

TECHNICAL SPECIFICATION

**LIST OF APPROVED MAKES
(CIVIL & SANITARY WORKS)**

S. No.	Item Description	Approved Make
CIVIL WORKS		
1	Ordinary Portland Cement	Ultratech, Binani, Jaypee
2	White Cement	Birla, J.K.
3	TMT "Fe - 500/415 D" Ribbed bars	Tata, RINL (VIZAG), SAIL
4	Structural Rolled Steel sections -beams, channels, tee, flats, angles, bars (round, square, hexagonal)	Tata, RINL (VIZAG), SAIL
5	Structural Hollow steel sections (Square & Rectangular)	Tata, Asian, Jindal
6	Coarse Aggregates (machine cut)& Coarse Sand	From Approved quarry
7	Shuttering plywood	Kitply, Alpro, Green, Pragati
8	Water proof/Marine grade plywood as per - IS - 710 (BWP)	Kitply, Alpro, Green, Pragati
9	Commercial Plywood - IS - 303 (BWR)	Kitply, Alpro, Green, Pragati
10	Decorative ply (Veneer)	Green, Alpro, Century
11	MDF	Nuwood, Duratuff (exterior grade only)
12	Prelam particle board	Novapan, Bhutan. (exterior grade only)
13	Laminate sheet	Greenlam, Decolam, Sundeck, Merino.
14	Cement bonded particle board	Shera ,NCL (Bison board), Everest (Eternite)
15	Calcium silicate board / Gypsum Board	Saint Gobain (India Gypsum), Hilux ,Lafartz
16	Flush door - decorative / non decorative	Green, Alpro, Uniply
17	Dead Locks/ Mortise locks/ Narrow stile dead locks/ Tubular locks	Kich, Dorma, Dorset
18	Float Glass / wired Glass, Mirror	Modi guard, Saint Gobain, Asahi
19	Reflective Glass	Saint Gobain, PPG, Asahi
20	Glazed tiles	Asian, Johnson, Somani, Kajaria, Nitco,
21	Ceramic tiles	Asian.Johnson, Somani, Nitco, Kajaria
22	Vitrified tiles	Johnson, Asian, RAK, Nitco
23	Handmade Ceramic Tile	Raja Tiles or Equi

24	Non-metallic floor hardener	Ironite
25	Construction chemicals Plasticisers, Bonding agents,	Cico, BASF, Fosroc
26	Water proofing chemicals Chemical Water proofing & Integral water proofing compound	Cico, Dr Fixit, Pidilite
27	Silicon sealant/ Silicon paint	Wacker, Dowcorning, GE, Soudal, Bostik
28	Paint, primer, putty	Asian, Berger, ICI, Birla (putty), JK (Putty)
29	Liquor /Melamine /PU polish	MRF, Asian, ICI, Taralac
30	Door Window Hardware	Kich, Dorma, Ozone
31	Floor spring	Dorma, Ozone, Hardwyn
32	Door closer	Dorma, Ozone, Hardwyn
33	Wooden Adhesives	Fevicol, Araldite
34	Tile adhesives & grouting material	BAL, Laticrete, Kerakoll
35	Aluminum sections	Jindal, Hindalco (Indal), Bharuka, Mahaveer
36	Anchor Fasteners	Hilti, Fischer, corroshield, Buildex
37	Anchoring chemical for rebar dowel bar	Hilti, Fischer
38	SS clamps for cladding	Hilti, Axel
SANITARY WORKS		
1	S.W.R UPVC PIPE & FITTINGS	SFMC/ SUPREME / FINOLEX
2	GULLY TRAP - SWR	SFMC/ SUPREME / FINOLEX
3	S.C.I. Pipes	NECO / BHARAT / KALPESH
4	C.I.COVERS	NECO / BHARAT / KALPESH
5	CPVC PIPE	SUPREME / DUTRON / ASTRAL
6	G.I. Pipes & Fittings	Jindal / Tata / Prakash Surya
7	METAL TO METAL & METAL TO PVC THREAD JOINTS	CHAMPION
8	VALVES (GUN METAL)	ZOLOTO / LEADER /KIRLOSKAR
9	ASBESTOS YARN	CHAMPION / CAPTAIN
10	BATH FIXTURES	JAQUAR OR EQUIVALENT / As approved by Architect
11	SANITARY FIXTURE	HINDWARE / PARRYWARE / CERA / As approved by Architect

All the Materials/Makes listed above and other than as specified above shall be used after obtaining prior approval from the Architect/Engineer-in-charge.

GENERAL TECHNICAL SPECIFICATIONS

All works shall be executed, measured and paid for as per latest Central Public Works Department (C.P.W.D.) Specifications, unless otherwise provided in the item detail / agreement.

The tenderers are requested to obtain the copies of the above documents directly from the office of Central Public Works Department (C.P.W.D.) as these Specifications are not being issued alongwith the tender documents. These specifications with upto date correction slips will form part of the contract agreement to be executed with the successful tenderer.

PARTICULAR TECHNICAL SPECIFICATIONS FOR CIVIL WORK

1. EARTH WORK:-

The work shall be done in accordance with CPWD Specifications - 2009 - Vol.I& Vol. II with upto date correction slips.

2. CONCRETE WORK:-

The work shall be done in accordance with CPWD Specifications - 2009 - Vol.I& Vol. II with upto date correction slips.

3. R.C.C. WORK (DESIGN MIX CONCRETE) :-

3.1 The RCC work shall be done with Design Mix Concrete. Wherever letter M has been indicated, the same shall imply for the Design Mix Concrete. The Design Mix Concrete will be designated based on the principles given in IS:456, 10262 & SP 23. The conditions & specifications stated herein shall have precedence over all conditions & specification stated in relevant I.S. Codes / C.P.W.D. Specifications. The concrete mix shall be designed for the specified target mean compressive strength in order to ensure that work test result do not fall below the acceptance criteria specified for the concrete mix. The Contractor shall design mixes for each class of concrete indicating that the concrete ingredients and proportions meeting requirements specified. The mix shall be designed with quantities of admixture / plasticizer proposed to achieve required workability & strength.

3.2 The sources of coarse aggregate, fine aggregate, water, admixture & cement to be used in concrete work shall be identified by the contractor & he will satisfy himself regarding their conforming to the relevant specification & their availability before getting the same approved by the Engineer-In-Charge.

a) Coarse Aggregate:- As per CPWD Specifications - 2009 - Vol.I& Vol. II with correction slips.

- b) Fine Aggregate:-As per CPWD Specifications - 2009 - Vol.I& Vol. II with correction slips.
- c) Water:- It shall conform to requirements laid down in IS:456-2000 / Para 5.4 or CPWD Specifications - 2009 - Vol.I& Vol. II with correction slips.
- d) Cement:- OPC of grade 43 shall be used for design mix concrete and shall conform to IS-8112, IS-12269 or IS-12270. However, if higher grade of cement is used by the contractor nothing extra shall be paid on this account.
- e) Admixture / Plasticizer - The admixture shall conform to IS:9103. Whenever required, the admixture of approved quality & approved make only shall be used to attain the required workability.

3.3 Grade of Concrete:- The compressive strength of various grades of concrete with various parameters shall be as follows :-

GRADE DESIGNATION	COMPRESSIVE STRENGTH ON 15 Cm. CUBES Min. 7 DAYS (N/mm ²)	SPECIFIED CHARACTERISTIC COMPRESSIVE STRENGTH AT 28 DAYS (N/mm ²)	MINIMUM CEMENT CONTENT (Kg. Per Cub. Mtr.)	MAXIMUM WATER CEMENT RATIO	SLUMP
M-20	As per Design	20	350	0.50	25-75
M-25	As per Design	25	350	0.50	25-75
M-30	As per Design	30	400	0.45	25-75
M-35	As per Design	35	400	0.45	25-75

NOTE :-

- a) In the designation of a Concrete mix letter M refers to the mix and the number of the specified characteristic compressive strength of 15 cm - Cube at 28 days expressed in N/mm².
- b) It is specifically highlighted that in addition to the above requirements. The maximum cement content for any grade shall be limited to 530 kg. / Cubic metre.
- c) The minimum / maximum cement content for design mix concrete shall be maintained as per the quantity

mentioned above. Even in the case where the quantity of cement required is higher than the minimum specified above to achieve desired strength based on an approved mix design, nothing extra shall become payable to the contractor.

3.4 The Contractor shall engage one of the following approved laboratories / test hosue for designing the concrete mix in accordance with relevant IS Code and to conduct laboratory tests to ensure the target strength & workability criteria for a given grade of concrete.

a) Any State University

b) IITs.

The various ingredients for mix design / laboratory tests shall be sent to the lab / test houses through the Engineer-in-charge and the samples of such aggregates sent shall be preserved at site by the employer.

In the event if all the three laboratories are unable to carry out the requisite design / testing, the contractor may have it done from any other laboratory with prior approval of the Engineer-In-Charge.

3.5 The contractor shall submit the report on design mix from any of above approved laboratories for approval of Engineer-In-Charge within 30 days from the date of issue of letter of acceptance of the tender. No concreting shall be done until the design mix is approved. In case of white portland cement and the likely use of admixtures in concrete with ordinary portland/ white portland cement, the contractor shall design and test the concrete mix by using trial mixes with white cement and / or admixtures also, for which nothing extra shall be payable.

3.6 In case of change of source or characteristic properties of the ingredients used in the concrete mix during the work, a revised laboratory mix design report conducted at laboratory established at site shall be submitted by the contractor as per the direction of the Engineer-in-charge.

3.7 TRIAL BATCHES

a) The designed mix proportions shall be checked for target mean compressive strength by means of trial batches.

- b) The quantities of materials for each trial mix shall be sufficient for at least six specimens (cubes) and the concrete required for carrying out workability tests.
- c) The workability of trial mix No.1 shall be measured and mix shall be carefully observed for freedom from segregation, bleeding and its finishing characteristics. The water content, if required, shall be adjusted corresponding to the required changes in the workability.
- d) With the modified water content, the mix proportions shall be recalculated by keeping with water cement ratio unchanged. The mix proportion, as modified, shall form the Trial Mix No.2 and tested for the specified strength and workability.
- e) In addition, trial mix No.3 and 4 shall be designed by keeping water contents same as that determined for trial mix 2 but varying the water cement ratio by + 10 percent of the specified value and tested for their design characteristics.

3.8 All cost of mix designing and testing connected therewith including charges payable to the laboratory shall be borne by the Contractor including redesigning of the concrete mix wherever required & directed by Engineer-In-Charge.

3.9 **APPROVAL OF DESIGN MIX:-**

- a) The mix design for a specified grade of concrete shall be done for a target mean compressive strength $T_{ck} = F_{ck} + 1.65s$

Where F_{ck} =Characteristic compressive strength at 28 days.

s = Standard deviation which depends on degree of quality control.

The standard deviation for different grades of concrete shall be as follows:-

<u>GRADE OF CONCRETE</u>	<u>STANDARD DEVIATION</u>
M-20	4.0
M-25	4.0
M-30	5.0
M-35	5.0
M-40	5.0

- b) Minimum three sets of separate preliminary tests shall be carried out for each trial batch of concrete mix. Each test shall comprise of six specimens and only one test-set of six specimens shall be made on any particular day.
- c) Out of the six specimen of each set, three shall be tested at seven days and remaining three at 28 days. The preliminary tests at seven days are intended only to indicate the strength to be attained at 28 days. While the design mix shall be approved only on the basis of test strength at 28 days.
- d) The design mix shall be considered satisfactory and approved if atleast three preliminary test-sets individually satisfy the following strength and workability criteria :
 - (i) The average strength of each test-set is not less than the specified target mean compressive strength (T_{ck}).
 - (ii) The strength of any specimen cube is not less than $0.85 T_{ck}$.
 - (iii) The concrete mix is of required degree of workability and acceptable concrete finish.

3.10 BATCHING & MIXING:-

- a) All concreting shall be done using computerised automatic concrete batching plant with automatic admixture dispenser which shall be installed by the contractor at site, calibrated & tested. The batching plant shall conform to IS: 4925. It shall have the facilities of data print-outs, presetting the quantity to be weighed with automatic cut-off when the same is achieved.
- b) In case of non-availability of batched concrete, ready mix concrete (RMC) may be used. The concrete to site shall be transported by transit mixtures. All the precautions shall be taken during the transportation and handling of concrete to achieve the desired strength, durability, etc. as envisaged in the mix design. Contractor has to get the approval from Engineer-In-Charge regarding source of ready mix concrete. Nothing extra shall be paid for ready mix concrete instead of batched mixed concrete.

- c) All measuring equipment shall be maintained in a clean and serviceable condition and their accuracy shall be checked atleast once a month.
- d) Only single sized good quality stone aggregate shall be brought to site of work from the approved source. The grading of the stone aggregate shall be controlled by blending the aggregate of different sizes in the required proportions at site of work

The aggregate of different sizes shall be stock-piled separately, preferably a day before use.

The grading of coarse and fine aggregates shall be checked as frequently as possible and as directed by the Engineer-In-Charge to ensure that the specified grading and quality of aggregate is maintained.

- e) It is important to maintain the water cement ratio constant at its specified or approved value by making adjustment for the moisture contents of both fine and coarse aggregates.

The moisture contents in the aggregate shall be determined as frequently as possible in keeping with the weather conditions and as per the provisions of IS:2386 (Part-III) 1963.

3.11 LAYING:-

- a) The concrete shall be placed in position using tower crane or concrete pumps of adequate capacity. Use of mechanical hoists shall not be permitted for lifting of concrete to various levels. For pumping of concrete the design of concrete mix shall be done separately. Nothing extra for laying concrete using concrete pumps or for extra concrete mix design shall be paid.

3.12 All other operations in concreting work like mixing, slump, laying, placing of concrete, compaction, curing etc. not mentioned in this particular specifications for Design Mix of Concrete shall be as per CPWD Specifications - 2009 - Vol.I& Vol. II with upto date correction slips.

3.13 SAMPLING:-

- a) Samples from fresh concrete shall be taken as per IS 1199-1959 and the test cubes shall be made, cured and tested in accordance with IS:516-1959.

b) Each test sample shall comprise of six test cubes (specimen), three of which shall be tested at 7 days and remaining for tests at 28 days.

c) **FREQUENCY OF SAMPLING:-**

(i) A random sampling procedure shall be adopted to ensure that the sampling is spread over the entire period of concreting and cover all mixing units.

(ii) The concrete work shall be notionally divided into lots as under for the purpose of sampling conditions.

- Footings, rafts etc.
- Columns and walls at all levels.
- Beams at all levels.
- Slabs at all levels.

(iii) At least one test sample shall be taken for each lot of concrete work.

(iv) Each grade of concrete shall form different lot of testing.

(v) The minimum frequency of sampling of concrete of each grade shall be in accordance with the following:-

QUANTITY OF CONCRETE IN THE WORK, CUBIC METRE PER DAY.	NUMBER OF SAMPLES
1-5	1
6-15	2
16-30	3
31-50	4
51 & above	4 Plus one additional sample for each additional 50cubic meter or part thereof.

NOTE:- At least one sample shall be taken from each shift.

d) The concrete work shall be assessed on day to day basis & samples shall be taken as specified.

3.14 Work strength test shall be conducted in accordance with IS:516 on random sampling.

3.15 TEST RESULTS OF SAMPLES:-

The test results of the sample shall be the average of the strength of three specimen. The individual variation shall not be more than $\pm 15\%$ percent of the average. If variation is more, the test results shall be treated as invalid. 90% of the total tests shall be done at the laboratory established at site by the contractor and remaining 10% in the laboratory of Central Designs Organization, CPWD or in any other laboratory as directed by the Engineer-in-Charge.

3.16 STANDARD OF ACCEPTANCE:-

- a) In case the test results of all the samples are above the characteristic compressive strength, the concrete shall be accepted.
- b) In case the test result of one or more samples fails to meet the requirement (a) above, it shall be accepted if both the following conditions are met:-
 - (i) Any individual test result is not less than $(F_{ck} - 3) \text{ N/mm}^2$.
 - (ii) The mean of test results from any group of four consecutive samples is more than $(F_{ck} + 3) \text{ N/mm}^2$.
 - (iii) Concrete of each grade shall be assessed separately.
- c) Concrete is liable to be rejected, if it is porous or honeycombed, its placing has been interrupted without providing a proper construction joint, the reinforcement has been displaced beyond the tolerances specified, or construction tolerances have not been met.

3.17 Only M.S. centring / shuttering and scaffolding material unless & otherwise specified shall be used for all R.C.C. work to give an even finish of concrete surface. However, marine-ply shuttering in exceptional cases as per site requirement may be used on specific request from contractor as approved by the Engineer-In-Charge.

3.18 Nothing extra shall be paid for the centring and shuttering, circular in shape whenever the form work is having a mean radius exceeding 6m in plan.

3.19 In order to keep the floor finish as per architectural drawings and to provide required thickness of the

flooring as per specifications, the level of top surface of R.C.C. shall be accordingly adjusted at the time of its centring, shuttering and casting for which nothing extra shall be paid to the Contractor.

As per general engineering practice, level of floors in toilet / bath, balconies, shall be kept 12 to 20mm as required lower than general floors shuttering should be adjusted accordingly. Nothing extra is payable on this account.

3.20 Measurement - As per CPWD Specifications - 2009 - Vol.I& Vol. II with upto date correction slips.

3.21 **Tolerances** - As per CPWD Specifications - 2009 - Vol.I& Vol. II with upto date correction slips.

3.22 **Rates:-**

- a) The rate includes the cost of materials, labour and T&P, including mixing, placing, transportation involved in all the operations described above except for the cost of centring, shuttering & reinforcement which will be paid for separately.
- b) In case of actual average compressive strength being less than specified strength which shall be governed by para "Standard of Acceptance" as above the rate payable shall be worked out accordingly as per CPWD Specifications - 2009 - Vol.I& Vol. II with upto date correction slips.
- c) In case of rejection of concrete on account of unacceptable compressive strength, governed by para "Standard of Acceptance" as above, the work for which samples have failed shall be redone at the cost of contractor. However, the Engineer-in-charge may order for additional tests (like cutting cores, ultrasonic pulse velocity test, load test on structure on part of structure, etc) to be carried out at the cost of contractor to ascertain if the portion of structure wherein concrete represented by the sample has been used, can be retained on the basis of results of individual or combination of these tests. The Contractor shall take remedial measures necessary to retain the structure as approved by the Engineer-in-charge without any extra cost. However, for payment, the basis of rate payable to contractor shall be governed by the 28 days cube test results and reduced rates shall be regulated in accordance with relevant clause.

3.23 In respect of all projected slabs at all levels including cantilever, canopy, the payment for the RCC work shall be made under the item RCC slabs. The

payment for shuttering at the edges shall be made under item of centering and shuttering for RCC slabs. Nothing extra shall be paid for the side shuttering at the edge of these projected balconies projected varandah slabs.

3.24 SHUTTERING:-

Steel shuttering as approved by the engineer-in-charge shall be used by the contractor. Minimum size of shuttering plates shall be 600mm x 900mm except for the case when closing pieces required to complete the shuttering panels.

Dented, broken, cracked, twisted or rusted shuttering plates shall not be allowed to be used on the work.

The shuttering plates shall be cleaned properly with electrically driven sanders to remove any cement slurry or cement mortar or rust. Proper shuttering oil or debonding compound shall be applied on the surface of the shutter plates in the requisite quantity before assembly of steel reinforcement.

3.25 REINFORCEMENT:-

- a) The reinforcement shall be done as per CPWD Specifications - 2009 - Vol.I& Vol. II with upto date correction slips.
- b) The rate of item of reinforcement of RCC work includes all operations including straightening, cutting, bending, welding, binding with annealed steel or welding and placing in position at all the floors with all leads and lift complete as per CPWD Specifications - 2009 - Vol.I& Vol. II with upto date correction slips.
- c) To avoid displacement of bars in any direction and to ensure proper cover, only factory made round type cover blocks shall be used by the contractor. Nothing extra shall be payable on this account.

4. BRICK WORK:-

- 4.1 The brick work shall be carried out with good quality well burnt FPS bricks of 75 designation as per CPWD Specifications - 2009 - Vol.I& Vol. II with upto date correction slips or as specified. The rate shall also include for leaving chases / notches for dowels / cramps for all kinds of cladding to come over brick work.

5. WOOD WORK :-

5.1 The wood work in general shall be carried out as per CPWD Specifications - 2009 - Vol.I& Vol. II with upto date correction slips.

5.2 All fittings and fixtures shall be got approved from the Engineer-in Charge before procurement well in advance and the approved samples shall be kept at site till completion of the work.

5.3 Glazing for toilets shall be of translucent type.

5.4 The shape and size of beading shall be as per drawings. The joints of beading shall be mitred.

5.5 FLUSH DOOR SHUTTERS :-

a) It shall be manufactured as per nomenclature of the item & as per drawings.

b) Flush door shutters shall be procured from approved manufacturer only.

c) Teak wood lipping shall be fixed on all the edges with the help of approved adhesive & using headless nails.

d) Laminate of required thickness shall be fixed on the flush door shutter using the approved adhesive.

e) On the entire exposed wooden surface, spirit polishing as per C.P.W.D. specification should be done.

f) Rate - Length and breadth shall be measured to a correct a cm.

6. STEEL WORK :-

6.1 The work shall be done in accordance with CPWD Specifications - 2009 - Vol.I& Vol. II with upto date correction slips.

7. FLOORING :-

7.1 All work in general shall be carried out as per CPWD Specifications - 2009 - Vol.I& Vol. II with upto date correction slips.

7.2 Whenever flooring is to be done in patterns tiles / stone, the contractor shall get samples of each pattern laid and approved by the Engineer-in-charge before final laying of such flooring for which nothing extra shall be paid.

7.3 Different stones / tiles used in pattern flooring shall be measured separately as defined in the nomenclature of the item and nothing extra for laying pattern flooring shall be paid over and above the quoted rate. No additional wastage, if any, shall be accounted for any extra payment.

7.4 The proper gradient shall be given to flooring for toilets, veranda, kitchen, courtyard, etc. as per the directions of Engineer-in-charge.

8. ROOFING:-

8.1 The work shall be done in accordance with CPWD Specifications - 2009 - Vol.I& Vol. II with upto date correction slips.

9. FINISHING:-

9.1 The work shall be done in accordance with CPWD Specifications - 2009 - Vol.I& Vol. II with upto date correction slips.

9.2 All painting material shall bring to the site of work in the original sealed containers. The material brought to the site of work shall be sufficient for at least 30 days of work. The material shall be kept under the joint custody of contractor and representative of the Engineer-in-charge. The empty containers shall not be removed from the site till the completion of the work without permission of the Engineer-in-charge.

10. WATERPROOFING WORK:-

The waterproofing work shall be done in accordance with the item description and with CPWD Specifications - 2009 - Vol.I & Vol.II with up to date correction slips.

11. MISCELLANEOUS WORKS

11.1 The work shall be done in accordance with CPWD Specifications - 2009 - Vol.I& Vol. II with upto date correction slips.

12. NON SCHEDULED ITEMS:-

12.1 Chicken Mesh

Providing and fixing hexagonal chicken mesh having opening 20mmx20mm of 26 gauge at junctions of concrete & brick work

or between different material etc. as directed by Engineer-in-charge

Material and Workmanship: As per item description and general specifications.

Mode of measurement and Payment: The item shall be measured in Sqm in plan area.

12.2 Anti Termite Treatment

Providing and injecting chemical emulsion for pre-constructional anti-termite treatment and creating a chemical barrier as per IS 6313 (Part II) for walls, trenches, foundation, top surface of plinth filling foundation of walls, floor along exterior perimeter of building etc. complete, conforming to manufacturers specifications & as directed by Engineer-in-charge using Chloropyriphos Emulsifiable 20 % concentration. (This item is for treating the areas under foundation of walls and building and beyond building aprons such as open yards etc. The actual ground horizontal area shall be measured).

Material and Workmanship: As per item description and general specifications.

Mode of measurement and Payment: The item shall be measured in Sqm in plan area.

12.3 Grooves in Plaster

Forming groove of uniform size from 12x12 mm and up to 25x15 mm in plastered surface as per approved pattern, using including wooden battens, nailed to the under layer including removal of wooden battens, repairs to the edge of plaster panel and finishing the groove complete as per specifications and direction of the Engineer-in-Charge.

Material and Workmanship: As per item description and CPWD specifications.

Mode of measurement and Payment: The item shall be measured in Rmt.

12.4 Filling of sunken portions with Foam Concrete

Filling of sunken portion of roof with foam concrete of required height including filling complete levelling and dressing the surface by 50mm thick cement concrete 1:2:4 as per specification.

Material and Workmanship: As per item description and manufacturer's specifications.

Mode of measurement and Payment: The item shall be measured in Cum

12.5 Fixing of Pole for Basket ball court

Providing and fixing on site 100 mm dia,2000 high M.S. Pipe with painting including excavation, refilling and disposal of surplus earth lead upto 50 metres etc. complete as per international standards.

Material and Workmanship: As per item description and manufacturers specifications.

Mode of measurement and Payment: The item shall be measured by each pole.

12.6 Painting of Basketball court

Painting two coats on basketball court surface all material, labour etc. Complete.

a) **Material and Workmanship:** As per item description, design, drawing and standard of sports authority.

b) **Mode of Measurement and Payment:** The payment shall be made for the complete job.

12.7 MS Pole arrangement for Volleyball net

Material and Workmanship: As per item description and standard laid by Volley ball association.

Mode of measurement and Payment: The payment shall be made for the complete job.

12.8 Mixing Plasticizers in R.C.C.

Material and Workmanship: As per item description and manufacturers specifications.

Mode of measurement and Payment: The item shall be measured in Kg.

12.9, 12.10 & 12.11 uPVC SWR Pipes

Material and Workmanship: As per item description, Specifications in Sanitary section and manufacturers specifications.

Mode of measurement and Payment: The item shall be measured as per item description.

12.12 Providing and fixing 40mm thick ,1000mm long & 650mm wide red sand stone drain covers over drains including cost of making 50mm dia holes for perforations for seepage of water and chisel-dressed to match level of stone cover and top of drain for all leads & lifts, all complete as per direction of Engineer-in-charge and provided drawings.

- a) **Material and Workmanship:** The stone to be used for the item is Agra / dholpur Sand Stone. The work shall including Providing, Cutting to required size & shape, Carving, Finishing, applying sealing coat of stone sealer and fixing them on the civil work carried out by the contractor, as per the instruction / guidance of the Architect.
- b) The contractor will have to take care in execution, transportation and fixing to avoid any chipping of edges, discoloration and stains on the stones. Any stones having such defects will be rejected by the Architect or the Site In charge and such stones will have to be replaced by the Contractors at their own cost.
- c) Moulding , Carving , engraving , dressing, cutting of stone work shall be done in Conformity with detailed working drawings for various parts of the structure. The detailed drawings shall be approved by the main Architect of the Work. Cutting, dressing, molding, carving work shall be carried out fine in quality and finely finished like polished. Carving work where ever required shall be done with adequate depth and in proportion with object / patterns being Carved.- small size of Grass, Peacock, Hans, Lion any kind of statue work or emboss work etc are part of the carving work.
- d) Special item like gun metal, Chemical or Other clamps, dowels (paus), Pins Anchor fasteners, Epoxy Grout, Araldite, etc. required for fixing shall be arranged by the Contractor at his cost.
- e) All the stone work shall be laid in Cement Mortar 1:3. At the location of visible joints White Cement with pigment to match the colour of the stone would be used for joining & pointing etc.
- f) Inner filling / hearting between two stone faces shall be filled with Cement Slurry. Masonry in Cement Mortar 1:3 as where pointed out by the Engineer -in - Charge shall be done.

Mode of Measurement

Mode of Measurement for stone work Measurement for stone work shall be done in each piece, as per prevailing practice for the same in consultation with the Architect of the Project, like measuring all the stones used after fixing

taking maximum length, width and depth for each decorative feature (consisting of base platform, engraved columns, arches, and a dome on top),. These measurements will be used for the Payment purpose.

Cleaning of the Stone work

- a) During execution of the work Cement Mortar and Cement Slurry, if, where ever, spilled on the finished carved and molded work, the same would be immediately removed and the surface should be cleaned.
- b) On completion of the work, Whole work shall be cleaned and polished with perfection. For cleaning use of any types of acids are prohibited. The area surrounding the main structure would be cleaned of all debris. All temporary structures and scaffoldings etc. shall be dismantled and removed.

Mode of measurement and Payment: The item shall be measured in each cover.

12.13, 12.14, 12.15 & 12.16 Horticulture

Material and Workmanship: As per item description, Standard practice and local horticulture.

Mode of measurement and Payment: The item shall be measured as per item specification.

12.17 Supply, Installation, Testing and commissioning of Chemistry lab in School consisting all material, equipments & instruments including cost of copper piping with all specials, fixtures and fittings for gas supply network, bunson burners, flexi connection pipes, tools, plants, machinery, labour, dismantling, demolishing and cost of making good the walls same etc complete work as the given design, drawings & instruction from Engineer-in-charge.

Material and Workmanship: As per item description, standard practice and requirement of school.

Mode of measurement and Payment: The payment shall be made for the complete job.

12.18 Supplying and stacking of good earth at site including royalty and carriage up to 1 km (earth measured in stacks will be reduced by 20% for payment.

Material and Workmanship: As per item description and standard practice.

Mode of measurement and Payment: The payment shall be made for Cum.

TECHNICAL SPECIFICATION
FOR SANITARY /WATER/SUPPLY

Section I SANITAEY FIXTUERS

1. Scope of Work

- 1.1 Work under this section shall consist of furnishing all labour necessary and required to completely remove all existing sanitary accessories and install new sanitary fixture and accessories as required by the drawing and specified hereinafter.
- 1.2 Without restricting to the generality of the foregoing the sanitary fixture shall include fixing all sanitary fixture, fitting and accessories etc, necessary and required for the installation.
- 1.3 Whether specifically mentioned or not all fixture and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers, as required
- 1.4 All exposed pipes within toilets and near fixture shall be chromium-plated brass or copper unless otherwise specified.

2. General Requirements

- 2.1 All fixture and fitting shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the specification and drawings.
- 2.2 All fixture and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per architectural/interior designer's requirements. Wherever necessary the fittings shall be centered to dimensions and pattern desired.
- 2.3 Fixing shrews shall be half round head chromium plated brass with chrome plated washers wherever required.
- 2.4 All fittings and fixture shall be fixed in a neat workman like manner true too levels and heights shown on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all Intel and outlet pipes at correct

positions. Faulty locations shall not be accepted and the Contractor shall rectify the same. Any consequential damages to the finished works shall also be made good by the Contractor at his own cost.

3. **Water Closet**

3.1 Water closet shall be floor mounted type European style or Indian style with P or S trap. The WC shall be with plastic seat and lid and seat mounted flushing cistern or flush valve as called for in BOQ.

3.2 Each WC seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the WC.

4. **Urinals**

4.1 Urinals shall be semi stall lipped type glazed vitreous china.

4.2 Urinals shall be provided with 15mm dia, chrome plated spreader, 23mm dia stainless steel domical waste and cast brass bottle trap with an wall flange and shall be fixed to wall by cast iron brackets as recommended by manufacturer complete.

4.3 Urinals shall be fixed with chrome plated brass screws.

5. **Lavatory Basin**

5.1 Lavatory basin shall be white glazed vitreous china.

5.2 Each basin shall be provided with cast iron brackets and clips and securely fixed to wall. Placing of basins over the brackets without secure fixing shall not be accepted.

5.3 Lavatory basins in all toilets are oval shape suitable for counter installation. Each basin is provided with mixer, chrome plated cast brass bottle trap and pair angle stop cocks.

6. **Sinks**

6.1 Sinks shall be stainless steel as described in the schedule of quantities.

6.2 Provide stainless steel sinks in the kitchen. Sinks in dish washing area shall be double compartment with/without drain board. The sink shall be provided with one hand sink mixer, swivel outlet with shower set be equipped with one hand mixer, swivel outlet. Provision shall also be made for waste disposal units.

7. **Accessories**

- 7.1 contractor shall install all chromium plated and porcelain accessories as shown on the drawings or directed by Managers/Consultants.
- 7.2 All CP accessories shall be fixed with CP brass half round head screws and cup washers in wall with rawl plugs or nylon sleeves and shall include cutting and making good as required or directed by Managers/Consultants.
- 7.3 Porcelain accessories shall be fixed in walls and set in cement mortar 1:2 (1cement:2 coarse sand) and fixed in relation to the tiling work.

Section II SOIL, WASTE, VENT & RAIN WATER PIPES

1. **Scope of Work**

- 1.1 Work under this section shall consist of furnishing all labour, material equipment and appliances necessary and required to install all new soil, waste, vent and rainwater pipes as required by the drawings, specified hereinafter.
- 1.2 Without restricting to the generality of the foregoing, the soil, waste, vent, and rainwater pipes system shall include the following:-
 - a) Providing all new pipes, fitting & accessories
 - b) Vertical and horizontal Soil, Waste and Vent Pipes, Rainwater pipes and Fittings, Joints, Clamps and Connections to Fixtures.
 - c) Connection of all pipes to sewer and storm water lines as shown on the drawings at ground floor level.
 - d) Floor and urinal traps, cleanout plugs, inlet fittings and rainwater heads.
 - e) Waste pipe connections from all fixture e.g Wash basin, sinks, urinals kitchen equipment and plant room equipment.

2 General Requirements

- 2.1 All material shall be new of the best quality conforming to specifications and subject to the approval of Architect.

- 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 passages etc.
- 2.4 Pipes shall be securely fixed to walls by suitable clamps at specified.
- 2.5 Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.
- 2.6 All work shall be executed as shown on the drawings.

Section III WATER SUPPLY PIPING & INSULATION

1. Scope of Work

- 1.1 Work under this section consists of furnishing all labour, material 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.
- 1.2 Without restricting to the generality of the foregoing the water supply system shall include the following:-
 - a) Providing of all new pipes, fittings and accessories.
 - b) Water distribution system to all parts of building.
 - c) Hot water distribution system.
 - d) Pipe protection and painting.
 - e) Insulation of hot water pipe lines.
 - f) Control valves, masonry chamber and other appurtenances.
 - g) Connection to all plumbing fixtures, kitchen equipment, tanks and applications.
 - h) Earth work.

2. Generals Requirements

- 2.1 All material shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Managers/Consultants.
- 2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- 2.3 Short or long bends shall be used on all main pipe lines as far as possible. Use of As far as possible

- all bends shall be formed by means of hydraulic pipe bending machine for pipes upto 65mm dia.
- 2.4 Valves and other appurtenances shall be located as shown on the drawings.

Section IV DRAINAGE (SEWERS & STORM WATER)

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 the drainage system as required by the drawings and specified hereinafter.

2. General Requirements

- 2.1 All material shall be new of the best quality conforming to specifications and subject to the approval of the Managers/Consultants.
- 2.2 Drainage lines shall be laid to the required gradients and profiles.
- 2.3 All drainage work shall be done in accordance with the local municipal bye-laws.
- 2.4 Contractor shall obtain necessary approval and permission for the drainage systems from the municipal or any other competent authority.
- 2.5 Location of all new manholes, catch basins etc, shall be got confirmed by the Contractor from the Managers/Consultants.

SECTION V : PIPES

1. SWR PIPES AND FITTINGS:

- 1.1 All downtake PVC Pipe ISI marked brand as per IS:13592-1992, type B ring fitted (for pipe size 110 / 75mm) & IS 4985 4 kg/sq. cm (for pipe size 50 / 40mm) complete with PVC Fittings conforms to IS: 14735-99 & fittings dimensions as per DIN 19531 & DIN 19534, Rubber ring conforms to IS:5382 with necessary clamps & hinges including cutting and making good the walls The pipes are provided with an integral rubber ring type socket at one end while the other end is kept plain, smooth and free from burrs. Rubber ring type socket ends provide easy push - fit type jointing. Simultaneously, allowance for thermal expansion can also be provided during installation.

1.2 All internal & external drainage SWR PVC PIPE TYPE-A (4 kg. cm. sq.) ring fit pipe shall be conforming to IS:4985 including all fittings such as bends, junctions, inspection doors, offests, cowl, access pieces/plugs etc. jointing with Solvent cement(lubricant) with O-Ring joints including cutting holes in walls and making good the same.

1.3 FITTINGS:

Fittings shall conform to the corresponding Indian Standard as for pipes. Contractor shall use pipes and fittings of matching specification.

Access door shall be secured air and water tight with 3mm thick insertion rubber washer and white lead. The bolts shall be lubricated with grease or white lead for easy removal.

Fittings shall be of the same make as that of pipes, injection moulded and shall conform to Indian Standard.

1.4 JOINTING:

The jointing of the pipes to the fittings shall be done as per the manufacturer's instructions / recommendation. The rubber ring socket fittings and pipes shall be jointed as follows:-

Clean the outside of the pipes spigot end and the inside of the ceiling groove of the fitting.

Apply the lubricant uniformly to the spigot end, sealing ring and pass the spigot end into the socket containing sealing ring until fully home. Mark the position of the socket edge with pencil or felt open on the pipe, then withdraw the pipe from the socket by approximately 10 mm to make the pipe fully fitted to the fitting. The horizontal pipes on the wall shall be fixed with M.S. fabricated clamps with necessary provisions to take care the expansion and contraction in PVC pipes. The spacing of the clamps shall be at the intervals of 1.5 mtr to 2 meter depends on the requirement of the supporting arrangements. Solvent joints shall be used as per manufacturer recommendations.

Rubber Seal Rings for Joints & Access Doors: Manufactured in accordance with IS: 5382 for 75 mm / 90 mm / 110 mm sizes. These are made out of natural rubber with a shore 'A' hardness pf 40 × 5. Provide superior resistance to biological attack. Special design of cross section ensures perfect sealing. Lubricant: Available in 100 gms, 250 gms & 500 gms packing. Specially formulated for

compatibility with rubber seal as well as PVC which does not support the growth of bacteria or fungi.

2. SAND CAST IRON PIPES AND FITTINGS:

2.1 The spun iron pipes shall conform to IS 1536. The spun iron pipes shall be of cast iron cast centrifugally and vary in diameters from 80 mm to 750 mm. These shall be of class LA, class A and class B, as specified. Pipes shall be tested hydrostatically at the pressure specified in table 18.2 & 18.3. Tolerances on specified dimensions shall be as prescribed in Appendix A.

2.2 FITTINGS:

All cast iron fittings shall be sound and free from laps, blow holes and pitting. Both internal and external surfaces shall be clean, smooth and free from sand etc. Burning, plugging, stopping or patching of the casting shall not be permissible. The bodies, bonnets, spindles and other parts shall be truly machined so that when assembled the parts shall be axial, parallel and cylindrical with surfaces smoothly finished.

2.3 JOINTING:

Lead Caulked Joints with Pig Lead

This type of lead caulking is generally done in providing joints in gas water and sewer lines wherever it is practicable to use cast lead caulking, but not in case of wet conditions.

The spun yarn shall first be inserted and caulked into the socket as described under jointing with pig lead. Lead wool or yarn shall then be introduced in the joint in strings not less than 6 mm thick and the caulking shall be repeated with each turn of lead wool or yarn. The whole of the lead wool or yarn shall be compressed into a dense mass. The joint shall then be finally finished flush with face of the socket.

3. PIPE, HANGERS, SUPPORT, CLAMP, BRACKETS ETC.:

3.1 Supports:

UPVC pipes require supports at close intervals. Recommended support spacing for unplasticised PVC pipes is 1200 mm for pipes 50 mm dia and above. Pipes shall be aligned properly before fixing them on the wooden plugs with clamps. Even if the wooden plugs are fixed using a plumb line, pipe shall also be checked for its alignment before clamping, piping shall be properly supported on, or suspended from clamps, hangers as specified and as required. The Contractor shall adequately design all the

brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency. Pipe supports shall be primer coated with rust preventive paint.

3.2 TESTING:

Before the system is put into use, it should be tested for leakages by air test, hydraulic test or smoke test.

3.3 Laying and Jointing:

The pipes shall be laid and clamped to wooden plugs fixed above the surface of the wall. Alternatively plastic clamps of suitable designs shall be preferred. Provision shall be made for the effect of thermal movement by not gripping or disturbing the pipe at supports between the anchors for suspended pipes. The supports shall allow the repeated movements to take place without abrasion.

Jointing for UPVC pipes shall be made by means of solvent cement for horizontal lines and 'O' rubber ring for vertical line. The type of joint shall be used as per site conditions/direction of the Client's Representative. Where UPVC pipes are to be used for rain water pipes, the pipe shall be finished with G.I. adopter for insertion in the R.C.C. slab for a water proof joint complete as directed by Client's Representative.

3.4 Repairs:

While temporary or emergency repairs may be made to the damaged pipes, permanent repairs should be made by replacement of the damaged section. If any split or chip out occurs in the wall of the pipe, a short piece of pipe of sufficient length to cover the damaged portion of the pipe is cut. The sleeve is cut longitudinally and heated sufficiently to soften it so that it may be slipped over the damaged hard pipe.

3.5 Testing

All lengths of PVC rain water pipes shall be fully tested for water tightness by means of water test maintained for not less than 30 minutes. All pipes shall be subjected to a test pressure of at least 1.5 meter head of water head. 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.

4. WASTE PIPE FROM APPLIANCES

4.1 Waste pipe from appliances e.g. wash basins, sinks, urinals, chrome plate where seen water coolers shall be of heavy duty GI pipes:

4.2 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 structural clamps. Spacing for clamps for such pipes shall be as follows:-

4.3 Vertical Horizontal
G.I. Pipes 300 cms 240 cms
P.V.C. Pipes 180 cms 120 cms

5. PAINTING

5.1 Soil, waste vent and rainwater pipes in exposed location, in shafts and pipe spaces shall be thoroughly cleaned to remove dirt, rust and other contamination, and painted with two or more coats of synthetic enamel paint to give an even shade.

5.2 Paint shall be of approved quality and shade, where directed pipes shall be painted in accordance with approved pipe colour code.

5.3 Waste pipes in chase shall be thoroughly cleaned to remove dirt, rust and other contamination, and painted with two coats of bitumen paint, covered with polythene tape and a final coat of bitumen paint. Exposed pipes shall be painted with two or more coats of synthetic enamel paint.

6. MEASUREMENTS :

6.1 These pipes shall be measured along the center line of the pipe including all specials in Rmt. The quoted rate for respective items shall include the following:-

- a) Cost of respective pipes and specials and jointing materials.
- b) Laying, fixing and jointing with necessary clamps, brackets, screws, etc., and curing.
- c) Making good all damages to the parts of the building to suit the surroundings.
- d) Testing and making good the defects, if any

7. TRAPS

7.1 NAHANI TRAP OR FLOOR TRAPS

Nahani traps or floor traps shall be cast iron / SWR deep seal with an effective seal of 50 mm.

The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:3 mix (1 cement: 2 coarse sand: 4

stone aggregate 20 mm nominal size) mixed with water proof compound 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 30 x 30 cms of the required depth. The trap shall be installed at lowest point ensure no pending occurs at perimeters of the drain.

7.2 FLOOR TRAP INLET

Bath room traps and connections shall ensure free and silent flow of discharging water.

Where specified, the Contractor shall provide a special type galvanised iron inlet fitting without or with one, two or three inlet sockets to receive the waste pipe. Joint between waste and fitting shall be connected to a C.I. 'P' or 'S' trap with at least 50mm seal (Hopper and traps shall be paid for separately). Floor trap inlet fittings and the trap shall be set in cement concrete blocks.

7.3 C.P./STAINLESS STEEL GRATINGS

Floor and Urinal traps shall be provided with 100-150mm square or round C.P./Stainless steel grating as approved by Client's Representative with rim, of approved design and shape. Minimum thickness shall be 4-5mm or as specified in the Bill of Quantities.

8. CLEANOUT PLUGS

Contractor shall provide cast brass cleanout plugs in all horizontal run more than 15 meter length required one cleanout plugs shall be threaded and provided with key holes for opening. Cleanout plugs shall be fixed to the pipe by a G.I. socket and lead caulked joint.

9. PIPE SLEEVES

Pipe sleeves 50mm larger diameter than pipes shall be provided wherever pipes pass through walls and slabs and annular space filled with fire proof materials like putty, fire seal etc. All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burs removed before laying. Open ends of the pipe shall be closed as the pipe is installed to avoid entrance of foreign matters. Vertical sleeve shall finish 50mm above finish floor level.

10. G.I. Pipes

10.1 Galvanised Iron Pipes

The pipes (tubes) shall be galvanised mild steel hot finished seamless (HFS) or welded (ERW) HRIW or HFW

screwed and socketed conforming to the requirements of IS 1239 Part-I for medium grade. They shall be of the diameter (nominal bore) specified in the description of the item, the sockets shall be designated by the respective nominal bores of the pipes for which they are intended.

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

10.2 Fittings

The fittings shall be of mild steel tubular or wrought steel fittings conforming to IS 1239 (Part-2) or as specified. The fittings shall be designated by the respective nominal bores of the pipes for which they are intended.

10.3 Laying and Jointing of Pipes and Fittings

The specifications described in 18.4 of CPWD Specifications 2009 with upto date correction slips shall apply as far as possible. The pipes and fittings shall run in wall chase as specified. Pipes shall run only in vertical or horizontal alignment as far as possible. The installation of pipes is similar to that of the metal pipes with the only difference in the jointing procedure.

The jointing of the PP-R pipes and fittings are done by fusion welding by means of a welding machine.

The marking on pipe shall carry the following information:-

- a) Manufacturer's name/ trade mark
- b) GI pipe
- c) SDR
- d) Outside diameter and minimum wall thickness
- e) Lot No. / Batch No. containing date of manufacturing. And machine number.

11. CPVC Pipes

11.1 Chlorinated Polyvinyl Chloride Pipes

CPVC pipes & fittings used in hot & cold potable water distribution system shall conform to requirement of IS

15778. The material from which the pipe is produced shall consist of chlorinated polyvinyl chlorides. The polymer from which the pipe compounds are to be manufactured shall have chlorine content not less than 66.5%.

The internal and external surfaces of the pipe shall be smooth, clean and free from grooving and other defects. The pipes shall not have any detrimental effect on the composition of the water flowing through it.

11.2 Fittings

The fittings shall be as follows:

- (a) Plain CPVC solvent cement fittings from size 15 mm to 160 mm.
- (b) Brass threaded fittings.
- (c) Valve from size 15 mm to 160 mm
- (d) Brass Threaded Fittings: All types of one end brass threaded male/female adaptors in various fittings like coupler, socket, elbow, tee are available for transition to other plastic/metal piping and for fixing of CP fittings. Ball, Gate valves in CPVC are available in all dimensions.
- (e) All fittings shall carry the following information:
 - (1) Manufacturer's name/trade mark.
 - (2) Size of fitting

11.3 Marking

Each pipe shall be clearly and indelibly marked in ink/paint or hot embossed on white base at intervals of not more than 3 m. The marking shall show the following:

- (a) Manufacturer's name or trade-mark
- (b) Outside diameter,
- (c) Class of pipe and pressure rating, and
- (d) Bath or lot number

List of preference for any other specifications not mentioned above is as under:

1. Item Specification
2. CPWD Specification 2009 with upto date correction slips
3. Relevant BIS Code
4. Any Other Code of Practice
5. Decision of Architect / Engineer in Charge.

PARTICULAR TECHNICAL SPECIFICATIONS (FIRE FIGHTING SYSTEM)

1. TERRACE PUMP:

One Terrace Pump is employed of capacity 450 LPM at 2900 rpm to keep fire hydrant system in pressure.

10 HP totally enclosed fan cooled squirrel cage induction motor suitable to operate at $415 \pm 5\%$, 3 phase, $50 \text{ c/s} \pm 3\%$ A.C. supply with combined voltage variation of $\pm 5\%$ having class 'E' insulation suitable for an ambient temperature of 450. The motor shall be provided by IP - 44 degree as per IS:4691.

The above pump and motor shall be coupled by means of flexible coupling and mounted on a common base plate.

The basic parameters of the pump are as per BOQ:

2. MOTOR CONTROL CENTRE.

The seller shall provide and install one control vender of approved dust and vermin proof type fabricated from 2 mm thick M.S. sheet and finished with synthetic enamel paint of approved shade and shall have plastic identification for different motors. The control center shall comprise of the following:

- a) Aluminium bus bar of rated capacity in a separate chamber with two additional spare chambers.
- b) Incoming main isolation switch fuse unit of required capacity with HRC fuses.
- c) Isolation switch fuse unit of required capacity HRC fuses, one for each motor.
- d) Fully automatic auto transformer starters with push buttons, one for each motor.
- e) Fully automatic "STAR DELTA" starters with push buttons for jockey pump.
- f) Single phasing preventer for suitable rating for each motor.
- g) Panel type ampere meters, one for each motor.
- h) Panel type voltmeter on incoming main with rotary selector switch to read voltage between phase to neutral and phase to phase.
- i) Three neon phase indicating lamps on incoming main.
- j) Two rotary switches for manual/auto operation of fire pumps.
- k) All interconnecting colour coded wiring from incoming main to switch gear and accessories within the switch

board panel. Motor Control Center shall be floor mounted type.

3. POWER CABLES:

3.1 Technical Specifications

Cables should conform to IS: 1554 and carry ISI certification mark.

All power and wiring cables shall be aluminium conductor PVC insulated, armoured and PVC sheathed of 1.1 KV grade.

All control cables shall be copper conductors PVC insulated, armoured and PVC sheathed of 1.1 KV grade.

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

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

4. AIR VESSEL:

The Air Vessel shall be provided to compensate for slight loss pressure in the system and to provide an air cushion for counteracting pressure surges whenever the pumping sets comes into operation. Air vessel shall conform to IS: 4736. The size of the air vessel shall be as specified in the schedule of quantities. It shall be provided with a 100 mm dia flanged connections from pump, one 25 mm drain with valve, one water level gauge and 25 mm sockets, for pressure switches. The air vessel shall be tested to 10.5 kg / cm² pressure.

It is used for compensating slight losses in pressure, and is of size 250 mm diameter and 1500 mm long, with

Dished ends. Each Air Vessel consists of:

Inlet Valve

Drain Valve.

This is mounted on the delivery side of the pump.

5. PIPES:

Pipes of the following types are to be used:

a) G.I. / Mild steel black pipes as per IS : 1239, heavy grade (for pipes of sizes 150 mm N.B. and below) suitably lagged on the outside with fiber tissue to prevent soil corrosion as per IS : 10221.

b) **Technical Specifications**

G.I./Steel pipe lines upto 150 mm dia shall have all fittings as per IS : 1239, Part II (heavy grade) while pipelines above 150 mm dia shall be fabricated from IS : 3589 Gr. 320 pipes as applicable or from steel plates.

c) For G.I./steel pipelines upto 50 mm dia screwed jointing shall be adopted, while for pipelines above 50 mm dia welded or flanged construction is to be carried out.

- d) Hangers and supports shall be capable of carrying the sum of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipeline movements as necessary. All guides, anchor, braces, dampener, expansion joint and structural steel to be attached to the building / structure trenches etc. shall be provided. Hangers and components for all piping shall be approved by the Architects.
- e) The piping system shall be capable of withstanding 150% of the working pressure including water hammer effects.
- f) Flanged joints shall be used for connections to vessels, equipment, flanged valves and also on suitable straight lengths of pipeline of strategic points to facilitate erection and subsequent maintenance work.
- g) Pipes shall be buried at-least one meter below ground level and shall have 230 mm x 230 mm masonry supports at-least 300 mm high at 3 m intervals. Masonry work to have plain cement concrete foundation (1 cement: 4 coarse sand: 8 stone aggregate) of size 380 x 380 x 75 thick resting on firm soil.

6. FITTINGS:

Mild Steel but welded heavy grade (above 50 mm). For 50 mm and below 50 mm heavy grade screwed G.I. fittings will be used.

7. BUTTER FLY VALVES:

The Butter Fly Valve shall be made of Cast Iron to IS: 210, grade FG 260 body, in circular shape and of high strength to take the minimum water pressure of 16 Kg/ cm². The disc shall be heavy duty C.I with anti corrosive epoxy or nickel coating. All Butter Fly Valves shall be full lug with internal threading. The rating of valves should be PN 1.6 with flange drilling as per IS: 1538.

8. HYDRANT SYSTEM

- a) The hydrant system shall comprise of terrace Pump, ms pipe network etc. as specified in schedule of quantities with all required accessories including valves, appurtenances, instrumentation and controls etc. complete in all respects. The system shall cover the entire area from independent pipe work from the fire water pump set. The hydrant work shall remain pressurized through the proposed Jockey Pump taking care of any leakages in the system pipelines and valve glands. All pumps/ motors/ engines to be of makes approved by T.A.C.
- b) The hydrant system shall be kept charged by pressurized water at all times. In the event of fire when any of the hydrant valve in the net work is opened, the resultant fall in header pressure should operate pressure switches automatically. Apart from the automatic starting of the pump sets, provisions shall be kept for manual starting also. However shutting down of the pump sets shall be manual.

- c) The hydrant system in the yard shall be furnished with external hydrants consisting of landing valves (positioned approx. one meter above ground level) fitted G.I.. (Heavy) flanged single headed stand pipes installed on pipe mains as marked on the plan.
- d) To compensate for slight losses of pressure in the system and to provide an air cushion for counteracting pressure surges whenever the pumping set comes into operation and prevent water hammer in the underground pipe work, air vessels conforming to IS: 3844 shall be furnished in the fire water pump house.

9. LANDING VALVE:

Landing valves shall be 63 mm dia. oblique female instantaneous pattern with caps and chains. Landing valves shall conform to IS : 5290 in all respects. Double headed landing valves shall have separate control valves. Landing valves shall be gunmetal and fitted with instantaneous coupling conforming to IS : 901. The valve body, stop valve, check valve, nut instantaneous female outlet and blank cap shall be of leaded-tin bronze conforming to Grade -II of IS : 318-1962. The valve spindle shall be of brass rod conforming to IS;320- 1962. The hand wheel shall be mild steel or cast iron washers gaskets shall be of rubber conforming to IS : 638-1965 or leather conforming to IS :581 :1969.

10. FIRE HOSE COUPLING:

Hoses pipes shall be of non-percolating type 100 % synthetic Pyroprotect as per IS : 636 Type B and or flax canvas ISI marked 4927, with nominal size of 63 mm and lengths of 15 meter or 7.5 meter, as per quantities specified for each. All hose pipes shall carry ISI marking on the body of the hose.

The hose shall have instantaneous spring lock-type coupling on ends. The instantaneous coupling shall be as per IS : 901. It shall be fixed to each other by copper rivets and galvanized M.S. wires and leather bands.

All coupling shall be interchangeable with each other, and shall bear ISI markings.

11. BRANCH PIPE:

Branch pipe shall be of either gunmetal or aluminium and should conform to IS:903. One end of the branch pipe will receive the coupling while the other end shall have a nozzle screwed to it. It shall bear ISI marking.

12. HOSE BOX:

Each hydrant shall be housed in a Hose cabinet of suitable size. The Hydrant Cabinet shall hold single headed hydrant 2 hoses and one branch pipe as required. Internal hydrants shall normally fit the niche made for it or shall be suitable for wall mounting. The cabinet shall be of minimum 14 SWG M.S. sheet double coated with P.O. Red paint after single

coat of Red Oxide primer with center opening glazed doors (clear glass of 4 mm thickness) . The glass shall be firmly fixed by means of steel clips and screws with rubber beading. Hinges shall also be screwed and not welded. The corner members (frame) shall be of 25 x 25 x 3 mm thick angle. The hose box shall be firmly fixed to the wall / support by means of brackets and dash fasteners. The steel work shall have one coat of primer and two coats of red paint. The words "Yard Hydrant", "Hydrant' etc., should be painted in white or red on the glass in 75 mm high letters, The Hose Box shall be lockable.

13. FIRE HOSE REEL:

Fire Hose Reel consists of 20 mm dia. High pressure rubber hose of 30 mtr. Length with Gun Metal nozzle of 5 mm bore. Rubber Hose is connected with wall mounted 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 with 25 mm dia. ball valve.

14. FIRE BRIGADE INLET CONNECTION:

A fire brigade inlet connection with a non-return valve shall be provided to facilitate the fire brigade to pump water into the installation by the use of their own equipment. Four way or 150 mm dia connection to the system shall comprise of four instantaneous pattern 63 mm dia. male inlets shall be with caps and chains complete with 150 mm dia. sluice valves, no-return valve housed in a M.S. cabinet with glass fronted door. The cabinet shall be suitable for recess mounting.

15. PRESSURE TYPE FLOW SWITCHES:

Switches shall be UL & ULC LISTED & FM approved of make given in BOQ.

Switches shall be provided with 1/2" NPT polysulfone male pressure connection and shall be into alarm, check valve of a wet sprinkler system constant pressure line on the system side of any shut off valve or check valve.

Repeatability shall be + 0.5% of full scale range.

Over-range shall be 150% of range without any deformation / damage to the sensing element.

16. TESTING OF THE HYDRANT SYSTEM:

- a) Flushing of underground connections Underground mains and lead-in connections to system risers shall be flushed before connections made to piping in order to remove foreign materials which may have entered underground during the course of installation. For hydrant system the flushing operation shall be continued until water is clear.

- b) Underground mains and connections shall be flushed at a flow rate of not less than 1620 ltrs. Per minute.
- c) Provision shall be made for the disposal of water issuing from test outlet to avoid property damage.
- d) Acceptance Test

At the time of taking over, the hydrant system shall fulfil the following acceptance tests:-

- (i) Starting up of the pressurization (Jockey Pump) The pressure switch shall be set at 7 kg /cm² at the lower limit and 7.5kg/cm² at the upper limit. The system drain shall be opened to cause a drop in the pressure. The Jockey Pump shall start as soon as the pressure gauge needle falls down to 7 kg. The Jockey Pump shall also automatically stop when the system has been pressurized again upto 7.5 kg /cm².
 - (ii) The terrace pump
The pump shall be set to start at 6.5kg /sq.cm An external hydrant valve using a single length of hose and branch pipe shall be fully opened to cause a drop of pressure in the system. when the pressure drop to 5 kg. should be allowed to test automatic start-up of the terrace pump. The terrace pump shall continue to run at-least for 5 minutes and register rise in the pressure upto 7.5kg. The terrace pump shall be stopped manually by pressuring the stop button.
- e) e) All these tests mentioned above shall be repeated after one hour interval. The result of all the tests shall be identical again. After the system has satisfactorily withstood the above tests, it can be taken over from the contractor.

17. TESTING OF PIPES:

All piping in the system shall be tested to a hydrostatic pressure of 14 Kg/ sq.cm without drop in pressure for 24 hours. Rectify all leakages, make adjustments and retest as required and directed.

18. MEASUREMENT:

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

Flanges shall include 1.5 mm thick compressed asbestos gasket, nuts, bolts and testing.

Butter Fly Valves, check 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.

Landing valves, hose cabinets, rubberized fabric linen fire hose pipes, first-aid fire hose reels (with gun metal full way valves) and gun metal branch pipes shall be measured by numbers and shall include all items necessary are required for fixing as given in the specifications/schedule of quantities.

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

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

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

TECHNICAL SPECIFICATION

1. GENERAL SPECIFICATION FOR ELECTRICAL WORK
2. DISTRIBUTION TRANSFORMERS (11KV)
3. VACUUM CIRCUIT BREAKER (11KV)
4. HIGH TENSION CABLE (XLPE) 11KV /22KV /33KV
5. L. T. PANELS (POWER CONTROL CENTERS & SWITCH BOARD PANELS)
6. MOULDED CASE CIRCUIT BREAKERS
7. METERING, INSTRUMENTATION AND PROTECTION
8. MEDIUM VOLTAGE CABLES
9. EARTHING FOR ELECTRICAL WORK & LIGHTNING PROTECTION SYSTEM

GENERAL SPECIFICATION FOR ELECTRICAL WORK:

1. **SCOPE**

In general, the contractor shall supply, store, erect, test and commission all the equipment required for Electrical Installation. The contractor shall provide all the materials, labour, tools and equipments required for the electrical work, as shown in the accompanying drawings and in the schedule of quantities and specifications hereinafter described.

2. **CONTRACTOR**

The Contractor shall be a licenced electrical contractor, possessing a valid electrical contractor's license in the state of Rajasthan, employing licensed supervisors and skilled workers having valid permits as per the Regulation of Indian Electricity Rules and Local Electrical Inspector's requirements. (In case the contractor does not have licence of that state then it should be clearly stated by local electrical contractor, the contractor shall submit the test report & a copy of the valid licence of the contractor along with the copy of their own licence of the state of their registration).

3. DEFINITIONS

The following abbreviations used in the bill of quantities specifications and drawings represents :

ISS	-	Indian Standard specification.
IER	-	Indian Electricity Rules, 1956.
BS	-	British Standard (where specifically called for)
BSCP	-	British Standard Code of Practice (if called for).
HRC	-	High Rupturing Capacity
GI	-	Galvanised Iron
MS	-	Mild Steel
CI	-	Cast Iron
APLSTS	-	Aluminium conductor, paper insulated lead sheathed, Double steel tape armoured and serving.
PVC	-	Polyvinyl Chloride.
XLPE	-	Cross Linked Polyethylene.
HT	-	High Tension.
LT	-	Low Tension.
A-Amp	-	Ampere.
KV	-	Kilo Volts.
PT	-	Potential Transformers.
CT	-	Current Transformers.
OCB	-	Oil circuit Breakers
VCB	-	Vacuum Circuit Breaker
ACB	-	Air Circuit Breakers
SFU	-	Switch fuse Unit
COS	-	Change Over Switch
CFS	-	Combination Fuse Switch
MCCB	-	Moulded Case Circuit Breaker.
MCB	-	Miniature Circuit Breaker
IC	-	Iron Clad
ICTPN	-	Iron Clad Triple Pole and Neutral
ICDP	-	Iron Clad Double Pole
DB	-	Distribution Board
KVA	-	Kilo Volts Ampere.
KVAR	-	Kilo Volts Ampere - Reactive.
NC	-	Normally Close
NO	-	Normally open
SWG	-	Standard Wire Gauge.

REGULATION & STANDARDS

The installation shall conform in all respects to Indian standard Code of Practice for Electrical Wiring Installation I.S. - 732 and 'National Electrical Code'. It shall be in conformity with the current I.E Rules and Regulations and requirements of the local Electric Supply Authority in-so-far as these become applicable to the installation. Wherever this specification calls for a higher standard of materials and/or workmanship then those required by any of the above regulations, these specifications shall take precedence over the said regulations and standards.

In general, the materials, equipments and workmanship not covered above, shall conform to the following Indian Standards (Latest Edition) unless otherwise called for:

SWITCHGEAR

- a. Requirements of A.C. Circuit Breakers.
(ACBs & MCCBs) : IS 13947-1, 2/IEC 60947-1, 2
- b. Switches and Switch Isolators above 1000V But
Not Exceeding 1.1 KV :
IS 4710
- c. Markings & arrangements for switchgear bus-
bars, main connection & auxiliary wiring :
IS 375

- d. Specification for normal duty air break switches & composite units for air break switches and fuses for voltage not exceeding 1000 Volts. : IS 4064
 - e. Heavy duty air-break switches and composite units of air-break switches and fuses for voltages not exceeding 1000 Volts. : IS 4047
 - f. Specification for miniature circuit breakers. : IS 8828
 - g. Specification for enclosed distribution, fuse boards and cut-outs for voltage not exceeding 1000 Volts: IS 2675
 - h. Installation and maintenance of switchgear. : IS 3072 (Part I)
 - i. HRC cartridge fuse links 650 Volts. : IS 9224
2. **CABLE**
- a. Specification for XLPE insulated armoured, PVC Sheathed cables (11kV/22kV/33kV) : IS 7098 (Part-II)
 - c. Specification for PVC insulated (Heavy Duty) cables for Voltage upto 1100 Volts : IS 1554 electric
 - d. Specification for XLPE insulated cables (for voltage upto 1100 V) with Aluminium conductors. : IS 7098 (Part-I)
- 3. Specification for rigid steel conduit for electrical wiring. : IS 9537
 - 4. Specifications for rigid non metallic conduits for electrical installations. : IS 9537
 - 5. Specifications for accessories for rigid steel conduits for Electrical wiring. : IS 3837
 - 6. Box for the enclosure of electrical accessories steel and C.I. Boxes. : IS 5133 (Part I)
 - 7. 3Pin plugs and sockets outlets : IS 1293
 - 8. Ceiling Roses : IS 371
 - 9. Adhesive insulating tapes for Electrical purposes (Part- I & II) : IS 2448
 - 10. General and safety requirements for Electrical lighting fittings. : IS 1913
 - 11. Watertight electric light fittings. : IS 3553
 - 12. Flood Lights. : IS 1947
 - 13. Ceiling fans and regulators. : IS 374
 - 14. Propeller type AG Ventilating fans : IS 2312
 - 15. Code of Practices for earthing. : IS 3043

- | | | | |
|-----|--|---|-----------------------------|
| 16. | Glossary of terms for electrical cable and conductors. | : | IS 1885 |
| 17. | Code of Practice for buildings (General) Electrical installation | : | IS 1646 |
| 18. | Protection of buildings and allied structures against lightning. | : | IS 2309 |
| 19. | Current Transformers | : | IS 2705 (Part-I to III) |
| 20. | Voltage Transformer | : | IS 3156 (Part-I to III) |
| 21. | Power Transformer | : | IS 2026-1977 (Part-I to IV) |
| 22. | Installation Transformer | : | IS 10029 |
| 23. | Shunt capacitors for Power system | : | IS 2834 |
| 24. | Direct acting electrical indicating instruments | : | IS 1246 |
| 25. | Factory assembled switchgear | : | IS 8623 |
| 26. | Rating for Cable | : | IS 3961 (Part -II) |
| 27. | Earthing | : | IS 3843 |

6. DRAWINGS

The drawings, specifications and schedule 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 specifically called for in both. The contract drawings indicate the extent and general arrangement of various equipment and wiring, etc. and are essentially diagrammatic. The drawings indicate the point of termination of conduit runs and broadly suggest the routes to be followed. The work shall be executed as per approved working drgs, subject to any minor changes, if found essential to co-ordinate installation of this work with other trades. All such changes shall be done without any additional major cost to the owners. The data given in the documents and drawings are approximate & their complete accuracy is not guaranteed. The drawings and data furnished are meant for guidance & assistance to the contractor. The exact dimension, location, distance and levels, etc., will be governed by the site conditions. The contractor shall examine all Architectural, structural, plumbing and sanitary and air-conditioning drawing before starting the work and report to the architect/consultant any discrepancy which in his opinion appear on them, and get the same clarified. He shall not be entitled to any extras for omissions or defects in electrical drawings or when they conflict with other work.

7.0 INSPECTION & APPROVAL OF THE WORK BY LOCAL AUTHORITY

On completion of the work, the contractor shall obtain and deliver to the owners the certificates of inspection and approval by electrical inspectorate of Local Administration. The fees paid for inspection will be reimbursed on production of challan /receipt. The contractor shall include in his rates all charges necessary for getting electrical installation approved which includes Sub-station, DG Sets, LT distribution, etc. by the Chief Electrical Inspector of the state government or/ and from any other authority required for the contract.

VACUUM CIRCUIT BREAKERS (11 KV)

1. GENERAL:

Vacuum Circuit Breakers shall be of latest state of art technology of vertical isolation horizontal drawout type. It shall be of proven design the Vacuum Circuit Breaker shall be rated for continuous current capacity at Rated System voltage.

2. SYSTEM PARAMETERS :

The Vacuum Circuit Breakers shall be suitable for the following parameters :

- | | | | |
|----|---------------------------|---|--------------------------|
| a. | Rated System Voltage | : | 11KV, 50Hz, 3Phase AC. |
| b. | Highest System Voltage | : | 12 KV |
| c. | Rated Current | : | 630 Amp. |
| d. | Rated breaking Capacity | : | 250 MVA at 11 KV |
| e. | Rated making capacity | : | 46, 83KA at 11 KV |
| f. | Power Frequency withstand | : | 28 KV. |
| g. | Impulse withstand | : | 75 KVP |
| h. | Opening time | : | less than 40 milli secs. |

3. CODES & STANDARDS :

The breaker shall conform to IS 3427/IFC 298.

Breaker shall be fully tested as per codes/ standards a test certificate from CPPI shall be furnished. Also, pressure test certificate as per PEHLA recommendations shall be furnished.

- a. Circuit breaker compartment
- b. Bus bar compartment
- c. CT & cable compartment
- d. L.T Compartment for mounting meters & instruments.

Breaker compartment shall be mounted in vertical isolation horizontal draw out truck with front plate which covers the cubicle when the breaker is in service position. The draw out truck shall have 'isolated'/'test & service' positions.

Bus bars shall be air insulated & mounted on cast epoxy insulated to withstand short current of 44 KA for 3 Secs.

CT & cable compartment shall be preferably located on rear side. CTS shall be epoxy insulated. Provision for terminating 2Nos. 3 core cable shall be provided. The cable entry shall be from the bottom of the panel.

4. TECHNICAL FEATURES:

The VCB shall have the following technical features:

- a. VCB shall have a mech. Endurance of 50.000 to 60.000 operations.

- b. VCB shall not require routine inspection upto 10,000 mech. operations or shall not require major inspection upto 30,000 mech. operations.
- c. VCB shall be totally restrike free. Auto-reclosing shall be pose any problem. The dielectric strength shall be recovered fast enough to perform multiple open-close-open-operation.
- d. VCB shall have negligible contact erosion even after 20,000 operations at rated current.

5. ACCESSORIES

The Vacuum Circuit Breaker shall provided the following accessories :

- a. Auxiliary Switch
- b. Closing Solenoid
- c. Tripping Solenoid
- d. Mech. Operation Counter
- e. Shunt release
- f. Motorised spring charging mechanise
- g. Earthing switch
- h. Space heaters
- i. ON/OFF/TEST/ISOLATED Indicators & name plate.
- j. Earth bus (copper) with earthing bolts for all SF- 6/VCB jointed together by bus links/bolts.

6. INSTRUMENT TRANSFORMERS :

VCB panel shall be provided with the following :

- a. One 11KV/ 110V, 100 VA PT of epoxy cast resin
- b. 3Nos. (double secondary) cast epoxy resin CTS of the following characteristics :
 - i. 15VA burden/ class 1.0 for core-1
 - ii. Class 5 P10 for core-2
- c. Terminal strip for all CTS/ PTS & control wiring with 1.5sq.mm. copper wiring cables.

7. SAFETY INTERLOCKS :

The VCBs shall have following safety & interlocking features :

- a. VCB truck can't be moved when in 'ON' position.
- b. VCB can't be switched 'ON' when the truck is in any position between test or service position.
- c. Front part of the truck can't be removed when breaker is in 'ON' position.
- d. Low voltage plug & socket can't be disconnected in any position except test/isolated position.
- e. Earthing switch can't be switched 'ON' when truck is inside the panel.
- f. The truck cannot be moved inside the panel when LT plug & socket is disconnected.
- g. Truck can't be inserted when earthing switch is in 'ON' position.
- h. Individual explosion vents for all channels on the top of the panel.
- i. Self locking safety shutters to close automatically when the truck is withdrawn to test/ isolated position.

8. METERING

- a. One 0-15 KV 96 sq. mm square voltmeter with selector switch & fuse.
- b. One no. Ammeter with selector switch.
- c. One Trivector meter for 3 Phase, 3wire unbalanced loads with ½ max. demand indecator.

- d. One KWH meter.
- e. Indicating Lamps:
 - i. VCB 'closed' lamp (1 No.)
 - ii. VCB 'open' lamp (1 No.)
 - iii. VCB 'Autotrip' lamp (1 No.)
 - iv. VCB 'Heating trip' lamp (1 No.)
 - v. VCB 'spring charged' lamp (1 No.)
 - vi. Non-trip alarm (1 No.)

DETAILED SPECIFICATIONS FOR UNITIZED SUB STATION

Package Sub- Station

- 1.1 The complete package sub-station shall be factory assembled with separate access to transformer, HT breaker and LT panel board as per specification / BOQ and each component housed in separate compartment. It should be possible to install the package sub-station in congested areas with blocked walls on two sides.
- 1.2 The sub-station enclosure shall be of modular design made from G.I sheet of 2.0 mm thickness (minimum) with polyurethane paint finish as per color shade approved by client. The enclosure should not require any artificial cooling through exhaust fans, etc. It should be naturally air-cooled.
- 1.3 There should be proper provision of internal lighting of each MV and LV compartments
- 1.4 Sufficient space should be available inside the package sub-station for performing any maintenance activity.
- 1.5 Fault passage indicator with core balance current transformer shall be provide inside the package sub-station.
- 1.6 Package sub-station shall be placed on RCC plinth to avoid ingress/collection of water during rainy season and also to facilitate sufficient cable bending radius for incoming HT and outgoing LT cables. The plinth height shall be 300 mm (minimum) above NGL. This shall also facilitate ease of operation and maintenance.
- 1.7 The package sub-station shall be delivered as a complete unit ready for direct installation on the plinth and no other assembly work is required/to be made at site other than termination of both types of cables.

The Package sub-station will have the following provisions: -

11KV VCB / SF6

The 11KV Breaker of Package Sub Station shall be non-extendable metal clad single compartment and comprising of 1 no SF6/Vacuum circuit breaker as supply source for distribution transformer. The 11 KV breaker shall be rated for 630A at 11 KV level, with SF6/ Vacuum as arc quenching medium and suitable for manual & Electrical closing aided by spring mechanism charged with handle. 11 KV VCB / SF6 with integral earth switch with interlocking facility and of suitable making capacity, live capacitive cable indicator for monitoring SF6 gas pressure and pad locking facility. 11KV (HT) breaker shall have the provision of ammeter, voltmeter, trivector meter to monitor various parameters with facility to indicate maximum current/demand attained at any point of time with reset facility.

The breaker shall be provided with microprocessor-based set of 2 nos. Over current and 1 nos. Earth Fault relay, Power Pack (suitable for 3 tripping), Master tripping relay, trip circuit supervision relay, indicating lamps etc as required for completion of scheme.

Transformer:-

The distribution transformer of corrugated design shall be of three phase 50 Hz 750 KVA rating with Dyn 11 vector group and with 4.5% as percentage impedance. It should be Oil immersed(Oil type) Natural Air

cooled with no load ratio of 11000/415 volts having both low and high voltage winding of high purity electrolyte copper. The transformer shall be complete with rating and diagram plate, 2 Nos. earthing terminals, and winding temperature indicator with Trip facility and with all standard accessories. The distribution transformer shall be provided with off load tap changer + 5% to – 10% in steps of 2.5% each on HT side. The loss figures of the transformer shall be indicated by the bidder/manufacture. However, current density should be restricted to 2.4 Amp./sq.mm. The bidder should attach GTP of the Transformer to be supplied by him.

L.T Panel Compartment

Incomer:

1 No. 4 pole 1250 Amp manually operated fixed type ACB with thermal magnetic / static release for over current short circuit and Earth Fault protection releases.

- 3 Nos. Metering CTs of ratio-1200/5A, 15VA burden and of 1.0 accuracy class.
- 1 No. Multi functional electronic meter.

- 4 pole bus bar of suitable current rating having current density not less than 0.7 AMP./ SQ. MM .

- 3 Nos. ON-OFF-Trip Indicating Lights (LED- Type)

Interlocking

Each compartment shall be provided with interlocking facility to avoid opening of each compartment in case supply is ON. However, in case of inadvertent error, facility of Hooter alarm should be provided.

HIGH TENSION CABLE (XLPE) 11KV / 22KV / 33KV

1. GENERAL

The high tension cable shall be aluminium conductor, cross linked, polyethylene insulated, steel armoured construction. The conductors shall be made from electrical purity aluminium wire conforming to IS : 8130. The conductor shall be circular or sector shaped standard conductors. The cables shall conform to IS : 7098 Part II with latest amendments.

2. RATING

The cable shall be rated for a voltage for 11KV/ 22KV/ 33KV (As indicated in BOQ)

3. CONSTRUCTION

Insulation shall be of high quality unfilled insulating compound of natural colour. Insulation shall be applied by extrusion process and shall be chemically cross-linked in continuous vulcanisation process.

The cable shall be provided with conductor shielding and insulation shielding comprising of extruded semi-conducting compound. In addition, insulation shield shall be provided with semi-conducting and metallic-tape shield over the extruded insulation shield.

Inner conductor shielding, XLPE insulation and outer shielding shall all be extruded in one operation by a special extrusion process to ensure perfect bonding of inner and outer shielding with insulation.

Multi-core cable, cores shall be stranded together with suitable non-hygroscopic filler in the interstices and provided with common covering of plastic tape wrapping, or wrapped inner sheath, extruded inner sheath could be provided.

The cable shall be provided steel armouring and tough outer PVC sheath (IS : 5831)

4. CORE IDENTIFICATION

Cores shall be identified by numbers 1, 2 & 3 printed on the insulation.

5. CURRENT RATING

The current rating shall be based on the following conditions:-

- | | | | |
|----|-----------------------------|---|---|
| a. | Max. conductor temperature | : | 90 ^o C |
| b. | Ambient air temperature | : | 40 ^o C |
| c. | Ground temperature | : | 30 ^o C |
| d. | Depth of laying | : | 90 cm for cables upto 11 KV,
105cm for 22 KV & 33 KV |
| e. | Thermal resistivity of soil | : | 105 ^o C cm/ Watt. |

6. SHORT CIRCUIT RATINGS

Short circuit ratings for the cables shall be based as per IS: 7098. However the rating shall be based on the following:-

- | | | | |
|----|--|---|--------------------|
| a. | Max permissible conductor temperature under full load conditions | : | 90 ^o C |
| b. | Max. permissible short circuit temperature | : | 250 ^o C |

7. SELECTION OF CABLES:

The cables have been selected considering the followings:

- Max connected load.

- b. Ambient temperature.
- c. Grouping of cables.
- d. Short circuit level.

The contractor shall recheck the sizes before the cables are ordered, installed and connected to the services.

8. STORING, LAYING AND JOINTING

H.T cables shall be laid in trenches or ducts unless otherwise specified. Generally, laying, jointing and commissioning shall be as per the regulations of local authorities.

a) STORING:

On receipt of H.T cables at site, cable shall be inspected to detect any damage. The ends of cables shall be in sealed condition. After inspection, cables shall be stored in a proper place with battens of cables drums being replaced. The cable drums shall not be stored "ON FLAT" with flanges horizontal.

b) CABLES IN OUTDOOR TRENCHES IN GROUND

- i. H.T cables shall be laid in outdoor trenches, if specifically called for, wherever cables are laid in outdoor trenches; the depth of the trenches shall not be less than 900mm plus radius of cable, from the upper surface of the ground. Where more than one multicore cable is laid in the same trench, a horizontal internal spacing of 30cm mm shall be left in order to reduce mutual heating & also be ensuring that fault occurring on one cable will not damage the adjacent cable. The trenches shall be cut square with vertical side walls and with uniform depth. Suitable shoring and propping may be done to avoid caving in of trench walls. The floor of the trench shall be rammed, levelled & shall be covered with 10cm thick layer of sand.
- ii. The cables shall be laid in trenches over the rollers placed inside the trench. The cable drum shall be rolled in the direction of the arrow for rolling. Wherever cables are bent, the minimum bending radius shall not be less than 12times the diameter of the cable. The cable shall be covered with a sand of 100mm thick layer. Over this sand layer, a layer of cable protection tiles / burnt bricks to overlap cables by 50mm on either side shall be provided. Trenches shall be back-filled with earth and consolidated. Suitable cable markers made on concrete or cast iron indicating the voltage grade & direction of run of the cables shall be installed at regulator intervals.

c) CABLES IN INDOOR TRENCHES:

Cables shall be laid in indoor trenches where specified. The trenches shall be made of brick masonry with smooth cement mortar finish. The dimensions of the trenches shall be determined depending upon the maximum number of cables that is expected to be accommodated. Suitable clamps, hooks and saddles shall be used for securing the cables in position. Spacing between the cables shall not be less than 300mm centre to centre. Wherever specified, trenches shall be filled with fine sand and covered with RCC precast slabs or steel chequered covers. Unless otherwise called for specifically in SOQ, the making of indoor trenches is outside the scope of this work.

d) CABLES IN HUME PIPE IN GROUND:

Cable shall be laid in Hume pipe at a depth of not less than 1000mm from Ground level. Suitable size of Masonry man holes shall be used at an interval of 25 meters. The making of masonry man holes is outside the scope of this work.

9. CABLE JOINTING (STRAIGHT THROUGH):

Cable jointing shall be made as per the instruction of the cable manufacturer. Cable jointing shall be carried out only by qualified and competent cable jointers. A copy of manufacturer's recommendations shall be submitted to the Consultants for approval and jointing shall not be done without prior approval of the Consultant. Straight through cable joint shall be carried out by using

crimped type ferrule to the conductors. The ferrule shall then be taped with self amalgamating tape covering the cores upto the armour. A suitable stress core shall be provided. The joint shall be encapsulated in a special cast-resin compound and cable joint box. Armour bonding conductor and heavy duty clamp shall also be fitted before the cable is encapsulated in cast resin compound.

10. END TERMINATION:

XLPE cables shall be terminated into H.T. switchgear by using cable jointing kit.

- a. Raychem
- b. 3M

11. TESTING

- a. Insulation resistance of both sections of the cables to be jointed should be checked by a 1000V megger.
- b. H.T cable shall be pressure tested with stand a test voltage, as given below, for 15 minutes.
 - i. 11KV cable 15 KV
 - ii. 22KV cable 25 KV
 - iii. 33 KV cable 35 KV

However, local regulations with regard to test voltage and duration of application shall take precedence over the above

L. T. PANELS (POWER CONTROL CENTERS & SWITCH BOARD PANELS)

1.1 GENERAL:

Medium voltage power control centres (generally termed as switch board panels) shall be in sheet steel clad cubicle pattern, free floor standing type, totally enclosed, compartmentalized design. This specification shall cover the following types of panels:

- a) Air circuit breaker panels - Drawout type with single or double tier arrangement as per design shown on the drawings.
- b) Panels with one or more Air circuit breakers with Draw-out arrangement and switch-fuse units of non-drawout design.
- c) Panels with switch- fuses of non- drawout type. However, the switch-fuse units can have drawout fuse-carriage if a particular make of switch-fuse is used.

The panels shall generally be of extensible type with provision for bus extension on or both sides as desired at the time of approved of shop drawings.

1.2 CODE/STANDARDS:

The panels shall generally conform to the requirements of following codes/ specifications:

- | | |
|-------------------|------------|
| a) IS-8623 | h) IS-2705 |
| b) IS-4237 | i) IS-722 |
| c) IS-2147 | j) IS-4064 |
| d) IS-3072 | k) IS-2208 |
| e) IS-375 | l) IS-6875 |
| f) IS-1248 & 2419 | m) IS-6005 |
| g) IS-5082 | |

The equipment shall conform to Indian Electricity Rules as amended upto-date.

The supplier shall examine the provision of these codes and confirm or indicate his comments.

1.3 CONSTRUCTION:

Power control centres/ switch board panels shall of free standing type, with sheet steel enclosure having following features:

- a) The panel shall be constructed of sheet steel of minimum 2.0 mm thickness. The internal frames shall be made of structural steel angles or made up sections (as per standard design of the manufacturer) specifications of which shall be submitted along with offers.
- b) The panel shall be compartmentalised to accommodate one feeder in each compartment. The main bus bar chamber shall be provided at the top of panel or bottom of the panel as required. The compartments shall be arranged in section with metallic/ phenolic barrier in between.

A vertical cable alley of at least 200mm width shall be provided to serve one/ two vertical section of feeders. Cable alley shall have hinged door/ doors with rubber gaskets. Suitable cable clamping arrangement with slotted steel members shall be provided in the cable alley. Similarly, vertical bus bar shall be housed in-between two feeder compartments in a separate bus chambers. The opening between bus chamber and feeder compartments shall be properly covered with Bakelite/ Hylam sheets of 3mm minimum thickness. The vertical bus chamber shall be provided with removable bolted covers on the front and back side. All the interconnecting links to the feeders shall be shrouded so as to avoid accidental contact, by means of phenolic barriers.

- c) Each compartment shall have its own hinged door with concealed hinges. The doors shall have heavy duty rubber gasket fixed on the inner side of the door. The door shall have interlocking facility with the feeder unit.
- d) The Panel shall have punched openings for mounting meters, lamps, push buttons, relays, etc.
- e) The dimensions of feeder compartments, bus chambers and cable alleys shall be as shown on the relevant drawings. However, the following minimum dimensions shall be strictly adhered to :
 - i. ACB compartment : Drawout -600mm wide x 1000mm deep x 900mm High.
 - ii. SWITCH FUSE UNITS/MOULDED CASE CIRCUIT BRACKER (NON-DRAWOUT TYPE) :
 - Up to 63A/ 100A : 300mm wide x 225mm high x 400mm deep
 - 250A : 400mm wide x 400mm high x 400mm deep
 - 400A to 630A : 400mm wide x 500mm high x 400mm wide.
(Or vice- versa).
 - iii. BUS CHAMBER:
 - Main bus (Horizontal) : 400mm high x 300mm deep
 - Vertical bus (Feeder bus) : 300mm wide x 400mm deep
 - iv. Cable alley : Min. 200mm wide.

These dimensions are furnished as a guide and the clearances required in between each live bus/ link and between bus/ links to the earth (panel wall/ sheet) shall be as per relevant Indian Standard Code of practice. However, minimum clearance between neutral bus and earth shall not be less than 25mm. The panel supplier shall furnish detailed sectional drawings and also arrange to get the panel inspection done at intermediate stages of fabrication to avoid fault defective fabrication of the panels (however, the compliance of these specifications shall entirely be the supplier's responsibility).

BUS BARS:

- a) The bus bars shall be suitable for 3 phase, 4 wire, 415 volts 50 Hz AC supply. The bus bars shall be made of high conductivity aluminium. The bus bars shall have uniform cross-section throughout the length. The bus bars shall be designed for carrying rated-current continuously. The bus bars and links shall be designed for a maximum temperature of 75°C. The max. current density of bus bars shall be as follows:
 - i. Copper : 1.2 Ampere/ Sq.mm. of cross section area.
 - ii. Aluminium : 1.0 Ampere/ Sq.mm. of cross section area.

It may be noted that these ratings are the upper limit to which the bus could be stressed. Suitable derating factors shall be applied to arrive at the correct cross section of bus bars.

- b. Bus bars shall be supported on suitable non hygroscopic, non combustible, material such as DMC/ SMC at sufficiently close intervals to prevent bus bar sag. All bus bar joints shall be provided with high tensile steel bolts (electro plated with suitable metal such as Nickel/ Cadmium), spring washer and nuts so as to ensure good contact. Alternatively, electroplated/ tinned brass bolts shall be used. The joints shall be formed with fish-plates on either side of bus bar to provide adequate contact area. Bus supports shall be provided on either side of joints (max. unsupported distance from the joint 400mm)
- c. Power shall be distributed to feeders in dual section by a set of vertical bus bars (Phases+neutral). Individual module shall be connected to the vertical bus bars through sleeved connections.

- d. Bus bars shall be insulated with PVC sleeves (heat shrink type) with colour coding (Red/ Blue/ Yellow/ Black).
- e. The bus bars and their supports shall be able to withstand thermal and dynamic stresses due to the system short-circuits. The supplier shall furnish calculations along with his drawing establishing the adequacy of bus bars both for continuous duty and short -circuit rating. Short circuit withstand capacity shall be for one second. Calculations for spacing of supporting of supports shall also be furnished.

1.5 EARTHING:

The panels shall be provided with a copper earth bus running throughout the width of the switchboard. Suitable earthing eye/bolts shall be provided on the main earthing bus to connect the same to the earth grid at the site. Sufficient number of star washers shall be provided at the joints to achieve earth continuity between the panels and the sheet metal parts.

1.6 MOUNTINGS:

Panels incorporating switch fuse units shall have suitable compartments of standard width. Each compartment shall incorporate a heavy duty load break switch fuse and HRC fuses. Suitable cable termination arrangement shall be provided for switch fuse/ fuse-switch unit feeders. Equipment shall be provided with proper fastening arrangements to ensure vibration free operation. Proper designation as given on the respective drawings shall be provided for every equipment.

Circuit breakers shall be mounted such that they are accessible from the front of the panel. More than two circuit breakers shall not be incorporated in a vertical section. The breakers compartment shall be divided into two parts, one for the breaker and the other for incorporating associated control gear. The necessary instrumentation shall be provided on the door of the compartment.

1.7 INTERLOCKING

The panels shall be provided with the following interlocking arrangements:

- a. The door of the feeder compartments is so interlocked with the switch drive or handle that the door can be opened only if the switch is in "OFF" position. De-interlocking arrangement shall also be provided for inspection.
- b. It shall not be possible for the breakers to be withdrawn when in "ON" position.
- c. It shall not be possible for the breakers to be switched "ON" unless it is either in fully inserted position or for testing purposes it in fully isolated position.
- d. The breaker shall be capable of being racked into "testing", "isolated" and maintenance position and kept in any of these positions.
- e. A safety catch to ensure that the movement of the breaker as it is withdrawn, is checked before it is completely out of the cubicle shall be provided.

1.8 PROTECTION AND INSTRUMENTATION:

Protection and instrumentation shall be as per standard specification.

1.9 WIRING

All the interconnections between the incoming, bus and the outgoings of 100A and above rating shall be done by insulated links/ strips of suitable sizes. Switch fuses and equipments below 100A rating shall be wired with PVC insulated copper conductors. The wiring for instrumentation protection and control equipment shall be carried out with PVC insulated flexible copper conductors.

The Power interconnections shall be carried out by means of bolted connections with washers. The wiring shall be terminated by using crimping sockets. Wiring shall be laid out neatly in bunches

which are fastened to the steel members of the panel. All the potential circuits shall be protected by fuses mounted near the tap-off point from the main connections.

1.10 TERMINALS:

All the control, instrumentation and protection wiring shall be provided with printed PVC ferrules at both ends. For terminating control cables on to the equipment in the panels, suitable terminals blocks shall be provided. The terminal shall also be numbered for easy identification and maintenance.

1.11 SURFACE TREATMENT

All sheet metal accessories and components of power, control centres and switchboard panels shall be thoroughly cleaned, degreased, derusted and phosphatised before redoxide primer is applied. The panel shall be stove enamelled to the required final finish. The interior surfaces of the panel shall also be painted to required shade. The supplier shall indicate in his offer, if there is any deviation from the treatment specified above.

1.12 ENCLOSURES

The panel enclosure shall be dust and vermin proof and shall be suitable for indoor installation. Enclosure design shall be in accordance with the requirements of IP 54 as per IS-2147-1962. The supplier shall confirm whether this requirement is met and a type test certificate furnished. If type test certificate for IP-54 is not available, the same shall be brought out clearly in his offer.

1.13 NAME PLATE

The panel as well as the feeders compartment doors shall be provided with name plates giving the switchboard/ feeder descriptions as indicated on the drawings.

1.14 TESTING

The power control centres shall be tested at factory after assembling of all components and completion of all interconnections and wiring. Tests shall be conducted in accordance with the requirements relevant IS Codes/ specifications.

a. INSULATION TEST

- i. Insulation of the main circuit, that is, the insulation resistance of each pole to the earth and that between the poles shall be measured.
- ii. Insulation resistance to earth of all secondary wiring should be tested with 1000V megger. Insulation test shall be carried out both before and after high voltage test.

b. HIGH VOLTAGE TEST :

A high voltage test with 2.5KV one minute shall be applied between the poles and earth. Test shall be carried out on each pole in turn with the remaining poles earthed. All units racked in position and the breakers closed. Original test certificate shall be submitted along with panel.

1.15 STORING, ERECTION AND COMMISSIONING

a. STORING

The panels shall be stored in well ventilated, dry places. Suitable polythene covers shall be provided for necessary protection against moisture.

b. ERECTION

Switchboards shall be installed on suitable foundation. Foundation shall be as per the dimensions supplied by the panel manufacturer. The foundation shall be flat and level. Suitable grouting holes shall be provided in the foundation. The switch boards shall be properly aligned and bolted to the foundation by at least four bolts. Cable shall terminate on the bottom plate or top plate as the case may be, by using brass compression glands. The individual cables shall then be lead through the

panel to the required feeder compartments for necessary terminations. The cables shall be clamped to the supporting arrangement. The switch board earth bus shall be connected to the local earth grid.

c. **PRECOMMISSIONING TESTS :**

Panels shall be commissioned only after the successful completion of the following tests. The tests shall be carried in the presence of engineer-in-charge.

- i. All main and auxiliary bus bar connections shall be checked and tightened
- ii. All wiring terminations and bus bar joints shall be checked and tightened.
- iii. Wiring shall be checked to ensure that it is according to the drawing.
- iv. All wiring shall be tested for insulation resistance by a 1000V megger.
- v. Phase sequence/ rotation shall be estimated.
- vi. Suitable injection tests shall be applied to all the measuring insuring instruments to establish the correctness and accuracy of calibration and working order.
- iii. All relays and protective devices shall be tested for correctness of settings and operation by introducing a current generator and an ammeter in the circuit.

GENERAL SPECIFICATION FOR: MOULDED CASE CIRCUIT BREAKERS

1.1 GENERAL:

Moulded case circuit breakers or fuse free breaker shall be incorporated in the switch board wherever specified. MCCBS shall conform to BS: 3871 Part II or JIS-C-8370 in all respects. MCCBS shall be suitable either for single phase 230V or three phase 415volts.

1.2 CONSTRUCTION:

The MCCB and case shall be made of high strength heat resistant and flame retardant thermo-setting insulating material. Operating handle shall be quick make/quick break, trip-free type. The operating handle shall have suitable "ON", "OFF" and "TRIPPED" indicators. Three phase MCCBS shall have a common operating handle for simultaneous operation and tripping of all the three phase. Suitable arc extinguishing device shall be provided for each contact. Tripping unit shall be of thermal-magnetic type provided on each pole and connected by a common trip bar such that tripping of any one pole actuates three poles to open simultaneously. Thermal magnetic/tripping device shall have IDMT characteristics for sustained over loads and short circuits. Contact tips shall be made of suitable arc resistant, sintered alloy for long electrical life. Terminals shall be of liberal design with adequate clearances.

1.3 ACCESSORIES:

MCCBS shall be provided with the following accessories, if specified in schedule of quantities:

- i. Under voltage release
- ii. Shunt release
- iii. Trip alarm
- iv. Auxiliary contacts.

1.4 INTERLOCKING:

Moulded case circuit breakers shall be provided with the following interlocking devices for interlocking the door of switch board:

- a. Handle interlock to prevent unnecessary manipulation of the breaker.
- b. Door interlock to prevent the door being opened when the breaker is in "ON" position.
- c. De-interlocking device to open the door even, if the breaker is in "ON" position.

1.5 BREAKING CAPACITY:

The moulded case circuit breaker shall have a breaking capacity of not less than 25kA rms at 415 volts. Wherever required, higher breaking capacity breakers of Rating 35kA / 50kA / 65kA to meet the system short circuit fault shall be used. All such ratings shall be as per equipment schedule/S.O.Q.

1.6 TESTING:

- a. Original certificate of the MCCBS as per BS: 3871 or JS-C-8370 shall be furnished.
- b. Pre-commissioning tests on the switch boards panel incorporating the MCCB shall be done as per specifications.

METERING, INSTRUMENTATION AND PROTECTION

1.0 GENERAL

The Specifications hereinafter laid down shall cover all the meters, instrumentation and protective devices required for the electrical work. The ratings, type and quantity of meters, instruments and protective devices shall be as per the schedule of quantities and drawings.

2.0 INSTRUMENT TRANSFORMERS

a. Current Transformers :

Current transformers shall be in a conformity with IS:2705 (Part I, II and III) in all respects. All current transformers used for medium voltage applications shall be rated for 1 KV. Current transformers shall have rated primary current, rated burden and class of accuracy as specified in the schedule. However, the rated secondary current shall be 5A unless otherwise specified. The acceptable minimum class of various applications shall be as given below.

Measuring	:	Class 0.5 to 1
Protection	:	Class 5P10

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 35 MVA on medium voltage system. Terminals of the current transformers shall be paired permanently for easy identification of poles. Current transformers shall be provided with earthing terminals for earthing chassis frame work and fixed part of the metal casing (if any). Each C.T shall be provided with rating plate indicating the following:

- i. Name and Make.
- ii. Serial Number
- iii. Transformation ratio
- iv. Rated burden
- iv. Rated Voltage
- v. Accuracy class

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CTs shall be with copper conductor PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

b. Potential Transformers:

Potential Transformers shall be provided if specifically called for. Potential transformers shall comply with the requirements of IS: 3156 (Part I, II and III) in all respects.

3.0 MEASURING INSTRUMENTS:

a. General

Direct reading electrical instruments shall be in conformity with IS: 1248. The accuracy of direct reading shall be 1/5 for Voltmeters and 1/5 for ammeters. Other type of instrument shall have accuracy of 1/5. The errors due to variations in temperature shall be limited to a minimum. The meters shall be Suitable for continuous operation between 0°C and 60°C. All meters shall be of flush mounting type with 144x144/96x96 sq. mm. The meter shall be enclosed in a dust tight housing. The housing shall be of ABS Body. The design and manufacture of the meters shall ensure the preventing of fogging of instrument glass. Instrument meters shall be sealed in such a way that access to the measuring element and to the accessories within the case shall not be possible.

Meters shall be provided with 12.5 mm height LED display. Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three phase supply.

b. Ammeters:

Ammeters shall be of digital LED display type. The ammeters shall be manufactured and calibrated as per the latest edition of IS: 1248. Ammeters shall be instrument transformer operated and shall be suitable for 5A secondary of instrument transformer. The ammeter shall have sensitivity of 5% minimum.

The scale shall be calibrated to indicate primary current, unless otherwise, specified. The ammeter shall be capable of carrying substantial overloads upto 120% of ratio current during fault condition without damage or loss of accuracy.

c. Voltmeters :

Voltmeters shall be of moving iron type. The range of 400 Volts, 3 Phase Voltmeter shall be 0 to 500 Volts. Suitable selector switch shall be provided for each voltmeter to read voltage between any two lines of the system. The voltmeter shall be provided with protection fuse of suitable capacity.

d. Wattmeter, Frequency Meters, Power Factor Meters:

i. Watt meters shall be of three phase, electronic type suitable for use with current & potential transformers associated with the particular panel. As per IS: 13779 Accuracy class 1/5 IEC 61036/CB 1P-88.

ii. Power Factor Meters:
Polyphase power factor meters shall be of electronic type with current and potential coils suitable for operation with current transformers and potential transformers associated with the particular panel. The scale shall be calibrated for 50% lag-100%-50% lead readings. Phase angle accuracy shall be + 2 degrees/1 degrees.

iii. Energy meters and reactive power meters:
Trivector meters shall be two elements, integrating type kilowatt hour, KVA kilovolt-ampere-hour reactive meters. The meters shall conform to IEC-61036/ CB 1P- 88 in all respects. Energy meters, KVAH and KVARH meters shall be provided with integrating registers. The registers shall be able to record energy consumption of 500 hours corresponding to maximum current at the rated voltage and unity power factor. These meters shall be suitable for operation with current and potential transformers associated with the particular panel and can also be integrated with PC with RS 485 port for energy management system.

4.0 RELAYS:

a. General

Protection relays shall be provided wherever required to trip and isolate the particular section under fault. All the relays shall be provided with flag type indicators to indicate the cause of tripping. The flag indicators shall remain in position until they are reset by hand reset.

Relay shall be designed to make or break the normal circuit current with which they are associated. The relay contacts shall be of silver or platinum alloy. The contacts shall be designed to withstand repeated operation without damage. The relays shall be of draw-out to facilitate testing maintenance Draw-out case shall be dust tight with a finish suitable for tropical country. The relays shall be capable of disconnecting the faulty section of the net work or fault equipment without causing interruption or disturbance to the remaining sections. The analysis of setting shall be made considering relay errors, pick-up and overshoot errors and shall be submitted to the Engineer/Architect for approval.

b. Over current Relay:

Over current relay shall be induction type with inverse definite minimum time lag characteristics. The over circuit relays shall be provided with adjustable current and time settings. The setting for current shall be 50 to 200% in step of 25%. The IDMT over current relays shall have time lag (delay) of 0 to 3 seconds. The time setting multiplier shall be adjustable from 0.1 to unity. Over current relays shall be fitted with suitable tripping device with trip coil being suitable for operation on 5Amp.

c. Earth Fault Relay:

Earth fault relay shall have current setting of 10% to 40% in steps of 10% otherwise; the earth fault relay shall conform to specification laid down for over current relays.

d. Under Voltage Relays:

Under Voltage Relays shall be induction type and shall have inverse limit operation characteristics, with pick up voltage range of 50-90% of the rated voltage.

5.0 TESTING

5.1 Instrument transformers shall be tested at factory as per IS: 2705 and IS: 3156. The test shall incorporate the following:

Routing Tests:

Original test certificates in triplicate shall be provided.

5.2 Meters shall be tested as per IS: 1248. The tests shall include routine tests. Original test certificate in triplicate shall be furnished.

5.3 Suitable injection tests shall be applied to the secondary.

a. Circuit of every instrument to establish the correctness of calibration and working order all relays and protective devices shall be tested to establish the correctness of setting and operation by introducing a current generator and an ammeter in the circuit.

POWER FACTOR IMPROVEMENT SYSTEM:

1.1 GENERAL:

The Power factor improvement system shall comprise of capacitors and associated switchgear and control gear as per the requirements.

1.2 CAPACITORS:

Power factor correction capacitors shall conform in all respects to IS: 2834- 1964. Capacitors shall have approval of fire insurance association of India. The capacitors shall be suitable for 3 phase 415 V, at 50 Hz frequency and shall be available in single phase and three phase units of 5, 10, 15, 20, 25 and 50 KVAR sizes. The capacitors shall be suitable for indoor use upto ambient temperature of 50⁰ 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 hour cycle.
- b. Current overload shall be 15% for continuous operation and 50% for 6 hours in a 24 hour cycle.
- c. Overload of 30% continuously and 45% for 6 hours in a 24 hour cycle. Capacitors shall be hermetically sealed in sturdy corrosion proof, sheet steel containers and impregnated with non-inflammable synthetic liquid. Every element of each capacitor unit shall be provided with its own built in silvered fuse. The capacitors 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 impregnates. The capacitors shall withstand voltage of 2500 V ac (power frequency test voltage) for one minute. The insulation resistance between capacitors, terminals and containers when test voltage of 500V DC is applied shall not be less than 50 mega ohms.

1.1 CAPACITOR CONTROL PANEL:

The capacitor control panel shall generally comprise of following:

- a) Power factor correction relay
- b) Step controller with reversing motor.
- c) Time delay and no-volt relays.
- d) Contactor & fuses/ MCCBs/ MCBs for individual capacitor banks.
- e) Auto- manual selector switch for either manual or automatic operation.
- f) Current Transformers (On main LT Panel)
- g) ON/OFF indicating lamps with fuses for each bank
- h) ON/OFF Push Buttons for each bank.

1.2 CONTROL PANEL:

The capacitor control panel shall be fabricated out of 2.0 mm sheet steel suitably rust inhibited and stove enamelled. The panel shall have adequate space for mounting the capacitors. The panel shall be of dust and vermin proof construction with suitable ventilation arrangement for capacitors. Panels shall be dead front pattern and floor mounting type, complete with cabling arrangement, bus bars and earthing, etc.

GENERAL SPECIFICATION FOR: MEDIUM VOLTAGE CABLES

1.1 TYPE:

Medium voltage cables shall be aluminium conductor, PVC insulated, PVC sheathed or XLPE and steel wire armoured or steel tape armoured construction. Aluminium conductors up to 10sq.mm may be solid, circular in cross section, and sizes above 10sq.mm shall be stranded. Sector shaped stranded conductors shall be used for sizes above 25sq.mm. The cable shall conform to IS 1554 (Part I) for PVC & IS 7098 (Part-I) for XLPE Cables.

1.2 RATING

The cable shall be rated for a voltage of 650/1100 Volts.

1.3 CONSTRUCTION

The conductors for power cables shall be made high conductivity aluminium & Copper / control cable from annealed high conductivity copper(complying with IS 8130- 1984). The conductors shall be insulated with high quality PVC base compound. A command covering (bedding) shall be applied over the laid up cores by extrusion or wrapping of a filling material containing unvulcanized rubber or thermoplastic material, armouring shall be applied over the inner sheath of bedding, over the armouring a tough outer sheath of PVC sheathing shall be extruded. The outer sheath shall bear the manufacturers name and trade mark at every 30 meter interval.

1.4 CORE IDENTIFICATION:

Core shall be provided with the following colour scheme of PVC insulation.

- i. 1 Core : Red/ Yellow/Blue
- ii. 2 Core : Red and Black
- iii. 3 Core : Red, Yellow, and Blue
- iv. 3.5/4 core : Red, Yellow, Blue and black.

1.5 CURRENT RATINGS:

The current rating shall be based on the following conditions.

		<u>PVC</u>
	<u>XLPE</u>	
i.	Maximum conductor temperature	70°C 90°C
ii.	Ambient air temperature	40°C/50°C 40°C/50°C
iii.	Ground temperature	35°C /40°C 35°C /40°C
iv.	Depth of laying	75cm 75cm

1.6 SHORT CIRCUIT RATING:

Short circuit ratings for the cables shall be as specified in IS: 1554 Part -I. for PVC & IS 7098 (Part-I) for XLPE Cables.

1.7 SELECTION OF CABLES:

Cables have been selected considering the conditions of the maximum connected load, ambient temperature, grouping of cables & the allowable voltage drop. However, the contractor shall recheck the sizes before the cables are fixed and connected to the service.

- a. **Storing**
All the cables shall be supplied in drums. On receipt of cables at site, the cables shall be inspected and stored in drums with flanges of the cable drums in vertical position.
- b. **Laying**
- 1.8 Cables shall be laid as per the specifications given below. The system adopted for this job shall be as per SOQ:
- i. **Duct system**
Wherever specified cables shall be laid in underground ducts. The duct system shall consist of a required number of reinforced "HUME" pipes with simplex joints. Wherever asbestos cement pipes are used, the pipes shall be enclosed in concrete of 75mm thick; the ducts shall be properly anchored to prevent any movement. The top surface of the cable ducts shall be laid with a gradient of at least 1:300. The ducts shall be provided with inspection manholes and all direction changes and at required regular intervals for drawing the cable. The manholes shall be of reinforced concrete either cast-in-situ or precast. The manhole cover and frame shall be of cast iron and machine finished to ensure a perfect joint. The manhole cover shall be installed flush with ground or paved surfaces. The duct entry to the man holes shall be made leakproof with lead-wool joints. The ducts shall be properly plugged at the ends to prevent entry of water rodents, etc. Suitable duct markers shall be placed along the run of the cable square embedded in concrete, indicating the voltages, no of ducts and the direction of run of the cable duct. Suitable cable supports made of angle iron shall be provided in the manholes for supporting the cables. Proper identification tags shall be provided for each cable in the manholes.
- ii. **Cables in outdoor trenches:**
Cables shall be laid in outdoor trenches wherever called for. The depth of the trenches shall not less than 75cm from the final ground level. The width of the trench shall not be less than 45cm. However, where more than one cable is laid, an axial distance of not less than 15cm shall be allowed between the cables. The trenches shall be cut square with vertical side walls and with uniform depth. Suitable shoring and propping may be done to avoid caving in of trench walls. The floor of the trench shall be rammed, levelled & shall be covered with 8cm thick layer of sand. The cables shall be laid in trenches over the rollers placed inside the trench. The cable drum shall be rolled in the direction of the arrow for rolling. Wherever cables are bent, the minimum bending radius shall not be less than 12times the diameter of the cable. The cable shall be covered with 8 cm. thick sand cushion. Over this, a course of cable protection tiles or burnt brick shall be provided to cover the cables 50mm on either side. Trench shall be backfilled with earth and consolidated. Cables shall be laid in Hume pipes at all road crossings and in CI pipes at the wall entries. Approved cable markers made of aluminium or CI indicating the voltages, no. of cables and the direction of rep. Of the cables shall be installed at a regular interval of 30 meters.
- iii. **Cables in indoor trenches:**
Cables shall be laid in indoor trenches where specified. The trenches shall be made of brick masonry with smooth cement mortar finish. The dimensions of the trenches shall be determined depending upon the maximum number of cables that is expected to be accommodated. Cables shall be arranged in tier formation inside the trenches. Suitable clamps hooks and saddles shall be used for securing the cables in position. Spacing between the cables shall not be less than 15cm centre to centre. Wherever specified, trenches shall be filled with fine sand and covered with RCC precast slabs or steel chequered covers. Unless otherwise called for specifically in SOQ, the making of indoor trenches is outside the scope of this work.
- iv. **Cable on Tray/ Racks:**
Cables shall be laid on cable trays/ racks wherever specified. Cable racks/trays shall have ladder type or channel design suitable for the purposes. The nominal depth of the trays/ racks shall be 150mm. The width of the trays shall be as per the design shown on drawing. The cable trays shall be made of steel or aluminium. The trays/ racks shall be completed with end plates, tees, elbows, risers, and all necessary hardware. Steel

trays/ Rack shall be painted with two coats of enamel paint of approved shade over a coat of red oxide primer. Cable trays shall be erected properly to present a neat and clean appearance. Suitable cleats or saddles made of aluminium strips with PVC covering shall be used for securing the cables to the cable trays. The cable trays shall comply with following requirements:

1. The trays shall have suitable strength and rigidity to provide adequate supports for all contained cables.
2. It shall not present sharp edged, burrs or projections injurious to the insulation of the wiring/ cables.
3. If made of metal, it shall be adequately protected against corrosion or shall be made of corrosion resistant material.
4. It shall have side rails or equivalent structural members.
5. It shall include fittings or other suitable means for changes in direction and elevation of runs.

1.9 INSTALLATION

1. Cable trays shall be installed as a complete system. Trays shall be supported properly from the building structure. The entire cable tray system shall be rigid.
2. Each run of the cable tray shall be completed before the installation of cables.
3. In portion where additional protection is required, non combustible covers/ enclosures shall be used.
4. Cable tray shall be exposed and accessible.

GENERAL SPECIFICATION FOR: EARTHING FOR ELECTRICAL WORK

1.1 General

All non-current carrying metal parts of the electrical installation shall be earthed as per IS: 3043. All metal conduits, trunkings, cable armour, switchgear, distribution boards, meter, light fixtures, fans and all other metal parts forming part of the work shall be bonded together and connected by two separate and distinct conductors to earth electrodes. Earthing shall also be in conformity with the provisions of Rules 32, 61, 62, 67 & 68 of IER 1956. These specifications apply to both copper and GI earthing system. The material to be used shall be as per that given in SOQ.

1.2 Earthing Conductors

1.2.1 All earthing conductors shall be of high conductivity copper or GI and shall be protected against mechanical damage and corrosion. The size of earth conductors shall not be less than half that of the largest current carrying conductor. The connection of earth continuity conductors to earth bus and earth electrodes shall be strong and sound and shall be easily accessible. The earth tapes shall be joined together using double rivets. The earthing conductor shall be laid in cable trenches, cable trays or conduits or on cable by using suitable clamps made of non-ferrous metals compatible with the earthing conductor. The following earthing conductors are required to be used for various sections of the installations.

- a. All fixtures - lighting, fan and switch enclosures, lighting conduits shall be earthed with 16 SWG bare copper wire or 1.5sq.mm. Copper conductor, PVC insulated wires or 16 SWG GI wire. (As per SOQ)
- b. 3rd pin of power socket outlets upto 20A shall be earthed with 1.5 sq.mm. copper conductor PVC insulated wire (As per SOQ)
- c. All single phase switches and DBs above 20A and upto 30A rating shall be earthed with one run of 10SWG bare copper wire or 2.5sq.mm copper conductor PVC insulated wire or GI wire.
- d. All single phase switches and DBs above 30A and upto 63A rating shall be earthed with one run of 8SWG bare copper wire or 4sq.mm copper conductor PVC insulated wire or GI wire.
- e. All three phase switches/ DBs upto 30A rating shall be earthed with 2 runs of 10SWG copper wire or 2.5sq.mm copper conductor PVC insulated wire or GI wire.
- f. All three phase switches/ DBs above 30A and upto 63A shall be earthed with 2 runs of 8 SWG copper wires or 4sq.mm copper conductor PVC insulated wire or GI wires.
- g. All three phase switches/DBs above 63A and upto 100A shall be earthed with 2 runs of 25x3mm Copper Strip/GI Strip.
- h. All three phase switches/DBs of 200A rating and above shall be earthed with 2 runs of 25x6mm copper Strip / GI Strip.
- i. All motor frames shall be earthed by two earthing conductors of specified cross section.

Earth conductors shall be properly terminated with bolts to the frames of panels/equipments and provided with crimped sockets in case of wires.

1.2.2 Main earth bus shall be taken from the main medium voltage panel to the earth electrodes. The number of electrodes required shall be arrived at taking into consideration the anticipated fault on the medium voltage net-work and soil resistivity.

1.2.3 All the sub mains and sub circuits shall be provided with earth continuity conductors as specified and connected to the main earth bus. Earthing conductors for equipment shall be run from the exposed metal surface of the equipment and connected to a suitable point on the sub main or main earthing bus. All switches shall be connected through double earthing conductor to the earth bus. Earthing conductors shall be terminated at the equipment using suitable lugs, bolts, washers and nuts.

- 1.2.4 All conduits, cable armouring, raceway, rising mains, etc. shall be connected to the earth all along their run by earthing conductors of suitable cross sectional area. Sprinkler, pipes, LPG pipes, water pipes, steel structural elements, cable trays/ racks lighting conductors shall not used as a means of earthing an installation. The electrical resistance of earthing conductors shall be low enough to permit the passage of fault current necessary to operate a fuse/ protective device a circuit breaker and shall not exceed 2 ohms. As rough guide the following sizes of earth continuity conductors shall be used for circuit wiring.

Size of circuit wires/ cables	Size of copper or GI earth wires
a. 2.5 sq.mm.	16 SWG or 1.5sq.mm. Cu. PVC insulated
b. 4 sq.mm.	14 SWG or 2.5sq.mm. Cu. PVC insulated
c. 6 sq.mm.	12 SWG or 2.5sq.mm. Cu. PVC insulated
d. 10 sq.mm./ 16 sq.mm.	8 SWG or 4.0sq.mm. Cu. PVC insulated
e. 25 sq.mm. / 35 sq.mm.	6 SWG or 6.0sq.mm. Cu. PVC insulated

All Single phase wiring shall have one run of earth wire and three phase wiring shall be provided with two runs of earth wires.

1.3 EARTHING ELECTRODES: (REFER IS : 3043)

- 1.3.1 Earthing electrodes shall be designed as per the requirements of clause 17.2 of IS : 3043. The number and size of earth electrodes shall be calculated so that under fault conditions no electrode is loaded above its maximum permissible current density. The resistance of earth electrode shall be as low as possible, the maximum allowable value being one ohm. Earthing electrodes of either plate or pipe electrode shall be decided according to the anticipated fault level of the net-work and local soil conditions. Generally, plate electrodes shall be used for sub-stations and large & medium voltage net work and pipe electrodes for small & medium voltage net-work and installations.

1.3.1 Plate Electrode (REFER IS : 3043)

Plate electrode shall be made of copper plate of 3.15mm thick and 60x60 cm. Size or as per S.O.Q. The plate shall be buried vertically in ground at a depth of not less than 2 meters to the top of the plate, the plate being encased in charcoal to a thickness of 15cm all round. It is preferable to bury the electrode to a depth where sub soil water is present. Earth leads to the electrode shall be laid in a GI pipe and connected to the plate electrode with brass bolts, nuts and washer. GI pipe of not less than 19mm dia shall be placed vertically over the plate and terminated in a funnel at 5cm above the ground. The funnel shall be provided with a wire mesh. The chamber shall be enclosed in masonry chamber of 30cm x 30cm x 30cm dimensions. The chamber shall be provided with CI frame and CI cover. The earth station shall also be provided with a permanent identification label/ tag.

1.3.3 Pipe Electrode (REFER IS: 3043)

Pipe electrode shall comprise of a 4.5 meter long 75mm dia GI pipe or as per S.O.Q. with holes drilled as per IS: 3043 and buried vertically in a pit of 35cm x 35cm size and filled with alternate layers of charcoal, salt and river sand and connected at the top to a GI pipe of 19mm, 1 metre long with a funnel at the other end, 5cm above ground. The earth lead shall be properly clamped to the pipe electrode with brass bolts, nuts and washers. The funnel and earth lead connection shall be enclosed in a masonry chamber of 30cm x 30 cm x 30cm dimensions. The chamber shall be provided with a CI frame and CI cover. Proper permanent identifications tag/ label shall be provided for each electrode.

1.4 PRECAUTIONS:

- 1.4.1 Earthing system shall be mechanically robust and the joints shall be capable of retaining low resistance even after passages of fault currents.
- 1.4.2 Joints shall be soldered, tinned and double riveted in case of copper and joints shall be filed and doubled riveted in case of GI. All the joints shall be mechanically, electrically, continuous and effective.

1.5 TESTING:

- 1.5.1 On the completion of the entire installation, the following tests shall be conducted.
 - a. Earth resistance of electrodes.
 - b. Earth loop impedance as per IS L 3043/NEC.
- 1.5.2 All meters, instruments and labour required for the tests shall be provided by the contractor. The results shall be submitted in triplicate to the engineer-in-charge for approval.
- 1.6 **SUB-STATION AND GENERATOR EARTHING**
 - i. H.T panels and transformer body shall be provided with double earthing with copper/ GI tape of suitable size depending upon the anticipated fault level. The contractor shall furnish detailed calculations in respect of the size of earth conductors and number of earth stations.

SPECIFICATIONS FOR MAINTENANCE FREE EARTHING

Grounding System – Electrolytic Maintenance Free Earthing

The effective earthing connection surface should be smooth and free from paints and oxide coatings

A General

- 1 Self – contained ground electrode (s) using electrolytically enhanced grounding where specifically indicated on the drawings.
- 2 The electrode shall operate by hygroscopic ally extracting moisture from the atmosphere to activate the electrolytic process.
- 3 Electrode shall be UL ® Listed
- 4 Electrode shall be 100 % self – activating, sealed and maintenance free. No additions of chemical or water solutions required.

B. Technical Specifications

Type and Technical Specifications (Long Life Maintenance Free Earthing Solution)

Type	Soil	Warranty (Years)	Current Capacity	Electrode Details			Back Fill Qty (Bags)	Test Well Cover
				Length (feet)	Outer (inch)	Thickness (mm)		
Electrolytic Earthing	Rocky	20/30	1 kA/9Se	10	2	2	3	Polyplastic

Note: Each Bags Contain 22.6 Kg materials.

- 1 The specifications with performance warranty and technical spec details shown in the tables.
- 2 The ground rod shall be filled from the factory with non – hazardous metallic salts to form the electrolytic process and enhance the grounding performance.
- 3 Ground rod shall be a minimum of ten feet long.
- 4 2Nos 40x5 mm GI Strip at the top of the electrode for the connections and inspection purpose.

C. Protective Test Well

- 1. Polyplastic well for non – traffic applications. Includes bolt down flush cover with “breather ports”

D. Environment Friendly Backfill Material

- 1. Non – corrosive, electrically conductive and ground enhancing backfill. Backfill will lower the contact resistance to earth by up 63% when in conjunction with copper grounding equipment.
- 2. No mixing or tamping shall be required for backfill application.

E. Excavation

- 1 Bore a hole in to the earth (minimum diameter 6”) Hole should be bored to allow installed unit to be as close to vertical as possible.
- 2. A 14” Hole must be provided for the cover box.

3. Depth of hole must be 6" deeper than the vertical length of the system.
4. Top vent ports must be left open to the atmosphere for continuous air circulations by using the protective test well provided.

F Installation

- 1 Remove sealing tapes from bottom of unit only. Tapes must be saved and made available to the electrical inspector to verify removal and proper installation. Do NOT remove the green and white "Bury to Here" marker from the top of the unit.
2. Position the unit in the hole. Use green and white "Bury to Here marker as a guide to depth in which unit shall be buried in TerraFill®. Three bags of TerraFill® are included with each 10' electrode.
- 3 Pour BackFill® (Each bag contain 22.6Kg Materials) around electrode in augured hole. Do not mound backfill past green and white marker.
4. Place box with cover over the top of the electrode so that the cover is at grade level. Use backfill to stabilizer box around the electrode .This keeps the breather holes free of obstructions and debris. Top of box should not contact the top of the electrode.
5. Remove top sealing tape ONLY after backfill is complete. This prevents soil from blocking the vent ports.

D. Connection

- 1 Connect grounding conductor to ground rod pigtail exothermally/ Stainless steel nut and bolts.
- 2 Bury grounding conductor 30inch below grade.

SPECIFICATIOSEN LIGHTING PROTECTION SYSTEM

Early Streamer Emitting Terminals are a preferred protections method for large area structures:

- Certified to UNE std 21186 and NFC std 17102 with five year warranty
- Designed and constructed as a single steel encased unit with latest advanced electronic circuitry
- No external power source required
- Withstands electrical discharge current of 100kA in field of 60kV positive and negative polarities.
- Break down time not more than 245.5µs
- Protections zone up to 800 times that of traditional single lighting rod in three zones
- Wind Resistance up to 120 miles /hours
- Produces a leader of not less than 2x 10E8 V/m/s in the lighting generated electromagnetic field.
- ESE Terminal
- Down Conductor (70 Sqmm, twisted, 19 Strand bare copper cable or 25x3Cu strip)
- Lighting Counter
- Maintenance Free Grounding System

These Components should form an integral part of protections plan. Each component must be considered independently and finally integrated together to form the complete lighting protections