed for a degree of protection of IP-52. The panel height shall not exceed 2350 mm including horizontal main bus bar at top. Keeping in view the operating height of the top switch 1750mm from finish floor. 400 mm clear space shall be left throughout the panel at bottom. The cold rolled sheet steel will be of 2mm thick.

All cut-outs and covers shall be provided with synthetic rubber gaskets. (Preferably neoprene).
The panel shall be divided into distinct vertical sections each comprising of:

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

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

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

iv) All cable alley must be provided with threaded nipples for CO flooding system and shall be connected to all compartment with centralized CO system

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

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

Each feeder shall have compartmentalized construction cable entry shall be from top/bottom (3mm thick gland plate shall be provided) as required.
The panel shall be provided with three phase buses and neutral bus bars of aluminum sections throughout the length of the panel and shall be adequately supported and braced to withstand the stresses due to the short circuit current of 50 KA rms. for 1 sec. Maximum temperature rise of bus bars and bus bar connection while carrying rated current shall not exceed 40 Cover an ambient temperature of 50 C.

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

All bus bars shall be colour coded as per IS: 375.
G.I. earth bus of 50x6mm size shall be provided at the bottom of the panel throughout the length. Similarly 40x6mm G.I. strip in each vertical section for earthing the individual equipment/accessories shall be provided and connected to main horizontal bus.

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

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

10.2 ACB

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

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

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

Breaker shall be provided with automatic safety shutters to screen the main live contact when the breaker is withdrawn.
The frame of the circuit breaker should be positively earthed when the breaker is racked into the cubicle.

The following safety arrangements shall be provided for the safety of the personnel to prevent mal-operation.

i) Interlock to prevent the truck from being withdrawn or replaced except in the fully isolated position.
ii) Interlock to prevent earth connection from being made by the earthing device except breaker is open.
iii) Interlock to prevent the breaker from being made alive without its rack in position.

10.3 Moulded Case Circuit Breaker (MCCB)

MCCB shall conform to the latest IS:13947-1993/IEC 947-1989. The Service Short Circuit Breaking Capacity (ICS at 415 VAC) should be 50 KA.
MCCB shall be Current Limiting and comprise of Quick Make - Break switching mechanism preferably Double Break Contact system are extinguishing device and the tripping unit contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses. All MCCBs shall be capable of defined variable overload adjustment. All MCCBs rated 200 Amps and above shall have adjustable Magnetic short circuit pick up.

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

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

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

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

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

10.4 Name Plates & Labels

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

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

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

10.5 Painting
All steel work shall be pre-treated in tanks in accordance with clause painting.

10.6 Wiring

Control and protective wiring shall be done with copper conductor PVC insulated 1100 volts grade multi-stranded flexible wire of 2. 5sq.mm 2 cross section. The colour coding shall be as per latest edition of IS:375.

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

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

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

11. CABLES

11.1 Contractor shall provide all power and control cables from the motor control center to various motors and control devices, of ratings as per IS:3961.

11.2 All power and wiring cables shall be FRLS with aluminum conductor PVC insulated armoured and PVC sheathed of 1.1 KV grade. Control cables and power cables of 2.5 sq.mm or less shall be of copper, FRLS, armoured. Cables and wires shall comply with requirements of IS:5831, 694, 8130, 7098(I) & 1554 as the case may be.

11.3 All cables shall have stranded conductors. The cables shall be supplied in drums as far as possible and hear the manufacturer's identification mark.

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

12. CABLE TRAYS

12.1 Cable trays shall be 2 mm thick CRCA hot dip galvanised sheet steel, ladder type/perforated cable tray including fixing along wall/ceiling complete with M.S. rod/flat hangers directly grouted in walls/ceiling etc. as required.

12.2 The sizes shall be as follows and as directed by Engineer-in-Charge.

A. PERFORATED CABLE TRAY

a) 150 mm wide 75 mm deep

b) 300 mm wide 75 mm deep

B. LADDER TYPE CABLE TRAY

a) 150 mm wide

b) 300 mm wide

13. EARTHING

13.1 The earthing pit would be provided by the Owner. Fire Fighting Contractors shall required to extend earthing from the earthing pit by earthing strips (G.I. 25x3mm) or earthing wires (G.I. 8 SWG) as may be required for proper earthing of the equipments supplied by him. Thickness of galvanization to be 75 microns (minimum). Each electrical equipment is to be earthed at 2 points.

14. COMMISSIONING

14.1 Commissioning of the systems shall commence only after:

a. All pipes, accessories, pumping set, fire alarms etc. have been completely installed and tested.
b. The electrical connection has been made and direction of motors rotation checked.
c. Related works by other agencies has been completed in all respects.
d. Water supply is available in adequate quantity in the underground tank.
e. Basement drainage pumps are fully commissioned.
f. On completion of all related work given in para above, start pumping sets and develop desired pressure in both the systems.
g. Open one hydrant and test if pumps starts at desired drop in pressure and the alarm operates. If required, make adjustments and reset.

15. MAINTENANCE MANUAL

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

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

16. MEASUREMENTS

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

16.2 Earthing shall be measured as a lump sum item.

16.3 Earthing tape will be linear measurement.

16.4 Cabling shall be measured per linear meter from switchboard to each motor and shall include all items necessary and required and given in the specifications.

SECTION 3

S P E C I F I C A T I O N S
FOR
HYDRANT SYSTEM

1. SCOPE OF WORK

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

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

a. Mild steel mains including valves, hydrants and all other accessories.
b. Mild steel pipe fire risers within the building.
c. Landing valves, canvas hose pipes, hose reels, hose cabinets, fire brigade connections, connection to pumps, appliances and pressure reducing devices.
d. Excavation, anchor blocks and valve chambers.

2. GENERAL REQUIREMENTS

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

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

2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages, etc.

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

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

3. PIPES AND FITTINGS

For Internal Work

a. All pipes within the building in exposed locations and shafts including connections buried under floor shall be ERW mild steel tubes conforming to IS:1239 (Heavy class) with screwed or welded joints as specified by the Engineer-in-Charge.
b. Fittings of 50mm or below shall be FORGED FITTINGS of approved makes. For 65mm and above shall be W.I./M.S. with butt weld ends.

4. JOINTING

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

5. EXCAVATION

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

5.2 Wherever required contractor shall support all trenches or adjoining structures with adequate supports to prevent landslides.

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

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

6. ANCHOR BLOCKS

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

7. VALVES

7.1 Butterfly valve 80mm dia and above shall be cast iron wafer type shall confirm to and marked IS:13095 Class PN-1.0.

7.2 Valves on M.S. pipe 50mm and below shall be heavy pattern gun-metal valves (with cast iron wheel) tested to 20 Kg/sq.cm pressure. Valves shall conform to and marked IS:778.

7.3 Check valves shall be DUAL PLATE TYPE with cast iron steel body and stainless steel internal trims.

8. EXTERNAL FIRE HYDRANTS

8.1 Contractor shall provide external hydrants. The hydrants shall have instantaneous type 63 mm dia outlets. The hydrants shall be of gunmetal and flange inlet and single outlet conforming to I.S. 908 with M.S. duck foot bend and flanged riser of required height to bring the hydrant to correct level above ground.

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

9. INTERNAL HYDRANTS

9.1 Contractor shall provide on each FHC at landing and other locations as shown on the drawings of required nos. single headed gunmetal landing valve with 63mm dia outlets and 80 mm inlet (I.S. 5290-1969) with individual shut off valves and cast iron wheels. Landing valves shall have flanged inlet and instantaneous type outlet as shown on the drawings.

9.2 Instantaneous outlets for fire hydrants shall be of standard pattern approved and suitable for fire brigade hoses. Contractor shall provide for each internal fire hydrant station TWO numbers of 63 mm dia 15-meter-long C.P./reinforced rubber lined hose pipes with gunmetal male and female instantaneous type coupling machine wound with copper wire (Hose to I.S. 636 type A and couplings to I.S. 903 with I.S. certification), fire hose reel, gunmetal branch pipe with nozzle I.S. 903 fireman's axe.

9.3 Each hose box shall be, after thorough cleaning of surface, painted with one coat of red oxide primer and 2 coats of enamel paint of fire red shade as per IS:5. The words FIRE HOSE to be painted on the inner face of the glass.

10. FIRST AID HOSE REELS

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

11. PRESSURE GAUGES

i) All pressure gauges shall be of dial type with bourdon tube element of SS 316. The gauge shall be of reputed make. The dial size shall be 150 mm dia and scale division shall be in metric units marked clearly in black on a white dial. The range of pressure gauge shall be 0 to 10 kg/sq.cm.

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

12. PRESSURE SWITCHES

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

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

iii) The electric rating of the switch shall be as under:

Type of supply	Voltage	Non -Inductive	Inductive
A.C.	110-380	10 Amp	6 Amp
D.C.	24-250	12 Watts	12 Watts

13. FIRE BRIGADE CONNECTION

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

14. AIR VALVES

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

15. DRAIN VALVE

15.1 The contractor shall provide 25mm dia G.I. pipe to IS:1239 (Heavy class) with brass ball valve for draining any water in the system in low pockets as shown in drawings or as directed by the Owner.

16. VALVE CHAMBERS

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

16.2 Valve chamber shall be of the following size :

For depths 100 cm and beyond 120x120 cms, Weight of C.I. frame and cover shall be 38 kg.

17. PIPE PROTECTION

PAINTING

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

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

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

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

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

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

17.7 Primer paint - two coat (minimum thickness 100 microns) of zinc chromate.

17.8 Finishing coats

a) For External areas - 2 coats (thickness minimum 50 microns each) of epoxy paint, fire red shade as per IS:5.
b) For Internal areas - 2 coats of synthetic enamel paint, fire red shade as per IS:5.

COATING WRAPPING FOR UNDERGROUND PIPES

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

17.10 The materials and workmanship shall in general confirm to IS:10221 or as directed by the Owner.

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

17.12 Priming - The primer shall be PYPKOTE/RUSTFIRE/CORPORATE undercoat. The manufacturers recommended procedure would be followed for applying the primer.

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

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

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

17.16 The 'Holiday Test' is to be conducted for detecting any entrapped air or any other defect. The Contractor is to arrange for the Holiday Test and to rectify the defects if found any.

18. PIPE SUPPORTS

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

18.2 All supports/clamps fabricated from M.S. structural e.g. roads, channels, angles and flats shall be painted as described in specifications for "Painting" ABOVE. The Shade shall be BLACK.

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

19. TESTING

19.1 All piping in the system shall be tested to a hydrostatic pressure of 14.0 kg/sq.cm without drop in pressure for at least 2 hours.

19.2 Rectify all leakage's, make adjustments and reset as required and directed.

20. HOSE CABINETS

20.1 Provide doors/hose cabinets for internal/external hydrants respectively fabricated from 14 gauge CRCA sheet with double glass front door and locking arrangement, with breakable glass key access arrangement, duly painted red with stove enameled paint fixed to wall floor as per site conditions. The cabinet shall have a separate chamber to stove a key with breakable glass as per approved design. Hose cabinets shall be hinged double door partially glazed with locking arrangement, stove enameled fire red paint with 'FIRE HOSE' written on it prominently. Detailed drawings of hose cabinet for indoor and outdoor works shall be got approved from Owner before fabrication and installation at site.

20.2 For external hydrants the hose cabinets shall be fabricated from 14 gauge thick CRCA sheet with double shutter glass front door and locking arrangement with breakable glass key access arrangement. The cabinet shall have 'FIRE HOSE" written on it prominently. Detail drawings of hose cabinet shall be got approved from the Owner before fabrication and installation at the site. (Also see Clause 9.3 of this Volume).

21. MEASUREMENT

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

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

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

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

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

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

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

SECTION 4

S P E C I F I C A T I O N S
FOR
MISCELLANEOUS FIRE SERVICES EQUIPMENT

1. GENERAL

1.1 This Section specifies the manufacture and installation of miscellaneous fire services equipment which shall be provided according to the Drawings for the completion of the FS installation.

1.2 The whole installation shall be installed and commissioned in accordance with DFS requirements.

2. STANDARDS

2.1 Relevant Codes and Standards

2.2 BS 1042: Measurement of Fluid Flow in Closed Conduits

2.3 Codes and regulations of the jurisdictional authorities

3. TECHNICAL AND INSTALLATION REQUIREMENTS

3.1 Portable Equipment

3.1.1 Carbon Dioxide (CO_2) Type Fire Extinguisher

a) CO_2 fire extinguishers shall be DFS approved, and shall also be FOC approved or UL listed.
b) Fire extinguishers shall be constructed of heavy duty mild steel case, stainless steel discharge lever and fixed carrying handle with a heavy duty, brass chrome-plated valve body.
c) Unit shall be operable to 40 °C.
d) Sturdy wall hanger shall be provided for fixing of each fire extinguisher.

3.1.2 Foam Type Portable Fire Extinguisher

a) The fire extinguishers shall be DFS approved, and shall also be FOC approved or UL listed.
b) The fire extinguishers shall be constructed of steel container and completed with nylon foam making branch pipe, operating lever, safety pin, gas cartridge piercer, gas cartridge, wall hook and screw.
c) Fire extinguishers shall be operable to 40 °C.

TECHNICAL SPECIFICATION OF ELECTRICAL WORKS

Index

PART- 4 (ELECTRICAL WORKS)

SECTION 1

S P E C I F I C A T I O N S
FOR
ELECTRICAL WORKS

1.0 GENERAL

To provide a complete electrical system for the distribution of electric power from the point of supply (SEB), D.G.s to the utilization equipment, all as shown in the drawings and described in these specifications. The quantities mentioned in BOQ are tentative. It will be the bidder's responsibility to work out the exact quantities from drawings or from work site, which trade provides said equipment's, materials, tools and labour.

2.0 SCOPE

The bidder shall supply, install and commission along with requisite spare, maintenance tools and tackles the following equipment's and system in the Building. The scope also covers the detailed engineering and calculations of the various equipment's/system mentioned hereunder and the same shall be approved by the Owner /Architect prior to execution of the job.

- Laying and termination of L.T. cables.
- Distribution Boards / Sub-Distribution Board
- Complete internal building wiring as per specification
- Safety to personnel and equipment during both operation and maintenance
- Reliability of Service
- Minimum fire risk
- Case of maintenance and convenience of operation
- Automatic protection of all electrical equipment through selective relaying system
- Electrical supply to equipment and machinery within the design operating limits
- Adequate provision for future expansion and modification
- Maximum interchange ability of equipment
- Fail-safe feature
- Suitability for applicable environmental factors

This specification defines the basic guidelines to develop a suitable electrical system as necessary for the Non- residential campus. All data required in this regard shall be taken into consideration to develop a detailed engineering of the system. Site conditions as applicable are mentioned elsewhere.

Compliance with these specifications and/or approval of any of the Contractor's documents shall in no case relieve the Contractor of his contractual obligations

All work to be performed and supplies shall be affected as a part of contract requires specific approval/review of Owner or his authorized representative. Major activities requiring approval/review shall include but not be limited to the following:

- Basic engineering documents e.g. overall single line diagram, area classification drawing, overall cable layout, testing, type test report, guaranteed particulars of all equipment's and maintenance manuals.
- Quality assurance procedures
- Field testing and commissioning procedures.
- Basic engineering calculations viz. load analysis; load flow, fault level calculations, and voltage drop calculations during motor start-up/re-acceleration etc.
- Control and protection schemes.
- Load sharing and annunciation scheme.
- Sizing calculation for cable trays/cable trenches.
- Sizing calculation for cable trays/cable trenches.
- Area-wise illumination level calculation and preparation of power supply distribution drawing.

Bidder shall be responsible for:

- Detailed co-ordination with other services, shop drawings for various electrical layouts such as equipment layout, lighting layouts, cabling layouts, earthing and lightning protection layouts, including equipment installation and cable termination details etc. prior to start of work
- Preparation of bill of materials for cabling, lighting, earthing and miscellaneous items etc.
- Cable schedule.
- Lighting/power panel schedule.
- Interconnection drawing.
- Protection co-ordination drawings/tables for complete power system
- Shop inspection and testing procedures.
- Field testing and commissioning procedures.
- Preparation of as built drawings for all services.
- Any other work/activity which is not listed above however is necessary for completeness of electrical system.

3.0 CODES & STANDARDS

The design engineering manufacturing and the installation shall be in accordance with established codes, sound engineering, practices, and specifications and shall conform to the statutory regulations applicable in the country. Contractor shall obtain all approvals from statutory authorities' e.g. Electrical inspector, pollution control boards, SEB as applicable before commissioning of electrical/DGs.

- Indian Electricity Act.
- Indian Electricity Rules.

- Factory Act.
- Pollution Control Act
- IS-732: Code of practice for electrical wiring installation system voltage not exceeding 650V.
- IS-3043: Earthing.
- IS-2309: Code of practice for the protection of buildings and allied structure against Lightning
- IS-7689: Guide for control of undesirable static electricity.
- IS-3716: Insulation co-ordination application guide.
- IS-8130: Conductors for insulated electrical cables and flexible cords.
- IS-5831: PVC insulation and sheath of electric cables.
- IS-3975: Mild steel wire, strips & tapes for armouring cable.
- IS-3961: Current rating of cables.
- IS-694: PVC insulated (heavy duty) electric cables for working. Voltage up to and including 1100 volts.
- IS-424- 1475 (F-3): Power cable flexibility test.
- IEC-439/IS-7098: Specification for cross linked polyethylene insulated PVC sheathed cable for working voltage up to 1.1 KV.
- IS-1554: PVC insulated cables up to 1100 volts.
- IS-10810: Test procedures for cables.
- IS-6121: Cable glands.
- IS-10418: Cable drums.
- IEC-754(1): FRLS PVC insulated cable.
- ASTM-D-2863: Standard method for measuring minimum oxygen concentration to support candle-like combustion of plastic (oxygen index).
- ASTM-D-2843: Standard test method for measuring the density of smoke from burning or decomposition.
- ASTM E-662/IEC 754(A): Standard test method for specific optical density of smoke generated by solid materials.
- IEEE-383: Standard for type test class-IE, electric cables, field splicers and connections for power generation station.
- IS 13947/IEC 947: Air circuit breaker/moulded case circuit breaker.
- IS-8623: Specification for factory built assemblies of switch gear and control gear for voltage upto and including 1000vac/1200vdc.
- IS 1018: Switchgear and control gear selection/installation and maintenance.

- IS 1018: Switchgear and control gear selection/installation and maintenance
- IS-1248: Direct acting indicating analogue electrical measuring instruments and testing accessories.
- IS-13779: Digital measuring instruments and testing accessories.
- IS-3156 : Voltage transformer
- IS-2705: Current transformer for metering and protection with classification burden and insulation.
- IS -2147: Degree of protection provided by enclosures for low voltage.
- PART 1,11,111 Switchgear and control gear
- IS-3427 : Metal enclosed switchgear and control gear
- BS-162: Safety clearance
- IS-3202: Code of practice for climate proofing of electrical equipment.
- IS-375 : Marking and arrangement for switchgear, bus bars, main connections and auxiliary wiring.
- IS-722 : Ac electric meters
- IS-3231: Electrical relays for power system protection.
- IEC-255
- IS-5082 : Electrolytic copper/aluminum bus bars
- IS-2834 : Capacitors
- IS-2713 : Steel tubular pole
- IS-335 : Specification for insulating oil
- IS-3837: Specifications for accessories for rigid steel conduit for electrical wiring.
- IS-2026&335 : Distribution transformer
- (PART I,II,III)GI/STEEL /PVC conduit pipe for electrical wiring.
- IS-2274: Code of practice for electrical wiring installation system voltages exceeding 650 volts.
- IS-6665: Code of practice for industrial lighting
- IS-3646 : Interior insulation part 1&2
- IS-1944: Code of practice for lighting of public through fares.
- IS-7752: Guide for improvement of power factor consumer's installation.
- IS-13346: General requirement for electrical for explosive gas atmosphere.
- IS-13408: Code of practice for the selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres
- IS-12360: Voltage and frequency for ac transmission & distribution system.

- IS-5572: Classification of hazardous area for electrical installations.
- IS-5571: Guide for selection of electrical equipment for hazardous area.
- IS-4201 : Application guide for Current Transformer
- IS-4146 : Application guide for Voltage Transformer
- IS-10028: Code of practice for installation and maintenance of transformer
- IS-8478: Application guide for on load tap changer
- IS-10561: Application guide for power transformer
- IS-1646: Code of practice for fire safety of buildings electrical installation
- IS-3034: Code of practice for fire safety of industrial building-electrical generating and distribution station
- IP-30 : National electrical code (NEC) BIS publication.
- IS-4722: Rotating electrical machines.
- IS-4889: Method of determination of efficiency of rotating electrical machines.
- IS-325: Three phase induction motors.
- IS-4729: Measurement and evaluation of vibration of rotating electrical machines.
- IS-900: Installation and maintenance of induction motors.
- IS-4029: Air break switches.
- IS-2208-9224: HRC cartridge fuses.
- IS-2959: Contactors.
- IS-9537: Rigid steel conduit.
- IS-1030-1982: Specification for carbon steel castings for general engineering purpose.
- IS-1601/ BS-649: Performance& testing of Internal Combustion (IC) engines for general purpose.
- AIEE-606(1959): Recommended specification for speed governing of I.C. engine generator units.
- BS-5514/IS-3046 8528(Part-2): Reciprocating IC engine driven A.C. generators.
- Any other standard may be followed provided it is equivalent or more stringent than the standards specified above.

In case of any deviation /conflict of this specification with the codes & standards, the following order of precedence shall govern.

a. Specification, particular specification if any, and drawings.
b. Indian regulations/ codes and standards.

4.0 SITE CONDITIONS

i) Design ambient 50 Deg.C. Maximum
2 Deg. C. minimum

ii) Relative Humidity 85% maximum

iii) Site environment Normal

5.0 DESIGN CRITERIA

5.01 DELETED

5.02 L.T. Power Distribution System

a)	Voltage	415V / 240 V
b)	Frequency	50 HZ
c)	Neutral Earthing	Grounded
d)	Short Circuit Fault withstand Capacity	10 KA - 45 KA (1 Sec.) as per B.O.Q. and specification

5.03 Emergency Lighting (Battery Operated With Self Charger)

a)	Voltage	12V / DC
b)	Source	Mains / D.G. Set

5.04 Control Supply for Electrical System

The various supply voltage to be used in the control panels for main equipment's are:

a)	Spring Charge Motor	230 Volt AC
b)	Closing /Trip Coil	24V DC / 230V AC
c)	Alarm / Indication / Relay	24V DC / 230V AC
d)	Heaters	230V AC

5.05	Power Supply Load Control/ Distribution Panel	433 V TPN / 240 V 1 phase A.C. (other supply if required shall be derived by package vendor).
5.06	Painting of Panel	Powder coating of approved shade.
5.07	Painting of Cable Tray and structural steel	Powder coating of approved shade.

6.0 CABLE DETAILS

6.01	Internal Wiring	Copper conductor PVC insulated 1.1 KV grade as called for in BOQ
6.02	Power Cables (L.T.)	XLPE insulated Al. Armoured/ Unarmoured Cable as called for in BOQ.
6.03	Power Cables (H.T.) 11 KV	Aluminum conductor XLPE insulated armoured cable.
6.04	Grounding Conductor	Copper/G.I. strip as called for in BOQ.
6.05	Lighting Conductor	G.I. Strip

7.0 ACCURACY CLASS OF METERS

a)	Revenue Meters	Class-0.5 or as per SEB approved.
b)	Ammeter, Voltmeter and other Instruments	Class – I Digital Analogue as called for in BOQ.

8.0 SPECIAL CONDITIONS

8.1 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. Any materials or accessories which may not have been specifically mentioned, but which are usual and necessary for the satisfactory and trouble free operation and maintenance of the equipment shall be provided without any extra cost of the purchaser. This shall also include spares for commissioning of the equipment.

8.2 PRICES

The rates quoted by bidder shall include supply, installation, Octroi all taxes, Excise duty & levies work contract tax, testing & commissioning charges. Laid, shall not be responsible for omission of any item party or fully by the bidder Quantity can be increased or decreased by any level.

9.0 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. All 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; a copy of the same shall be delivered to the Owner through consultant. Contractor shall be responsible for handing over to SEB (BSES) and other authorities shall be responsibility of contractor till commissioning and getting electricity in the complex.

The Owner shall have full power regarding the materials or work got tested by independent agency at the electrical contractor's expenses in order to prove their soundness and adequacy. The contractor will rectify the defects/suggestions pointed out by independent agency through Owner 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 (for F.F. etc.) as amended up to date, thereunder 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/perform the assigned duties to fulfill the requirement of Rule No.3 of IER 1956 as amended up to date.

10.0 DRAWINGS

a) The list of drawings along with these specifications is given in Annexure. These drawings are meant to give general idea to bidder regarding the nature of work covered by these specifications.

b) Any information/data shown/not shown in these drawings shall not relieve the contractor, his responsibility to carry out the work as per the specifications. Additional information required by the bidder for successfully completing the work shall be obtained by him

c) Shop Drawing

The contractor shall prepare detailed coordinated electrical shop drawing indicating lighting/lighting fixtures, convenience outlets, D.G.'s, H.T., Transformer, M.V. Panel Boards/Relay Panel, PCC, DB's, Rising Mains,Cable Schedule with other relevant services and submit to the Owner for approval or the Engineer-in-Charge before commencing the work. The shop drawings shall indicate all setting out details and physical dimensions of all components with wiring and cable details including system operating write up in the system Control and Relay Panel Package Substation, D.G.'s, PCC's, MCC's, 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 do not relieve the contractor of his responsibility for providing maintenance free and fool proof system including any missing component/accessories to meet with the intent of the specifications. Contractor will submit 2 prints for preliminary approval and finally six prints for distribution. The contractor shall prepare detailed coordinated electrical shop drawing indicating lighting/lighting fixtures, convenience outlets, D.G.'s, H.T., Transformer, M.V. Panel Boards/Relay Panel, PCC, DB's, Rising Mains, Cable Schedule with other relevant services and submit to the Owner for approval or the Engineer-in-Charge before commencing the work. The shop drawings shall indicate all setting out details and physical dimensions of all components with wiring and cable details including system operating write up in the system Control and Relay Panel Package Substation, D.G.'s, PCC's, MCC's, 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 do not relieve the contractor of his responsibility for providing maintenance free and fool proof system including any missing component/accessories to meet with the intent of the specifications. Contractor will submit 2 prints for preliminary approval and finally six prints for distribution.

d) Completion Drawings/As Built Drawings

On completion of the work and before issue of certificate of virtual completion, the contractor shall submit to the consultant 4 sets along with soft copy of 'As Built' drawings of the work along with 01 Nos. cloth tracing originals

including write up (trouble shooting, installation, operation and maintenance manual with instructions) incorporating all such changes and modifications during engineering and execution along with warrantee & guarantee certificates from manufacturers.

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 PCC's, MCC's, Feeder Pillars, capacitor control panels, PLC D.G. set panel, UPS panel, and relay panels with description detailed control wiring diagram
- Location of transformer and its details and control wiring diagram
- Location of Hume pipe and manhole including HT/LT cable layout and scheduling
- Location of D.G.'s, exhaust and auxiliary equipment's 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

e) Position of HT/LT Switch Boards/Transformer & D.G.'s

The recommended position of the switch boards transformer & D.G.'s as shown on the layout drawings will be adhered to as far as practicable.

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 Owner. For all non- specified items, approval of the Owner/Consultant shall be obtained prior to procurement of the same. Owner shall in no way be liable for rejection of the any material due to poor quality, poor workmanship, poor material etc.

11.0 MANUFACTURER'S INSTRUCTIONS

Where manufacturers have furnished specific instructions, relating to the material/equipment's to be used on this job, covering points not specifically mentioned in this document, manufacturers' instructions should be followed**.**

12.0 MATERIALS AND EQUIPMENTS

All the materials and equipment's shall be of the approved make and design. Unless otherwise called for any approval by Owner's Engineer-in-Charge, only the best quality materials and equipment shall be used.
The contractor shall fill in the data sheet for capital equipment as attached elsewhere in this document. The Tender shall be rejected due to not giving / filling in the details of the said equipment.

13.0 GENERAL DETAILS

13.01 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.

13.02 Fungi static 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.

13.03 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.

13.04 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 specification / BOQ whenever it is not mentioned it shall be as given below.

- Installed out door: IP-55 or as in BOQ.
- Installed indoor in air-conditioned area: IP-52
- Installed in covered area: IP-52
- Installed indoor in non-air-conditioned area where possibility of entryof 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.

13.05 Rating Plates, Name Plates and Labels

Main PCC, PCC's, MDB and auxiliary's items installed in the building are to permanently attach to it in a conspicuous position. A rating plate of non-corrosive material with engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions of equipment in question has been designed to operate and such diagram plates as may be required by the purchaser. The rating plate of each equipment shall be according to IEC requirement.

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.

13.06 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.

14.0 DESIGN IMPROVEMENTS

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 Owner will be sought. If any such agreed upon change is such that if 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.

15.0 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.

The Purchaser or his duly authorized representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Contractor/his Vendor's quality management and control activities.

16.0 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 customer inspection points (CIP) as mutually and methods used to verify the inspection and testing points in the quality plan were performed satisfactorily.

17.0 INSPECTION, TESTING AND INSPECTION CERTIFICATE

The Purchaser and the Consultant or duly authorized representative shall have at all reasonable times free access to the Contractor'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 Owner/Consultant the detailed programme about the tests at least three (3) weeks in advance in case of domestic supplies. If for any item type test is pending payment would be made on successful completion of type/routine test(s) actually carried out as per Consultant/Owner instructions.

The Contractor shall give the Consultant/Owner thirty (30) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account. The Consultant/Owner unless witnessing of the tests is virtually waived 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 Owner/Consultant and he shall forthwith forward to the Consultant duly certified copies of tests in triplicate.

The Consultant/Owner 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 Consultant/Owner shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Consultant/Owner, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the Consultant/Owner. 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 Purchaser 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 Owner/Architect.

The contractor shall arrange all necessary instruction and testing facilities free of cost for this purpose including air travel, lodging and boarding expenses.

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 Owner/Consultant or this authorized representative to carry out effectively such tests of the equipment in accordance with the Specification.

The inspection by Owner/Consultant and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract.

The Consultant/Owner 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 Owner/Consultant 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's for these tests shall be provided by the Contractor.

18.0 TESTS

18.01 Charging

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 Owner/Consultant 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.

18.02 Commissioning Tests

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.

All instruments, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.

Pre-commissioning test shall be carried out as per relevant IS and/or as specified in the relevant clause.

The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning of the equipment. However necessary fee shall be reimbursed by Owner on production of requisite documents.

19.0 PACKAGING

All the equipment's 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, wharf age and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. Owner takes no responsibility of the availability of any special packaging/transporting arrangement.

20.0 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 piping 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.

21.0 FINISHING OF METAL SURFACES

21.01 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.

21.02 Hot Dip Galvanizing

The minimum weight of the zinc coating shall be 700 gm/ sq.m and minimum thickness of coating shall be 85 microns.

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 discoloured 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.

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.

The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.

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.

- Coating thickness
- Uniformity of Zinc
- Adhesion Test
- Mass of Zinc coating

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.

21.03 Painting

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 swaf 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.

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 shoved.

The exterior colour of the paint shall be as per shade no.697 of IS-5 or as approved by Architect and inside shall be white or as approved by Architect. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipment’s, if required. 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 Owner’s review and approval.

22.0 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 Owner/Consultant. 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 Owner 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, wharf age 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 the Owner 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 Owner, 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 codes.

23.0 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.

24.0 DESIGN CO-ORDINATION

The Contractor shall be responsible for the selection and design of appropriate equipment’s 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.

25.0 DESIGN COORDINATION MEETING

The Contractor will be called upon to attend design co-ordination meetings with the Engineer, and the Consultants of the Owner during the period of Contract. The Contractor shall attend such meetings at his own cost at New Delhi or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during those discussions.

26.0 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 equipment’s.

SECTION 2

S P E C I F I C A T I O N S
FOR
ELECTRIFICATION

1.0 33 KV H.T. SWITCHBOARD

This specification covers the 'General Requirements' for the design, manufacture, supply performance, inspection, testing and commissioning including supply of indoor type high voltage switch boards up to 33 KV including necessary termination, cabling, bus work required for satisfactory operation.

Specific requirements shall be in accordance with single line diagram/specification/data sheet. In case of conflicting requirement between the Technical Data and General Specification the former shall prevail.

The technical parameters of switchgear equipment's, transformers etc. shall be submitted by the Contractor for approval by the consultant/ client.

This specification shall cover both 33 KV and Single Panel Board.

1.1 STANDARDS

All equipment, material and components shall comply with the requirements of the latest editions of Indian Standards with updated amendments. Standards and Regulations applicable in the area where equipment is to be installed shall also be followed.

The equipment offered complying with other standards, these standards shall be equal to or superior to those specified and full details of the differences shall be furnished along with the tender.

Some of the relevant Indian and British Standards are listed below:

- IS 13947 - A.C. Circuit Breakers (Relevant Parts/SCC)
- IS 13941 - High voltage Circuit Breaker (Relevant Parts/SCC)
- IS13118 - Gas insulated Switchgear
- IS 3427 - Metal enclosed Switchgear & Control Gear
- BS 162 - Safety Clearances
- IS 2705 - Current Transformers (Parts 1 to 4)
- IS 3156 - Voltage Transformers (Parts 1 to 4).
- IS 3202 - Code of Practice for climate proofing of electrical equipment
- IS 375 - Marking & Arrangement for Switchgear Bus Bars, main connections and auxiliary wiring.
- IS 722 - A.C. Electric Meters.
- IS 1248 - Direct acting Electrical Indicating Instruments.
- IS 3231 - Electrical Relays for Power System Protection.
- IS 2544 - Epoxy Cast Resin Insulators.
- IS 5082 - Electrolytic Copper and Aluminum.
- IS 5792 - High Voltage HRC fuses.
- IEC 60694- High Voltage Switchgear.
- IEC 60947- High voltage Circuit Breaker
- IEC 60056- Gas insulated Switchgear
- IEC 60298- Metal Enclosed High Voltage Switchgear

1.2 DETAIL OF DESIGN CONSTRUCTION

The switch boards shall be cubicle type, suitable for indoor/outdoor installation, floor mounting and free standing. The design shall be totally enclosed, dust - tight, dam proof and vermin proof offering degree of protection not less than IP-42 for Indoor Application & IP-54 for Outdoor application or as per BOQ.

Separate segregated compartments shall be provided for circuit breakers, bus bars, cable box, voltage transformers, wire ways, relays, and instrument and control devices. Switchgear cubicles/ modules shall be provided with hinged doors in front with facility for padlocking door handles.

Vent openings shall be covered with grills so arranged that hot gases cannot be discharged through them in a manner that can injure the operating personnel. These vent openings shall be vermin proof.

All the High Voltage compartments i.e. Circuit Breaker, Bus Bar, and Cable Compartments shall be separated from each other by metallic partitions in line with IEC-600298. These compartments must have pressure relief flaps for exit of gas due to internal arc to ensure operators safety. All the HV design must ensure conformity to IEC -600298 and must be Type tested for Internal Arc Test. The supplier shall submit Type Test report from CPRI or other independent agency to prove the above.

All panels shall be of same height, width and depth. Panels shall be bolted together to form a continuous flush front switch board, suitable for front of board operation.

The switchgear cubicles shall be rigid and robust in design and construction, fabricated out of CRCA sheet steel. Cubicles shall be made from rigid welded structural frames made of structural steel sections or of pressed/formed sheet steel of not less than 2mm thickness. The frames shall be enclosed by sheet steel of at least 2mm thickness, smoothly finished, leveled and free from flaws. Stiffeners shall be provided wherever necessary. Height of the operating handle, push button etc. shall be restricted between 300 mm to 2000 mm from the finish floor level. Fixing screws and nuts shall be used. Self-tapping screws shall not be used in the construction.

All doors, panels, removable covers shall be provided with non-deteriorating (neoprene) gaskets all around the perimeter.

All doors shall be removable and supported by concealed type hinges. The hinges shall be strong and braced to ensure freedom from sagging, bending and general distortion of panel or hinged part.

Floor mounted cubicles with minimum 75 mm high channel and 5 mm thick channel base frame. Approx. 200 mm- blank space between the floor of the switchboard and bottom most unit shall be provided. The total height of the cubicle shall not exceed 2400mm.

2.0 BUSBARS & BUSBAR CHAMBER

Three phase bus bars shall be of high conductivity electrolytic copper as stated in B.O.Q. The bus bars shall be air insulated and housed in a separate compartment, which segregated from all other compartments, in case of Vacuum Circuit Breaker. In case of Gas Insulated Circuit Breaker the Bus Bars shall be housed in separate SF6 gas filled stainless steel tank. Current density of **Cu. Bus-Bar** shall not exceed 1.5 Amps / $mm^{2.}$

Bus bars & bus bar connections shall be of uniform cross section shall be suitable for carrying rated current continuously and short circuit current for specified duration without overheating. The bus bars connections shall be adequately supported on insulators to withstand dynamic stresses due to short circuit current specified. Normal operating temperature for bus bars shall be 85 Deg. C. Short circuit rating of the bus bars shall be 35 KA for 1 sec.

All bus bar joints and bus tap joints shall be silver or tin plated. Joints shall be bolted type and shall be insulated. Spring/Lock washers shall be provided to ensure good contact the joints.

Direct access to accidental contact with bus bars and primary connections shall be avoided by providing shrouds. All apertures and slots shall be protected by barriers to prevent accidental shorting of bus bars. To provide a tight seal between cubicles, bushings or insulating panels shall be provided for bus bars crossing from one cubicle into another.

All insulating materials used shall be non-hygroscopic and shall be treated for preventing fungus growth. Surface of insulators shall be highly glazed and treated with silicone compounds to minimize accumulation of dust, condensation and tracking.

3.0 CIRCUIT BREAKERS

The circuit breakers shall be Triple Pole double break type and the Insulation and Arc interruption medium shall be either Vacuum or SF6 gas medium. The Breaker shall be enclosed in a sealed Vacuum Tank or SF6 gas filled Stainless Tank. A pressure relief device along with Manometer shall be provided with the Tank in case of SF6 CB to release and monitor any excessive pressure and for testing purpose.

The circuit breakers shall be of horizontal draw out construction with horizontal/vertical isolation. The circuit breaker

including its operating mechanism shall be mounted on a wheeled carriage moving on guides, designed to align correctly and allow easy movement on the circuit breaker. There shall be three discrete positions viz. Service, Test and Isolated. Locking facility in all three positions shall be available. Position indicator shall be provided on the panel to indicate the position of the circuit breaker. Test position shall offer testing of circuit breaker operation/interlocks without energizing the power circuit.

Circuit breakers shall have stored energy spring mechanism charged by manually operated handle as well as electrically operated mechanism. The closing mechanism of the circuit breakers shall be Motor operated, spring charged with a provision for manual charging.

The operating mechanism shall be mechanically and electrically trip free and non-pumping. Anti-pumping feature may be built in or separate anti-pumping relay may be provided. In case spring charged mechanism, spring charged indication shall be provided.

Local manual trip device shall be provided on the operating mechanism. The trip device shall be suitable for front operation and positive mechanical 'ON-OFF' indication shall be provided.

Main contacts of circuit breaker shall have ample area and adequate contact pressure to carry the rated and short time current without excessive temperature rise. The contacts shall be adjustable for wear and easily replaceable. Main contacts shall open before and close after the arcing contacts when these are provided. Arcing contacts shall be easily accessible for inspection and replacement in case of VCB.

Each breaker shall normally be provided with auxiliary contacts of 6 NO+6NC directly operated from breaker operating mechanism. These contacts shall be in addition to these used in circuit breaker internal wiring. These contacts shall be rated for 10 Amps at 240V AC and 20 Amp (inductive breaking) at 220V D.C. If more breaker auxiliary contacts are required latching relay shall be used to multiply the contacts.

Shunt trip coil as called for shall be provided for tripping the circuit breaker. The trip coil/s shall operate satisfactorily between 50% - 110% of rated control voltage. Wattage of trip coils will be sufficiently high to prevent it from picking up or holding on with specified number of trip circuit supervisory indicating lamps wired in series.

It shall be possible to trip the breaker, in case of failure of control supply Circuit breaker type duty and rating shall be submitted in Data Sheet by the Contractor.

Circuit breakers of similar rating shall be interchangeable.

4.0 CURRENT TRANSFORMERS

Current transformers shall be of ratio, burden (shall be worked out by panel supplier), class/accuracy as specified in Single Line Diagram/BOQ.

Current transformers shall conform to latest edition to relevant standards. Current transformers shall be epoxy resin cast with bar Primary or ring type.

CT core laminations shall be of high grade silicon steel. The design and construction shall be sufficiently robust to withstand thermal and dynamic stresses due to the maximum short circuit current of the circuit.

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

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

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

Current transformers (core) shall be used for metering and protection. Each CT shall be provided with rating plate indicating: Name and Make, Serial number, Transformer Ratio, Rated burden, Rated voltage and Accuracy class.

5.0 CURRENT TRANSFORMERS

Potential Transformers shall conform to latest edition of "IS-3156 (Part I, II & III) as applicable relevant standards. Potential transformers shall be Fixed type cast epoxy resin type. The PTs shall be of single phase construction.

The PT shall be capable of operating continuously at 110% of the rated voltage without any damage. When star - star connection is required in non-effectively or ungrounded system, the PTs shall be suitable for continuous operation with a persistent phase to ground fault.

Maximum temperature rise of the transformer at rated burden and with rated primary voltage and frequency shall not exceed 40 Deg.C above an ambient of 45 Deg.C.

The PT's shall be fixed at rear bottom / top of the panel as called for. An interlock or automatic shutters shall be provided to prevent access to live HV parts when PT is withdrawn.

HRC Fuses shall be provided both primary & secondary side. It shall be possible to replace PT fuses easily without having to de-energize the main bus bars. Prospective interrupting current rating of the fuses shall be same as the system fault level.

Voltage transformer ratio, output and class shall be as specified in the BOQ and shall be stated in data sheet by the Vendor/Contractor. Nameplate as per relevant standards shall be provided on the PT.

6.0 PROTECTIVE RELAYS

Relays type and numbers shall be in accordance with the protective scheme required or as per drawings and B.O.Q.

Relays shall be digital microprocessor based or analogue type, as called for in BoQ. It shall be enclosed in rectangular shaped cases, suitable for flush mounting only, dust tight covers projecting from the front cover panel. The case shall be dust tight, damp proof and tropicalized. The relays shall be either self-powered or a 24V DC Power-pack of suitable capacity with charging device shall be provided within the HT panel.

Relays shall be accessible for setting from the front. Access to setting devices shall be possible only after removal of front cover.

Protective relays shall be drawing out type. Where it is not possible to provide protective relays of the draw out pattern, fixed type relays with facilities for plugging in a portable test plug shall be provided. Necessary test plugs shall be furnished along with the relays.

Relays shall be provided with positive action self-reset type with indicator. The indicator/s shall be visible from the front.

Relays conform to relevant standards in all respects. Relays shall be provided with minimum two pairs of self or hand reset type contacts as specified. Auxiliary relays shall have the number of NO and NC contacts as required and shall be in data sheet by the Vendor / Contractor.

7.0 SAFETY/ PROTECTION INTERLOCKS/ FEATURES

Following interlocks and features shall be incorporated for equipment protection and personnel safety under mal- operation. No deviations on these interlocks and safety features are allowed. These interlocks and safety features shall be fail-safe, positive and full-proof.

a) It shall not be possible to plug-in or isolate a closed-circuit breaker. An attempt to do so shall trip the breaker. (In case of breakers with vertical isolation, this will apply to raising and lowering). There shall be a positive locking facility to prevent closing of circuit unless it is in Service or Test position.

b) Closing and opening operations shall be possible only in discrete, well defined Test and Service positions and not in any position midway. An extension adapter cable with plugs and sockets shall be preferably be provided so that the closing and opening operation of the circuit breaker can be done in fully withdrawn position outside the cable.

c) Slow operation of circuit breakers shall be possible only in the circuit breaker in Test or Isolated position.

d) Isolating switches if provided shall be interlocked with respective circuit breakers to prevent them making or breaking the current.

e) 1 no. bus earthing truck shall be supplied with each panel to earth the outgoing cable of the VCB.

f) Automatic safety shutters for all openings which will lead to access to the live parts of the switchgear upon withdrawal or any operation the switchgear components/parts shall be provided, preferably with a padlocking facility.

g) Spring of motor operated spring charged mechanism shall not discharge until they are fully charged and charging means are fully disconnected.

h) Where key interlocking is employed, tripping of a closed circuit breaker shall not occur if any attempt is made to remove the trapped key from the mechanism.

i) Annunciation window shall be provided for winding temperature trip / alarm as required.

j) Any other interlocks which manufacturer may deem to be required for safety and specifically specified separately required for the system shall be included.

k) All terminals, connections which may be live and exposed for accidental contact shall be adequately shrouded.

l) Components within cubicles shall be properly labelled to facilitate testing.

8.0 EARTHING

The switch board shall be provided at the bottom throughout its entire length with a earth bus of copper of adequate size to carry the fault current for the duration same as short time rating of the circuit breaker. Earth bus shall have two earthing connection facility at its both ends of earthing conductor.

All non-current carrying metal parts, frames and equipment mounted in the switchboard shall be bonded to earth bus.

Earthing of moving carriage of draw out equipment shall be achieved by scraping earthing device. The earthing device shall maintain positive earth continuity in all Service Test and Isolated positions.

It shall be possible to connect each circuit or set of three phase bus bars to earth either through earthing trucks or through the circuit breakers.

One earthing trolley suitable for earthing of cables or bus bars and common for all circuit breakers of the same type/rating shall be provided.

9.0 INSTRUMENT & METERS

Electrical indicating instruments shall be digital type with zero adjustment, probe from outside the cover. Multi- function meter of CL 1.0 accuracy with RS 485 port shall be provide. Instruments/meters shall be suitable for flush mounting on the panel with flanges protecting outside the panel. All meters shall be industrial grade with accuracy of class 1.0 unless specifically indicated.

10.0 CONTROL WIRING

All wiring for control, protection, alarm, indicating circuits and remote tripping mechanism on all equipment shall be carried out with at least 650V grade, PVC insulated, stranded, copper, 2.5 Sq.mm conductors.

All wiring shall be run on the sides of the panels and shall be neatly bunched and cleated without affecting access to equipment mounted in the panel. Where wiring enters or passes through compartments containing HT apparatus then they shall be in earthed metallic conduits or ducts.

All wiring shall be taken to terminal blocks without joints or tees in their run. All wiring shall be colour coded as follows:
Instrument Transformer AC circuit -Red, Yellow & Blue determined by the phase with which the wire is associated.

AC Phase Wire	-	White
AC Neutral.	-	Black
DC Circuits	-	Grey
Earth connections	-	Green

Engraved core identification ferrules, marked to correspond with the wiring diagram shall be fitted to each wire. Ferrules shall fit tightly on the wires, without falling off when wire is removed. Ferrules shall be of white colour with black lettering. Each wire shall be identified by letter to denote its function followed by a number to denote its identity at both ends.

All wiring for external connections shall be brought out to individual terminals on a readily accessible terminal block.

All unused auxiliary contacts of the circuit breaker and relays shall be wired up to terminal block.

11.0 FITTINGS AND ACCESSORIES

11.1 Indicating Lamps

Neon type indicating lamps or LED indicators shall be provided everywhere except where low voltage filament type with series resistor called for.

Lamp covers shall be provided with interchangeable colored lenses of Perspex or equivalent unbreakable material. The lenses shall not discolor in course of time due to heat of the lamp.

Bulbs and lenses shall be interchangeable and replaceable from the front. Following colors shall be used for the function indicated:

Red	-	Circuit Bracker 'ON'
Green	-	Circuit Breaker 'OFF'
White	-	Continuous trip supply supervision Amber - Auto Trip
Blue	-	Spring charged
R.Y.B.	-	Potential Indication
Green	-	Earth

11.2 Push Buttons

All push buttons shall be push to actuate the contact type.

Start & Stop push buttons shall be colored green and red respectively. Reset push buttons shall be yellow in color and test push buttons shall be blue in color. All other push buttons shall be black in color.

Emergency stop push buttons shall be lockable in the operated position, i.e. push to operate and key to release type. Push buttons for emergency stop shall be recessed/shrouded type to avoid accidental operation.

11.2 Control & Selector Switches

Control and Selector switches shall be of rotary type, having enclosed contacts accessible only after removal of cover.

All control and selector switches for circuit breakers and instruments shall be mounted on the front of the panel. Control switches for space heater/s and control supplies shall be mounted inside the panel.

Circuit Breaker control switches shall be provided with pistol grip handles. Selector switches shall be provided with round, knurled handles. All handles shall be black in colour. Properly designated escutcheon plates clearly marked to show the

operating positions shall be provided on all switches.

All other instruments and selector switches shall have stay put contacts.

Circuit breaker control switches shall normally have three positions close - Normal - Trip with spring return to normal position. Switch operating mechanism shall prevent the switch from being operated twice successively in the same direction. Circuit breaker control switch shall have one NO-NC contact along with other contacts as required.

Contacts of all control and selector switches shall be rated for 10 Amps at 240V AC or 20 Amps at 220V dc (inductive break). Switch for space heater supply and control voltage supply shall normally be two pole rated for 25A A.C.

11.3 Control Terminal Blocks

Box - clamp type, 650V grade line up terminals of minimum 2.5 Sq.mm size shall be provided. Connection to terminals shall be from front. Not more than one wire on each side shall be connected on any terminal. Where duplication of terminals block/s is necessary, suitable solid bonding links shall be incorporated. Terminal blocks at different voltage shall be segregated into groups and distinctly labelled. Current transformer secondary leads shall be brought to terminal blocks having facility for short circuiting and grounding the secondary. Terminals shall be numbered for identification and grouped according to function. Engraved back on white PVC labels shall be provided on the terminal blocks describing the function of the circuit. Separate terminal stems shall be provided for internal and external wiring. Control terminal blocks shall be so located that control cables are fully segregated from power cables. Suitable insulated or earthed metal race ways shall be provided for control wiring. Separate undrilled removable gland plate shall be provided for the control cables at the bottom of each panel. Minimum 10% of total number spare terminals shall be provided for future use.

11.4 Name Plates and Labels

One Name plate giving designation of the HV switchboard shall be affixed prominently on top of the switch board. Details of designation will be specified.

Labels giving following details shall be affixed on each feeder panel:

i) Feeder Name :
ii) Equipment reference no. & Description :
iii) Rating (KVA/Amp) :

All components whether mounted inside or on the door shall be permanently and clearly labelled with reference number/letter or their function. Rating of fuse shall be part of fuse designation. Paper labels, stickers or labels fixed with adhesives are not acceptable. All labels shall be properly fixed by screws with provision to prevent distortion due to expansion.

All labels shall be non-corroding, preferably laminated plastic or rear engraved Perspex with white letters on black background.

Labels for feeder panel designation fixed on front side shall be fitted with chrome plaste, self-tapping, and counter sunk head screws. These labels shall be of identical size to permit interchange.

11.5 Space Heaters

Adequately rated anti-condensation space heaters shall be provided in each cubicle. Space heater/s shall be trip type, rated with operation voltage of 240V, 50 Hz. AC supply. Each space heater shall be complete with a 2P MCB, 10KA and a control thermostat. The space heater shall be rated for maintaining the panel inside temperature 10 Deg.C above outside ambient temperature.

11.6 Cubicle Lighting

Each cubicle shall be provided with interior lighting by means of CFL light fixture. An ON/OFF switch/door switch shall be provided. The lighting fixture shall be suitable for operation from a 240V single phase, 50 Hz. A.C. supply.

12.0 AUXILIARY SUPPLY

Auxiliary supply for control, indication, space heater etc. shall be made available at one point on the switch board. Vendor shall provide suitable auxiliary supply in the switch board.

13.0 FUSES

All fuses in control, indication and metering circuit shall be HRC link type of approved make. Mounting of fuse fitting shall ensure adequate dissipation of heat generated and shall facilitate inspection and easy replacement of fuse.

14.0 CABLE TERMINATION

The switch board panel shall be provided with separate compartment for cable termination complete with suitable cable end termination for XLPE insulated cables suitable for bottom entry. Cable and sealing box shall preferably be mounted inside the panel. Cable compartment doors shall be self–locking type, interlocked and shall have Arc withstand capability due to short circuit. The compartment shall be provided with cable testing facility in case of gas insulated medium. For XLPE cables adequate space and clearances shall be made for heat/cold shrinkable termination e.g. Raychem or cold flowing stress grading joints.

Two earthing terminals shall be provided in each panel in cable box/cabling chamber for earthing armour/screen.

Where more than one core is terminated on each phase, links suitably designed and properly supported shall be provided to avoid unnecessary bending of cable cores without decreasing the length of insulated cable tail. Electrical clearances which would normally be required when using one core per phase shall be maintained.

Where core balance type current transformers are provided on switchgear feeder circuit cable/s for earth fault protection sufficient space, clearance and support, mounting arrangement shall be provided for the CT.

15.0 PAINTING

All steel work shall be pre-treated in tanks and finally powder coated of approved shade of the levels not less than 100 microns.

16.0 TESTING & INSPECTION

Four copies of all test certificates and certificates from sub-vendor shall be furnished. After completion of all work at the manufacturers works the switchboards shall be inspected and tested in presence of Purchaser's/Consultant's representative. However, stage inspection may be carried out from time to time to check progress of work and workmanship. The following tests shall be carried out:

i) All routine tests specified in relevant Indian/British Standards shall be carried out on all circuit breakers.

ii) Test for protective relay operation by secondary injection method.

iii) Operation of all meters.

iv) Secondary wiring continuity test.

v) Insulation test with 1000 Volts megger, before and after voltage test.

vi) HV test on secondary wiring and components on which such test is permissible (2 KV for one minute)

vii) Simulating external circuits for remote operation of breaker, remote indicating lights and other remote operations, if any.

viii) Measurement of power required for closing/trip coil of the breaker.

ix) Pick up and drop out voltages for shunt trip and closing coils.

x) CT Polarity test.

xi) Power frequency voltage withstand test.

Vendor shall provide all facilities such as power supply, testing instruments and apparatus required for carrying out the tests. Required copies of test certificates for all the tests carried out along with copies of type test certificates and certificates from Sub-Vendor for the components procured from them are to be submitted before dispatch of switch boards.

17.0 DRAWINGS AND INFORMATION

The Vendor shall furnish following drawings/documents in accordance with enclosed requirements:

i) General Arrangement drawing of the Switchboard, showing front view, plan, foundation plan, floor cut-outs/ trenches for external cables and elevations, transport sections and weights.

ii) Sectional drawings of the circuit breaker panels, showing general constructional features, mounting details of various devices, bus bars, current transformers, cable boxes, terminal boxes for control cables etc.

iii) Schematic and control wiring diagram for circuit breaker and protection including indicating devices, metering instruments, alarms, space heaters etc.

iv) Terminal plans showing terminal numbers, ferrules markings, device terminal numbers, function etc.

v) Relay wiring diagrams.

vi) Equipment's list.

vii) Bus Bar sizing calculations

Vendor shall furnish required number of copies of above drawings for Purchaser's review, fabrication of switch boards shall start only after Purchaser's clearance for the same. After final review, required number of copies and reproducible shall be furnished as final certified drawings.

The information furnished shall include the following:

i) Technical literature giving complete information of the equipment.

ii) Erection, Operation and Maintenance Manual complete with all relevant information, drawings and literature for auxiliary equipment and accessories, characteristics curves for relays etc.

iii) A comprehensive spare parts catalogue.

18.0 TOOLS

One complete set of all special or non-standard tools required for installation, operation and maintenance of the switchboard shall be provided. The manufacturer shall provide a list of such tools individually priced with his quotation.

19.0 SPARES

Contractor shall also quote separately for the maintenance spares for 2 years normal operation for owner to decide for placement of order at a later date. The quote shall remain valid at least for 6 months. The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

19.0 QUALITY ASSURANCE

Quality Assurance shall follow the requirements of Owner/ Consultant as applicable. Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser's requirements.

20.0 DEVATIONS

Clause wise deviation for the specification must be stated in writing at the quotation stage. In absence of such a statement, it will be assumed that the requirements of the specifications are met without exception.

SECTION 3

S P E C I F I C A T I O N S
FOR
33 KV / 440V, 3 PHASE, 50 Hz TYPE TRANSFORMER

1.0 SCOPE

Covers the detailed requirements regarding design, manufacturing and testing & commissioning of resin cast transformer required for sub-station.

2.0 CODES AND STANDARDS

Transformers shall comply with the latest editions of Indian Standards no. IS: 2026 Part-I to Part-V (Power Transformers) and IS-11171 (Dry Type Power Transformers). In case the provision of Indian Standards is not directly applicable to Dry Type Transformers, the provision of latest IEC – 726 and any other relevant IEC shall apply. Latest Standards as applicable shall be followed for Insulating Materials, Bushing, Installation and Maintenance of Transformers.

3.0 SERVICE CONDITIONS

Altitude	:	Less than 1000 meters Maximum Ambient Temp. ;	50deg C
Minimum Ambient Temp.	:	0deg C	
Installation	;	Highly Corrosive, dusty, humid and tropical	

4.0 RATING AND TYPE

The transformer shall have core type construction, 3 phases and shall be suitable for Indoor / Outdoor service under the climatic conditions prevailing at site. The transformer shall be capable of withstanding thermal and mechanical effects of Short circuit at terminals of any winding with full voltage maintained on other winding as per IS – 2026.

5.0 WINDINGS

The windings shall be manufactured from high quality electrolytic grade copper conductor and fully insulated for rated voltage by nomex-calendered paper. The high and low voltage windings shall be totally encapsulated and should be Cast under vacuum in moulds with fiber glass reinforced epoxy resin laminate. Both HV & LV windings of each phase shall be separately cast as a rigid tubular coil with no mechanical & electrical connection between their co-axial arrangements. The transformer shall be free of partial discharges at least up to 1.1 times the rated voltage. The windings shall absorb no moisture under the worst tropical conditions.

6.0 CORE

The core shall be built up with high quality, non-ageing, low loss & high permeability CRGO (Cold reduce Grain Oriented) Silicon Steel Lamination of very high magnetic properties. CRGO sheet shall be coated with inorganic material like carlite or equivalent insulation to reduce eddy current to minimum. After shearing, the laminations shall be treated to remove all burrs and shall be annealed to remove all the residual stresses.

Core framework and clamps shall be arranged and tightened to securely hold laminations in order to prevent any settling or displacement in case of heavy shocks during transport, handling or short circuits. All the iron parts, except the core shall be galvanized and treated with high temperature resistant paint. Core fastening bolts shall be insulated to reduce losses and avoid hot spots. Transformer shall be designed to withstand 10% over fluxing corresponding to rated voltage.

Suitable lugs shall be provided for lifting the complete core & coil assembly of the transformer.

7.0 INSULATION

Inter-turn and inter coil insulation shall be designed such that the dielectric stress is uniformly distributed throughout the windings under all operating conditions. The windings shall be provided with Class `H' insulation or better.

8.0 TEMPRATURE RISE

The temperature rise of the windings shall not exceed 90o C by resistance on continuous full load above maximum ambient temperature of 50o C and in no case shall reach value that may damage the core itself or other adjacent parts.

9.0 PARALLEL OPERATION

The transformers shall be suitable to operate in parallel among themselves.

10.0 VECTOR GROUP

Transformer shall have vector group of Dyn 11.

11.0 IMPEDANCE

The desired impedance shall be as mentioned in the IS – 2026.

12.0 FLUX DENSITY

The maximum flux density at any point in the core and the winding shall not exceed 1.6 Tesla on the normal rated tap voltage & frequency.

13.0 CURRENT DENSITY

The maximum current density at any point in the winding shall not exceed 2.2 Amps per sq.mm. at the rated full voltage & frequency.

14.0 COOLING

The transformer shall be designed for natural cooling (AN).

15.0 ENCLOSURE

Transformers shall be provided with a sheet steel enclosure with adequate provision for ventilation. The degree of protection of enclosure shall be IP – 21 for indoor installations. The sheet steel thickness of enclosure shall be minimum 2 mm CRCA.

16.0 END TERMINATION

Cable box shall be provided on HV side suitable for 11 KV XLPE Cable & LV side suitable for termination of cables / bus trunking.

17.0 UNDER CARRIAGE

Transformers shall be supported on structural base equipped with bi-directional rollers suitable for moving the fully assembled transformers.

18.0 ACCESSORIES

The following fittings shall be provided on the Dry Type Transformers:

i) Rating & Terminal marking plate
ii) 4 nos. bi-directional flat rollers
iii) 2 nos. earthing terminals with lugs on the transformer base channel on diagonally opposite ends.
iv) Lifting arrangement
v) Extra Neutral point
vi) 1 no. PT-100 sensor in each LV windings wired upto the winding temperature indicator scanner. The instrument shall have two sets of adjustable contacts for alarm & trip. Instrument shall have scanner to read and show temperature of all the three phases sequentially.

19.0 TESTS

Transformers shall be subjected to routine and type tests as specified in IS: 2026, IS: 11171, IEC – 726 & given below:

19.1 Routine Tests:

All routine test shall be carried out as per IS / IEC at manufacturer work type test certificate shall be furnished by manufacture after award of work

20.0 L.T. PANELS & SWITCHGEARS

Medium voltage switch boards/distribution boards, the combination of both these and components shall conform to the equipment's of the latest revision including amendments of the following codes and standards.

The drawings, specification and BOQ complement each other and which is shown or called for one shall be interpreted as being called for on both. Material, if any, which may not have been specified but fairly required to make a complete assembly

of switch gear as shown on the drawing, specifications shall be construed as being required and no extra charges shall be payable on this account.

20.1 CODES & STANDARDS

The design, manufacture and performance of equipment shall comply with all the currently applicable statues, safety codes, relevant Bureau of Indian Standards (BIS), British Standards (B.S.), International Dutro Technical Commission (IEC) Publication, NEMA, IDE & DEMA standard as amended up to date.

a) IS: 13947- Air circuit breaker/moulded case circuit breaker. 1993/IEC 60947-1989
b) IS:3156- Voltage transformers
c) IS: 2705 Part-I, II & III 1964 - Current transformers for metering and protection with classification burden & insulation.
d) IS: 9224: Low voltage fuse and protection.
e) IS: 3231: Specification for electrical relays for power system protection.
f) IS:8623: Specification for factory built assemblies of switchgear and control gear for voltage up to and including 1000-V AC/1200 V-DC
g) IS: 4237: General requirements for switch gear and control gear for voltage not exceeding gear.
h) IS: 2147; Degree of protection provided by enclosures for low voltage switch gear and control gear.
i) IS: 1018: Switchgear and control gear selection/installation and maintenance.
j) IS: 1248: Direct acting electrical indicating instruments.
k) IS: 375: Arrangement for switchgear, bus bars, and main connections, auxiliary wiring and marking.
l) IS:: 2959: AC contactors for voltage not exceeding 1000V.
m) IS: 5578: Guide for marking of insulated conductors.
n) IS: 11050: Guide for forming system of marking and identification of conductor's apparatus terminal.
o) IS: 1248: Direct acting indicating analogue electrical measuring instruments and Testing accessories.
p) IS:600: Code of practice for phosphating of iron & steel

20.2 The board shall be metal enclosed single front, indoor, floor mounted, free standing type or wall mounting type as mentioned in BOQ. The panel shall be designed for a degree of protection of IP-55. However bus bar chamber shall have IP: 42 degree of protection incase bus bar rating exceed 1600 Amps. Keeping in view the operating height of the top switch 1750mm from finish floor. 400mm clear space shall be left throughout the panel at bottom. The cold rolled sheet steel will be of 2mm thick. The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 3mm thickness and 50mm height.

All cut-outs and covers shall be provided with synthetic rubber gaskets (preferably neoprene). The panel shall be divided into distinct vertical sections each comprising of:

i) Complete enclosed bus bar compartment for running horizontal and vertical bus bars.
ii) Complete enclosed switchgear compartment one for each circuit for housing air circuit breaker, MCCB/MPCB with starters etc.
iii) Compartment for power and control cables of at least 300mm width covering entire height provided.
iv) The panel shall have sufficient space at least 20% of outgoing feeders for future use.

The front of each compartment shall be provided with hinged single leaf door with locking facilities. Panel shall be provided with suitable lifting facilities. Isolators and MCCB/ACBs and accessories shall be of fixed/draw out type as per BOQ.

Each feeder shall have compartmentalized or non-compartmentalized for MCB feeders only. Ri-tall type with separate construction cable entry shall be from top/bottom (3mm thick gland plate with suitable numbers & sizes of knockout holes (as called for in schematic/ fabrication drawings) shall be provided.

The panel shall be provided with three phase buses & neutral bus bars of high conductivity electrolytic copper/Aluminum sections throughout the length of the panel & shall be adequately supported and braced to withstand the stressed due to the short circuit current of 35 KA rms. for 1 sec. as called for in BOQ/Data Sheet. Maximum temperature rise of bus bars and bus bar connection while carrying rated current shall not exceed 40 Deg.C over an ambient temperature of 50 Deg.C. The Current density of Bus Bar shall be 1.0 Amp/mm^2 for Aluminum and 1.5 Sq.mm/mm^2 for copper.

The minimum clearance in air between phases and between phases and earth for the entire run of the bus bar connections shall be 32mm minimum. Bus bars support insulators shall be made of non-hydroscopic non-combustible track resistant and high strength SMC or polyester fiberglass moulded material.

All bus bars shall be colour coded as per IS: 375.

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

Sheet steel hinged lockable doors shall be interlocked with MCCB to prevent opening of the panel when MCCB is on position. Safety interlock with operating handle shall be provided.

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

21.0 ACB (IEC 60947-2; IS 13947)

The circuit breaker shall be of air break type in order to eliminate fire and explosion risk and shall comply with the IEC with a rupturing capacity of not less than 35 MVA at 415 volts or as specified elsewhere (The service short circuit breaking capacity shall be as specified and equal to the short circuit with stand value Ics = Icu). The breaker shall be provided with variable microprocessor based releases within built fault differentiation for integral over load, short circuit and earth fault & other protection as called for in BOQ, LED indication for type of fault, CT's for protection and measurement class as called for in BOQ, and LCD display of curves and parameters. Electrical endurance without maintenance shall be greater than 2000 cycles

Mechanical & electrical anti pumping devices shall be provided in breaker, as required.

The breaker shall have memory for logging history for type of fault, load, time & date and the Vendor shall mention in the data sheet for no. of loggings available in the breaker memory.

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

Self-aligning cluster type isolating contacts shall be provided on breaker for interlocking protection metering and for any other purposes. The breaker should have 3 distinct positions - SERVICE/TEST/ISOLATED within the cubicle.

The ACB shall be with molded housing class II front fuse and shall be suitable for Isolation as per the annexure 7.1.2 in the standard.

Breaker shall be provided with automatic safety shutters to screen the main live contact when the breaker is withdrawn. The frame of the circuit breaker could be positively earthed when the breaker is racked into the cubicle.

The following safety arrangements shall be provided for the safety of the personnel to prevent mal-operation.

i) Interlock to prevent the truck from being withdrawn or replaced except in the fully isolated position.
ii) Interlock to prevent earth connection from being made by the earthing device except breaker is open.
iii) Interlock to prevent the breaker being closed unless it is fully raised.
iv) Interlock to prevent the breaker from being made alive without its rack in position

21.1 Protection Releases

Self-powered & true RMS sensing microprocessor based release with following features:

a) Incomer ACB of Panels

Long-time short circuit protection with time delay. Instantaneous and earth fault protection with LCD display to show RMS current in all three phases, neutral (for 4pole) simultaneously. The other features of the release to be as under.

- The release should display distinct fault indication for each type of tripping for faster fault diagnosis and reduce down time & should protect ACB from over temperature and Phase unbalance.
- Release should provide contact wear indication in display no. of operation seen by the breaker for case

of maintenance.

- The release shall be self-diagnosis & should provide fault history including cause of fault as well as level of fault current. It should be possible to store minimum 20 last trip data with non-volatile memory.
- The protection setting of release should be accessible to change locally.
- LCD display should be at least 4-line display and should be able to display current is all the 3 phases and neutral (4 pole) simultaneously.

b) For Outgoing ACB feeder

Long-time Short circuit protection with time delay (for discrimination), instantaneous. The other features of the release to be as under.

- The release should have distinct fault indication for each type of tripping for faster fault diagnosis and reduced down time and shall protect ACB from over temperature and phase unbalance.

  - Operation counter
  - Alarm and warning indication

- Type test certificate: The ACB's shall be type tested ad certified for coplion is to IS 13947/equivalent / EC standard from Indian / International testing authority, supplier to submit certificate of the same.

22.0 MOULDED CASE CIRCUIT BREAKER (MCCB)

MCCB shall confirm to the latest IS13947 -1993/IEC 60947. The Service Short Circuit Breaking Capacity (Ics at 415 VAC) should be as specified.

MCCB shall be Current Limiting and comprise of Quick Make – Quick Break switching mechanism & Double Break Contact system. The arc extinguishing device and the tripping unit contained in a compact, high strength, heat resistant, flame retardant, insulating molded case with high withstand capability against thermal and mechanical stresses. All MCCBs shall be capable of defined variable overload short circuit and earth fault adjustment with thermo- magnetic releases up to 250A and with electronic release above 250A onwards.

The Service Short Circuit Breaking Capacity (Ics at 415 VAC) should be as called for in BOQ and is the required minimum value for that feeders/ panel, however if the rating of feeder mentioned is not available, the contractor shall used next higher rating without any extra charges. The service short circuit breaking capacity shall be equal to ultimate breaking capacity of MCCB, i.e. Ics= 100% Icu

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

The handle position shall give positive indication of 'ON', 'OFF' or 'Tripped' thus qualifying to disconnection as per the IS/IEC indicating the true position of all the contacts. In case of 4 pole MCCB the neutral shall be defined and capable of offering protection up to full rating. The remote tripping coil should be of continuous duty. The general-purpose control switch shall be provided for ON/OFF Auto/Manual. The switch shall be provided with engraving plates on the front with the complete inscription.

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

Indicating lamps shall be of the panel mounting, LED type and shall have execution plates marked with its function wherever necessary. The color of the lamp cover shall be red for 'ON' and green for 'OFF' indicating lamps shall be provided with series resistor. MCCB shall be provided with interlocking devise for interlocking the door of switchboard. Following shall be included if specified in the drawing or in the schedule of quantities.

- Under voltage trip
- Shunt trip

- Alarm Switch
- Auxiliary switch

The contactors should comply with the latest IEC947-4 and the corresponding IS13947-4 standards. They shall have UL and CSA approval. The contactors should be rated for AC3 duty at 415V and 50Hz. The contacts should be fast closing and fast opening type. The making and breaking capacity values of the contactors should be as follows (as per IEC947-4):

For AC3 Duty

- Making Capacity equal to or more than 10 Ie
- Breaking Capacity equal to or more than8 Ie

For AC4 Duty

- Making Capacity equal to or more than 12 Ie
- Breaking Capacity equal to or more than 10 Ie

The contactors should be capable of frequent switching and should operate without derating at 600C for AC3 applications. They should be climate proof as standard. The coil of the contactor should have class H insulation to support frequent switching.

The rated voltage of the contactor shall be equal or superior at 690 V, and rated insulation voltage shall be 690 V. The rated impulse voltage of the contactor should be 8 KV.

The contactor should be modular in design with minimum inventory requirements and built in mechanically interlocked 1NO 1NC auxiliary contact up to 32A. They should be suitable for the addition of auxiliary contacts and other electrical auxiliaries without any compromise on the performance or the operation of the contactors. The contactors from 4 KW to 400 KW will be associated with the same auxiliary contact block range.

Wherever D.C control is required, the contactor should have wide range (0.7 to 1.25Uc) D.C coil with built in interference suppression as standard.

The control and power terminals should be at separate **layers preferably with colour coding (black for power and white for control**).

All contactors power connection will be **finger safe (IP2X)** as standard.

They should be capable of being integrated into automated system (PLCs etc.) without any interposing components in minimum operating conditions.

The thermal over load relay if used will be directly mounting under the contactor without any specific connections.

22.1 NAME PLATES & LABELS

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

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

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

22.2 PAINTING

All steel work shall be pre-treated in tanks and finally powder coated of approved shade.

22.3 WIRING

Control and protective wiring shall be done with copper conductor PVC insulated 1100 volts grade multi-stranded flexible wire of 2. 5sq.mm cross section. The colour coding shall be as per latest edition of IS: 375.

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

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

Not more than one wire shall be connected to any terminal block. All doorframe of L.T. switchboard shall be earthed with bare braided copper wire.

22.4 TESTING & INSPECTION

After completion of all work at the manufacturer's works the switchboards shall be inspected and tested in presence of Purchaser's representative. However, stage inspection may be carried out from time to time to check progress of work and workmanship. The following tests shall be carried out:

i) All routine tests specified in relevant Indian/British Standards shall be carried out on all circuit breakers.
ii) Test for protective relay operation by primary or secondary injection method. Operation of all meters.
iii) Operation of all meters.
iv) Secondary wiring continuity test.
v) Insulation test with 1000 Volts megger, before and after voltage test.
vi) HV test on secondary wiring and components on which such test is permissible (2KV for one minute)
vii) Simulating external circuits for remote operation of breaker, remote indicating lights and other remote operations, if any.
viii) Measurement of power required for closing/trip coil of the breaker.
ix) Pick up and drop out voltages for shunt trip and closing coils.
x) CT Polarity test.

Vendor shall provide all facilities such as power supply, testing instruments and apparatus required for carrying out the tests. Required copies of test certificates for all the tests carried out along with copies of type test certificates and certificates from Sub-Vendor for the components procured from them are to be submitted before dispatch of switchboards.

22.5 DRAWINGS AND INFORMATION

The Vendor shall furnish following drawings/documents in accordance with enclosed requirements:

i) General Arrangement drawing of the Switchboard, showing front view, plan, foundation plan, floor cut-outs/trenches for external cables and elevations, transport sections and weights.
ii) Sectional drawings of the circuit breaker panels, showing general constructional features, mounting details of various devices, bus bars, current transformers, cable boxes, terminal boxes for control cables etc.
iii) Schematic and control wiring diagram for circuit breaker and protection including indicating devices, metering instruments, alarms, space heaters etc.
iv) Terminal plans showing terminal numbers, ferrules markings, device terminal numbers, function etc.
v) Relay wiring diagrams.
vi) Equipment List.

Vendor shall furnish required number of copies of above drawings for Purchaser's review, fabrication of switch boards shall start only after Purchaser's clearance for the same. After final review, required number of copies and reproducible shall be furnished as final certified drawings.

The information furnished shall include the following:

i) Technical literature giving complete information of the equipment.
ii) Erection, Operation and Maintenance Manual complete with all relevant information, drawings and literature for auxiliary equipment and accessories, characteristics curves for relays etc.
iii) A comprehensive spare parts catalogue.

22.6 TOOLS

One complete set of all special or non-standard tools required for installation, operation and maintenance of the switchboard shall be provided. The manufacturer shall provide a list of such tools with his quotation.

22.7 SPARES

The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

22.8 QUALITY ASSURANCE

Quality Assurance shall follow the requirements of Owner/ Consultant as applicable.

Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser's requirements.

22.9 DEVIATIONS

Deviation from specification must be stated in writing at the quotation stage. In absence of such a statement, it will be assumed that the requirements of the specifications are met without exception.

23.0 BATTERY & BATTERY CHARGER

23.1 SCOPE

The specifications give details of the Battery Charger suitable for HT/ LT Panels. The batteries are housed in the Bottom Compartment of the Battery Charger. Sealed maintenance Free Batteries upto 24V – 200AH or Lead Acid Batteries upto 24V – 150AH can be housed in the Battery Compartment. The Battery Charger is a composite Battery Charger cum DC Distribution Board.

23.2 GENERAL

The Battery Charger shall be Float cum Boost type, Thyristor controlled. The Charger shall have selector switch for Auto Float – Boost/Manual Float/Manual Boost Mode of operation. During Auto Float – Boost Mode, Automatic Changeover shall take place from Float Mode to Boost Mode and vice – versa. This means that when the Batteries are fully charged the charging shall automatically change from Boost charge to Trickle charge.

Construction Feature

Float cum Boost Charger and DC Distribution Board shall be housed in Sheet Steel Cubicle with Panels of 1.6mm thickness, louvers for ventilation, gland plate will be provided for cable entry from bottom. The cubicle shall be painted in Siemens Grey Shade. The Battery Charger shall be divided into two Compartments. The Upper Compartment shall house the Battery Charger & DCDB with all the necessary controls. The Lower Compartment shall be suitable for housing the Batteries.

23.3 PERFORMANCE

A) The D.C. Output Voltage of Float/Boost Charger shall be stabilized to within □ 2% for A.C. Input variation of 230V □ 10%, frequency variation of 50 Hz □ 5% and D.C. Load variation of 0– 100%. The Voltage Regulation shall be achieved by a constant voltage regulator having fast response SCR controlled. The ripple content in output shall

be within 3% of D.C. Output Nominal Voltage.

B) There shall be provision to select Auto Float/Manual Float /Manual Boost Modes. During Auto Float Mode the Battery Charging shall automatically changeover from Boost Mode to Float Mode and vice – versa. During Manual Float/Boost Modes it shall be possible to set the output volts by separate potentiometers.

The Battery Charger shall have automatic output Current Limiting feature.

23.4 COMPONANTS

The Battery Charger shall essentially comprise of the following:

A. 1 No. Double Pole ON/OFF MCB at A.C. Input.

B. 1 No. Pilot Lamp to indicate Charger ON.

C. 1 No. MAIN TRANSFORMER: Double Wound, naturally air – cooled, having Copper winding.

D. 1 Set Single Phase full wave Bridge Rectifier consisting of 2 nos. Diodes and 2 nos. SCR's, liberally rated, mounted on Heat Sinks and complete with Resistor/Condenser network for surge suppression.

E. 1 No. Rotary Switch to select AUTO FLOAT/MANUAL FLOAT/MANUAL BOOST. During Auto Float Mode Automatic Changeover shall take place from Float Mode to Boost Mode and vice-versa.

F. 1 Set Solid state constant potential controller to stabilize the DC Output Voltage of the Float cum Boost Charger at □ 2% of the set value for AC Input Voltage variation of 230V □10%, Frequency variation of □ 5% from 50Hz and simultaneous Load Variation of 0 - 100% and also complete with Current Limiting Circuit to drop the Float Charger Output Voltage upon overloads to enable the Battery to take over.

G. 1 No. Electronic Controller to automatically changeover Battery Charging from Boost to Float and vice – versa.

H. 1 No. DC Ammeter and Toggle Switch to read Charger Output Current and Battery Charge / discharge current.

I. 1 No. Moving Coil DC Voltmeter to read the DC Output Voltage.

J. 2 Set Potentiometer to adjust the output Voltage during Manual / Auto Float and Boost Modes.

K. 1 No. Double Pole ON/OFF MCB at Charger Output.

L. Dc Distribution Board :

INCOMER: 1 No. 63A DP MCB, as called for in BOQ.
OUTGOING: Suitable No. 16A/20A DP MCB, as called for in BOQ

23.5 ALARM ANNUNCIATION

Visual and Audible Alarm with Manual Accept/Reset Facility shall be provided for the following:

a) A.C. Mains Fail.

b) Charger Fail.

c) Load/Output overvolt.

RAITING

AC INPUT ; 230V □10% AC 50 Hz Single Phase

DC OUTPUT ; To Float/Boost charge 24V / 100AH, Batteries and also supply a continuous load
CURRENT RATING : 15.0 Amps
FLOAT MODE ; 27.0V Nominal (Adj. between 24.0 – 28.0V)
BOOST MODE : 28.0V Nominal (Adj. between 24.0 – 30.0V)
VOLTAGE REGULATION: 2% of the set value
RIPPLE : Less than 3%

For 24V / 100 AH Batteries the Charger Rating is given in the Specification for Batteries of other capacities refer to the Table as given below:

BATTERY CAPACITY	CHARGING RATING
24V / 40AH	10.0Amp.
24V / 60AH	15.0Amp.
24V / 100AH	15.0Amp.
24V / 120AH	20.0Amp.
24V / 150AH	25.0Amp.
24V / 200AH	30.0Amp.

24.0 EARTHING

All electrical equipment is to be earthed by connecting two earth tapes from the frame of the equipment to a main earth ring. The earthing ring will be connected via several earth electrodes. The cable armour will be earthed through cable glands. Earthing shall be in conformity with provision of rules 32, 61, 62, 67 & 68 of Indian Electricity Rules 1956 and as per IS-3843-1966.

The following shall be earthed:

1. Transformer & D.G. Set neutrals.
2. Transformer Housing.
3. H.T. Panels.
4. Non-current carrying metallic parts of electrical equipment such as switchgear, bus ducts, rising mains, panel boards, motor control centers, power panels, distribution boards, cable trays, metal conduits, welding sockets etc.
5. Generator & motor frames.
6. All fixtures, sockets outlets, fans, switch boxes and junction boxes etc. shall be earthed with PVC insulated copper wire as specified in item of work. The earth wires ends shall be connected with solderless bottle type copper lugs.
7. The third pin of Outlets on UPS shall be provided with a separate PVC insulated Cu. Wire (green with yellow stripe) as Isolated ground earth wire apart from the earthing of box.

The earth connections shall be properly made. A small copper loop to bridge the top cover of the transformer and the tank shall be provided to avoid earth fault current passing through fastened bolts, when there is a lightning surge, high voltage surge or failure of bushings.

The shop drawing for earthing system shall be prepared by the contractor and be got approved by Owner/Architect. The work shall be done in accordance with approved drawings.

All earth electrodes shall be given to a depth sufficient to reach permanently moist soil. Their location shall be marked and approval taken from Engineer-in-Charge before excavation for the same.

The earth electrodes shall be tested for earth resistance by means of a standard earth test ohms meter. All tests shall take place during the dry months, preferably after a protected dry spell.

The resistance between earthing system and the general mass of earth shall not be greater than 1 ohm.

The earth loop resistance to any point in the electrical system shall not be in excess of 1 ohms in order to ensure satisfactory operation of protective devices. The resistance to earth shall be measured at the following: -

a) At each electrical system ground or system neutral ground.
b) At one point on each grounding system used to ground electrical equipment enclosures.
c) At one point on each grounding system used to ground wiring system enclosures such as metal conduits and cable seaths or armoured.

All earthing conductors shall be of high conductivity copper/ G.I. as per B.O.Q. and shall protected against mechanical damage. The cross-sectional area of earth conductors shall not be smaller than half that of the largest current carrying conductor. However, the contractor shall use the sizes specified in the bill of quantities of the Tender.

24.1 Pipe Earth Electrode

G.I. pipe shall be of medium class and of the size and dia as specified in BOQ. G.I. Pipe electrode shall be cut tappered at bottom and provided with holes of 12mm dia drilled not less than 7.5cm from each other upto 2m of length from bottom. The electrode shall be burried in the ground vertically with its top not less than 20cm below ground level.

24.2 Pipe Earth Electrode

The plate earth electrode shall consist of copper plate or G.I. plate as per item of work. The plate electrode shall be burried in ground with its faces vertical and top not less than 2.5m below Ground level. The plate shall be filled with charcoal dust and common salt filling, extending 15cm around it on all sides.

A watering pipe as specified in BOQ, of medium class G.I pipe shall be provided. The top of the pipe shall be provided with a funnel and a G.I. mesh screen for watering the earth. In the case of pipe electrode a removable plug shall be provided as per drawing. This will be housed in a masonry sump (with cement plastering) of not less than 40 cm square and 40 cm deep. A C.I. frame with hinged cover of 10mm thickness and locking arrangement shall be suitably provided over the sump. The earthing lead from electrode onwards shall be suitably protected from mechanical injury by a suitable dia medium class PVC/ HDPE pipe. The overlapping in G.I. strips in joints shall be rivetted with revets and welded in approved manner. The protection pipe within ground shall be burried at least 30 cm deep (to be increased to 60cm in case of road crossing and pavements). The portion within the building shall be recessed in walls and floors to adequate depth. In the case of plate earth electrode, two nos. 50mm x 6mm GI/Cu. Strip the earthing lead shall be securely bolted to the plate with two zinc passivated bolts, nuts, checknuts and washers. In case of pipe electrode, it shall be connected by means of a through bolt, nuts and washers and cable socket. Main earthing conductor is taken from the earth electrode with which the connection is to be made.

No earth pit shall be fixed within 2.5M of a wall of foundation. The location of the earth electrode will be such where the soil has reasonable chance of remaining moist. Effort shall be made to locate them in grass lawns or near flowerbeds or water taps. The distance between two earthing stations shall be at least 3.0 meters.

24.3 Testing & Commissioning

Testing and commissioning shall be done as per the programme/ instructions to be given by Owner's authorised representative. All testing equipments necessary to carry out the tests shall be arranged by the electrical Contractor.

Before the electrical system is made live, the electrical Contractor shall carry out suitable tests to the satisfaction of Owner that all equipment wiring and connections have been correctly done and are in good working condition and will operate as intended.

All tests shall be conducted in the presence of the Owner authorised representative by the electrical Contractor and shall be notified one week before tests are to take place.

All measurements shall conform to establish minimum acceptable test values. Owner's Engineer reserves the right to approve all test results before circuit or equipment's are energised for the first time.

25.0 LIGHTNING PROTECTION SYSTEM

Protection of buildings against lightning shall generally be done in accordance with latest IS-Code. The installation shall be done as per routes and location of equipment indicated on the drawing and bill of quantities. The conductors and the earth electrode conductor shall be fixed so that they are free to expand and contract. Special care shall be taken in the fixing of support to allow free movement.

The materials of lightning conductors, down conductors, earth termination etc. shall be reliably resistant to corrosion or be adequately protected against corrosion. All air terminations shall be GI and the conductors shall be GI.

The entire lightning protection system should be mechanically strong to withstand the mechanical forces produced in case of a lightning strike. The system shall be installed such that it does not spoil the architectural or aesthetic beauty of the buildings but on other hand at should meet IS code/safety code.

Horizontal air terminations should be so interconnected that no part of the roof is more than 9 metres away from the nearest horizontal conductor. For a flat roof horizontal air termination along the outer perimeter of the roof is used. For a roof of larger area a network of parallel horizontal conductors shall be installed. Horizontal air terminations shall be laid along contours such as ridges, parapets and edges of flat roofs and where necessary area flat surfaces in such a way as to connect each air termination to the rest and shall, they form a closed network.

All metallic finials, chimneys, ducts, vent pipes, railings, gutters, metallic flag staff, on or above the main surface of the roof of the structure shall be bonded to and form part of the air termination network. All air terminations shall be effectively recessed against overturning either by attachment to the object to be protected or by means to substantial braces and fixing which shall be permanently and rigidly attached to the buildings.

Down conductors shall be distributed around the outside walls of the structure. They shall preferably be run along the corners and other projection, due considerations being given to the locations of air terminations and earth terminations. Lift shafts shall not be used for fixing down conductors. Metal pipes leading rainwater from the roof to the ground may be connected to the down conductors but cannot replace them. Such conductors shall have disconnecting joints. All vertical conductors shall be plumbed before fixing. Insulation shall be provided between down conductors and wall.

The lightning protective system shall have as few joints in it as possible. Wherever joints in the down conductor above ground level are necessary they shall be mechanically and electrically effective. The joint overlap shall not be less than the width of the tape. In the down conductor below ground level there shall be no joint. The joints may be clamped, screwed, bolted, riveted, sweated, braced or welded. The bonding of the external metal forming part ofa structural or drain water pipe shall have a cross sectional area not less than that employed for the main conductors. Gas pipe, however, in no case shall be bonded to the earth termination system.

Conductors shall be securely attached to the building to be protected by fasteners, which shall be substantial in construction, not subject to breakage and shall be of steel. The conductors shall be secured at not more than 900mm apart for horizontal run and 750mm for vertical run.

Where tape are required to pass through roof asphalting or other waterproofing membranes, a special seal shall be used comprising a 38mm diameter plastic, copper or aluminum tube with 100mm diameter flange 50mm from the top of the tube. The tube length shall suit the thickness of the roof through which the conductor passes, allowing for the tube to protrude 50mm above the membrane. The seal is to be asphalted in position and the conductor shall be sealed in the tube by a setting waterproof compartment.

Each down conductor shall have an independent earth termination. The interconnection of all the earth termination shall be preferable. It should be capable of isolation for testing purpose by “testing joints” at position approachable easily for the meggar testing. The whole of the system could have a combined resistance to earth not exceeding 2 ohm before any bonding has been affected to metal in or on structure or two surfaces below ground.

26.0 CAPACITORS

Power factor correction capacitors shall conform in all respects to IS 2834-1964. The capacitors shall be suitable for 3 phases 415V at 50Hz. frequency and shall be available in units as per B.O.Q. to form a bank of capacitors of desired capacity. All these units shall be connected in parallel by means of high conductivity electrolytic copper busbars of adequate

current carrying capacity having S.C rating of 25 KA for 1 sec. Each capacitor bank shall be for PVC insulated aluminum conductor armoured cables. Two separate earthing terminals shall be provided for each bank for earth connection. The capacitor bank shall be housed indoor.

The capacitor bank shall be subject to routine tests as specified in relevant Indian Standard and the test certificate shall be furnished. The capacitor shall be suitable for indoor use up to 45 Deg.C over and above ambient temperature of 50degree C. The permissible overloads shall be as given below:

a) Voltage overload shall be 10% for continuous operation and 15% for 6 hours in a 24 hours cycle.
b) Current overloads 15% for continuous operation and 50% for 6 hours in a 24 hours cycle.
c) Overload of 30% continuously and 45% for 6 hours in a 24 hours cycle.

The capacitor banks shall be floor mounting type indoor housing using minimum floor space with protective guard or fencing. The capacitor bank shall be provided with 7% Detuned reactor filter to compensate third harmonics from being generated.

Capacitors shall be of aluminum foil and craft paper. Hermetrically sealed in sturdy corrosion-proof sheet steel 2mm thick containers and impregnated with non-inflammable synthetic liquid and of low power loss version. Every element of each capacitor unit shall be provided with its own built in silvered fuse. The capacitor shall have suitable discharge device to reduce the residual voltage from crest value of the rated voltage to 50 V or less within one minute after capacitor is disconnected from the source of supply. The loss factor of capacitor shall not exceed 0.005 for capacitors with synthetic impregnants. The capacitors shall withstand voltage of 2500V AC supply for 1 minute.

The insulation resistance between capacitor terminals and containers when test voltage of 500V A.C. is applied shall not be less than 50 megohms.

- Capacitor bank and switching equipments shall be housed in a cubicle having degree of protection IP-51 and constructed with sheet steel of minimum 2mm thickness.
- Capacitors shall be unit type having non-PCB, non-flammable non-toxic dielectric.
- Necessary discharge resistor shall be provided externally to reduce the terminal voltage to or less then 50V in 60 seconds of disconnection from supply.
- Testing shall be done as per applicable standards for shunt capacitors.

27.0 CAPACITOR CONTROL PANEL

The capacitor control panel shall general comprise of the following:

a) Automatic power factor correction relay.
b) Step controller with reversing motor.
c) Time delay and no-volt relays.
d) Protection MCCB / MCB.
e) Contactor (AC-3 duty) for individual capacitors of suitable rating.
f) Change over switch for either automatic operation or manual operation with push button control.
g) C.T.s with ammeter and selector switch as asked for in BOQ.
h) Voltmeter with selector switch.
i) Indicating lights RYB.

All the capacitors and contactors shall be interconnected with PVC insulated copper conductor wires of adequate size in a neat and acceptable manner. Three phases and neutral bus bar shall be provided in panel as required.

The above control gear, P.F. meter, Digital Microprocessor based P.F. correction relay, push button station etc. shall be housed in a sheet steel metal enclosure cubical type, free standing front operated with lockable doors. The panel shall be fabricated from MS sheet steel 2mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet steel shall be seam-welded. The panel shall be totally enclosed design completely dust tight and vermin proof. Gaskets between all adjacent units and beneath all covers shall be used to render the joints effectively.

All sheet steel material used in the construction of capacitor control panel should have undergone a rigorous rust proofing process comprising Alkaline Degreasing, descaling in dilute sulphuric acid and recognized phosphating process. The steel work should then receive two coats of primer before applying final coat of epoxy paint of approved shade.

27.1 QUALITY ASSURANCE

Quality Assurance shall follow the requirement of Client/ Consultant. Q.A. documents as applicable.

Q.A. involvement will commence at enquiry and follow through to composition and acceptable thus ensuring total conformity to purchaser's requirement.

27.2 DEVIATIONS

Deviations from the specification must be stated in writing at the quotation stage.

In the absence of such a statement it will be assumed that the requirements of the specifications are met without exception.

27.3 SPARES

The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

28.0 H.T. CABLE (XLPE) (33 KV)

The cross-linked polyethylene (XLPE) cable shall be aluminum conductor PVC outer sheath steel strip armoured over inner sheath construction. XLPE cable shall conform to testing in accordance with IS: 7098 (Part-I) 1977 and (Part-II) 1973. The screening shall be done on individual cover. The armouring applied over the common covering shall be flat steel wires. Each and every length of cable shall be subjected to routine test.

The termination and jointing techniques for XLPE cables shall be by using heat shrinkable or push on cable jointing kits.

While laying underground cables in ducts care should be taken so that any underground structures such as water pipes, sewerage lines etc. are not damaged. Any telephone or other cable coming in the way shall be properly protected as per instructions of the Engineer-in-charge. The H.T. cable shall be laid at least 900mm for cable upto 3 KV
(E) below the ground level in a trench 450mm wide.

Insulation tests shall be done before and after laying of cables.

After laying and jointing work is completed a high POT test shall be performed in presence of Engineer and test results submitted for approval in order to ensure that they have not been damaged during or after the laying operation. In case, the test results are unsatisfactory, the cost of all repairs and replacement and all extra work of removal and relaying will be made good by the contractor without any extra cost.

29.0 H.T. CABLE (XLPE) (33 KV)

29.1 WIRES

The design manufacture, testing and supply of single core FRLS PVC insulated 1.1 KV grade multi-stranded twisted wires under this specification shall comply with latest edition of following standards.

IS : 3961 Current rating for cables.

IS: 5831 PVC insulation and sheath of electric cables.

IS : 694 PVC insulated cables for working voltage upto and including 1100 volts.

IEC: 754(i) FRLS PVC insulated cable.

Copper multi-stranded twisted conductor FRLS PVC insulated wires shall be used in conduit as per item of work. The wires shall be colour coded R Y B, for phases, Black for neutral and Green for earth.
Progressive automatic in line indelible, legible and sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of wire.

29.2 CABLE

The design, manufacture, testing and supply of the cable under this specification shall comply with latest edition of following standards:

IS: 8130 Conductors for insulated electric cables and flexible cords. IS: 7098 XLPE insulation and sheath of electric cables.
IS: 3975 Mild steel wires, strips and tapes for armouring cables. IS: 7098 Current rating of cables.
IS: 7098 XLPE insulated (heavy duty) electric cables for working voltage upto and including 1100 volts. IS: 424-1475(F-3) Power cable-flammability test.
Specification for cross-linked polyethylene insulated XLPE sheathed cable for working voltage upto 1.1 KV. Specification for XLPE insulated (heavy duty) electric cables for working voltages upto and including 1100 volts.
ASTM-D: 2863 Standard method for measuring the minimum oxygen concentration to support candle-like combustion of plastics (Oxygen Index).

ASTM-D: 2843 Standard test method for measuring the density of smoke from the burning or decomposition.

IEEE: 383 Standard for type of test Class-IE, Electric cables, feild splicers and connections for power generation station.

ASTME: 662IEC:754(x) Standard test method for specific optical density of smoke generated by solid materials. IS: 10418 Cable drums.

29.3 Technical Requirements:

i. The cables shall be suitable for laying in racks, ducts, trenches conduits and under-ground buried installation with uncontrolled back fill and chances of flooding by water.
ii. They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating condition.
iii. The aluminum/copper wires used for manufacturing the cables shall be true circular/sector in shape before stranding and shall be of uniformally good quality, free from defects. The conductor used in manufacture of the cable shall be of H2 grade.
iv. The cable should withstand 25 KA for 0.5 sec with insulation armour insulated at one end. Bidder shall furnish calculation in support of capability to withstand the earth fault currents. The current carrying capacity of armour and screen (as applicable) shall not be less than the earth fault current values and duration.
v. The fillers and inner sheath shall be of non-hygroscopic fire retardant materials and shall be suitable for the operating temperature of the cable. Filler and inner sheath shall not stick to insulation and outer sheath.
vi. Progressive automatic in line indelible, legible and sequential marking of the length of the cable in meters at every one meters shall be provided on the outer sheath of all cables and at every 5 meter ‘FRLS’ marking in case of ‘FRLS’ cables.
vii. Strip/Wire armouring following method (b) mentioned in IS: 3975 shall only be acceptable. For single core cable aluminum wire armouring shall be used.
viii. Allowable tolerance on the overall diameter of the cables shall be + 2mm.
ix. The normal current rating of all XLPE insulated cables shall be as per IS: 7098.
x. A distinct inner sheath shall be provided by pressure extrusion process for all multicore armoured and Unarmoured cables as per IS: 5831.
xi. Outer sheath shall be provided by extrusion process as per IS: 5831
xii. The breaking load of armour joint shall not be less than 95% of that armour wire. Zinc rich paint shall be applied on armoured joint surface.
xiii. In plant repairs to the cables shall not be accepted.
xiv. All the cables shall be supplied in non-returnable drums as per IS: 10418.
xv.

29.4 In Case of FRLS Cables

i. The outer sheath of cables shall have an oxygen index of not less than 29 as per ASIMD: 2863.
ii. The maximum acid gas generation by weight as per IEC: 754 (i) shall not be more than 20% for outer sheath material of all cables. Bidder shall also guarantee the maximum theoretical acid gas generation with 20% by weight of outer sheath.
iii. The cables outer sheath shall meet the requirement of light transmission of 40% (minimum and shall be tested as per ISTMD: 2843). In case the test for light transmission is conducted as per ASTME: 662. The bidder shall furnish smoke density values as per this standard and shall co-relate the anticipated light transmission when tested as per ASTMD: 2843.
iv. The cable shall pass the fire resistance test as per SS: 42, 41, 475 (I) and flammability test as per EEE:

29.5 Inspection:

All cables shall be inspected on receipt of the same at site and checked for any damage during transit.

29.6 Joint in Cables

The contractor shall take care that the cables received at site are distributed to various locations in such a manner as to ensure maximum utilisation and avoidance of cable jointing. Cable shall be rechecked before cutting in lengths, where the joints are unavoidable, and the location of such joints shall be got approved from the Owner/Consultant. The joints shall be done by qualified jointer strictly in accordance with manufacturer's instruction/drawings.

29.7 Joint Boxes for Cables

The cable joint boxes shall be of appropriate size suitable for type of cable of particular voltage rating.

29.8 Jointing of Cables

All straight through joints shall be done in epoxy mould boxes with epoxy resins. Straight through joints shall not be permitted unless the length of run is in excess of cable drum.

End terminations of cables more than 1.1 KV grade shall be done with epoxy mould boxed and epoxy resin. Cable glands shall be 1.1KV grade double compression type and made to tin plated heavy-duty brass casting and machine finished. Glands shall be of robust construction capable of clamping cable and cable armour, firmly without injury of cable.

All washers and hardwares shall be made of brass tinned. Rubber components used in the glands shall be made of neoprene of tested quality.

Cable lugs shall be tinned copper/aluminum solderless crimping type conforming to IS: 8309 suitable for aluminum or copper conductor.

Crimping of terminals shall be done by using Corrosion inhabitory compound, with crimping tool. Fire resistant paint has to be applied 1 Meter on either side of cable joint.
The contractor shall liaise fully with all other contractors to achieve an efficient and properly coordinated installation where equipment has to be re-positioned due to lack of site liaison; no extra cost shall be incurred by the client.

29.9 Testing of Cables

Cables shall be tested at factory as per requirement of IS: 7098 Part-I. The tests shall incorporate routine tests, type tests and acceptance tests. Prior to laying of cables, following tests shall be carried out:

i. Insulation test between phases and phase to earth for each length of cable before and after jointing.

On completion of cable laying work, the following test shall be conducted in the presence of Architect/Owner.

i. Insulation resistance test (Sectional and overall) 1000/5000V depending upon the voltage grade of cable.

ii. Continuity resistance test.

iii. Sheathing continuity test.

iv. Earth test.

29.10 Laying of Cable

The cable drum shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming links. At all changes in directions in horizontal & vertical places, the cable shall be bent with a radius of bend not less than 8 times the diameter of cable.

The cable of 1.1KV grade shall be laid not less than 750mm below ground level in a 375mm wide trench (throughout), where more than one cable is to be laid in the same trench, the width of the trench shall be increased such that the interaxial spacing between the cables except where otherwise specified shall at least be 150mm minimum or as per site requirements or as approved by the Engineer-in-charge. Where single core cables are used in multiphase systems, the cables shall be installed in trefoil where possible.

In case the cables are laid in vertical formation due to unavoidable circumstance the depth per tier shall be increased by 200mm (minimum). Cable shall be laid in reasonably straight line, where a change in direction takes place a suitable curvature shall be i.e. either 12 timesthe dia meter of the cable or the radius of the bend shall not be less than twice the diameter of the cable drum or whichever less is. Minimum 3-meter long loop shall be provided at both sides of every straight through joint & 3 meters at each end of cable or as directed at site.

Greater care shall be exercised in handling the cable in order to avoid forming 'Kinks'. The cable drum shall in-verbally convey on wheels and the cable unrolled in right direction as indicated on the drum by the manufacturer. The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains.

Cables laid in trenches in single tier formation, 10 cms. All around sand cushioning is provided below and above the cable before a protective cover is laid. For every additional vertical tier. The 30cm of sand cushion are provided over the initial tier. The cable shall be protected by 2nd class bricks of size not less than 230x115x75mm, stone tiles/RCC curved channel be placed on top of the sand breadth wise for the full length of the cable and where more than one cable is to be laid in the same trench the brick shall cover all cables and project at least 8 cms. Over the outer sides of the end cables.

Filling of trenches shall be done after the sand cushioning and laying of tilesor bricks are carried out to the satisfaction of the Engineer-in-charge (Refer drawing). Back fill for trenches shall be filled in layer not exceeding 150 mm. Each layer shall be properly rammed & consolidate before laying the next layer.

PVC pipe shall be provided for all road crossing. The size of the pipe shall be according to the cable and a minimum 100mm dia. pipe shall be provided. The pipe shall be laid in ground with special arrangement and shall be cement jointed and concreting with 1:5:10 shall be made as per relevant IS with latest amendment. Location of cables laid directly underground shall be indicated by cable marker at an interval of 30 meters & with change of direction. Aluminium strip cable tag of 20mm wide with engraved tag no. shall be provided at both ends of cable.

Where the cables are to be laid in ducts (pucca trenches) inside the building, they will have to be laid on MS rack/ on MS cable trays grouted in walls trenches. Cables sizing through floors shall be protected from mechanical damage by a steel channel to a height of one meter above the floor where cable pass through wall they shall be sleeved with PVC/steel conduit.

Where the cables are laid in open (in building) along walls, ceiling or above false ceiling, cable rack (ladder type) or cable tray shall be provided. The size of the cable tray or rack shall depend on the number of cables to pass over that rack. Cable tray/rack shall be properly supported through wall/ceiling according to the site conditions. Cable laid on tray & riser shall be neatly dressed &clamped at an interval of 1000 mm & 750mm for horizontal & vertical cable run respectively either side at each bend of cable. All power cables shall be clamped individually & control cables shall be clamped in groups of three or four cables. Clamps for multicore cables shall be fabricated of 25x3 GI flats. Single core power cable shall be laid in trefoil formation & clamped with trefoil clamps made of PVC/fibre glass.
Cable openings in wall/floor shall be sealed by the contractor suitably by hessian tape & bitumen compound or by any other proven to prevent ingress of water.

After the cables are laid, these shall be tested as per IS and the results submitted to Architects/Engineer and in case the results found unsatisfactory, all the repairing/ replacing of cables will be done by the contractor free of charge.

29.11 Fire Seal System

i. All the floor/wall opening provided for cable crossing shall be sealed by fire seal system.

ii. The fire proof sealing system shall fully comply with the requirements of relevant IS/BS: 476 Part-B. The fireproof seal system shall have minimum one hour fire resistance rating.

iii. The fire proof seal system shall be physically, chemically, thermally stable and shall be mechanically secured to the masonry concrete members. The system shall be completely gas and smoke tight, antirodent and anti- termite.

iv. The material used in fireproof seal system shall be non-toxic and harmless to the working personnel.

v. Type of fireproof seal system shall be foaming type or flame mastic type compound or approved equivalent.

After laying and jointing work is completed, high voltage test should be applied to all cables to ensure that they have not been damaged during or after the laying operation and that there is not fault in the jointing.

Cables for use on low and medium voltage system (1.1KV grade cables) should withstand for 15 minutes a pressure of 3000V DC applied between conductors and also between each conductor and sheaths. In the absence of pressure testing facilities it is sufficient to test for one minute with a 1000V insulation tester In case the test results are unsatisfactory the cost of repairs and replacements and extra work of removal & laying will be made good by the contractor.

Cable shall be installed so that separation shown in the table below are observed. HV Cable (11 KV) - HV Cable (11 KV)	50mm
ELV & LV 230 V/433 V - ELV & LV cable 230 V/433 V	Equal to the diameter of the bigger cable HV cables (11 KV)
- ELV & LV cables 230 V/433 V	300mm
LV cables 433 V- Telephone/Instrument cable	350mm
All cables- All hot pipe work	200 mm

29.12 Quality Assurance

Quality Assurance shall follow the requirements of Owner/ Consultant as applicable. Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser's requirements.

29.13 Deviations

Deviation from specification must be stated in writing at the quotation stage.

In absence of such a statement, it will be assumed that the requirements of the specifications are met without exception.

29.14 Spares for Commissioning Including Consumables

The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools and consumables. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

30.0 CABLE TRAY

30.1 Ladder type Cable tray – for Power Cables only

Cable trays shall be ladder type fabricated out of mild steel/slotted angles and flats of required width as per design. Bends shall be prefabricated. The cable tray shall be hot dip galvanized or primed and painted with powder coating as asked for in BoQ or as approved by Owner/Consultant. The minimum weight of the zinc coating shall be 460 gm/sq.m and minimum thickness of coating shall not be less than 75 microns.

30.2 Perforated Cable tray – for Power Cables & Low current service both

The perforated cable trays are fabricated out of 1.6mm thick CRCA sheet steel having minimum 50mm depth or as called for in BOQ, hot dip galvanized or epoxy coated of approved shade. Perforations are maximum 10mm spaced at maximum 20mm distance. The cables shall be tied with the cable tray with nylon strip/aluminum clamps/M.S. clamps as per requirements.

Suitable provision shall be made where a tray crosses expansion joints. The width of the tray shall allow for a suitable separation between cables the design shall allow for adequate bending radius for the sizes of cables. No sharp bend to be allowed in cable tray. Joints between sections shall be bolted.

The tray shall be suspended from the surface of the concrete slab by means of approved steel hangers spaced at a distance of not more than 125cms. Suitable bushes shall be provided where cables pass through apertures in the tray. Cables must be securely fixed to the tray with clamps or cable ties. In routing necessary barrier and spacing shall be maintained for cables of different voltages in case they lie side by side. Telephone cables shall cross the power cables only at about right angle and these two shall not run in close proximity. Full details of the tray shall be approved by the Consultant/Site Engineer before fabrication. Earth continuity shall be maintained between each section of cable tray and each total run of tray shall be effectively bonded to the nearest earth continuity 0conductor. All nuts and bolts used shall be of galvanised steel.

Depending on the size of cable trays space of 20-33% has to be maintained for future expansion.

Cable tray is manufactured to comply with the specifications of National Electrical Code (NEC) and National Electrical Manufacturer's Association (NEMA).

31.0 INTERNAL ELECTRICAL WORKS

31.1 Conducting (M.S Conduit)

All conduits shall be of heavy gauge solid drawn ERW welded manufactured out of 16 (1.6mm) gauge MS Sheet up to 32mm dia and of 14 (2 mm) gauge for sizes higher than this. Both inner and outer surfaces shall be smooth without burrs, dents and kinks. Conduits shall be black stove enameled inside and outside. The cross section of conduit shall be uniform throughout. The welding shall be uniform such that welded joints do not yield when subjected to flattening test. Welded joint shall not break when threaded or bent at an angle. Conduit shall conform to specifications of IS: 9537 (Part-II) and the capacity of conduits shall be in accordance with the standards and shall never be exceeded. The minimum size of the conduit shall be 20mm dia. Care shall be taken to ensure that all conduits are adequately protected while stored at site prior to erection and no damaged conduit shall be used.

31.2 PVC Conduit

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

31.3 Accessories

Conduit accessories such as normal bends, unions, circular junction boxes and pull boxes, locknuts etc. shall be heavy gauge type and approved make. Conduit accessories shall conform in all respects to IS: 3837-1966 with latest amendment. Wherever several conduits are running together, adequately sized adoptable boxes common to all runs shall be used to avoid inserting inspection boxes in the individual run. Where it is necessary to segregate wiring metal filler shall be fixed with in the box.

Conduits shall be laid before casting in the upper portion of a slab or otherwise, as may be instructed or in accordance with approved drawings, so as to conceal the entire run of conduits and ceiling outlet boxes. Vertical drops shall be buried in columns or walls. Wherever necessary, chases will be cut by the contractor with the help of chase cutting m/c or by hand. Nothing extra shall be paid to the contractor on this account. In case of exposed brick/ rubble masonry work special care shall be taken to fix the conduit and accessories in position along with the building work. Sufficient depth of the chases will be made to accommodate the required number of conduits. The chase will be filled with cement, coarse sand mortar (1:3) and properly cured by watering for one week.

If a chase is cut in an already finished surface the contractor shall fill the chase and finish it to match the existing finish. Contractor must not cut any iron bars to fix conduits. Conduits shall be kept at a minimum distance of 100mm from the pipes of other non-electrical services. Where the conduit is to be embedded in a concrete member it shall be adequately tied to the reinforcement to prevent displacement during casting, conduits in chases shall be held by steel hooks of approved design at maximum of 100 cm centers. The embedding of conduits in walls shall be so arranged as to allow at least 12mm plaster cover the same. All threaded joints of conduit pipes shall be treated with some approved ‘preservative compound’ to secure protection against rust.

Suitable expansion joints fittings of approved make and design shall be provided at all the points where the conduit crosses the expansion joint in the building. (Preferably with Pilca metallic watertight conduits). Conduits shall cross at right angles of the joints only.

Separate conduit shall be used for:

i. Normal light, fan call bell
ii. 16 A power outlets
iii. Emergency Light Point
iv. Fire alarm System
v. Computer Outlets
vi. P.A System
vii. Telephone system
viii. TV Network
ix. Or any other services not mentioned here.

Wiring for short extensions to outlets in hung ceiling or to vibrating equipment’s, motors etc. shall be installed in flexible conduits. Flexible conduits shall be formed from a continuous length of spirally wound interlocked wire steel with a fused zinc coating on both sides. The conduit shall be provided with approved type adopter. A separate and accessible earth connection shall bond across the flexible conduit.

Conduit runs on surfaces shall be supported with metal 1.2 mm thick saddles, which in turn are properly secured on to GI spacer to the wall or ceiling. Fixing screws shall be with round or cheese head and of rust proof materials. Exposed conduits shall be neatly run parallel or at right angles to the walls of the building and shall be painted in colour matching the adjoining area. Unseemly conduit bends and offsets shall be avoided by using better appearance. Cross cover of conduits shall be minimum and entire conduit installation shall be clean and with good appearance. For surface work, the boxes shall be raised back pattern type, designed for use with distance saddles to give clearance of 6mm between the back of conduit and the fixing surface.

Where conduits are run on steel work, they will be fixed by means of purpose made GI Caddy clips in manner meeting with the approval of the Engineer prior to the installation being carried out. Other methods of fixing may be agreed in special circumstances, but approval must first be obtained from the site engineer.

The spacing of saddles shall be not more than 600mm centers for up to 32mm diameter conduits and at 750mm for conduit sizes of 40mm diameter and above in case of MS conduit and not more than 600 mm for PVC conduit. In addition, saddles shall be fixed at each side of any bend/Tee, or set at a distance of 200mm from the bend/Tee. The holes in the brickwork or concrete for fixing plugs shall be neatly drilled by means of a masonry drill of the appropriate size.

All the GI sheet steel /passivated boxes used for housing switches, plugs, fan regulator etc. shall be five sided conforming to IS: 5133 Part I-1969. Suitable size of boxes shall be provided a minimum of 2 adjustable fixing lugs on vertical sides. Suitable earth terminal inside each box shall be provided. All fixing lugs shall be threaded to receive standard machined chromium plated brass screws. Sufficient number of knockouts shall be provided for conduit entry. Conduits carrying wires

of different circuit can terminate in common J.B having metal compartments. Necessary GI pull wires shall be inserted into the conduit for drawings wires. In case conduit pipe is required to cross any RCC beam special adopter boxes shall be provided for crossing & nothing shall be paid extra.

Where conduits are used for non-air-conditioned space to air -conditioned space or into a fan chamber or duct, a junction box shall be installed to break the continuity of such conduit at the point of entry or just outside and conduit shall be sealed around the conductors.

Particular care shall be taken during the progress of the work to prevent the ingress of dirt and rubbish such as plaster droppings into erected conduits. Conduit which has become so clogged shall be entirely freed from these accumulations or will be replaced. Screwed plastic or metal caps or turned wooden plugs shall be employed to protect all open ends. Plugs of waste wood, paper, cotton or other fibrous matter shall not be used. All unused conduit entries shall be blanked off in an approved manner and where conduits terminate in adaptable boxes, all removable box covers shall be firmly secured to provide complete enclosure. If considered necessary by the Engineer-in-charge, the conduits shall be swabbed out by drawing swabs of rag through the conduit to remove moisture prior to any cables being drawn in.

All conduit installations must be completed and erected in their totality before they are wired and must be fully rewireable from outlets to distribution boards or trunking systems etc. to which they connect. No wiring of any part of the installation shall be commenced until instructions are received to do so by the Engineer-in-charge at such time as he is satisfied that the wiring will not be damaged due to building operations.

Conduits shall be installed so that they are self-draining in the event of ingress of moisture due to condensation or any other reason. A suitable drainage hole shall be drilled at the bottom of the lowest conduit box in every 9-meter of horizontal run.

PVC bush of good quality shall be used in each conduit termination in a switch box, draw box, lighting fixtures and circular junction boxes.

Exposed conduits running above false ceilings shall be suitably clamped independently along with the dropped ceiling. Perforated straphangers or twisted attachment shall not be acceptable. In no case shall raceways be supported or fastened to other pipe for repair and maintenance. They shall be arranged symmetrically and in the cost compact design, in no way unduly criss- crossing each other. Proper spacing shall be maintained when two or more conduits run side by side. The layout of the pipes shall be coordinated with other services if any. The junction boxes and conduits used in hazardous areas shall be flameproof type with cast iron construction complete with threaded covers. The conduit of each circuit or section shall be completed before conductors are drawn in. The entire system of conduit after erection shall be tested for mechanical and electrical continuity throughout and permanently connected to earth conforming to the requirements by means of special approved type of earthing clamp efficiently fastened to conduit pipe in a workman like manner for a perfect continuity between the earth and conduit.

The conduit system shall be so laid out that it will obviate the use of tees, elbows and sharp bends. No length of conduit shall have more than the equivalent of two-quarter bends from inlet to outlet. The conduit itself being given required smooth bend with radius of bends suiting to the site conditions but not less than 6 times overall diameter.

Outlet boxes shall be of heavy-duty sheet steel installed as to maintain continuity throughout. These shall be so protected at the time of laying that no mortar finds its way inside during concrete filling or plastering. For fluorescent fittings, the outlet boxes heavy duty shall be provided 300mm off center for a 1200mm fitting and 150mm off center for a 600mm fittings or as per B.O.Q.

Draw boxes of ample dimensions shall be provided at convenient points to facilitate pulling of long runs of cables. They shall be completely concealed with MS covers flush with plasterwork painted to match the wall. These boxes will be as few as possible and located where found suitable by the consultant.

31.4 Switch Boxes

The switch boxes shall be zinc passivated & shall not be less than **18 SWG** thick or shall be as called for in BOQ. It will be so designed that accessories could be mounted on integral pedestals or on adjustable flat iron mounting straps with tapped holes by brass machine screw. Leaving ample space at the back and on the sides for accommodating wires and check nuts at conduit entries. These shall be attached to conduits by means of check nuts on either side of their walls. These shall be completely concealed leaving edges flush with wall surfaces. Earthing terminal inside box shall be provided.

Moulded plate switches screw less as specified in item of work shall be provided. No timber shall be used for any supports. Boxes, which come within concrete, shall be installed at the time of casting. Care shall be taken to fix the box rigidly so that its position is not shifted while concreting.

31.5 Wiring

All the wiring installation shall be as per IS: 732 with latest amendment. PVC insulated copper conductor cables as specified in bills of quantity shall be used for sub-circuit runs from the distribution boards to the points and shall be pulled into conduits. They shall be twisted copper conductors with thermoplastic insulations of 660/1100 volts grade. Colour Code for wiring shall be followed.

Looping system of wiring shall be used, wires shall not be jointed. Where joints are unavoidable, they shall be made through approved mechanical connectors with prior permission of the consultant. No reduction of strands is permitted at terminations. No wire smaller than 1.5 sq.mm shall be used and shall be as per B.O.Q. Wherever wiring is run through trunkings or raceways, the wires emerging from individual distributions shall be bunched together with cable straps at required regular intervals. Identification ferrules indicating the circuit and DB number shall be used for submains sub-circuit wiring. The ferrules shall be provided at both end of each submain and sub-circuit.

Where single-phase circuits are supplied from a three phase and a neutral distribution board, no conduit shall contain the wiring fed from more than one phase. In any one room in the premises where all or part of the electrical load consists of lights, fans and/or other single phase current consuming devices, all shall be connected to the same phase of the supply. Circuits fed from distinct sources of supply or from different distribution boards or through switches or MCBs shall not be bunched in one conduit. In large areas and other situations where the load is divided between two or three phase, no two single-phase switches connected to different phase shall be mounted within one box.

All splicing shall be done by means of terminal blocks or connectors and no twisting connection between conductors shall be allowed.

Industrial sockets shall be of moulded plastic BOQ and deeply recessed contact tubes. Visible scraping type earth terminal shall be provided. Socket shall have self-adjustable spring loaded protective cap. Socket shall have MCB/ELCB/RCCB as specified in the schedule of work.

Maximum number of PVC insulated 650/1100 V grade/copper conductor cable conforming to IS: 694-1990.

Conduit size	20mm		25mm		32mm		40mm		50mm		60mm	
Wire size in sq.mm.	S	B	S	B	S	B	S	B	S	B	S	B
1.50	7	5	12	10	20	14	-	-	-	-	-	-
2.50	6	5	10	8	18	12	-	-	-	-	-	-
4	4	3	7	6	12	10	-	-	-	-	-	-
6	3	2	6	5	10	8	-	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	-	4	3	7	6	-	-	-	-
25	-	-	-	-	3	2	5	4	8	6	9	7

Notes:

i. The above table shows the maximum capacity of conduits for a simultaneous drawing inof cables.
ii. The columns heads ‘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 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.

32.0 TELEPHONE SYSTEM AND LAN WIRING.

32.1 Enhanced Category 5 UTP specifications

i. The UTP shall be 4-pair, with 24 SWG solid or standard copper conductors.
ii. The UTP-based cabling system shall have a 160 MHz channel channel bandwidth over a maximum distance of 100m (328 ft)and a channel power sum attenuation-to-crosstalk ratio (PSACR) of 9.6 dB@ 100 MHz using an interconnect or BIX cross connect configuration.
iii. The UTP-based cabling system shall use matched components from a single manufacturer, certified to deliver system performance over the lifetime of the application that the cabling system was originally designed to support.
iv. All component used in the UTP-based cabling system shall be warranted for a period of 25 years from date of installation against defects in materials and workmanship.
v. The UTP-based cabling system shall comply with the following standards:
Enhanced Category 5 – TIA/EIA Addendum
Category 5 – ANSI/TIA/EIA-568, TIA/EIA TSB67
Class D – CENELEC EN50173
Class D – ISO/IEC 11801

32.2 UTP Outlets

i. The outlet UTP connection module and its optional cover shall be available in the following colors: grey, almond, white, black, orange, red, yellow, green, blue, purple and brown.
ii. The outlet UTP connection module shall be Power Sum rated, with a power Sum NEXT performance equal to or better than ANSI/TIA/EIA-568 Category 5 pair-to-pair NEXT performance specifications, and shall have a PS5 marking to indicate compliance.
iii. The eight-position outlet UTP connection module shall accommodation six-position modular plug cords without damage to either the cord or the module.
iv. It shall be possible to inspect and/or re-terminate the UTP cable at the outlet through front access at the face plate.
v. The faceplate housing the outlet UTP connection modules shall have aperture plugs to cover any unused openings in the faceplate.
vi. The faceplate housing the outlet UTP connection module in wall mounted single and dual-gang electrical boxes, utility poles and modular furniture (cubical) access points using manufacturer – supplied faceplates and/or adapters, equipped with front, side or angled-entry options for modular cords.

32.2 UTP Outlets

a) There are two primary field test parameters for an UTP-based end-to-end cabling system. These are continuity/wire mapping and a visual inspection, both to be performed by the vendor.

b) Continuity/wire mapping is used to verify consistency pair-to-pin terminations at each end of a given cable. It also checks for faulty connections in the run. For each of the eight conductors in the cable, continuity/wire mapping indicates:

c) Continuity of the channel to the remote end. Shorts between any two or more conductors. Crossed pairs. Reversed pairs. Split pairs. Any other miss-wiring.

32.3 TELEPHONE TAG BLACK (TTB / IDF)

CAT-5e (enhanced) unshielded twisted pair cable in MS conduit shall be used to have modern structured cabling network for telephone system, to have latest facilities for Internet and also data cabling. All the telephone Jack must terminated on RJ-11 jacks and installed onto a dual Jack faceplate. Telephone RJ-11 Jacks must be terminated with a BLACK Connector/Jack.

For LAN CAT 6 UTP cables shall be used for interconnecting the RJ 45 outlets to Intermediate Switch (Hub) or directly to IT room, if the running length limit permits. These Intermediate switch shall be installed in a rack/cabinet and located in electrical room of the respective floors. Fibre Optic cable or CAT-6 UTP cable shall be used for backbone to interconnect the Intermediate switch to IT room's Server rack, as per the design requirement of the specialized Vendor. All the Data Jack

must terminated on an 8 wire, 8-position Jack. Each RJ-45 Data Connection will be terminated with a BLUE Data Jack

Only conduit routing & wiring shall be provided by the Electrical contractor and the configuration & wiring shall be done by the Vendor for the IT Networking.

EPABX system, with latest technology will be provided by a separate Vendor to provide Voice Mail & Call Accounting by costing of all calls made by telephones.

A small cabinet for Low current services shall be provided at the false ceiling level at entrance of guest room, to locate all the terminal points like Tel.Tag block, tap -off box for MATV etc., for interconnecting all the low current outlets (jacks) provided in the guest room. Each tel. outlet in guest room shall be provided a separate wire from the room tag block.

Similarly one CAT-5e wire from the floor TTB/IDF shall be provided for each Tel. Outlet proposed.

A Multi pair box as per BOQ Tel. Cable shall be laid from the Service gate to the Telephone switch room MDF for Direct lines from the Service provider. Some of the lines shall be bypassed to EPABX and shall be directly provided to Top management's office & Telephone operators for direct communication to outside. Rest of the lines shall be routed through EPABX for the use of patrons & staff through extensions. The following area/desk shall have direct access to outside Tel. lines:

i. Telephone Operator's room
ii. Telephone Switch room
iii. Security room Fire officer room

33.0 MATV SYSTEM

33.1 Co-Axial Cables

The co-axial cable shall be of wideband type with operation up to 860MHz capability, with PE dielectric and PVC jacket. The cable shall meet or exceed the following specifications:

		RG-6	RG-11
1.1	IS Standard IS:14131	5CA4	7CA4
1.2	Centre Copper Conductor Dia	1.02mm	1.63mm
1.3	Dielectric Dia	4.57mm	7.11mm
1.4	Dielectric Material	Cellular PE	Cellular PE
1.5	Outer Dia	7.0mm	10.03mm
1.6	Bending Radius	>75mm	>115mm
1.7	Impedance	75 Ohms	75 Ohms
1.8	Return Loss	>23 dB	>23 dB
1.9	Attenuation at 20^0C	Max dB/100Mtr	Max dB/100Mtr
	5 MHz	1.9	1.25
	45 MHz	5.25	3.5
	300 MHz	11.65	7.38
	450 MHz	14.45	9.02
	550 MHz	16.1	9.97
	860 MHz	20.1	12.52

34.0 DISTRIBUTION BOARDS & MCBs

34.1 General

Distribution boards shall be of standard make with MCBs as per approved make given. Distribution boards shall be constructed out of steel sheet all weld enclosure with double door IP42 protection and shall be powder coated. Ample clearance between the conductors of opposite pole, between conductors and sheet steel body shall be maintained in order to obviate any chance of short circuit. Removable conduits entry or knockouts plates shall be provided at top and bottom to facilitate drilling holes at site to suit individual requirements. Also on additional/separate adopter box of suitable length and size shall be provided to accommodate wires and cables. No. of conduits etc. and nothing shall be payable on this account. The MCBs shall be mounted on high-grade rigid insulating support and connected by electrolytic copper bus bars. Each incoming MCB isolator shall be provided with solderless cable sockets for crimping. Phase separation barriers made out of arc resistant materials shall be provided between the phases. Bus bars shall be colour coded for phase identification.

Distribution boards shall be recessed in wall nitch or if required mounted on the surface of the wall with necessary clamp bolts etc. The mounting height shall not exceed 1200mm from finished floor level. Distribution board shall be provided with proper circuit identification nameplate and danger sticker/plate as per requirements.

All the distribution boards shall be provided with engraved nameplates with ‘lighting’, ‘power’ or ‘UPS’ with DB Nos., as the case may be. Each DB shall be provided with a circuit list giving details of each circuit. All the outgoing circuit wiring shall be provided with identification ferrules giving the circuit number & phase.

Each distribution board shall have a separate neutral connection bar and a separate 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 armouring shall be bonded together & connected to the distribution board earth bar.

Where oversized cables are specified due to voltage drop problems, it shall be contractors responsibility to ensure that satisfactory terminal arrangements are provided without an extra cost.

34.2 Earth Leakage Circuit Breaker

ELCB shall be 4 pole 415 volts 50Hz, 30-300mA sensitivity. These shall be of approved make. The rating of the ELCB shall be as specified in BOQ. These shall be suitable for manual closing and opening and automatic tripping under earth fault circuit of 30-300mA as specified in item of work. The enclosure of the ELCB shall be moulded from high quality insulating material. The material shall be fire retardant, anti-tracking, non-hygroscopic, and impact resistant and shall with stand high temperature. All parts of switching mechanism shall be non-greasing, self-lubricating material so as to provide consistent and trouble free operation. Operation of ELCB shall be independent of mounting position and shall be trip free type. The RCCB shall be protected against nuisance tripping by protective device.

34.3 Miniature Circuit Breaker

i. The MCB shall be current limiting type and suitable for manual closing and opening and automatic tripping under overcurrent and short circuit. The MCB shall also be trip free type.
ii. Single pole/three pole versions shall be furnished as required.
iii. The MCB shall be rated for 10 KA/15 KA fault level.
iv. The MCB shall be suitable for its housing in the distribution boards and shall be suitable for connection at the outgoing side by tinned cable lugs and for bus-bars connection on the incoming side.
v. The terminal of the MCBs and the open and close conditions shall be clearly and indelibly marked.
vi. The MCB shall generally conform to IS: 8828. -1996
vii. The MCB shall have 20,000 electrical operation up to 63A.
viii. The MCB shall have minimum power loss (Watts) asper I.S./ IEC.

35.0 SPECIAL CONDITIONS OF CONTRACT

35.1 Drawings

The drawings, specifications and bill of quantities shall be considered, as a part of this contract and any work or materials shown on the drawings and not called for in the specifications or vice-versa, shall be executed as if specification called for

in both. The contract drawings indicate the extent and general arrangement of various equipment's and their wiring, etc. and are essentially diagrammatic. The drawings indicate the point of termination for conduit runs and broadly suggest the routes to be followed. The work shall be done as indicated on the drawings. However, any minor change if found essential to co-ordinate the installation of this work with other traders shall be made without any additional cost to the owners. The data given herein and on the drawings is as could be secured but its complete accuracy is not guaranteed. The drawings and specifications are for the assistance and guidance of the contractor. The exact location, distances and levels etc. will be governed by the space conditions. The contractor shall examine all Architectural, structural, Plumbing and Sanitary, Air-conditioning and electrical drawings before starting the work and report to the architect any discrepancies, which in his opinion appear, on them, and get them clarified. He shall not be entitled to any extras, for omissions or defects in electrical drawings or when they conflict with other works.

35.2 Shop Drawings

The Contractor shall prepare and submit to the Consultants/Architect/ Owner for their approval detailed shop drawings within 30 days of signing of the contact or before 7 days of particular work or whichever is earlier. The shop drawings shall clearly indicate.

i. The general arrangement and schematic diagram of main D.G Panel, PLC Panel, clearly stipulating the material, size of sheet steel, bus bar, inter connections detail, make and rating of switchgear and other equipment etc.

ii. Number, size and route of the Cable Tray, and fixing details.

iii. Total number of cable runs, size make, material and type of cables with clear routing, trenches / treys detail, installation mode, starting and termination point of each and individual cable etc.

iv. The shop drawings shall also show all setting out details and physical dimensions of all equipments components used in the system, location of manholes fixing, cutout details etc.

35.3 Quality

The Olectra Greentech Limited's / Consultants decision with regard to the quality of the material and workmanship will be final and binding, any material rejected by the Olectra Greentech Limited / Consultant shall be immediately removed by the Contractor from the site. The Olectra Greentech Limited / Consultant or their representative shall at all reasonable times have free access to the works and / or to the workshops, factories or other places where materials are being prepared or constructed for the contract and also to any place where the material lying or form which they are being obtained, and the contractor shall give every facility necessary for inspection and examinations and test of the material and workmanship free of cost.

35.4 Cost of Samples & Test

The Contractor at his own cost shall supply all samples and the cost of making any test as per specifications shall be borne by the contractor. The Contractor shall submit four copies of all brochures, manufacturers' description data and similar literature. One copy will be returned to the Contractor after approval.

35.5 Completion Drawings

The Contractors shall submit to the Owner / Consultant, layout drawings drawn at approved scale in six sets and a reproductive (original) copy clearly showing.

i. Location of distribution and PLC Panel

ii. All types of cables (L.T. / Control etc.) layout.

iii. Layout of DG Room and switchgears and associated equipment's.

iv. Layout of Diesel Generator Sets.

v. Location of Fuel Tank, Cooling Towers, Pumps and fuel and water piping layout.

vi. As built drawing with equipment's operation and maintenance literature

After the completion of the work and before issuance of certificate of virtual completion.

35.6 Foreman/ Supervisor

The Contractor shall employ a competent, licensed qualified full time electrical engg. / foreman supervisors to direct the work of electrical installations in accordance with the drawings and specifications. The foreman / supervisor shall be available at all times on the site to receive instructions from the Architect / Engineer in the day to day activities throughout the duration of the Contract and as long as there after as the consultants may consider necessary until the expiration of the "Defect Liability Period". The Foreman / Supervisor shall correlate the progress of the work in conjunction with all the relevant requirements of the supply authority. The skilled workers employed for the work should have requisite qualifications and should possess competency certificate from the Electrical Inspectorate of the Local Government. The Contractor shall on the request of the consultants immediately dismiss from the works any person employed there on who may, in the opinion of the consultants, be unsuitable or incompetent or who may misconduct himself and such person shall not be again employed or allowed on the work without the permission of consultants/Employee.

35.7 Inspection and Testing

Contractor shall employ a full time qualified Engineer who shall be available at all working hours at site for taking instructions and to look after the quality of the work. Instructions given to the Engineer of the contractor shall be construed as issued to the contractor.

Contractor shall maintain at site the following tools and instruments, but not limited to the list below in working conditions.

i. Clip-on Ammeter and voltmeter
ii. 1000 V Meggar and 5 KV Meggar
iii. Steel tapes of various lengths
iv. Sprit Level
v. Hydraulic Crimping Tool
vi. Earth Testing Meggar
vii. Pipe bending Tool, thread-cutting die, bench vice etc.
viii. Cable jointing kit

The contractor shall provide at least four permanent benchmark at site, which shall be preserved till the completion of works. These are essential for laying of cables at correct levels.

35.8 Clearance from Local Authorities

The Contractor shall get the entire installation tested inspected and approved by Local Authorities like Electrical inspectorate pollution control explosive clearance and any other agency required to take permission for commissioning of the installation. He will also undertake the Liaison work with local Electricity Supply Company for obtaining the Electrical Service Connection.

35.9 Clearance from Local Authorities

In general, the contractor shall supply, store, erect test and commission all the equipment required for electrical installation. The contractor shall furnish all the materials, labour, tools and equipment for electrical work, as shown in the accompanying drawings and in the bill of quantities and specifications hereinafter described.

35.10 Contractor

The contractor shall be a licensed electrical contractor, possessing a valid electrical contractor's in the state, employing licensed supervisors and skilled workers having valid permits as per the regulation of Indian Electricity Rules and Local Electrical Inspector's requirements.

35.11 Preamble to BOQ

1. All items of work under this Contract shall be executed strictly to fulfill the requirements laid down under the specifications. Type of equipment, material specifications, methods of installation and testing, and type of controls shall be in accordance with the Specifications, approved shop Drawings and the relevant Indian Standards, however, capacity of each component and their quantities shall be such as to fulfill the above mentioned requirement.

2. The rate for each item of work included in the Bill of Quantities shall, unless expressly stated otherwise, include cost of:

a. All materials, fixing materials, accessories, appliances, tools, plants, equipment, transport, labour and incidentals required in preparation for and in the full and entire execution, testing, balancing, commissioning and completion of the work called for in the item and as per Specifications and Drawings.

b. A stage on materials and labour.

c. Loading, transporting, unloading, handling / double handling, hoisting to all levels, setting, fitting and fixing in position, protecting, disposal of debris and all other labour necessary in and for the full and entire execution and to fully complete the job in accordance with the contract documents, good practice and recognized principles.

d. Liabilities, obligations and risks arising out of Conditions of Contract.

e. All requirements of specifications, whether such requirements are mentioned in the item or not. The specifications and drawings where available, are to be read as complimentary to and part of the Schedule of Quantities and any work called for in one shall be taken as required for all.

f. In the event of conflict between Bill of Quantities and other documents including the specifications, the most stringent shall apply and the interpretation of the consultants shall be final and binding.

3. The unit rate for each equipment or materials shall include cost in Rupees for equipment and material including the excise duty, and also including forwarding, freight and insurance up to Contractor's store at site, storage, installation, testing balancing, commissioning and other works required.

4. The extension for (total) amounts against each item shall be based on the quantities indicated in this Schedule.

5. All equipment, quantities and technical data indicated in this Schedule are for the Contractors guidance only; these are based on the documents prepared by the Consultants. The contractor shall assess the required quantity of cables, cable trays, piping etc that are required for completion of the work. This schedule must be read in conjunction with these documents. The Contractor shall be paid for the actual quantity of work executed by him in accordance with the approved shop drawings at the contract rates.

6. The quantities given in this schedule are provisional, the Owner reserves the right to increase or decrease the quantities of work or to totally omit any items of work and the Contractor shall not be entitled to claim any extras or damages on these grounds. These variations shall be permitted until such time Contractors shop drawings are approved.

7. This schedule shall be fully priced and the extensions and totals duly checked. The rates for all items shall be filled in INK.

8. No alteration whatsoever is to be made to the text or quantities of this Schedule unless such alteration is authorized in writing by the Consultants. Any such alterations, notes or additions shall unless authorized in writing be disregarded when tender documents are considered.

9. In the event of an error occurring in the amount column of the Schedule, as a result of wrong extension of the unit rate and quantity, the unit rate quoted by the tenderer shall be regarded as firm and the extensions shall be amended on the basis of the rates.

10. Any errors in totaling in the amount column and in carrying forwarded totals shall be corrected. Any error, in description or in quantity or commission of items from this schedule shall not vitiate this contract but shall be corrected and deemed to be a variation required by the Consultants.

35.12 Tools & Tackles and Spares

a) After completion of installation & commissioning of the power plant, necessary tools & tackles are to be provided free of cost by the bidder for maintenance purpose. List of tools and tackles to be supplied by the bidder for approval of specifications and make from SECI/ owner.

b) A list of requisite spares in case of PCU/inverter comprising of a set of control logic cards, IGBT driver cards etc. Junction Boxes. Fuses, MOVs / arrestors, MCCBs etc along with spare set of PV modules be indicated, which shall be supplied along with the equipment. A minimum set of spares shall be maintained in the plant itself for the entire period of warranty and Operation & Maintenance which upon its use shall be replenished.

35.13 Danger Boards and Signage's:

Danger boards should be provided as and where necessary as per IE Act. /IE rules as amended up to date. Three signage shall be provided one each at battery –cum- control room, solar array area and main entry from administrative block. Text of the signage may be finalized in consultation with SECI/ owner.

35.14 Fire Extinguishers:

The firefighting system for the proposed manufacturing unit for fire protection shall be consisting of:

a) Portable fire extinguishers in the control room for fire caused by electrical short circuits

b) Sand buckets in the control room

c) The installation of Fire Extinguishers should confirm to TAC regulations and BIS standards. The fire extinguishers shall be provided in the control room housing PCUs as well as on the Roof or site where the PV arrays have been installed.

35.15 Drawings & Manuals:

a) Two sets of Engineering, electrical drawings and Installation and O&M manuals are to be supplied. Bidders shall provide complete technical data sheets for each equipment giving details of the specifications along with make/makes in their bid along with basic design of the power plant and power evacuation, synchronization along with protection equipment.

b) Approved ISI and reputed makes for equipment be used.

c) For complete electro-mechanical works, bidders shall supply complete design, details and drawings for approval to SECI/owners before progressing with the installation work

35.16 Planning And Designing:

a) The bidder should carry out Shadow Analysis at the site and accordingly design strings & arrays layout considering optimal usage of space, material and labour. The bidder should submit the array layout drawings along with Shadow Analysis Report to SECI/Owner for approval.

b) SECI reserves the right to modify the landscaping design, Layout and specification of sub-systems and components at any stage as per local site conditions/requirements.

c) The bidder shall submit preliminary drawing for approval & based on any modification or recommendation, if any. The bidder submit three sets and soft copy in CD of final drawing for formal approval to proceed with construction work.

35.17 Drawings to Be Furnished By Bidder After Award Of Contract

a) The Contractor shall furnish the following drawings Award/Intent and obtain approval

b) General arrangement and dimensioned layout

c) Schematic drawing showing the requirement of SV panel, Power conditioning Unit(s)/ inverter, Junction Boxes, AC and DC Distribution Boards, meters etc.

d) Structural drawing along with foundation details for the structure.

e) Itemized bill of material for complete SV plant covering all the components and associated accessories.

f) Layout of solar Power Array

g) Shadow analysis of the roof

35.18 Safety Measures:

The bidder shall take entire responsibility for electrical safety of the installation(s) including connectivity with the grid and follow all the safety rules & regulations applicable as per Electricity Act, 2003 and CEA guidelines etc.

35.19 Display Board

The bidder has to display a board at the project site (above 25 kWp) mentioning the following:

a. Plant Name, Capacity, Location, Type of Renewable Energy plant (Like solar wind etc.), Date of commissioning, details of tie-up with transmission and distribution companies, Power generation and Export FY wise.

b. Financial Assistance details from SECI/MNRE/Any other financial institution apart from loan. This information shall not be limited to project site but also be displayed at site offices/head quarter offices of the successful bidder

c. The size and type of board and display shall be approved by Engineer-in-charge before site inspection.

SECTION 4

S P E C I F I C A T I O N S
FOR
ANALOGUE ADDRESSABLE FIRE DETECTION & ALARM SYSTEM

ANALOGUE ADDRESSABLE FIRE DETECTION & ALARM SYSTEM

1. DESCRIPTION OF WORK

a. This specification outlines the requirements for an analogue addressable fire detection and alarm system.

b. The work described in this specification consists of all labor, materials, equipment and services necessary and required to complete and test the automatic fire detection and alarm system. Any material not specifically mentioned in this specification or not shown on drawings but required for proper performance and operation shall be furnished and installed for a complete and operational system, by the contractor at no extra cost.

c. The contractor shall furnish and install complete and ready for intended use and operation, an automatic fire detection and alarm system including control panel (s), initiating devices (manual call point, intelligent smoke and heat detectors, etc.) indicating devices (hooters, bells, visual warning signals, etc.) and repeater panel, wiring apparatus and accessories.

d. The installation and locations of equipment and devices in the building shall be governed by the specifications and drawings with due regard to actual site conditions, manufacturers' recommendations, ambient factors affecting the equipment and other operations in the vicinity. If any departure from the specifications or drawings is necessary, approval shall be obtained from the Project Manager before work is started thereon.

e. Materials and equipment shall be new, first grade, standard, current models of the manufacturer and shall be suitable for this system. Where two or more pieces of equipment performing the same function are required, they shall be exact duplicates produced by the same manufacturer.

f. All materials, devices, and equipment shall be compatible with the circuits or systems in which they are utilized.

g. The system shall be based on an “Open Protocol” to ensure flexibility of using Sensors / Detectors of an alternate manufacturer, in case the user requires such an option at a later date.

h. The system shall have provisions for interfacing with BMS.

2. APPLICABLE CODES, STANDARDS AND APPLICABLE PUBLICATIONS

IS: 2175	:	Heat Sensitive Detectors.
IS: 2189	:	Automatic Fire Detection and Alarm System.
IS: 11360	:	Smoke Detectors.
NFPA 71 & 72 / BS: 5839	:	Commissioning Tests for Fire Alarm Systems.
BS: 5445, UL/FM/ NFPA/	:	Fire Detection and Alarm System. VDS/EN54/LPCB

3. SUBMITTALS

3.1 Drawings and Data

a) Shop drawings showing location of all the detectors, control modules, Fire Alarm panel, Repeater Panel etc.

b) Conduit & wiring layout.

c) Block diagram indicating connection of detectors, numbering, loop connections etc.

d) Specific catalogue cuts of all the items to be installed.

e) Control panel interior wiring diagram identifying all symbols.

f) Point-to-point wiring diagrams showing the points of connection and terminals used for all electrical field connections in each system, all equipment or systems which are supervised and controlled by the fire alarm system. Diagrams shall show all connections from field devices to the control panel initiating modules, output modules, switches, relays and terminals. Diagrams shall show interconnection of all devices, modules, output modules, switches, relays and terminals.

g) Custom Build software details for project with loop/device annunciation description and automatic control functions for each specific loop/device.

3.2 Tests & Test Reports

a) Tests certificates will be furnished for approval of all Fire alarm devices and system devices.

b) All routine tests as per relevant codes for the Fire Alarm Panel shall be conducted and results furnished to the Project Manager.

4. SPECIFICATIONS

4.1 FIRE ALARM SYSTEM DEVICES

4.1.1 General

i. The detectors shall be set by inserting a coded plastic card into each mounting base, allowing up to a minimum of 126/240 unique address codes. The address will be a simple seven-bit binary code, set at the time of commissioning. The detector address card will be held in the base so that it cannot be accidentally removed with the detector. The detector should support automatic as well as soft addressing feature.

ii. Each address card shall provide a space visible from below when the detector is in place. The loop number and individual address or any other information can be written in the space.

ii. Devices shall receive loop power for Short Circuit isolators and communication from the same pair of conductors/Wire.

iii. Each device shall contain screw terminals with rising plates for positive termination of wiring specified in schedule of quantities.

4.1.2 Addressable Manual Call Point

i. Manual call point should be made of fire-retardant polycarbonate material for semi-flush mounting. Call Point shall be of the resettable design. They shall use a key operated test-reset lock and shall be designed so that after actual emergency operation, they cannot be restored to normal use except using a key.

ii. Manual Call Point shall be capable of being remotely tested from the Fire Alarm Control Panel (FACP).

iii. Provisions shall be made such that the address cannot be changed merely from opening the Manual Call Point.

Technical specification: Addressable Manual call point (Indoor)

1. Type: Indoor Addressable Manual Call Point.
2. Operating Principle: Push to activate Alarm.
3. Indication: 170° viewable tri colour LED.
4. Tamper: Built-in tamper-resistant feature, if device is removed from base the panel shall indicate alarm.

5. Addressing: Manual decimal hard addressing.
6. Isolator: In-built Isolator.
7. Reset mechanism: Resettable with Key.
8. Colour: Fire Red.
9. Operating Voltage: 17-28V DC (loop powered).
10. Operating temperature: -40°C to +70°C.
11. Relative humidity: Up to 95% non-condensing.
12. Type of protection: Minimum IP 44.
13. Material: Fire retardant polycarbonate.

4.1.3 Addressable Analog Detectors in General:

i. All fire sensors shall mount on a common base to facilitate the changing of sensor type if building conditions change. The base shall be incompatible with conventional detectors to preclude the mounting of a non-intelligent device.

ii. If the Fire Alarm Panel determines that the sensor is in alarm, the Fire Alarm Panel shall command the sensor LED to remain on to indicate alarm.

iii. Each sensor shall be capable of being tested for alarm via command from the Fire Alarm Panel.

iv. Each sensor shall respond to Fire panel scan for information with its type identification to preclude inadvertent substitution of another sensor type. The Fire Alarm panel shall operate with the installed type but shall initiate a mismatch condition until the proper type is installed or the programmed sensor type changed.

v. Each sensor shall respond to Fire Alarm Panel scan for information with an analog representation of measured fire related phenomena (smoke density, particles of combustion, temperature). Such response proves end-to-end sensor including the operation of the sensor electronics. Systems which only monitor the presence of a conventional detector in an addressable base shall not be acceptable.

vi. The detector should be of distributed intelligent type. i.e.It can take its own decision without depend on FACP and keep it log file store in its non-volatile memory.

4.1.4 Addressable Analog Heat Detectors

i. The Heat Detector shall be Analog, addressable Detector with its own manually set digital code and be able to give a single digitized output to the Fire Alarm Panel regarding its condition. The Detector shall employ the thermistor principle for heat sensing and the fixed temperature setting shall be from57 degrees to 90 degrees Centigrade. Detectors should have inbuilt isolator for fault isolation.

ii. The Base of the Detector shall be interchangeable with other Smoke Detectors and the construction shall be of flame retardant material. LEDs shall be provided to indicate locally alarm condition. The enclosure shall meet min IP 54 protection grade.

iii. It shall be able to withstand storage temperature variations from -40o C to 80o C. Further, relative Humidity (no Condensing type or Icing) up to 95% shall not hamper its performance. The Voltage rating shall be from 17 V DC to 35 V DC, though the voltage may be changed depending upon the working voltages of a proprietary Fire Alarm Panel.

iv. It shall be possible to test the Detector's working both from the Panel as well as locally by means as designed by the Contractor and approved by the Project Manager / Programmer. The approved coverage per Detector for unhampered areas shall not be less than 56.3 m sq. The detector shall be capable of being reset from panel after any alarm condition.

v. All mode of detector (for the temperature setting) should be approved by EN/VDS/UL/FM.Detector having non-approved modes are not acceptable since they are not approved as per standards.

Technical specification: Addressable Heat Detector

1. Operating principle: Heat sensitive resistance(redundant)
2. Operating Modes:

a. Heat detector with A1R class.

b. Heat detector with A2R class.

c. Heat detector with A2S class.

c. Heat detector with BR class.

c. Heat detector with BS class.

d. Heat detector with CR class.

e. Heat detector with CS class.

3. Alarm condition: Visible 360-degree viewable tri colour LED.
4. Polling Status: Required.
5. Tamper: Built-in tamper-resistant feature, if device is removed from base the panel shall indicate alarm.
6. Addressing type: Manual decimal hard addressing.
7. Base: Every detector shall be with in-built isolator bases & address should be hard type with base.
8. IP rating: Minimum IP54.
9. Storage temperature: -40°C to +80°C.
10. Relative humidity: Up to 95% non-condensing.
11. Detectors should have inbuilt isolator.

4.1.7 Addressable Analog Multi sensor Smoke Detector.

i. The Addressable Analog Photo Electric Smoke Detector shall have an optical sensing chamber that operates on the light scattering principle and responds to those particles in smoke also the Detector shall employ the thermistor principle for heat sensing and the temperature setting shall be rate of rise type 57-degree C. Detector shall be completely solid state with 360-degree tri colour LED indication at the detector.

iii. The coverage is same as specified in earlier points. This coverage area will reduce depending upon structural configurations or partitions etc. It shall be possible to connect Multi sensor smoke Detector with Heat Detector or Manual Call Point in the same circuit. The sensitivity of Detector shall be adjusted and set by the contractor to suit the site requirement.

iv. It shall have in built safety device to monitor the removal and pilferage of the Detector. The Detector also must have facility for remote indication. The detectors should have inbuilt isolator for fault isolation.

v. The Multi sensor smoke detector shall be intelligent Analog Addressable Detector with its own manually set digital code and be able to give Analog output to the Fire Alarm Panel regarding any changed condition. It shall be able to communicate with the Fire Alarm Panel.

vi. The Base of the Detector shall be interchangeable with other Smoke, Multi sensor or Heat Detectors. LED shall be provided to indicate locally alarm condition. The enclosure shall meet IP 44 protection grade.

vi. It shall be able to withstand temperature variations from -40^{O} C to 70^{O} C. Further, Relative Humidity (no Condensing type or Icing) up to 95% shall not hamper its performance. The voltage rating shall be from 17 V DC to 35 V DC, though the voltage may be changed depending upon the working voltages of a proprietary Fire Alarm Panel.

vii. It shall be possible to test the Detector's working both from the Panel as well as locally by means as designed by the contractor and approved by the Project Manager/Programmer.

viii. Photoelectric smoke sensor shall be provided as indicated on the place. The sensitivity of the smoke detector should be 2.8 %/m for grey smoke and can be adjusted from 1.1%/m to 4.2 %/m depending on the site conditions by the operator.

ix. All mode of detector should be approved by EN/UL/VDS/FM and should have Drift compensation for all the modes (except the heat mode) Detector having non-approved modes are not acceptable since they are not approved as per standards.

Technical specification: Addressable Multi sensor Detector

1. Operating principle: The detector shall have an optical smoke sensor and a dual thermistor temperature sensor, whose outputs shall be combined to give the final analogue value. Logical operation 'AND' shall be performed by the detector microcontroller.
2. Operating Modes: It shall have minimum 5 operating modes.
a. Multi sensor with high smoke sensitivity.
b. Smoke detector only.
c. Multi sensor with moderate sensitivity.
d. Multi sensor with high heat sensitivity.
e. Heat detector only
3. Alarm condition: Visible 360-degree viewable tri colour LED.
4. Polling Status: Required.
5. Tamper: Built-in tamper-resistant feature, if device is removed from base the panel shall indicate alarm.
6. Addressing type: Manual decimal hard addressing.
7. Base: Every detector shall be with standard bases & address should be hard type with base.
8. IP rating: Minimum IP44.
9. Operating temperature: -40°C to +70°C.
10. Relative humidity: Up to 95% non-condensing.
11. Detectors should have inbuilt isolator.

4.1.8 Addressable Beam Detector:

i. The Addressable Beam Detector shall work on the light obscuration principle & shall be able to detect the presence of smoke within internal open spaces up to 100m in the length up to 15 m wide, giving and effective protection area of 1500m square.

ii. The analogue addressable beam smoke detectors shall comprise a trans- mitter, receiver and interface (end-to-end beam detector) or shall have the transmitter and receiver in single housing with a reflector to return the infrared beam from the transmitter to the receiver (reflective beam detector.

iii. The transmitter shall project a modulated beam of infrared light to a receiver which shall convert it to an electrical signal for processing. The received signal shall be continuously analysed, and in the event of the smoke obscuring the light by a pre- selected minimum level for a period of 8 to 10 seconds, a fire alarm condition shall be activated.

iv. The analogue addressable beam smoke detectors shall provide selectable detection smoke levels to suit different environments. These levels are to be selectable via the interface.

v. The analogue addressable beam detectors shall be given a unique address.

vi. The beam transmitter, receiver, and interface unit shall be capable of being powered directly from the loop wiring.

vii. The analogue addressable beam detectors shall include Automatic Gain Control (AGC) circuitry capable of providing compensation for long-term degradation of signal strength caused by component ageing or gradual accumulation of contamination on the lenses of the detector. The analogue addressable beam smoke detectors shall be capable of operating within these parameters.

Technical specification: Addressable Auto aligning Beam Detector Reflective Type.

1. Principle: Light scattering principle.
2. Distance:8 to 100M.
3. Reset: 30 secs after alarm event ceases and in 3 seconds after the removal of fault.
4. Power: Loop powered

5. Addressable: Yes.
5. Alarm threshold: 10 % to 60 %.
6. Type: Auto alienable type with reflective principle.
7. Humidity: 0 -93 %.
8 Operating temperature: -10 to 55-degree C.
9. Humidity: 0 to 93% (Non-condensation or Icing).
10. IP Rating: IP 50.

4.1.8 Strobe cum Alarm Hooters (Addressable)

Addressable loop powdered Strobe cum Alarm hooters shall be suitable for indoor / outdoor. All hooters shall be 24 V DC operated and Loop Powered. The minimum sound level shall be 90 db. Sounders shall be surface mounted. All the hooter cum strobe should have inbuilt fault isolator.

Technical specification of loop powered sounder & beacon base (Indoor):

1. Operating principle: Electronic addressable sounder cum visual shall be addressable and loop powered, external power supply and addressable control modules are not acceptable.
2. Isolator: Device shall be with in-built isolator.
3. Volume: The sounder shall support unto 90 db.
4. Tamper: Device locking feature, if device is removed from base the panel shall indicate alarm.
5. Synchronization: Tones and Flashes can be synchronized.
6. Tone: 15 tones supported.
7. Visual flash rate: 1 Hz.
8. Operating voltage: 17-28 V DC.
9. Operating temperature: -20°C to +60°C.
10. Mounting: Shall be flush or surface mounted.
11. Soft start option: Required.
12. Should have inbuilt isolator.

4.1.9 Input Devices

i. The Input Device shall provide an addressable input for N.O. contact devices such as manual stations, water flow switches, sprinkler supervisory devices, etc. It must have inbuilt isolator. It should have tri colour LED status for Polling, alarm, fault/Isolation.

ii. The input device shall provide a supervised initiating circuit. An open-circuit fault shall be annunciated at the Fire Alarm panel (Subsequent alarm shall be reported.)

iii. The device shall contain an LED which blinks upon being scanned by the Fire Alarm panel. Upon determination of an alarm condition of an alarm condition, the LED shall be ON.

Technical specification addressable Input/output Unit:

1. General: The addressable Input/output Unit provides supervision of one or more normally open contact connected to single pair of cables & set of changeover relay contact.
2. Isolator: Controllable.
3. *Failsafe Mode: Required.
4. *Earth Fault Monitoring: Required.
5. Polling Led: Required.
6. Relay Output contact Rating: 1A @ 30 VDC.
7. *It should support following modes.
   a. Output & alarm NO Input.

b. Output & alarm NC Input.
c. Output with feedback NC.
d. Failsafe Output with feedback NC.
e. Failsafe Output without feedback.
f. Momentary Input Activation Sets Output Relay.
g. Input activation sets output.
h. Alarm delays.

8. Humidity:0 to 95%.
9. Operating Temperature: -40 to 70-degree C (non-condensation or icing)
10. IP Rating: IP65.
11. Should have inbuilt isolator.

4.1.11 Response Indicator.

i. Response indicator should be made up of polycarbonate material. It should be placed where the detectors are not easily accessible or visible.
ii. It should glow steady red when detector is in alarm condition.
iii. RI should be made of ABS
iv. Duel LED

4.2 FIRE ALARM PANEL (FACP)

4.2.1 Fire Alarm panel shall be provided with TFT Module with fully touch screen facility without manually press function key pad. Internal Backup of 24 hrs.in normal condition and 30 minutes in Alarm condition.

4.2.2 Functions

The Fire Alarm Control Panel shall include a full featured operator interface control that shall include a 4.3” TFT fully touch screen display.

All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel.

The main FACP shall perform the following functions:

a. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.

b. Supervise all initiating signaling and notification circuits throughout the facility by way of connection to monitor and control modules.

c. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed.

d. Should have backup facility for loaded program and log results via USB stick.

When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

a. The system alarm LED shall flash.

b. A local electric audible device in the control panel shall sound a distinctive signal.

c. The 4.3” graphic display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.

e. All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

4.2.3 The Fire alarm control panel shall provide the following features:

a) Control-By-Time (Delay, Pulse, time of day, etc.)
b) Device Blink Control (turn of detector LED strobe)
c) Smoke Detector Pre-alarm Indication at Control Panel
d) System Status Reports
e) Alarm Verification, by device, with tally
f) Multiple Printer Interface
g) Non-Fire Alarm Module Reporting
h) Automatic Detector Test
i) Programmable Trouble Reminder
j) Upload/Download System Database to PC Computer
k) Security Monitor Points
l) Cloud Based Remote programming.
m) Provision to integrate with PA and BMS System
n) Remote backup facility for program and log files via USB stick for service purpose.

4.3.1 Networking

An additional output drive card must be provided to facilitate networking between two or more panels.

4.3.2 Wiring

Writing shall be carried out with 2 core, 1.5 sq. mm. stranded copper conductor which shall be PVC insulated with Aluminum foil, screen 50% ABC braided and PVC sheathed.

4.4 DEFINITIONS

a. Alarm Indicating Circuits

Circuits to which alarm indicating devices are connected. Alarm indicating devices are audible or visual devices for warning building occupants. They include but are not limited to alarm bells, hooters and visual warning signal lights.

b. Alarm Initiating Circuits
Circuits to which automatic or manual alarm initiating devices are connected. Alarm initiating devices include manual call point, automatic fire (smoke and heat) detectors and other emergency reporting devices.

c. Alarm Signal

A signal which signifies a state of emergency requiring immediate notification of the fire services.

d. Beam Detector

A Beam smoke detector detects the smoke with the help of Light obscursion principle. It measures the reduction of intensity of a beam of light due to presence of smoke particles.

e. Photo Electric Type Smoke Detector (Optical)

A detector which detects smoke, works on light scattering principle and is Analog Addressable type with switches/codes etc. to define the Detector.

f. Heat Detector

A detector which detects heat and is Analog Addressable type with switches/codes etc. to define the Detector.

g. Manual Call Point

A device which shall be addressable type with switches/codes etc. to define the station.

h. Strobe cum Hooter

A device which shall be addressable and shall be able to give audible alarm through it and also give indication and controlled from the Fire Alarm Panel.

i. Fault Isolator

This equipment shall be placed in the electrical wiring and shall be able to isolate electrical short circuiting and loose wiring. The isolator shall be able to keep the part of the electrical circuit in operation that is connected directly to the Fire Alarm Panel.

j. Fire Alarm Panel

This refers to the microprocessor-based Panel that shall be connected to the various Detector loops. There shall be multiple looping/zoning as indicated on the drawing. The panel shall be able to watch individual Detectors for performance as well as to give pin point location of fire alarm. Hooter Alarm as well as facility for cutting off of AHUs and electrical power is also included in this panel.

k. Loop

A loop or a zone shall mean a 2 wire circuit connecting at least 126 addressable analog devices.

l. Control Switches

Switches shall mean points from the Fire Alarm Panel with potential free contacts for tripping of AHUs power supply etc. as required. Any switch shall be able to trip an individual AHU.

5 TESTING AND COMMISSIONING

5.1 Fire Alarm Panel:

The panel shall be checked for basic tests, such as, visual checking of input voltage and amperage. All loops one by one, shall be D-wired to check for fault signal indication in the panel.

Subsequently, in every loop of panel, a detector shall be subjected to smoke or heat test and signals shall be checked on the panel.

The hooter shall sound automatically, and the sounders shall also sound. It shall also be possible to check that the hooters of all panels sound automatically when the panels in Alarm Mode as per programming.

The power source shall be cut off and checked for standby supply from the batteries. After six hours the power source shall be switched on to check for auto switch over to mains mode. The trickle charger shall take over the charging of the battery to its maximum cut off level with auto cut off. A set of discharged batteries shall be connected to the panel in place of the new batteries and the trickle/boost switch checked for charging of the batteries.

Tests shall be conducted for AC failure, charger failure, battery disconnected or battery failure. In all such cases the relevant indication should come.

5.2 Photoelectric Smoke Detector:

The testing shall be carried out for each loop initially one detector in a loop and subsequently two or more disassociated detectors in each loop with time gap between the detectors for alarm acknowledge and Reset.

An identified detector will be subjected to smoke aspiration from Smoke Detector Tester Kit (Solo or Specified as per the Make). The panel should indicate through sounder and hooter that alarm signal has been transmitted throughout the system.

This test shall be carried out in different loops as well as two loops simultaneously.

5.3 Heat Detector:

The same test in the same sequence shall be carried out for this type of detector but with the application of heat from a Heat Detector Tester Kit (Solo or Specified as per the Make).

5.4 Multisensor:

The same test in the same sequence shall be carried out for this type of detector but with the application of heat and smoke from a Smoke & Heat Detector Tester Kit (Solo or Specified as per the Make).

5.5 Manual Call Point:

The manual call point should be activated by manual push. The MCP shall instantaneously give a fire signal in the panel.

5.6 Random Sample Testing:

About 5% of all fire alarm components shall be subjected to random testing by connecting to the panels. All smoke detectors shall be tested as given above and later cleaned with a vacuum cleaner.

5.7 Testing of Earthing system:

The earth continuity conductor including metallic parts of the equipment's shall be tested for earth to electrical continuity. All tests shall be carried out as per IS 3043 and resistance of complete installation shall not be more than one ohm.

6. COMMISSIONING AND ACCEPTANCE TESTS

The commissioning and acceptance tests shall be apart from the standard or routine tests prescribed and normally conducted by the manufacturer /Design-Build Contractor and will be irrespective of the fact whether the same are covered by such tests or not.

a. Each sounder circuit shall be energized separately, and the sound level reading taken to check for conformity with the minimum standards.

b. Mains failure performance.

c. Battery disconnection test.

d. Open circuit of each sounder circuit to be tested.

e. Short circuit of each sounder circuit to be tested.

f. The results of the above tests either by fault warning or fire alarm shall be recorded in the log books which will be signed both by the Design-Build Contractor and the Olectra Greentech Limited's Representative.

7. TESTS AT SITE

i) All commissioning tests at site will be in line with BS5839 / NFPA-71 and 72.

a. Loop Checking.

b. Double address.

c. Short circuit

b. Checking of smoke detectors, Heat detectors etc. by simulation.

c. Functional tests for fire alarm panel.

d. The Mock trial of the complete Fire Detection and Alarm system.

e. Cause and effect matrix.

Public Address and Voice Alarm System

1. General description

The contractor shall supply, install, test, connect and commission a high quality fast-acting **Public Address and Voice Alarm System** complying strictly with BS 5839 part8 and EN60849 and shall be TUV or Equivalent Agency approved. The Public Address and Voice Evacuation System shall comprise of Audio Matrix Units, High quality speakers, Audio rack all mounted on a 19" Rack and fully connected and **integrated on the fire alarm loop**. The system shall be used for Professional Sound Reproduction for all the areas where possible special events take place.

Prior to placing order for any equipment, the contractor shall submit comprehensive document comprising working drawings, catalogues and descriptive literature of components, acoustic calculation to meet with BS5839 part8 RASTI (Room Acoustic Speech Transmission Index) requirements of 0.5 on the STI scale and 0,7 on the CIS scale. The contractor shall be required to train and instruct client's personnel in the correct use, operation and supervision of the system, preferably prior to the handing over of the project.

In order to ensure whole site integration capability, the fire and voice alarm system will be awarded to a single specialist local supplier who will be responsible for the design, global operation, management and interfacing of the system. The contractor shall make sure that all power tapping of the speakers must be carried out as specified, even if the acoustic calculations indicates less power tapings. The contactor must endure minimum of 10dB above the ambient noise levels are achieved.

The system shall be fully programmed to accommodate fire alarm and voice communication zones as indicated on the drawings and schematics. The system shall be configured to allow on site modifications with the minimum of disruption using the PC based software to facilitate future changes or alterations to the buildings.

2. Scope of Work

The scope of work under this head shall include designing supplying and installing of Public Address System. The work under this system shall consist of furnishing all materials, equipment's and appliances and labor necessary to install the said system, complete with Speakers, Amplifiers, Microphone, Zone Selection Panel for interfacing with other systems. The PA system is designed to serve the dual purpose of making general announcement and Voice Evacuation at the time of Fire alarm activation.

3. System Design

The PAVA system shall be connected on the same Fire Alarm panel. The system shall be de-centralized in nature, each distributed rack DAU (Distributed Amplifier Unit) shall have all the DSP (Digital Signal Processing), messages, amplifiers, monitoring in such a way that can work in a stand-alone mode in case the master rack is faulty or down.

The Man Machine Interface (MMI) shall be connected back to the control room, to monitor and control the entire PAVA system. The DAU shall play background / Foreground music and in case of Fire Alarm / Paging announcement, the system shall go to full power as programmed to provide the enough SPL (Sound Pressure Level) levels to comply with BS5839 part8, with minimum of 10dB above the noise levels.

All system components shall be digitally monitored including and not limited to, Messages, Amplifiers, and back up amplifiers, Speaker Circuits, Audio Matrix units, Paging Microphone, Battery Charger and the 230VAC line. Each amplifier / line circuit shall be monitored individually and shall report any faults back to the Master Audio Matrix Unit as well as the Paging Microphone.

There shall be one back up amplifier, the system shall automatically change over to the back up in case of any amplifier failure, and the back up amplifiers shall be monitored as well.

The Battery Back up shall provide 24 hours of back up and 30 min of alarm operation. The power supply / charger must comply with EN54 part 4 and shall be 19" rack mounted. Battery calculation must strictly comply with BS5839 part 8 and shall be based on the amplifier size and not the speaker circuit load.

The PAVA system shall be properly integrated with the fire alarm system. The integrated PAVA system shall cover all normally accessible areas including the car parks.

In addition, a FIRE DRILL, BOMB ALERT, EARTHQUAKE ALERT and an ALL CLEAR message shall be incorporated into the operation. A fire alarm broadcast signal shall cancel any public-address operation and shall override it. When a fireman's

microphone is operated, this shall override any automatic voice alarm signal being transmitted to the zone selected.

All amplifier gain shall be monitored and measured for open, short or earth faults. The Entertainment Rack shall be located in the Control/Security Room enabling the operator to select music from the CD player, FM tuner or the double cassette deck to transmit music to selected zones or all the zones in the building from the touch screen paging microphone. A public-address announcement shall override the music transmission to selected zones or all zones. The Speakers shall be distributed in the entire floor and shall be configured in different zones. The announcement can have made in zone wise or to all the speakers simultaneously in ALL CALL mode. Fire Alarm shall be announced immediately on receipt of Fire signal from the panel to all zones or group of Zones.

System shall have following functions:

Voice Evacuation and Public Address system integration includes paging system and background music system. Monitoring of microphone, controller, amplifier, fireman microphone, and source modular, AC&DC power Supply, and Volume Control.

The Amplifier shall be used only Class-D with Digital switching power technology

4. Amplifiers

All amplifiers shall be power amplifier with High quality speech and Music broadcast. The power amplifiers shall have adequate continuous (RMS) power output to meet the requirement of the configuration. The unit shall can deliver the rated output power with less than 0.1% harmonic distortion in the design bandwidth. The amplifier shall have a broad band frequency response of 20 Hz to 20 KHz. The output voltage and impedance shall meet with the system requirements. Amplifiers shall be protected against over loads and output shorts and a special thermal overload on the heat sink.

The Amplifier shall be lass –D Amplifier have one channel, Two Channel and four channels' each channel have rated power 120/240or 500W. The Amplifier shall have switch power technology for power electricity saving, sleep mode is automatically enabled when no signal input is detected.

Amplifier shall have AC 230V power supply and DC 24V input, having separate fuse for each channel. The Amplifier shall be connected through balanced audio input and shall work on 100V Speaker Line.

Technical Specifications

- Rated Output Voltage(RMS) 250/500 W
- Amplification Class-D
- Battery Voltage 24VDC (max 10% deviation)
- Frequency Response 20Hz to 20KHz
- S/N Ratio >80 dB
- Total Harmonic Distortion <0.1% @ 1kHz
- Power Efficiency >75%

5. Speakers

1. Speakers shall be especially designed for broadcasting high quality, integrated emergency fire alarm signals and voice communications and approved by an appropriate authority for use in such situations.
2. Speakers shall be ceiling, wall mounted or Horn Speaker as shown in the schedule of work and shall be completed with mounting brackets accessories etc. Speakers shall be in metal enclosures only.
3. Speakers shall be interconnected in the zone configuration.

5.1 6Watt Ceiling Mounted Speaker

The ceiling mounted 6 W speakers shall be installed as depicted in the drawing. The speakers support EASE, CATT or ULYSSES models for acoustic studies. This mean the acoustic model can be designed to simulate the sound quality and distortion prior to installation. The Ceiling speaker shall work on 100V line so that it can reduce line losses over long distance and allow easy parallel connection of multiple loudspeakers. The Speaker shall have multiple tapping for different application according to room size and ambient noise environment. The Speaker shall have aluminum grille and metal baffle and shall have spring clip clamp for easy installation.

Technical Specifications

- Rated power 6 W
- Tapings 100V line 6/3/1.5W
- Operation Voltage 100V or 70V
- Effective frequency range 110 ~ 15kHz
- SPL @ 1W/m >91 dB
- S.P.L. ,@Full power/ 1m, dB >97 dB
- Speaker Drive 6”
- Color White

5.2 6 Watt Wall Mounted Speaker

- Rated power 6 W
- Effective frequency range 110 ~ 15kHz
- Sensitivity 98dB
- Power Handling 6W
- Line Input 100V
- Component 6.5”
- Material ABS
- Grille Power coated Iron mesh
- Color White

5.3 15W Horn Speaker

The Horn speakers with 15W Output shall be installed as depicted in the drawing. The speakers support EASE, CATT or ULYSSES models for acoustic studies. This mean the acoustic model can be designed to simulate the sound quality and distortion prior to installation. The Speaker should be complying BS/EN 60065, 2003 and EMC (BS EN 61000-6-Part 1/2/3/4). The Horn speaker shall work on 100V line so that it can reduce line losses over long distance and allow easy parallel connection of multiple loudspeakers. The Speaker shall have multiple tapping for different application per room size and ambient noise environment.

Technical Specifications

- Rated power 15 W
- Tapings 100V line 15W/7.5W
- Operation Voltage 100V or 70V
- Effective frequency range 250 ~ 8kHz
- SPL @ 1W/m >103 dB
- S.P.L. ,@Full power/ 1m, dB >113 dB
- Color White

5.4 20W unidirectional wall/column mounted Speaker

The speakers with 20W Output having taping of 10/15/20 watt shall be installed as depicted in the drawing. The speakers support EASE, CATT or ULYSSES models for acoustic studies. This mean the acoustic model can be designed to simulate the sound quality and distortion prior to installation. The Speaker should be complying BS/EN 60065, 2003 and EMC (BS EN 61000-6-Part 1/2/3/4). The Horn speaker shall work on 100V line so that it can reduce line losses over long distance and allow easy parallel connection of multiple loudspeakers. The Speaker shall have multiple tapping for different application per room size and ambient noise environment.

Technical Specifications

- Rated power 20 W
- Tapings 100V line 20W/15W/10W
- Operation Voltage 100V or 70V
- Effective frequency range 250 ~ 8kHz
- SPL @ 1W/m >103 dB
- S.P.L. ,@Full power/ 1m, dB >113 dB
- Color White

6. Remote Paging Microphone

The Remote Paging Microphone should be fully digital connected via CAT6 Cable with Controller. The Microphone should have capability to make announcement in 6 Zones and have all call facility. The Microphone shall have ability to control music and should be able to route the music in zones. The Microphone should have LED indication for the different faults, the unit shall be able to indicate AC, DC, Fault, Mic and Test status through LED. The Microphone shall have 6 input & Mic/line Selection buttons. The Microphone have reset/channel, All call & Call buttons. The Unit shall have 2 RJ45 ports for Microphone so that the other microphone shall be able to link with the unit.

The Microphone shall have following features:

1. AC 230V and DC24V battery inputs.
2. Built-in monitor speaker.
3. Paging mode: PTT & Normal paging
4. Phantom Power: 20V – 27.5V
5. Power Consumption: < 2.4A
6. Line input Sensitivity: 775 mV
7. Microphone input Sensitivity: 5 mV
8. S/N ratio: >70dB
9. Humidity: <95%

7. Voice Alarm Controller (VAC)

The network controller shall be a control unit for a public address and emergency sound system with inbuilt 500 watt amplifier. It shall control and route audio with audio signals comprising e.g. announcements made via call stations or background music from a connected CD-player. The network controller shall have an RJ-45 Ethernet connection for connecting a configuration PC, directly or via an Ethernet network. After the configuration, the network controller shall be able to run stand-alone without PC, although it shall be possible to keep the network controller connected to the network or PC for additional functions, such as logging of call and fault events or remote control. The network controller shall provide power to connected equipment on the network. It shall provide 6 analog audio input channel.

The controller shall have a supervision system to monitor its operation conditions. Network connectivity status and fault conditions of the network controller itself and all network-connected units shall be stored inside the network controller. The network controller shall have 6 control inputs for activation switches, with configurable for open and short circuits. The control inputs shall have configurable functionality, such as automatically starting an emergency alarm in case of activation by a fire alarm. The network controller shall have relay outputs, that can be configured for integration with the third party. The Network controller should have 2 Separate players for alert and EVAC and should have SD Card to store the prerecorded messages. The Controller shall have message recording in following format MP3 or WMA format, two separate players of SD card with protection cover, programmable voice message up to 255.

The unit shall be able to operate at a maximum operating temperature of 55°C to accommodate high density rack mounting. The network controller shall be as per the international standard IEC 60849 for emergency sound systems. The unit can be free-standing on a tabletop or mounted in a 19" rack.

The following features shall be available or supported by Network controller.

1. The Controller shall have Class-D 500W Digital amplifier
2. 6 zone AB speaker line low impedance supervision.
3. Red button EVAC message push to activate with priority except fireman mic.
4. 6 zone speaker outputs.
5. 6 zone separate indicator for EVAC, fault, music/paging & select.
6. System indicators of AC, DC, fault and indicators for EVAC, alert & fireman mic.
7. Zone capacity of 120 zones by cascaded routers.
8. Priority level: fireman mic, EVAC, input 1, remote microphone, timer & BGM.
9. Two RJ45 for cascade router, two RJ45 for remote microphone input and two RJ45 for LAN/WAN/Internet network.
10. AC 230V and DC24V battery input. Auto switch into the battery backup when AC fails.

Technical Specification:

1. Power Supply AC 220V – 250V/24VDC, 50/60Hz
2. Power Consumption 650W

3. Fireman Impedance	600Ohm
4. Fireman Microphone:	5mV, 600 Ohm
5. Line 1 – 2 input:	385mV
6. Frequency Response:	80Hz – 20kHz
7. Line 3 – 6 input:	350mV
8. THD	<0.1%
9. S/N Ratio	>70dB
10. Relative Humidity	95%

8. 19" Rack

The equipment shall be housed in a standard rack of suitable height, with Plexiglas door or metal mesh and lock. Ventilation panels of 1U height shall be provided between each item of equipment.

Details of the proposed equipment shall be forwarded to the Consultant with performance specifications, dimensions, construction and finish for approval.

Rack should comply with ANSI/EIA RS-310-D; DIN41491; DIN41494; IEC297-2; and GB/T3047.2-92.
The Rack should have DIN Rail Mounted Terminal Blocks for termination of Speaker Zone cables on the rear. All cables coming from Speaker zones, Call Stations, Power supply should enter from Bottom.
Rack should be installed at location which has minimum 600mm space from front & back for accessing it easily. Rack should be installed in well ventilated room preferable Air conditioned. The unit should have Fans from top.

The unit should have Lockable Glass door at front Dimensions

- Height as per the Quantity of PA Processor & Amplifiers
- Depth 600mm Deep
- Width 19"

9. Testing PAVA System

Sr. No.	Description	Visual	Test Readings	Documentation
1	All cables are tested for continuity, insulation, resistance etc.			√
2	System installation proper as per drawing	√		
3	Carry out visual checks on all speakers & Processors are free from any mechanical damage, cables, inter phase modules etc.to ensure they are properly installed.	√		
4	Check for proper termination of bootlace lugs & feruling	√		
5	Check Input A/C Supply Voltage		√	
6	Check location / spacing of loudspeakers as in drawing.	√		√
7	Check Distribution of Zones as per Drawing.	√		√
8	Check full load speaker sound quality & measure Sound pressure level (SPL) in dB.	√	√	
9	Check if local loudspeakers overrides by voice messages in case of emergency evacuation.	√		√
10	If power fails, whether Voice evacuation system is working on battery supply if yes for what time		√	
11	Check if recorder messages are CLEAR, free from any noise distortion & easy to understand with Room acoustic speech transmission Index (RaSTI) value >0.5.	√	√	
12	Processor LED's and all keys are working properly	√		
13	Check for Microphone locations & the sensitivity by paging	√		√
14	Play a soft music & check sound quality	√		

SECTION 5

S P E C I F I C A T I O N S

FOR

I N V E R T E R

1.	**Product**	**Inverter**
a)	Capacity	Kva
b)	Technology	IGBT based PWM Pure sine wave
2.	**Input**	**Single**
a)	Voltage	230 V ±20%
b)	Frequency	50 Hz ±5%
3.	**Output**	**Single**
a)	Voltage	230 V ±5%
b)	Frequency	50 Hz ±1.5%
c)	Waveform	Pure Sine Wave
d)	Power Factor	0.8
e)	Efficiency	>80%
f)	Backup Duration	60 Min
4.	**Battery**	**With Stand**
a)	Type	External: SMF/VRLA
b)	Battery Ah & Nos	for 60 Min
c)	Nominal Float Voltage	54 V
d)	Recharge Time	8 - 10 Hours
5.	**Features**	
a)	Standard	Cold Start & O/L Reset
		Spike & Surge Suppressor
		Front Panel LCD Display
6.	**Protection**	
a)	Charger	Charger Fuse/Circuit Breaker
b)	Inverter	Mains Low & High Voltage Cut-off, Over Load Cut-off & Short Circuit Protector
c)	Battery	Over Charge Voltage & Current Cut-off & Battery Deep Discharge Cut-off
7.	**Indication**	
a)	Visual	Mains On, Charger On, Inverter On, Over Load & Battery Low
b)	Audible	Inverter On, Over Load & Battery Low
8.	**Environment**	
a)	Altitude	0 - 2000 m
b)	Temperature	0 - 40 °C
c)	Humidity	95% Non Condensing
d)	Noise	<60 dB

SECTION 6

S P E C I F I C A T I O N S

FOR

S O L A R S T R E E T L I G H T

S. No.	Specification	
1.	Dimming profile	V6
2.	System wattage	12DC, 35 Watts
3.	System lumen output	60000
4.	Solar panel module capacity	60W
5.	Battery capacity	384Wh
6.	PIR range	6mtrs above the ground
7.	Color temperature	3000K, 4000K, 5700K
8.	System efficacy	175lm/W
9.	Battery type	Lithium Ferro Phosphate LiFePo4
10.	Charging electronics	Integrated MPPT charger with driver
11.	Driver efficiency	>90%
12.	IP Rating	IP65
13.	Housing	Aluminum pressure die cast with anti-corrosive coating
14.	Front cover	UV stabilized polycarbonate cover
15.	CRI	>70
16.	Switch for On-Off	Provided
17.	Charging and discharging indicator	Provided
18.	Mounting	Horizontal and vertical pole mounting options
19.	Adjustable tilt angle	0-15 degree adjustable
20.	Outer mounting diameter	48-60mm
21.	Operating humidity	Up to 95%
22.	Operating temperature	0 to 35 degrees; Charging: 0 to 45 degrees; Discharging : -20 to 35 degrees
23.	Connectivity	Android BLE app for configuration and health check on-site. RMU for remote control and monitoring.