TENDER DOCUMENT

TENDER No.: DLI/CON/604/463

FOR

CONSTRUCTION OF INTERMODAL IWT TERMINAL AT VARANASI (U.P).

VOLUME – II

ADDITIONAL CONDITIONS OF CONTRACT, TECHNICAL SPECIFICATIONS AND DRAWINGS

EXECUTING AGENCY

ENGINEERING PROJECTS (INDIA) LIMITED
(A GOVT. OF INDIA ENTERPRISE)
Core-3, Scope Complex,
7, Lodhi Road, New Delhi-110003
TEL NO: 011-24361666, FAX NO. 011-24363426
1.0 The following Additional Conditions of Contract shall be read in conjunction with General Conditions of Contract. If there are any provisions in these Additional Conditions of Contract, which are at variance with the provisions of General Conditions of Contract, the provisions in these Additional Conditions of Contract shall take precedence.

2.0 INTRODUCTION

In order to promote Inland navigation, the need of which has been reinforced after declaration of Ganga as National Waterway No.1, the owner / client has plans to develop Varanasi as major Intermodal River Terminal. The proposed site is located at Varanasi. Upstream of New Ramnagar By Pass Bridge (chainage 1318 of Right Bank) site is located on the right side bank of Ganges at a distance of 9 Km upstream of Malviya road cum Railway Bridge connecting Varanasi to Mughalsarai. Recently constructed (Opened to traffic in July, 1999) Pt. Deendayal Setu which is bypass to Mughalsarai, Ramnagar & Varanasi towns is hardly 500 metres from the proposed site. The bye pass bridge is on NH2, which is also a part of the Delhi-Kolkata part of the Golden Quadrilateral. The left side of the right bank (coming from NH7 to Allahabad along new bypass road) is a suitable site for the proposed terminal. A metalled service road connecting NH7 & left bank of bypass road is situated at a distance of about 500m only from the proposed site. The site is having connectivity to both NH2 and NH7. Terminal is center of receipt, export, storage, distribution of cargo and embarkation of passengers. Terminal form the hub of connection at transit through various means and modes of transportation. They are the shelters where vessels can berth and load or unload cargo and set its suppliers.

3.0 SCOPE OF WORK INCLUDED IN THE CONTRACT

The brief scope of work included in this tender shall include (but not limited to) Civil, structural, sanitary & plumbing, Electrical, Fire-Fighting, Architectural, Development and landscaping works, EOT crane, DG set, bought-out items etc. for Construction of Intermodal IWT Terminal at Varanasi. Apart from above any other services not covered above but required as per direction of EPI are deemed to be included in the scope of work. The work is to be carried out as per bill of quantities and tender conditions.

4.0 QUALIFICATION OF TENDERERS

The price bid of short listed tenderers who fulfill the eligibility criteria shall only be opened. The decision of EPI in this regard shall be final & binding on the tenderers.

5.0 DISQUALIFICATION

The tenderers may note that they are liable to be disqualified and not considered for the opening of Price Bid if;

a) Representation in the forms, statements and attachments submitted in the pre-qualification document are proved to be incorrect, false and misleading.

b) They have record of poor performance during the past 10 years such as abandoning the work, rescinding of contract for which the reasons are attributable to the non-performance of the contractor, inordinate delay in completion, consistent history of
litigation / arbitration awarded against the contractor or any of its constituents or financial failures due to bankruptcy etc. in their on going / past projects.

c) They have submitted incompletely filled in formats without attaching certified supporting documents and credentials to establish their eligibility to participate in the Tender.

d) If the tenderers attempt to influence any member of the committee.

EPI reserves its right to take appropriate action including disqualification of tenderer(s) as may be deemed fit and proper by EPI at any time without giving any notice to the contractor in this regard. The decision of EPI in the matter of disqualification shall be final and binding on the Tenderers.

6.0 The set of tender documents shall contain tender drawings one set of hard copy. The original hard copy of tender drawings shall be returned along with the tender documents duly signed and stamped by the tenderer & shall form part of agreement.

7.0 SPECIFICATIONS

7.1 The work in general shall be carried out as per latest CPWD specifications New Delhi for Civil Works (updated with correction slips issued upto last date of submission of tender) and latest CPWD specification New Delhi for electrical works (updated with correction slips issued up to last date of submission of tender) unless otherwise specified in the nomenclature of the individual item or in the particular specifications of concerned items of works.

7.2 For items not covered under latest CPWD specification, for Civil Works / latest CPWD specification for Electrical Works and in particular specification or nomenclature of the individual item as above, the work shall be done as per latest relevant BIS codes of practice.

7.3 In case specification are not covered under para 7.1 & 7.2 above the work shall be carried out as per the provisions of technical specification given in Vol. IIB.

7.4 In case of non availability of any specification in the above paras or any overlapping provisions, non-clarity on any issue, applicability of particular provision out of above, shall be decided by Engineer-in-Charge whose decision shall be final & binding on the contractor.

7.5 Thermo Mechanically Treated bars conforming to IS: 1786, Fe 500 grade as required, from approved manufacturers viz SAIL/RINL/TISCO shall be used. The other provisions of clause 45.2 of G.C.C. remain unchanged.

7.6 The Portland Pozzolona Cement (PPC) as per IS:1489-1991 or ordinary Portland Cement (OPC) as per IS:8112 shall be used on the works. The other provisions of clause 45.1 of GCC remain unchanged.

7.7 Specified material viz: cement, steel, structural steel etc shall be used. Material other than specified shall be used only with prior approval of client/EPI and recovery at prevailing market rate shall be done if material other than specified used.
8.0 **Clause No.69.1 (IV) of GCC stands modified as under:**

If the rates for the altered, additional or substituted work cannot be determined in the manner specified in sub-clauses (i) to (iii) above, then the Contractor shall, within 7 days of the date of receipt of order to carry out the work, inform the Engineer-in-Charge the rates which he intends to charge for such class of work, supported by analysis of the rate or rates claimed, and the Engineer-in-Charge shall determine the rate or rates on the basis of prevailing market rates of the material, Labour, T&P etc. plus 15% (Fifteen percent) to cover the Contractors supervision, overheads and profit and pay the Contractor accordingly. The opinion of the Engineer-in-Charge as to the current market rates of materials and quantum of labour involved per unit of measurements will be final and binding on the Contractor. However, the Engineer-in-Charge, by notice in writing, will be at liberty to cancel his order to carry out such class of work and arrange to carry it out in such manner, as he may consider advisable. But under no circumstances, the Contractor shall suspend the work on the plea of non-settlement of rates of items falling under the clause.

9.0 **The clause No.72.1 of GCC shall be replaced as under:**

The Contractor shall ensure adequate progress during the execution of work according to the detailed Bar Chart / PERT chart so that the activities are completed in the period allowed in the completion schedule as given at S. No. 11.0 of Additional Conditions of Contract (ACC).

However, the Contractor shall also maintain monthly progress strictly in accordance with bar chart and / or detailed time schedule that will be worked out on the basis of completion schedule for various stages mentioned at 11.0 of ACC. If the Contractor fails to maintain the above progress or to complete the work and clear the site on or before the contract or extended date of completion, he shall without prejudice to any other right or remedy of the EPI on account of such breach, pay as agreed compensation and not as penalty at the rate of half percent (1/2%) per every week of delay of the value of the work shown above if there is delay for a particular stage or the entire value of contract if the whole of the work is delayed.

The total amount of compensation payable by the Contractor for delay in stage-wise completion or completion of the whole work shall not exceed 10% of the total contract value as awarded.
10.0 **Clause No. 72.4.1 of GCC stands modified as under:**

Within 10 (Ten) days of date of Letter of Intent, the contractor shall submit a Time and Progress Chart (CPM/PERT/Quantified Bar Chart) and get it approved by the Engineer-in-Charge. The Chart shall be prepared in direct relation to the time stated in the contract documents for completion of items / scope of the works. It shall indicate the forecast (mile stones) of the dates of commencement and completion of various items trades, sections of the work and may be amended as necessary by agreement between the Engineer-in-Charge and the Contractor within the limitations of time imposed in the contract documents, to ensure good progress during the execution of the work. The physical report including photographs shall be submitted by the contractor on the prescribed format & the intervals (not later than a month) as decided by the Engineer-in-Charge. The compensation for delay as per clause 72.1 (revised as per ACC) shall be leviable at intermediate stages also, in case the required progress is not achieved to meet the time deadlines of the completion period and / or milestones of time and progress chart provided always that the total amount of compensation for delay to be paid under this condition shall not exceed 10% of the tendered value of work.

In case entire work is completed within the total time period of completion or extended period of completion allowed, the compensation for delay due to not achieving progress at intermediates stage, if any, shall be refunded without any interest charges.
### 11.0 COMPLETION SCHEDULE

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Period from the date of Start</th>
<th>Cumulative value as a percentage of total value of work to be completed, till the end of period specified under column no. 2</th>
<th>Description of work to be completed during the period specified under column no. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>From the date of start up to the end of 2nd month</td>
<td>8%</td>
<td>Completion of boundary wall, cutting &amp; filling, leveling of plot and sub grade of road.</td>
</tr>
<tr>
<td>2</td>
<td>From the start of 3rd month upto the end of 4th month</td>
<td>10%</td>
<td>Finishing of boundary wall including gate and completion of foundation work of various structures up to plinth level.</td>
</tr>
<tr>
<td>3</td>
<td>From the start of 5th month upto the end of 7th month</td>
<td>12%</td>
<td>Completion of well foundation work for gantry girder over ground.</td>
</tr>
<tr>
<td>4</td>
<td>From the start of 8th month to end of 11th month</td>
<td>15%</td>
<td>Completion of foundation work inside the river bed and bank protections.</td>
</tr>
<tr>
<td>5</td>
<td>From the start of 12th month to end of 13th month</td>
<td>10%</td>
<td>Completion of superstructure of building, pump house, internal electrification, plumbing &amp; sanitary work.</td>
</tr>
<tr>
<td></td>
<td>From the start of 14th month to end of 17th month</td>
<td>30%</td>
<td>Completion of fire fighting system and external electrification work, road and pavement and horticulture work. Progress of all fittings and fixtures including finishing work and supply of EOT crane, DG set, bought-out items and necessary fixtures</td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------</td>
<td>-----</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>7</td>
<td>From the start of 18th month to end of 20th month</td>
<td>10%</td>
<td>Erection of EOT crane, DG set and necessary fixtures</td>
</tr>
<tr>
<td>8</td>
<td>From the start of 21st month to end of 22nd month</td>
<td>5%</td>
<td>Completion of all fittings and fixtures including commissioning and handing over</td>
</tr>
</tbody>
</table>
NOTE:

In case of mismatch in financial and physical progress as at col. No. 3, 4 above at any milestone stage, the financial progress shall be considered levy of compensation of delay, if any, under clause: 11.0 of ACC.

12.0 WORK METHODOLOGY

Some portion of works including well foundation/piling is to be carried out inside the river water. Construction work is to be carried out in the water logged area in lean season. The contractor has to plan accordingly and complete the necessary arrangement to keep the area dry during construction stage. The cost of providing temporary arrangement for, if required, platform structure, coffer dam, river diversion etc shall be included in the cost of civil works and such arrangement shall be got approved from the Engineer-in-Charge before executing the work. Bidders are requested to consider the expenditure while quoting their rates. Nothing shall be paid extra for providing such arrangement.

For specialized work, the contractor shall submit the methodology of work for the approval of Engineer-in-Charge before commencement of the work.

The contractor has to deploy resources and plan the work accordingly and nothing extra shall be payable to the contractor on this account. Since the part of the building shall be occupied during construction stage itself the contractor has to ensure safety of the men and material & sufficiently barricade the area so as to avoid any hazard to occupants.

13.0 PRICE VARIATION CLAUSE

If the prices of materials and/or wages of labour required for execution of the work increase the contractor shall be compensated for such increase as per provisions detailed below and the amount of the contract shall accordingly be varied, subject to the condition that that such compensation for escalation in prices and wages shall be available only for the work done during the stipulated period of the contract including the justified period extended under the provisions of clause 72.4.3 of the GCC without any action under clause 72.0 of the GCC. However, for the work done during the justified period extended as above, the compensation as detailed below will be limited to prices/wages prevailing at the time of stipulated date of completion or as prevailing for the period under consideration, whichever is less. Such compensation for escalation in the prices of materials and labour, when due, shall be worked out based on the following provisions:-

(i) The base date for working out such escalation shall be the last stipulated date of receipt of tenders including extension, if any.

(ii) The cost of work on which escalation will be payable shall be reckoned as below:

(a) Gross value of work done upto this quarter : (A)
(b) Gross Value of work done upto the last quarter : (B)
(c) Gross value of work done since previous quarter (A-B) : (C)
(d) Full assessed value of Secured Advance fresh paid in this quarter : (D)
(e) Full assessed value of Secured Advance recovered in this quarter : (E)
(f) Full assessed value of Secured Advance for which escalation is payable in this quarter (D-E): (F)
(g) Advance payment made during this quarter: (G)
(h) Advance payment recovered during this quarter: (H)

(i) Advance payment for which escalation is payable in this quarter (G-H) (I)

(j) Extra Items/deviated quantities of items paid as per Clause 69.1 (iv) of the GCC based on prevailing market rates during this quarter: (J)

Then,  
\[ M = C + F + I - J \]
\[ N = 0.85 M \]

Cost of work for which escalation is applicable: \[ W = N \]

(iii) Components of cement, steel, materials, labour, P.O.L., etc. for the purpose of this clause.

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>15%</td>
</tr>
<tr>
<td>Steel</td>
<td>25%</td>
</tr>
<tr>
<td>Materials</td>
<td>30%</td>
</tr>
<tr>
<td>Labour</td>
<td>25%</td>
</tr>
<tr>
<td>POL</td>
<td>5%</td>
</tr>
</tbody>
</table>

(iv) The compensation for escalation for cement, steel, materials and P.O.L. shall be worked as per the formula given below:

(a) Adjustment for component of 'Cement'

\[ V_c = W x \left( \frac{Xc}{100} \right) \times \frac{CI - CI_0}{CI_0} \]

\[ V_c = \] Variation in cement cost i.e. increase or decrease in the amount in rupees to be paid or recovered.

\[ W = \] Cost of Work done worked out as indicated in sub-para (ii) of this Clause.

\[ Xc = \] Component of cement expressed as percent of total value of work.

\[ CI = \] All India Wholesale Price Index for cement for the period under consideration as published by the Economic Advisor to Govt. of India, Ministry of Industry & Commerce.

(In respect of the justified period extended under the provisions of clause 72.4.3 of the GCC without any action under clause 72.0 of the GCC, the index prevailing at the time of stipulated date of completion or the prevailing index of the period under consideration, whichever is less, shall be considered.)
$C_{lb} = \text{All India Wholesale Price Index for cement as published by the Economic Advisor to Govt. of India, Ministry of Industry & Commerce as valid on the last stipulated date of receipt of tenders including extensions, if any.}$

(b) Adjustment for component of 'Steel'

$$V_s = W \times \frac{X_s \times (S_I - S_{Io})}{100}$$

$V_s = \text{Variation in steel cost i.e. increase or decrease in the amount in rupees to be paid or recovered.}$

$W = \text{Cost of Work done worked out as indicated in sub-para (ii) of this Clause.}$

$X_s = \text{Component of steel expressed in percent to the total value of work.}$

$S_I = \text{All India Wholesale Price Index for steel (bars & rods) for the period under consideration as published by Economic Advisor to the Government of India, Ministry of Industry & Commerce. However, the Price Index shall be minimum of the following:}$

(i) Index for the month when the last consignment of steel reinforcement for the work is procured or

(ii) Index for the month in which half of the stipulated contract period is over

(iii) Index for the period under consideration

For the justified period extended under the provisions of clause 72.4.3 of the GCC, without any action under clause 72.0, of the GCC the same principle as for the period within stipulated period of completion, will apply.

$S_{Io} = \text{All India Wholesale Price Index for steel (bar & rods) published by the Economic Advisor to Govt. of India, Ministry of Industry & Commerce as valid on the last stipulated date of tender including extension, if any.}$

(c) Adjustment for civil component (except cement and steel) / electrical component of construction 'Materials'.

$$V_m = W \times \frac{X_m \times (M_I - M_{Io})}{100}$$

$V_m = \text{Variation in material cost i.e. increase or decrease in the amount in rupees to be paid or recovered.}$

$W = \text{Cost of Work done worked out as indicated in sub-para (ii) of this Clause.}$

$X_m = \text{Component of 'materials' expressed as percent of the total value of work.}$

$M_I = \text{All India Wholesale Price Index for civil component/electrical component of construction material as worked out on the basis of All India Wholesale Price Index for Individual Commodities/Group Items for the period under consideration as published by Economic Advisor to Govt. of India, Ministry of Industry & Commerce and applying weightages to the Individual Commodities/Group Items. (In respect of the justified period extended under the provisions of clause 72.4.3 of the GCC without any action under clause 72.0 of the GCC, the index prevailing at the time of stipulated date of}$
completion or the prevailing index of the period under consideration, whichever is less, shall be considered.)

\[ M_{I_0} = \text{All India Wholesale Price Index for civil component/electrical component}^* \text{ of construction material as worked out on the basis of All India Wholesale Price Index for Individual Commodities/Group Items valid on the last stipulated date of receipt of tender including extension, if any, as published by the Economic Advisor to Govt. of India, Ministry of Industry & Commerce and applying weightages to the Individual Commodities/Group Items.} \]

*Note: relevant component only will be applicable.

(d) Adjustment for component of 'POL'

\[ V_F = W \times \frac{Z \times (F_I - F_{I_0})}{100} \]

\[ V_F = \text{Variation in cost of Fuel, Oil & Lubricant i.e. increase or decrease in the amount in rupees to be paid or recovered.} \]

\[ W = \text{Cost of Work done worked out as indicated in sub-para (ii) of this Clause.} \]

\[ Z = \text{Component of Fuel, Oil & Lubricant expressed as percent of the total value of work.} \]

\[ F_I = \text{All India Wholesale Price Index for Fuel, Oil & Lubricant for the period under consideration as published by Economic Advisor to Govt. of India, Ministry of Industry & Commerce, New Delhi. (In respect of the justified period extended under the provisions of clause 72.4.3 of the GCC without any action under clause 72.0, of the GCC the index prevailing at the time of stipulated date of completion or the prevailing index of the period under consideration, whichever is less, shall be considered.)} \]

\[ F_{I_0} = \text{All India Wholesale Price Index for Fuel, Oil & Lubricant valid on the last stipulated date of receipt of tender including extension, if any.} \]

(v) The following principles shall be followed while working out the indices mentioned in para (iv) above.

(a) The compensation for escalation shall be worked out at quarterly intervals and shall be with respect to the cost of work done as per bills paid during the three calendar months of the said quarter. The first such payment shall be made at the end of three months after the month (excluding) in which the tender was accepted and thereafter at three months' interval. At the time of completion of the work, the last period for payment might become less than 3 months, depending on the actual date of completion,

(b) The index (MI/FI etc.) relevant to any quarter/period for which such compensation is paid shall be the arithmetical average of the indices relevant to the three calendar months. If the period up to date of completion after the quarter covered by the last such installment of payment, is less than three months, the index MI and FI shall be the average of the indices for the months falling within that period.

(vi) The compensation for escalation for labour shall be worked out as per the formula given below:-

\[ V_L = W \times \frac{Y \times (L_I - L_{I_0})}{100} \]
VL: Variation in labour cost i.e. amount of increase or decrease in rupees to be paid or recovered.

W: Value of work done, worked out as indicated in sub-para (ii) of this clause.

Y: Component of labour expressed as a percentage of the total value of the work.

LI: Minimum wage in rupees of an unskilled adult male mazdoor, fixed under any law, statutory rule or order as applicable on the last date of the quarter previous to the one under consideration. (In respect of the justified period extended under the provisions of clause 72.4.3 of the GCC without any action under clause 72.0, of the GCC the minimum wage prevailing on the last date of quarter previous to the quarter pertaining to stipulated date of Completion or the minimum wage prevailing on the last date of the quarter previous to the one under consideration, whichever is less, shall be considered.)

LI₀: Minimum daily wage in rupees of an unskilled adult male mazdoor, fixed under any law, statutory rule or order as on the last stipulated date of receipt of tender including extension, if any.

(vii) The following principles will be followed while working out the compensation as per sub-para (vi) above.

(a) The minimum wage of an unskilled male mazdoor mentioned in sub-para (vi) above shall be the higher of the wage notified by Government of India, Ministry of Labour and that notified by the local administration both relevant to the place of work and the period of reckoning.

(b) The escalation for labour also shall be paid at the same quarterly intervals when escalation due to increase in cost of materials and/or P.O.L is paid under this clause. If such revision of minimum wages takes place during any such quarterly intervals, the escalation compensation shall be payable at revised rates only for work done in subsequent quarters;

(c) Irrespective of variations in minimum wages of any category of labour, for the purpose of this clause, the variation in the rate for an unskilled adult male mazdoor alone shall form the basis for working out the escalation compensation payable on the labour component.

(viii) In the event the price of materials and/or wages of labour required for execution of the work decreases, there shall be a downward adjustment of the cost of work so that such price of materials and/or wages of labour shall be deductible from the cost of work under this contract and in this regard the formula herein before stated under this Clause shall mutatis mutandis apply.

14.0 PLANT & MACHINERY

All plant & machinery required for execution of work shall have to be arranged by the contractor at his own cost. However, the Contractor has to deploy following minimum plant & machinery at site immediately after award of work:
### Additional Conditions of Contract

**Engineering Projects (India) Limited**

**Signature of Contractor**

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<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description</th>
<th>Minimum numbers required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Total Station</td>
<td>One</td>
</tr>
<tr>
<td>2.</td>
<td>Leveling Instruments</td>
<td>One</td>
</tr>
<tr>
<td>3.</td>
<td>Vibrators (Petrol / Electrical)</td>
<td>Eight</td>
</tr>
<tr>
<td>4.</td>
<td>Needles of Vibrator</td>
<td>Fifteen</td>
</tr>
<tr>
<td>5.</td>
<td>Concrete Mixers</td>
<td>One</td>
</tr>
<tr>
<td>6.</td>
<td>Weigh batches</td>
<td>One</td>
</tr>
<tr>
<td>7.</td>
<td>DG Set (63 KVA &amp; 125 KVA)</td>
<td>One each</td>
</tr>
<tr>
<td>8.</td>
<td>Concrete batching plant of minimum capacity 60M³/hr</td>
<td>One</td>
</tr>
<tr>
<td>9.</td>
<td>Transit mixer</td>
<td>Three</td>
</tr>
<tr>
<td>10.</td>
<td>Tower crane</td>
<td>One</td>
</tr>
<tr>
<td>11.</td>
<td>Concrete Pump</td>
<td>One</td>
</tr>
</tbody>
</table>

**Note:**

a) Any other equipment for site test as outlined in CPWD/ BIS specification and as directed by the Engineer-in-Charge.

b) The quantities of equipments indicated are tentative and can be increased as per the requirement of work OR as per the direction of Engineer-in-Charge. The above equipment list is indicative and not complete. The contractor has to deploy all the required equipment to complete all the works within stipulated specifications & time period as per contract documents.

c) The contractor will not be allowed to take out equipments from the site without the written permission of Engineer-in-Charge.

**15.0** The final bill will be submitted by the contractor within 90 days from the date of acceptance of completion of work accompanied by the following documents:

a) Completion certificate issued by the Engineer-in-Charge specifying the handing over of the work including list of inventories (fittings & fixtures).

b) Computerized stage wise payment schedule.

c) No claim certificate by the contactor.

d) No claim certificate from the sub-agencies / venders engaged by the contractor.

e) ‘As built’ drawings.

f) Periodical services and measurement books.

g) Drawings for layout of underground cables and details showing location of sluice valves, electric cable joints etc.

h) All operation and maintenance manuals.

i) All statutory approvals from various state / central govt. local bodies, if required for completion & handing over of the work as included in scope of Contractor.

j) Manufacture’s guarantee of various machines / equipments installed as part of works.
16.0 CONCRETING

16.1 The concreting shall be done using Batching Plant, concrete mixers deployed at the site. The contractor may opt to use Ready Mixed Concrete of reputed firm after obtaining prior written approval from the Engineer-in-charge.

16.2 The minimum drum capacity of the transit mixers shall be of 4 cum / 6 cum.

16.3 Concreting by crane and buckets will be allowed in rare case with the prior approval of Engineer-in-charge.

16.4 The contractor shall provide construction joints only at the specified positions and as per BIS codes and the concreting for columns shall be from floor level to beam level in a one lift only, and in case the concreting is to be done in two lifts the minimum height of first lift of columns shall be 2.4 meters.

16.5 The fine aggregates and coarse aggregates of required size and zone shall be from the quarries approved by the Engineer-in-Charge. The samples of the materials shall be got approved along with the concrete mix design.

16.6 Plasticizers of the required specification and make shall only be permitted as per approved mix design. The cost of plasticizers / additives is deemed to be included in the rates of concrete & nothing extra shall be payable on this account.

16.7 Ready mix concrete brought from outside sources shall be as per the approved design mix. The properties of the materials used for ready mix concrete shall be as per the BIS specifications and got approved from the Engineer-in-charge prior to usage.

16.8 The Contractor shall provide all cut outs in RCC work in Co-ordination with other agencies and as per instructions of Engineer-in-Charge and nothing extra shall be payable. In case the same is not provided by the Contractor the same shall be got done at their risk & cost.

17.0 BRICK WORK

17.1 The bricks should be minimum class designation 75 conforming to IS 1077: 1992.

17.2 The brick work for all external walls should be done from outside. The rigid scaffolding of MS pipe and the supports shall be sound and strong, with horizontal MS pipes. The contractor shall be responsible for providing and maintaining sufficiently strong scaffolding so as to withstand all loads likely to come upon it. Due care shall be taken by the contractor to ensure the execution of brick masonry walls in plumbs from outside. The Contractor shall arrange sufficient quantity of scaffolding for this purpose so as to complete the project within stipulated time.

17.3 All brick works shall be with the bricks of specified grade & source as approved by Engineer-in-Charge and no efflorescence due to salt water shall be allowed. The contractor shall have to give proper treatment in any such case and nothing extra shall be payable and the rates quoted shall be all inclusive.
18.0 CENTERING & SHUTTERING

18.1 Centering & shuttering works for columns shall be made out of laminated shuttering plywood of minimum 12 mm thickness as per BIS, with angle iron frame. The centering, shuttering and staging system shall be got approved from the Engineer-in-Charge.

18.2 The shuttering used for beam shall be of laminated shuttering plywood as per BIS. The support system shall be integrated with the slab. For slabs in case plywood shutters is not used, welded steel plates will be allowed to be placed in uniform pattern. The thickness of plates and pattern to be got approved from the Engineer-in-Charge.

18.3 All joints in the shuttering i.e. plate to plate etc. shall have to be sealed with adhesive / foam, to ensure water tightness of the form work.

18.4 All shuttering work for Architectural features shall be with fiber glass moulds and the rate quoted by the contractor in the schedule of rate shall be inclusive of same.

18.5 All shuttering joints in the slab, beams and lintels etc. shall be treated with tape of required width to make it water tight and the rates quoted for centering, shuttering work shall be all inclusive and nothing extra whatsoever shall be payable over and above the quoted price.

18.6 The shuttering shall be tightened by using runners, tie rods and bracings. No Ghughoo / welded system shall be allowed. Support shall be adequate and proper.

19.0 GENERAL

19.1 Flooring works shall be executed as per the approved drawings / design & specifications. The pattern shown in the tender drawings, if any, can be modified as per the site requirements by Engineer-in-Charge within the proportions of the flooring materials to be provided and nothing extra whatsoever shall be payable over and above the rate quoted.

19.2 The water proofing for the terraces, underground tanks / toilet floor etc. shall be got executed only through the authorized applicators of the manufacturers and the guarantee for the same shall be in the name of EPI / owner for a period of ten years after the expiry of defect period liability on the prescribed format given in the GCC.

19.3 Plumbing & Sanitary work to be executed by licensed plumber and the plumbing scheme / drawing to be got approved from statutory authorities through the appointed licensed plumber without any extra cost. The agency shall have to submit the valid license of plumbers before starting the work.

19.4 SCI pipes for sanitary and GI pipes for water supply if fixed in RCC members like columns, beams etc. shall be fixed with scrub plugs.

19.5 The contractor shall be responsible for all protection of sanitary, water supply, electrical fittings & fixture against pilferage, breakage during period of installation until the completion of work and handed over to EPI.
19.6 Welding wherever required in the work like in grill, railing etc shall be done in full length of the contact area and grinding shall be done properly to get an even surface. SFRC covers for manholes etc, if provided, shall have name of owner / client and year of manufacturer as engraved.

19.7 The electrical works shall be executed only through licensed electrician and the agency shall have to submit the valid license of electricians before starting the work.

19.8 It will be the sole responsibility of contractor to obtain all statutory approvals / compliance required for construction / implementation of the project including right of way Forest clearance and completion clearance from the all relevant statutory bodies for plumbing, sewerage, sanitary and PHE work, fire department for fire protection, fire fighting, fire fighting installation, electrical works etc. and for all other services as included in the scope of contract etc. from the concerned department as required within the stipulated time frame. Liaison work on behalf of EPI / owner with the local bodies will also have to be done by the contractor. Nothing extra shall be payable to contractor on this account.

19.9 The contractor shall erect MS sheet fencing along the periphery of the site as per drawing of EPI with proper colour as directed by the Engineer-in-Charge and name / logo, safety slogan etc. written at appropriate places within ten days of issue of LOI. The contractor shall be responsible for daily cleaning of this fencing with water etc. to keep the fencing in neat & clean condition at all times. The damaged fencing should be replaced immediately by the contractor. The cost of MS sheet fencing, its maintenance etc. is deemed to be included in the quoted rates. The contractor shall engage sufficient number of security guards at his cost to ensure controlled entry to site and not to allow unauthorized personnel at site.

19.10 The tenderers shall make necessary safety arrangements at site including as mentioned in GCC and indemnify EPI against any consequence of accident at site.

19.11 EPI is awarding this Contract on behalf of Inland Water Ways Authority of India. In case M/s. EPI cease to be an agency for the project, the right and responsibility etc. of EPI in the Contract shall get transferred to Inland Water Ways Authority of India or their nominated agency shall operate this Contract.

20.0 ARBITRATION:

20.1 Clause no. 76.1 alongwith note

Deleted - There shall be no Arbitration Clause for this Contract except between Central Public Sector Undertakings inter se / Government of India Departments / Ministries as mentioned in the Clause No. 76.2 below:-

20.2 Clause no.76.2 ARBITRATION BETWEEN CENTRAL PUBLIC SECTOR ENTERPRISES INTER SE / GOVERNMENT OF INDIA DEPARTMENTS / MINISTRIES
i) In the event of any dispute or difference relating to the interpretation and application of the provisions of the contract, such dispute or difference shall be referred by either party to the arbitration as per the instructions (Office Memorandum / Circulars) issued by Govt. of India from time to time with regard to arbitration between one Government Department and another one Government Department and a Public Sector Enterprise and Public Sector Enterprise inter se.

ii) Subject to any amendment that may be carried out by the Government of India from time to time, the procedure to be followed in the arbitration shall be as is contained in D.O. No. DPE/4/(10)/2001-PMA-GL-I dated 22.01.2004 of Department of Public Enterprises, Ministry of Heavy Industries and Public Enterprises, Govt. of India or any modification issued in this regard.

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21.0 Clause No.76.3, stands modified as under:

**JURISDICTION:** The courts in Delhi/ New Delhi alone will have jurisdiction to deal with matters arising from the contract, to the exclusion of all other courts.

22.0 MOBILIZATION ADVANCE:

22.1 Mobilization Advance at the interest rate of State Bank of India PLR plus (+) 2% maximum upto 10% of the Contract Value shall be paid to the contractor as per clause 8.0 of General Conditions of Contract.

22.2 Mobilization Advance and interest thereof shall be recovered on pro-rata basis from each RA bills and in such a way that entire Mobilization Advance stands recovered when works of 80% value are completed.

22.3 Contractor shall instruct his banker's to send the Bank Guarantee (BG's), in duly approved format directly to EPI under registered post AD.

23.0 FACILITIES

The sub-clause 28.3 of the clause no. 28 of General Conditions of Contract (GCC) for Furnished Office Accommodation & Mobility and Communication to be Provided by Contractor to EPI shall be replaced and read as under:

The contractor shall make his rates in Bill of Quantities sufficiently comprehensive to cover the cost of the facilities as per details shown below and the contractor shall not be entitled for any extra payment for the same.
### I. OFFICE WITH FACILITIES – The contractor is to provide office with following facilities till defect liability period.

#### A (i) PORTA CABIN OFFICE ACCOMMODATION

Furnished office with one conference room at one or more locations as per direction of Engineer-in-Charge with basis amenities like Toilets, Drinking water arrangement, lights, other facilities for winter and summer season etc. for EPI Engineer & Staff & maintenance of it till Defect Liability Period

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furnished office with one conference room</td>
<td></td>
<td></td>
</tr>
<tr>
<td>at one or more locations as per direction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>of Engineer-in-Charge with basis amenities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>like Toilets, Drinking water arrangement, lights,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>other facilities for winter and summer season</td>
<td></td>
<td></td>
</tr>
<tr>
<td>etc. for EPI Engineer &amp; Staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&amp; maintenance of it till Defect Liability Period</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### (ii) FURNITURE

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office tables</td>
<td>Nos.</td>
<td>5</td>
</tr>
<tr>
<td>Office Chairs</td>
<td>Nos.</td>
<td>10</td>
</tr>
<tr>
<td>Executive Table &amp; Chair</td>
<td>Nos.</td>
<td>2</td>
</tr>
<tr>
<td>Steel Almirah</td>
<td>Nos.</td>
<td>3</td>
</tr>
<tr>
<td>File Cabinet</td>
<td>Nos.</td>
<td>3</td>
</tr>
</tbody>
</table>

#### B) OFFICE EQUIPMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Fax Machine</td>
<td>No.</td>
<td>1</td>
</tr>
<tr>
<td>b) Computer (Pentium-IV, Office Edition) with minimum 40 GB HDD along with UPS &amp; Operator</td>
<td>No.</td>
<td>1</td>
</tr>
<tr>
<td>c) Laser Printer or any other Printer of equivalent amount A3 size</td>
<td>No.</td>
<td>1</td>
</tr>
<tr>
<td>d) Internet Facilities</td>
<td>No.</td>
<td>1</td>
</tr>
<tr>
<td>e) Refrigerator (165 Ltrs)</td>
<td>Nos.</td>
<td>1</td>
</tr>
<tr>
<td>f) Aqua Guard (Drinking water)</td>
<td>Nos.</td>
<td>1</td>
</tr>
<tr>
<td>g) Air Conditioner</td>
<td>Nos.</td>
<td>2</td>
</tr>
<tr>
<td>h) Photocopy machine (CANON NP 3050 or equivalent model)</td>
<td>No.</td>
<td>1</td>
</tr>
<tr>
<td>i) Digital Camera</td>
<td>No.</td>
<td>1</td>
</tr>
</tbody>
</table>

Running & maintenance of the equipments mentioned above are to be done by the contractor at his own cost.

#### C) CONSUMABLES

All consumables like Stationary, ink etc. shall be provided by Tenderer till end of defect liability period.

(Stationary items are inclusive of visiting cards, rubber stamps, letter pads, photocopies papers & other items of daily office use). Amount shall be restricted to Rs. 5000/- per month

#### D). CONVEYANCE AND OTHER FACILITIES

Vehicle (Brand New) Four wheel drive Renault Duster vehicle or equivalent with Driver and accessories.
**E). TELEPHONE WITH STD FACILITIES AND INSTRUMENTS**

<table>
<thead>
<tr>
<th>Item Description</th>
<th>No.</th>
<th>Nos.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office Telephone (Fixed Line)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mobile Phone</td>
<td>No.</td>
<td>Nos.</td>
</tr>
</tbody>
</table>

Monthly running shall be restricted to 3000 Kms each.

The vehicle shall be brand new and shall be provided with driver on full time basis. Consumables like diesel/petrol/oil lubricants and spare parts etc. shall be provided by the Tenderer at their cost. The vehicles shall be maintained in good working condition. In case of breakdown, replacement of vehicle shall be provided by Tenderer. In case a vehicle is not required by EPI, a recovery of Rs. 45,000/- per month per vehicle shall be made from the Tenderer for this purpose till the end of defect liability period.

In case Driver, POL, maintenance of any vehicle is not required by EPI for any vehicle, a recovery of Rs. 45,000.00 per month per vehicle shall be made from the Tenderer for this purpose till the end of defect liability period.

The above gadgets facilities should be brand new and of reputed make and all facilities shall be provided and maintained properly (including payment of water & electricity bills etc. for office accommodation only) by the Tenderer at Project site or at any other office related with execution of this project till completion of wok, handing over, defect liability period in all respect at his own cost. The Tenderer shall also make stand-by arrangement for water & electricity to ensure uninterrupted supply. The equipment/items shall be the property of Tenderer at the end of contract. The Tenderer shall be responsible for watch and ward of site office and other facilities etc. In case of Theft/damage of any equipment/items, the Tenderer shall immediately replace the same within a maximum period of two days.

The Tenderer shall provide ‘Sign Board(s)’ as per design approved by EPI and/or Client.

In case the above facilities are not provided by the Tenderer within 10 (ten) days of award of work or replacement is not provided within the specified period, EPI shall arrange the same at the risk and cost of the PARTY and make the recoveries from the bills of the Tenderer for the same. The decision of EPI shall be final and binding on the Tenderer in this regard.
24.0 Deployment of Technical Staff for the work

<table>
<thead>
<tr>
<th>Cost of work (Rs in Crores)</th>
<th>Contract period (Months)</th>
<th>Requirement of Technical Staff</th>
<th>Minimum experience (Years)</th>
<th>Rate of recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>40.55</td>
<td>22</td>
<td>i) Project Manager with degree</td>
<td>10</td>
<td>Rs. 80,000/- p.m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii) Graduate Engineer Degree (Civil)</td>
<td>5</td>
<td>Rs. 60,000/- p.m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iii) Safety Officer</td>
<td>2</td>
<td>Rs 20,000/- p.m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iv) Quality Control Engineer</td>
<td>5</td>
<td>Rs 50,000/- p.m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>v) Supervisors (Diploma Engineering in Electrical/ Mechanical/Civil or ITI)</td>
<td>1</td>
<td>Rs 30,000/- p.m</td>
</tr>
</tbody>
</table>

Rate of recovery in case of non-compliance of above will be stipulated as above

25.0 VARIATION IN TAXES, DUTIES, LEVIES & IMPOSITION OF NEW TAXES ETC:

i) The bid price shall be inclusive of work contract tax / VAT/ GST / Labour Cess or any other tax levied on the transfer of property and goods involved in the “Works Contract” in accordance with the relevant Act in the State Act and rules made there under including amendments, if any. The liability on account of such tax as per the rates of tax prevailing as on seven days prior to last date of bid submission shall be included in the price bid. In case of any variation in the rates of tax after this date, the same shall be paid / recovered from the contractor subject to the submission of documentary evidence and proof of having made the payment at the revised rate.

ii) The bid price shall also be inclusive of Service tax, if applicable on Construction Service as per the rates prevailing as on seven (7) days prior to the last date of submission of tender (including abatement as applicable). In case of any variation in the rate of Service Tax, after this date, an equitable adjustment of the Contract Price shall be made to fully take into account any such change by addition / deduction to the Contract Price.

iii) If a new tax, duty or levy is imposed under statute or law in India after the date seven (7) days prior to the last date of submission of tender and the contractor becomes liable there under to pay and actually pays the said new tax, duty or levy for bonafide use on the works contracted, the same shall be reimbursed to the contractor against documentary evidence of proof of payment, provided that the amount thus claimed is not paid / payable under price variation provision of the Contract.

iv) The payment / reimbursement of statutory variations in the rates of tax and / or of new tax, duty or levy imposed under statute or law in India as per para (i), (ii) & (iii) above, would be restricted only to direct transaction between the EPI and the Contractor.
v) Rates shall remain firm till completion of entire works and shall be inclusive of all taxes, Entry tax, duties, Octroi, Royalties, VAT / WCT/GST or any other similar tax in the state concerned, Labour Cess and other levies etc. as applicable.

26.0 Payment Terms

Subject to statutory deduction which EPI might be entitled to make under the contract, the contractor shall receive payment of contract value as follows for supply, erection, testing & commissioning for the equipments related to only for Item Sl. No. 196, 197, 234, 235, 236, 238, 282, 285, 286, 289, 290, 292, 324, 332, 333, 334 & 335:

26.01 60% of the contract value pro-rata (item wise) shall be paid on delivery of equipment/material at site after due inspection by EPI or Inspection Agency appointed by EPI. The equipment / material shall be maintained in safe custody by the contracting agency at his own cost till the time of erection / installation.

26.02 25% of the contract value pro-rata (item wise) shall be paid on successful completion of erection/ installation of the Equipments /Materials.

26.03 10% of contract value pro-rata (item wise) shall be paid on successful commissioning / energizing, trial run for entire work.

26.04 5% of the contract value pro-rata (item wise) shall be paid on completion of defect liability period of 12 months.

27.0 FINAL BILL

The final bill will be submitted by the contractor within 90 days from the date of acceptance of completion of work accompanied by the following documents.

a) Interim, Completion certificate issued by the Engineer-in-Charge specifying the handing over of the work including list of inventories (fittings & fixtures).

b) Computerized stage wise payment schedule.

c) No claim certificate by the contractor.

d) No claim certificate from the sub agencies / vendors engaged by the contractor.

e) ‘As built’ drawings.

f) Periodical services and measurement books.

g) Drawings for layout of underground cables and details showing location of sluice valves, electric cable joints etc.

h) All operation and maintenance manuals, guarantees & measurements.
28.0 ROAD PERMIT

Road permit for transportation of goods across state border shall not be issued by IWAI / EPI and will have to be arranged by contractor on his own. Transit Insurance of the equipment shall be arranged by the contractor. Nothing extra shall be paid on this account. Contractor must get registered with Sales Tax Department of Uttar Pradesh.
TECHNICAL SPECIFICATION
CIVIL WORKS
PARTICULAR SPECIFICATIONS FOR CIVIL WORK

1.0 All works will be executed in the most substantial and workman like manner both as regards materials and otherwise in every respect in strict accordance with DSR-2014/ Latest CPWD Specifications with up to date correction slips.

2.0 EARTH WORK

2.1 Before commencing the earth work, the ground levels shall be taken at 5 to 15m interval or as shall be directed by the Engineer-in-charge. Where local mounds, pits or undulations are met with closer internal shall be adopted.

2.2 The ground levels shall be recorded in the level books and plotted on plan on suitable scale as per direction of Engineer-in-charge. The North direction and position of Bench Mark shall be shown on the plans. The ground levels for building and the sub-soil water level shall be determined with respect to the bench mark approved by the Engineer-in-charge before commencement of the work and these levels shall be recorded in the level book and also indicated on the ‘Plan’ showing ground levels. These plans shall be signed by the Contractor and the Engineer-in-charge before the earth work is started.

2.3 All labour and material for setting out and making profile and taking ground levels shall be supplied by the contractor and nothing extra shall be payable on this account.

2.4 The Bidder shall co-operate and provide all possible assistance to the other agency / agencies executing other works. He shall adjust his execution program to accommodate such essential activities of construction.

2.5 Rate for earth work shall include the following operations:
   a. Setting out works, profiles
   b. Site clearance
   c. Protection measures and putting up caution signs and lights.
   d. Handling useful materials and Antiques.
   e. Bailing out or pumping of rain water out of excavation.

3.0 CONCRETE / REINFORCED CEMENT CONCRETE WORK/ DESIGN MIX CONCRETE

3.1 Cement concrete work using nominal mix concrete shall be executed as per DSR/CPWD Specifications with up to date correction slips.
3.1(a) The item machine batched, machine mixed and machine vibrated design mix concrete used in the nomenclature of “Sub head RCC Work” shall mean the concrete produced in automatic concrete batching and mixing plant and transported by transit mixers (if necessary), placed in position and vibrated by surface vibrator/ needle vibrator / plate vibrator as the case may be to achieve required strength and durability.

3.2 All stone aggregate and stone ballast shall be of hard stone variety to be obtained from approved quarries or any other source to be got approved by the Engineer-in-charge.

3.3 Sand to be used for cement concrete RCC work shall not contain silt content by more than 8%.

3.4 Ordinary Portland Cement (OPC) not less 43 grade as per IS: 8112 or Portland Pozzolona Cement (PPC) as per IS: 1489-1991 shall be used for the entire work.

3.5 All shuttering shall either be of steel or marine ply. All scaffolding shall be of steel. The contractor will have to manufacture new shuttering so as to obtain exposed concrete surface of even and uniform shade wherever required. Shuttering already used on other work(s) will not be permitted to be used in this work for obtaining exposed concrete surface. The steel / marine ply centering, shuttering and steel scaffolding shall be as per DSR/CPWD specifications.
3.6. Keeping in view the flooring thickness as per nomenclature of the item, the structural drawings shall be reconciled with the architectural drawings to make appropriate adjustment in the level of shuttering for RCC slab so as to achieve the final floor finish level as per Architectural drawing.

**DESIGN MIX CONCRETE**

3.7. The contractor shall exercise “very good” quality control over site conditions for production of controlled concrete by using fresh cement and regular tests employing fully automatic cement batching plant for batching of all materials, grading of aggregate, determination of moisture contents and control of water cement ratio, frequent supervision and by conducting regular workability and strength tests and maintaining adequate field laboratory facilities to maintain the specified quality of concrete consistently.

3.7(a) The aggregate used for RCC work shall be 20mm nominal maximum size aggregate. The minimum cement content and the maximum water cement ratio for various grades of concrete shall be as given below:

<table>
<thead>
<tr>
<th>Grade Designation</th>
<th>Compressive strength on 15cm cubes min 7 days (N/mm²)</th>
<th>Specified Characteristic compressive at 28days (N/m²)</th>
<th>Minimum cement content (kg per cubic metre)</th>
<th>Maximum water cement ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-25</td>
<td>AS per Design</td>
<td>25</td>
<td>330</td>
<td>0.50</td>
</tr>
<tr>
<td>M-30</td>
<td>AS per Design</td>
<td>30</td>
<td>340</td>
<td>0.45</td>
</tr>
<tr>
<td>M-35</td>
<td>AS per Design</td>
<td>35</td>
<td>350</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Note: Excess/Less cement content used as per design mix in respect of the above specified limit is payable / recoverable separately.

3.7(b) The concrete mix will be designed for minimum workability as per the table given below:

<table>
<thead>
<tr>
<th>Placing conditions</th>
<th>Degree of workability</th>
<th>Slump (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lightly reinforced sections in slabs, beams, walls and columns</td>
<td>Low</td>
<td>25 –75</td>
</tr>
</tbody>
</table>
### INTERMODAL IWT TERMINAL AT VARANASI

<table>
<thead>
<tr>
<th>Heavily reinforced section in slabs beams walls and columns</th>
<th>Medium</th>
<th>50-100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumped concrete</td>
<td>Medium</td>
<td>75-100</td>
</tr>
</tbody>
</table>

3.8. The contractor shall engage one of the following approved laboratories, test houses for designing the concrete mix in accordance with the relevant I.S. Codes and to conduct laboratory tests to ensure the target mean strength and workability criteria for a given grade of concrete

i. I.I.T., Delhi

ii. I.I.T., Guwahati / near any N.I.T

iii. C.R.R.I., Delhi.

If all the above laboratories express in writing their inability to carry out designing and testing of concrete mixes by a specified date, the contractor may be allowed to engage any other laboratory with prior approval of Engineer-in-charge.

3.9. The source and quality of all ingredients of a concrete mix shall be got approved from the Engineer-in-charge before designing the mixes and their testing and the same shall be maintained during the execution of the work as well.

3.10. Any change in source or characteristic of any ingredient used in the concrete mix during the work execution shall require revised mix design and laboratory testing as per direction of the Engineer-in-charge and no further concrete work shall be proceeded without approval of the revised design mix.

3.11. In the event of use of admixtures to achieve the required workability, the mix shall be designed and tested using the admixture in suitable proportion.

3.12. All cost and charges of designing the concrete mix and its testing by approved laboratory including the redesigning of the concrete mix, whenever required and directed by the Engineer-in-charge, shall be borne by the Contractor and nothing extra shall be payable over the quoted rates.

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

3.14. 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 test.

3.15. 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 change in the workability.

3.16. With the modified water content, the mix proportions shall be recalculated by keeping with water cement ratio unchanged. The mix proportion, so modified, shall form the Trial Mix No. 2 and tested for the specified strength and workability.
INTERMODAL IWT TERMINAL AT VARANASI

3.17. 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.

APPROVAL OF DESIGN MIX CONCRETE

3.18. 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.

3.19. Of the six specimens of each test-set, three specimens shall be tested at 7 days and remaining three at 28 days.

3.20. The Preliminary tests at 7 days are intended only to indicate the likely strength to be attained at 28 days while the design mix shall be approved only on the basis of test strength at 28 days.

3.21. The contractor shall submit the design mix report from the approved laboratory within 45 days of award of work for approval of Engineer-in-charge. No concreting work shall be executed until the mix design is approved.

3.22. The design mix shall be considered satisfactory and approved if at least three preliminary test-sets individually satisfy the following strength and workability criteria:
   a. The average strength of each test-set is not less then the specified target mean compressive strength.
   b. The strength of any specimen cube is not less than 0.85 times the target mean compressive strength.
   c. The concrete mix is of required degree of workability and acceptable concrete finish.

PRODUCTION OF CONTROLLED CEMENT CONCRETE

3.23. Automatic Batching Plant conforming to IS 4925-1968 and minimum 30 cum/ hour capacity shall be used for production of controlled concrete.

3.24. Automatic batcher shall be charged by devices which, when actuated by a single starter switch, will automatically start weighing operation of each material and stop automatically and interlocked when the designated weight of each material has been reached.

3.25. The batching system shall have rated capacity (in terms of concrete in a single batch) to match the maximum rated size of the mixer that could be adopted for use with the plant.

3.26. The mixers shall be free fall tilting type conforming to IS 1791-1968.

3.27. All measuring equipment shall be maintained in a clean and serviceable condition and their accuracy shall be checked at least once a month.

3.28. 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.

3.29. The aggregate of different sizes shall be stock piled separately at least 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.

3.30. 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.

3.31. The moisture contents in the aggregate shall be determined as frequently as possible in keeping with the weather conditions as per the provisions of I.S 2386 (Part III) 1963.

3.32. All other operations involved in concrete work like laying, placing, compaction and curing etc. shall be done as per CPWD specifications 1996 Volume I to VI with up to date correction slips.
For RCC Work, the contractor may be permitted to use ready mixed concrete (RMC) procured from the approved suppliers of RMC instead of producing concrete at site. The specifications for RMC shall be same as for Design mix concrete produced at site. The prescribed tests for design mix concrete shall also be carried out for RMC in addition to getting the test report from the supplier. Nothing extra shall be paid for using RMC.

The contractor shall obtain prior approval of Engineer –in - Charge for using RMC, which shall be granted only in exceptional cases like failure of plant or other exigencies.

**SAMPLING AND STRENGTH OF WORK TEST OF CONCRETE**

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.

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.

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.

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

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

Each grade of concrete shall form different lot of testing.

The minimum frequency of sampling of concrete of each grade shall be as given below:

<table>
<thead>
<tr>
<th>Qty. of Concrete work (in Cum .)</th>
<th>Number of Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>1</td>
</tr>
<tr>
<td>6-5</td>
<td>2</td>
</tr>
<tr>
<td>16-30</td>
<td>3</td>
</tr>
<tr>
<td>31-50</td>
<td>4</td>
</tr>
<tr>
<td>51 and above</td>
<td>4+ one sample for additional 50m³ or part thereof.</td>
</tr>
</tbody>
</table>

The concrete work shall be assessed on day to day basis and samples shall be taken as specified.

**TEST STRENGTH OF A SAMPLE**

The test strength of the sample shall be taken as the average of the strength of its three specimens, the individual variation between the three specimens should not be more than ± 15 percent of the average test results of the sample.

If individual variation in strength of three specimens is more than ± 15 percent of average, the test results of the sample shall be invalid.

90% of the total work tests shall be done at the field laboratory established at the site of work and the remaining 10% work tests shall be got done from any Govt. laboratory or the lab oratory approved by the Engineer in charge.
MEASUREMENTS
3.44 The measurements of work and the allowable tolerances shall be governed by provisions of CPWD specifications read with up to date correction slips.
3.45 The theoretical consumption of cement in designs mix concrete shall be worked out on the basis of proportions approved for Design mix subject to the permissible variations under clause 42 of the tender documents.

RATE
3.46 The rate shall include cost of all materials and labour involved in all operations described above including the cost of designing and testing of concrete mix in the approved laboratory including admixture but excluding the cost of centering, shuttering and reinforcement.

4.0 WATER PROOFING TREATMENT
4.1 GENERAL
4.1.1 The waterproofing treatment shall be carried out as per detailed specifications indicated for the same from the agency to be approved by the Engineer in Charge.
4.1.2 Two samples of the waterproofing materials / compound proposed to be used shall be submitted to the Engineer-in-charge along with test result from a testing laboratory of repute confirming its quality and performance and the constituents making it.
4.1.3 Total quantity of the waterproofing material / compound required shall be arranged only after obtaining the prior approval of the Engineer-in-charge in writing. Materials shall be kept under double lock and key and proper account of the waterproofing / material compound used in the work shall be maintained. It shall be ensured that the consumption of the material / compound is as per specified requirement.
4.1.4 Cement based integral waterproofing compound
Shall be of specified quality and also satisfy all the performance requirements indicated in IS Code 2645-1975. The compound shall be used @ 2% by weight of cement used (or as recommended by the manufacturer).

Any other waterproofing compound, if specified for use, shall satisfy the manufacturer’s specifications.
4.2 MEASUREMENT
4.2.1 The measurement shall be taken along the finished surface of treatment including the rounded and tapered portions at junctions. Length and breadth shall be measured correct to one centimeter and area shall be worked out nearest to two decimals.
4.3 RATE
4.3.1 The rate shall be inclusive for all operations described in the nomenclature and the specifications applicable to the item, including any incidental expenditure. Nothing extra shall be payable on any account whatsoever.

5.0 BRICK WORK
5.1 The brick work shall be carried out with good quality well burnt bricks of specified designation, free from ash, dust or mud etc.
5.2 Only well wet bricks shall be used for brick work in cement mortar.
5.3 The cement mortar of specified mix shall be uniformly mixed to the required consistency in the Mixer Machine with hopper attached only and measuring boxes shall be used for proper proportion of mortar mix.
5.4 All the joints of brick work both horizontal and vertical shall be filled in completely with cement mortar. The joints shall be of uniform thickness of not more than one cm.
6.0 WOOD WORK (Doors / Cup Board frames and shutters)

6.1 The contractor shall procure the shutters and get them fixed only from approved manufacturer / contractor for manufacturing such shutters as per the specification specified herein.

6.2 The specialized agency manufacturing factory made shutters shall be got approved from the Engineer-in-charge before placing bulk supply order.

6.3 The contractor shall get at least 4 shutters of each type of door fabricated from the approved manufacturer immediately after start of the work and give written intimation to the Engineer-in-charge who shall arrange inspection of the samples at factory premises for approval. The two approved samples shall be left with manufacturer / suppliers and the remaining two samples will be delivered at the site of work for sample fixing.

6.4 The officer approving each shutter shall put his signature on each of the approved shutter and the contractor shall fix such approved shutters only and preserve the officer’s signature until the completion of work.

7.0 Powder coated Aluminum Work for Doors and windows:

7.1 The Contractor shall engage specialized agency for doing the aluminum work and the agency shall be got approved from the Engineer –in -Charge.

7.2 The materials conforming to specifications as mentioned in the nomenclature of item shall only be used for fabrication of Aluminum doors and windows.

7.3 All Aluminum work shall be free from defects impairing strength, durability and appearance. The makes of aluminum sections shall be as given in “List of approved Makes for Civil Work”

7.4 The contractor shall submit shop drawings and samples of each type of doors and windows to the Engineer-in-charge for approval. The shop drawings shall show full size sections of doors and windows. Shop drawings shall be based on actual dimensions available on site, which should not vary from those on drawings by 1.5mm.

7.5 The glazed aluminum windows shall be made completely water proof to the satisfaction of the engineer-in-charge. Silicon/ Polysulphide sealants etc; shall be provided wherever required to make the window water proof.

7.6 All joints shall be accurately fabricated. The finished surface shall be free from visible defects.

7.7 The Powder coating shall be of approved colour and conform to IS code

7.8 Doors, windows or fixed glazing, frames shall be fixed to concrete /brick work / base frame with approved metal fasteners. Method of fixing shall be approved by the Engineer-in-charge before mass fabrication.

7.9 A thick layer of the clear transparent lacquer based Methacrylates or Cellulose Butyrate shall be applied on the powder coated surfaces before they are brought to site. The same shall be removed on completion of erection.

7.10 All screws shall be stainless steel screws.

7.11 The corners of the frame shall be fabricated true to right angle. Both the fixed and openable frames shall be fabricated out of sections, which have been cut to length, mitred and jointed mechanically. All members shall be accurately machines milled and fitted to form hair line joints. The joining accessories such as cleats, brackets, etc shall be such material so as not to cause any bimetallic corrosive action.
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All frame members shall be in plumb and level and jointed in such a way that the expansion and contraction shall not cause distortion or leakage. The contractor shall be responsible for their satisfactory performance/operation after fixing is complete.

7.12 Clear glass: The glass shall be float glass of Brand Modi or equivalent. Clear glass used in glazing of openable/fixed doors, windows and ventilators shall provide clear, completely undistorted vision and reflection. It shall be free from any bubbles, waves or blemishes. Glass used shall be of required size as per drawings.

7.13 Tinted Glass: Tinted glass shall have same quality and specifications as indicated above for clear glass. It shall however be transparent glass tinted to Bronze/Blue/Green/Smoke grey shade as required and would be expected to absorb a greater proportion of sun's radiant heat and reduce transmission than clear glass.

7.14 Rate: The rate shall include the cost of all materials as mentioned above and in the nomenclature of item, labour and T&P required for proper completion of the work including the sealant but excluding the clear/tinted glass which shall be measured and paid separately under relevant item. For payment purposes, the weight of aluminium sections finished to size as provided in doors and windows excluding the cleats shall only be measured.

7.15 Five years guarantee bond in prescribed Performa `B' attached in Tender Document Volume - I shall be submitted by the contractor which shall also be signed by both the specialized agency and the contractor to meet their liability/liabilities under the guarantee bond against structural stability, water leakage, faulty materials, workmanship and defective anodized finish.

8.0 Flooring

8.1 Only machine cut Kota stone, sand stone marble, granite slabs shall be used for flooring and veneering work.

8.2 Proper gradient shall be given to flooring for toilets, verandah, kitchen, court, yard etc and shall be determined by providing required gradient in the lean concrete/sub-grade surface.

8.3 The bed mortar on concrete shall be fully compacted, particularly at the junctions of panels, during laying of flooring so that the finished floor does not give hollow sound.

9.0 Roofing

9.1 The roofing shall be executed as specified in the nomenclature and detailed specifications for the item.

9.2 The work of fixing rainwater pipes, grouting around mouth of rain water pipes and making khurra shall be done before starting the items of roofing. The roofing shall overlap the khurra surface by about 100mm.

9.3 Plastering of parapet wall shall only be done after providing required cement concrete gola at the junctions with horizontal surface of roofing. In case of RCC parapet wall 75 x 75mm cement concrete gola shall be provided after making groove at least 20mm in depth. Cement slurry shall be applied over the groove before laying cement concrete gola. For parapets walls in brick work, the cement concrete gola shall be provided as per operations described in DSR/CPWD Specifications with up to date corrections slips.

10.0 Finishing

10.1 The cement paint, primer, synthetic enamel paint, bitumen, plastic emulsion and distemper etc. of approved manufacturer shall only be brought to the site of work in the original sealed
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containers. The material brought to the site of work in lots of atleast 25% of the total requirement. The materials shall be kept under the joint custody of contractor and Engineer-in-charge. The empty containers shall not be removed from the site till the completion of the work.

10.2 Nothing extra shall be paid for providing drip course or moldings in RCC projected slabs wherever required.

10.3 The item of glass mosaic tiles included under the sub head of “Road and Path Work “ shall also be executed on building facias in bands of required width as shown in the Architectural drawings and nothing extra shall be paid for the same.

10.4 The rate for relating to stainless steel cramps shall include the cost of 100mmx100mm x100mm cement concrete 1:2:4 (1cement:2 coarse sand:4 graded stone aggregate 20 mm nominal size) blocks in brick masonry wall in which the cramp shall be embedded.

10.5 The rate for to stainless steel cramps of size 15x6mm-16.5cm long shall include the cost of two nos. Wedge expansion type hold fasteners (with threaded dia of size 6mm) for fixing each cramp to RCC / CC backing.

10.6 Nothing extra shall be paid for shuttering and other inputs required at the locations of construction joints in RCC work.

11 RCC WORK

11.1 To ensure proper cover only factory made approved cover blocks will be used to avoid displacement of bars in any direction.

11.2 The Steel bars of different diameters should be stored about 30 to 45 cm above ground level to avoid corrosion of steel. No extra payment shall be made on this account.

12 WOOD WORK

12.1 Thickness of glass in glazing shall be as specified in the item in woodwork / steel works. Glazing in toilets shall be of opaque type.

13 FLOORING:

The rate of items of flooring is inclusive of providing sunk flooring in bathrooms, kitchen etc. and nothing extra on this account is admissible. The flooring is to be laid in pattern of various combinations as per architectural drawings. The flooring in treads and risers of stair case is to be laid in single piece. Nothing extra shall be paid on these accounts. The measurement shall be made for finished work of flooring.

Misc

1. Structural glazing

General
1) Framing system
   Aluminium anodized extruded sections manufactured by reputed manufacturers. For all types of members like brackets, mullions, transom etc.

2) Sealant
   As specified in the item of silicon sealant

3) Insulation
   50mm thick glass wool of minimum density 48kg/cum sandwiched with black polythene sheet 100 micron on one side and aluminium foil of 100 Micro on the other side or as specified by manufacturer at spandrel area. The surface after fixing insulation shall be plain without any distortion.
4) Heat reflective Toughened Glass
   (a) St. Gobain – Reflectosolar as specified.
   (b) Glaverbel/ Glavermass – Super Silver
   (c) Visteon Ford

Brown or Grey Color or any shade approved by the Client/ Engineer-in-Charge/ Architect.

**SCOPE OF WORK**

**Preliminary Requirements**

(i) The contractor shall design, test, fabricate, deliver, install and guarantee all construction necessary to provide a complete curtain wall system for the proposed building, all in conformity with the drawings as shown.

(ii) Specification and all relevant construction regulations including providing any measures that may be required to that end, notwithstanding any omissions or inadequacies of the drawings.

(iii) The curtain wall system shall also include the following activities:
   (a) Metal frames, glass glazing, spandrels, ventilators, finish hardware, copings, metal closure, windows etc.
   (b) All anchors attachments, reinforcement and steel reinforcing for the systems required for the complete installations.
   (c) All thermal insulation associated with the system
   (d) All fire protection associated with the system
   (e) All copings and closure and metal cladding to complete the system
   (f) All sealing and flushing including sealing at junctions with other trades to achieve complete water tightness in the system.
   (g) Isolation of dissimilar metals and moving parts.
   (h) Anticorrosive treatment on all metals used in the system.
   (i) Polyester powder coating aluminium sections.
   (iv) The contractor shall also be responsible for providing the following:
      (a) Engineering proposal, shop drawings, engineering data and structural calculations in connection with the design of the curtain wall system.
      (b) Mock-ups, samples and test units.
      (c) Performance testing of the curtain wall framing and glazing assembly.
      (d) Co-ordination with the work of other trade.
      (e) Insulation with glass wool 48 kg/ cum at spandrels area.
      (f) Protection.
      (g) All final exterior and interior cleaning and finishing of the curtain wall system.
      (h) As built record drawings and photographs.
      (i) Guarantees and warranties.
      (j) All hoisting, scaffolding, staging and temporary services.
      (k) Conceptualizing and design of a suitable maintenance system for curtain glazing.
      (v) The water tightness and structural stability of the whole curtain wall system are prime responsibility of the contractor. Any defect or leakage found within the guarantee period shall be sealed and made good at all the risk and cost of the contractor.
      (vi) The curtain wall system shall be designed to provide for expansion and contraction of components which will be caused by an ambient temperature range without causing buckling, stress on glass, failure of joint sealants, undue stress on structural elements or other detrimental effects, specific details should be designed to accommodate thermal and building movements.
Quality Consideration and Other Activities

(i) The contractor while submitting the detailed design calculations should submit the following information on the quality of materials to be used and other aspects as detailed below:

1. Metal quality, finishes and thickness
2. Glass quality, coating and thickness and proposed manufacturer's brand names
3. Aluminium extruded sections including mullions and transoms together with structural calculations and proposed manufacturer’s brand name and also the name of agency proposed for fabrication work
4. Arrangement and jointing of components.
5. Field connections especially mullion to mullion and transom to mullion.
6. Fixing and anchorage system of typical wall unit together with structural calculations.
7. Drainage system and provision in respect of water leakage in the curtain wall system
11. Wind load and seismic load and any other specific load considered in the design

(ii) Design concept over lightening protection link-up system of the curtain wall for connection and incorporation into the lightening conductor system of the building (Lightening conductor system of the building to be done by any other agency)

(iii) The maximum permissible structural tolerances of the building that the system has been designed to accommodate in case these tolerances exceed those specified in the specification.

Tolerances

Any parts of the curtain wall, when completed, shall be within the following tolerances:

1. Deviation from plumb, level or dimensioned angle must not exceed 3mm per 3.5m length of any member or 6mm in any total run in any line.
2. Deviation from theoretical position on plan or elevation, including deviation from plumb, level or dimensioned angle must not exceed 9mm total at any location.
3. Change in deviation must not exceed 3mm for any 3.5m run in any deviation.

Test of Wind Pressure

(i) The equivalent load of wind pressure or wind suction shall be given to the test unit as increasing or decreasing the inside pressure in the “pressure chamber” at which the test unit is fixed.

(ii) The static wind pressure shall be applied up to 1.5 kpa at maximum wind pressure.

(iii) The variation of dynamic pressure shall be of any approximate sine curve line.

(iv) Deflection on each observational points of the test unit shall be observed and recorded under static pressure as described above.

(v) Any damage and harmful permanent deformation on any parts except sealing materials shall not be found at maximum wind pressure.

(vi) The deflection on the main structural parts in this condition shall not exceed:

1. 1/175 of the span between supports or 20mm, whichever is less for vertical elements.
2. 1/250 of the span between supports for horizontal elements.
3. The extent of recovery of deformation, 15 minutes after the removal of the test load, is to be at least 95%.
Test of Lateral Deflection per Floor Height

(i) Lateral deflection per floor height shall occur on the test unit, when the structural frame which fixes the test unit is deflected horizontally.
(ii) The deflection of every ± 2.5mm shall be increased up to ± 13mm on the test unit (static deflection test).
(iii) The dynamic deflection shall be applied up to ± 13mm.
(iv) The variation of dynamic deflection shall be of an approximate sine curve line, on period of 3 seconds.
(v) The dimensions of the deflection on each observational point of the test unit shall be measured under the condition as described above and the same shall be observed.
(vi) Any damage and harmful permanent deformation shall not be found in any parts of the curtain wall except the damage to sealant at maximum deflection.

Water Tightness Test

(i) Water shall be sprinkled to the ‘Test Unit’ under wind pressure.
(ii) Pressure shall not be applied to the test unit.
(iii) The volume of the sprinkling water in one minute shall be 5 litres per sqm minimum (01.gal/sq.ft.)
(iv) All water leakage and drainage system at the joint and the openable sash of the curtain wall system shall be observed from the outside of the chamber.
(v) Hold the test two times, in sequence as described below, conforming to the above mentioned conditions.
(1) Install the test unit.
(2) Hold first water tightness test.
(3) Hold test of wind pressure as described above.
(4) Hold second water tightness test.
(5) Lateral deflection test.
(vi) Water leakage shall not be observed inside at all parts of the test unit during first water tightness test.

Mode of Measurement

the breadth and the height of the finished work including the openable windows shall be measured in meters and centimetre and the net quantity for payment shall be calculated in sqm up to two place of decimal, the area to be considered for measurement shall be the net area of the exterior face of the curtain wall as fixed including the openable windows if any as part of the curtain wall.

Rate

The rate shall include the cost of all operations described above including the cost of materials, labors, designs of drawings, erection and testing, mock-up test units, fabrication, erection, finishing, scaffolding, undertaking performance guarantee. No other claims of any kind pertaining to this work shall be entertained.

2. Providing & fixing Slate tile work for wall lining over 12 mm thick bed of cement mortar 1:3 (1 cement : 3 coarse sand) ans cement slurry @ 3.3 Kg/Sqm including pointing in white cement complete.

General

Slate Tile shall be of the type specified; It shall be machine cut to requisite size and thickness. They shall be of colour indicated in the drawings or as instructed by the Engineer-in-Charge.
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It shall be hard, sound, durable and tough, free from cracks, decay and weathering and defects like cavities, cracks, flaws, holes, patches of soft or loose materials etc. before starting the work, the contractor shall get the stones approved by Engineer-in-Charge. All work related to this specification section should be coordinated with the works described in other specification sections, including:

**Mortar**
The mortar for jointing shall be as specified.

**Laying**
All stones shall be wetted before placing in position. These shall be floated on mortar and bedded properly. The walls and pillars shall be carried up truly plumb or battered as shown in drawings.

**Joints**
All joints shall be laid truly horizontal and vertical.

**Curing**
The work in cement or composite mortar shall be kept constantly moist on all faces for a minimum period of seven days.

**Mode of Measurement**
The finished work shall be measured correct to a centimetre in respect of length and breadth nearest to two places of decimal.

**Rate**
The rate shall include the cost of materials and labor required for all the operations described above.

3. Providing & fixing Bhuj block tile (stone look) work for wall lining over 12 mm thick bed of cement mortar 1:3 (1 cement : 3 coarse sand) and cement slurry @ 3.3 Kg/Sqm including pointing in white cement complete.

**General**
Bhuj Block Tile shall be of the type specified; It shall be machine cut to requisite size and thickness. They shall be of colour indicated in the drawings or as instructed by the Engineer-in-Charge. It shall be hard, sound, durable and tough, free from cracks, decay and weathering and defects like cavities, cracks, flaws, holes, patches of soft or loose materials etc. before starting the work, the contractor shall get the stones approved by Engineer-in-Charge.

All work related to this specification section should be coordinated with the works described in other specification sections, including:

**Mortar**
The mortar for jointing shall be as specified.

**Laying**
All stones shall be wetted before placing in position. These shall be floated on mortar and bedded properly. The walls and pillars shall be carried up truly plumb or battered as shown in drawings.

**Joints**
All joints shall be laid truly horizontal and vertical.
**Curing**
The work in cement or composite mortar shall be kept constantly moist on all faces for a minimum period of seven days.

**Mode of Measurement**
The finished work shall be measured correct to a centimetre in respect of length and breadth nearest to two places of decimal.

**Rate**
The rate shall include the cost of materials and labor required for all the operations described above.

4. Granite work gang saw cut (polished and machine cut) of thickness 18mm for wall lining, skirting and dado (veneer work) in cement mortar 1:3 (1 cement : 3 coarse sand) including pointing with white cement mortar 1:2 (1 white cement : 2 marble dust) with an admixture of pigment to match the marble shade: (To be secured to the backing by means of cramps, which shall be paid for separately).

**General**
Granite Stone shall be of the type specified and the material promptly in accordance with specifications, it shall be hard sound durable and tough free from cracks, and defects like cavities cracks flaws holes etc. Before starting the work the contractor shall get the sample approved by the Engineer – in –Charge / architect.

**MATERIALS**
Granite Standard: Granite shall comply Standard Specification for material characteristics, physical requirements, and sampling for selection of granite.
All granite shall be of standard architectural grade, free of cracks, seams, or starts, which may impair its structural integrity or function. Color or other visual characteristics indigenous to the particular material and adequately demonstrated in the sampling will be accepted provided they do not compromise the structural or durability capabilities of the material. Texture and finish shall be within the range of samples approved by the Engineer – in –Charge. Anchor Provision: Cut and drill sink provisions and holes in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone in place. Provide chases, reveals, ringlets, openings, and similar features as required to accommodate adjacent work.

**Shop Drawings**
The Contractor shall submit: copies of required shop drawings to the Engineer-in-charge for approval. These drawings shall show all bedding, bonding, jointing and anchoring details, and the dimensions of each piece of granite. No final sizing or finishing shall be done until the shop drawings for that part of the work have been approved.

**STONE INSTALLATION**
Proceed with the installation of the stonework in accordance with Drawings and using skilled mechanics capable of proper handling of the setting of the stone and able to field cut where necessary with sharp and true edges. Set stone with joints uniform in appearance and stone edges and faces aligned tolerances indicated. Clean surfaces that are dirty or stained. Scrub with fiber brushes, and then rinse with clear water. Provide expansion, control, and pressure-relieving joints of widths and at locations shown on Drawings.

**Cleaning**
After installation and pointing or caulking are completed, the contractor shall carefully clean the granite, removing all dirt, excess mortar, weld splatter, stains, and/or other site incident defacements Stainless steel wire brushes or wool may be used, but the use of other wire
Protection of Finished Work
After the granite work is installed, the granite shall be properly and adequately protected from
damage. Boxing or other suitable protection shall be provided wherever required, but no
lumber which may stain or deface the granite shall be used. All nails used shall be non-
corrosive. All granite work in progress shall be protected at all times during construction by
use of a suitable strong, impervious film or fabric securely held in place.

Defective Work
Any area or piece of granite found defective it shall be removed, and to be patched or
redressed for use. Nothing extra on this account will be entertained.

Related sections
All work related to this specification section should be coordinated with the works described in
other specification sections, including:

Mortar
Joints
Pointing
Curing

Mode of Measurement
The finished work shall be measured correct to a centimetre in respect of length and breadth
nearest to two places of decimal. The rate shall include the cost of all operations described
above including the cost of materials, labors, designs of drawings, erection and testing,
fabrication, erection, finishing, scaffolding, etc. No other claims of any kind pertaining to this
work shall be entertained.

Rate
The rate shall include the cost of materials and labor required for all the operations described
above.

5. Granite stone flooring with 18mm thick stone flooring (sample of shall be
approved by Engineer-in-charge) over 20 mm (average) thick base of cement mortar
1:4 (1 cement : 4 coarse sand) laid and jointed with grey cement slurry including
rubbing and polishing complete with :

General
Granite Stone shall be of the type specified and the material promptly in accordance
with specifications, it shall be hard sound durable and tough free from cracks, and defects like
cavities cracks flaws holes etc. Before starting the work the contractor shall get the sample
approved by the Engineer – in – Charge / architect.

MATERIALS
Granite Standard: Granite shall comply Standard Specification for material
characteristics, physical requirements, and sampling for selection of granite.
All granite shall be of standard architectural grade, free of cracks, seams, or starts, which may
impair its structural integrity or function. Color or other visual characteristics indigenous to the
particular material and adequately demonstrated in the sampling will be accepted provided
they do not compromise the structural or durability capabilities of the material. Texture and
finish shall be within the range of samples approved by the Engineer – in –charge.

Shop Drawings
The Contractor shall submit: copies of required shop drawings to the Engineer-in-charge for
approval. These drawings shall show all bedding, bonding, jointing details, and the
dimensions of each piece of granite. No final sizing or finishing shall be done until the shop
drawings for that part of the work have been approved.

STONE INSTALLATION
Proceed with the installation of the stonework in accordance with Drawings and using skilled
mechanics capable of proper handling of the setting of the stone and able to field cut where
necessary with sharp and true edges. Set stone with joints uniform in appearance and stone
edges and faces aligned tolerances indicated. Clean surfaces that are dirty or stained. Scrub
with fiber brushes, and then rinse with clear water. Provide expansion, control, and pressure-
relieving joints of widths and at locations shown on Drawings.

Cleaning
After installation and pointing or caulking are completed, the contractor shall carefully clean
the granite, removing all dirt, excess mortar, weld splatter, stains, and/or other site incident
defacements Stainless steel wire brushes or wool may be used, but the use of other wire
brushes or of acid or other solutions which may cause discoloration is expressly prohibited.
Fabricator should be contacted before cleaners other than detergents are used.

Protection of Finished Work
After the granite work is installed, the granite shall be properly and adequately protected from
damage. Boxing or other suitable protection shall be provided wherever required, but no
lumber which may stain or deface the granite shall be used. All nails used shall be non-
corrosive. All granite work in progress shall be protected at all times during construction by
use of a suitable strong, impervious film or fabric securely held in place.

Defective Work
Any area or piece of granite found defective it shall be removed, and to be patched or
redressed for use. Nothing extra on this account will be entertained.

Related sections
All work related to this specification section should be coordinated with the works described in
other specification sections, including:
Mortar
Joints
Pointing
Curing

Mode of Measurement
The finished work shall be measured correct to a centimetre in respect of length and breadth
nearest to two places of decimal.

Rate
The rate shall include the cost of materials and labor required for all the operations described
above.
Well Foundations

1201 DESCRIPTION
This work shall consist of construction of well foundation, taking it down to the founding level through all kinds of sub-strata, plugging the bottom, filling the inside of the well, plugging the top and providing a well cap in accordance with the details shown on the drawings and as per these Specifications, or as directed by the Engineer.
In case of well foundations of size larger than 12 m diameter, supplemental construction specifications will be necessary.

1202 GENERAL

1202.1 Wells may have a circular, rectangular or D-shape in plan and may consist of one, two or more compartments in plan. The outer wall of the well, known as well steining may be cellular. The process of taking down the well to the founding level is known as well sinking. After reaching the founding level, the hollow inside the well, (“dredge hole”) is plugged at the bottom by concrete (“bottom plug”). The dredge hole is then filled with approved filling upto the level indicated on the drawings and provided with a concrete plug (“top plug”). To facilitate sinking of well, steel cutting edge is fabricated and connected to a concrete well curb of required shape. On top of the well curb, adequate height of well steining is cast and the process of sinking is carried out. After a portion of the well has been sunk, another height of well steining is cast on top of the previous section and further sinking carried out. This process is continued till the bottom level of the well reaches the founding level.
At the top of the well steining, well cap” is laid which transmits the loads and forces from the sub-structure (piers or abutments) to the foundations.

1202.2 At least one bore-hole must be available/carried out in accordance with these specifications at each well foundation location, prior to commencement of work. The depth of bore-holes should extend upto a depth equal to one and a half times the outer diameter/ least dimension of the well below the anticipated founding level. The results of soil exploration should be presented in accordance with Clause 704.3 of IRC:78. In case the well foundation is to rest on a rocky strata, it may be necessary to undertake additional borings/probings prior to commencement of work to ascertain the actual profile and the quality of the rocky strata, at the level at which the well has to be seated, etc.

1202.3 Blasting may have to be resorted to in order to facilitate sinking through difficult strata, such as boulders and rocks etc. In case blasting is anticipated, protective/ strengthening measures specified in Sub-Clause 6 of Appendix 4 of IRC:78 shall be taken. The grade of concrete in bottom 3 m of steining shall not be leaner than M 20 or as shown on the drawings.

1202.4 In case the bore hole data shows the presence of steeply dipping rock, chiseling may have to be resorted to so as to obtain proper seating of the foundation. For this purpose, the well may require to be dewatered completely under high air pressure inside the well. This process is known as pneumatic sinking. Pneumatic sinking may also have to be resorted to in cases where obstacles such as tree trunks, large sized boulders or hard strata etc. cannot be removed by open dredging. The necessity of adopting pneumatic sinking shall be decided by the Engineer.
The curb and steining have to be specifically designed for special loadings when pneumatic sinking is adopted.
1203 SETTING OUT AND PREPARATIONS FOR SINKING

1203.1 Necessary reference points shall be fixed, away from the zone of blow-ups or possible settlements resulting from well sinking operations. Such reference points shall be connected to the permanent theodolite stations with the base line on the banks. The center of the individual wells shall be marked with reference to these stations. The distance, wherever practicable, shall be checked with the help of accurate tapes and precision distomat.

Reference points shall also be fixed to mark X-X axis (usually traffic direction) and Y-Y axis (normal to X-X axis) accurately.

A temporary bench mark shall also be established near the well foundation, away from the zones of blow-ups or possible settlement. The bench mark shall be checked regularly with respect to the permanent bench mark established at the bridge site.

1203.2 For wells which are to be located in water, an earthen or sand island shall be constructed. Sand islands are practicable for water depths of about 5 m under stable bed soil conditions. For greater depths or in fast flowing rivers or for locations where soil is too weak to sustain sand island, floating caissons may have to be adopted.

The plan dimensions of sand islands shall be such as to have a working space of at least 2 m all around the steining. The dimension of the sand islands shall however be not less than twice the dimension in plan of the well or caisson. Sand islands shall be maintained to perform their functions, until the well is sunk to a depth below the bed level at least equal to the depth of water.

Sand island shall be protected against scour and the top level shall be sufficiently above the prevailing water level to be decided by the Engineer so that it is safe against wave action.

While sand islands are constructed at well location, floating caissons are generally fabricated at or near the banks on dry land or dry docks. Floating caissons are towed into position in floating condition.

Floating caissons may be of steel, reinforced concrete or a combination of the two. They should have at least 1.5 m free board above water level and increased, if considered necessary, in case there is a possibility of caissons sinking suddenly due to reasons such as scour likely to result from the lowering of caissons, effect of waves, sinking in very soft strata etc.

Stability of floating caissons shall be ensured against overturning and capsizing while being towed and during sinking for the action of water current, wave pressure, wind etc.

For floating caissons, a detailed method statement for fabrication, floating and sinking of caissons shall be prepared and furnished to the Engineer. Such statement shall include the total tonnage of steel involved, fabrication and welding specifications, list of materials and plant and a description of operations and manpower required for the work. The caisson shall be tested for leakages before being towed to site.

For well placed in the banks of the river or in the dry area, the bed may be prepared by excavating the soil up to 1.5 m followed by leveling and dressing before placing the cutting edge.

1203.3 Equipment

Equipment shall be deployed for construction of well foundation as required and as directed by the Engineer. Generally, the following equipments may be required for the work:
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a) Crane with grab buckets – capacity 0.5 to 2.0 cu.m
b) Submersible pumps
c) Air compressors, air locks and other accessories where pneumatic sinking of well is anticipated
d) Chisels of appropriate sizes
e) Aqua-header for cutting rocky strata
f) Diving helmets and accessories
g) Equipments for concrete production, transportation and compaction

1204 CUTTING EDGE

1204.1 The mild steel cutting edge shall be made from structural steel sections and shall be strong enough to facilitate sinking of the well through the type of strata expected to be encountered. The weight of the cutting edge shall not be less than 40 kg per metre length and be properly anchored into the well curb, as shown in the drawing.

When there are two or more compartments in a well, the bottom end of the cutting edge of the inner walls of such wells shall be kept at about 300 mm above that of outer walls.

In V shaped cutting edge, the inclined plate should meet the vertical plate in such a way that full strength connection by welding is feasible.

1204.2 The parts of cutting edge shall be erected on level firm ground. Temporary supports shall be provided to facilitate erection and maintaining the assembly in true shape. The fabrication may be carried out in the shop or at site. Steel sections shall not be heated and forced into shape. However, “V” cuts may be made in the horizontal portion, uniformly throughout the length, to facilitate cold bending. After bending, such “V” cuts should be closed by welding. Joints in the lengths of structural sections, unless otherwise specified shall be filler welded using single cover plate to ensure the requisite strength of the original section.

1204.3 The cutting edge shall be laid about 300 mm above prevalent water level.

1205 WELL CURB

1205.1 The well curb shall be such that it shall offer minimum resistance while sinking, but shall be strong enough to be able to transmit superimposed loads from the steining to the bottom plug. The shape and the outline dimension of the curb as given in Appendix -3 (Fig. 2) of IRC:78 may be referred for guidance. The internal angle of the curb as shown in Appendix 3 shall be about 30° to 37° depending upon geotechnical data.

The well curb may be pre-cast or cast-in-situ. The well curb shall be reinforced concrete of mix not leaner than M 25 with minimum reinforcement of 72 kg/cu.m excluding bond rod. The steel shall be suitably arranged to prevent spreading and splitting of curb during sinking. Steel formwork for well curb shall be fabricated strictly in conformity with the drawing. The outer face of the curb shall be vertical. The bottom ends of vertical bond rods of steining shall be fixed securely to the cutting edge with check nuts or by welds.

The formwork on outer face of curb may be removed within 24 hours after concreting. The formwork on inner face shall be removed after 72 hours. All concreting in the well curb shall be done in one continuous operation.
1205.2 In case blasting is anticipated, the inner faces of the well curb shall be protected with the steel plates of thickness not less than 10 mm up to the top of the well curb. If it is desired to increase the steel lining above the well curb then the thickness in the extended portion can be reduced to 6 mm. This extra height of the steel shall not exceed 3 m, unless specific requirement exists, as decided by the Engineer. The curb in cases involving blasting, shall be provided with additional hoop reinforcement consisting of 10 mm dia mild steel or deformed bars at 150 mm spacing which shall also extend up to a height of liner.

1206 WELL STEINING

1206.1 The dimensions, shape, concrete strength and reinforcements of the well shall strictly conform to those shown on the drawings. The formwork shall preferably be of M.S. sheets shaped and stiffened suitably. In case timber forms are used, they shall be lined with plywood or M.S. sheets.

1206.2 Steining built in the first lift above the well curb shall not be more than 2 m and in subsequent lifts it shall not exceed the diameter of the well or the depth of well sunk below the adjoining bed level at any time. For stability, the first lift of steining shall be cast only after sinking the curb at least partially for stability. Concreting of steining may be carried out in subsequent lifts of about 2 to 2.5 m. Attempts should be made to minimize the number of construction joints. The concreting layers shall be limited to 450 mm restricting the free fall of concrete to not more than 1.5 m. Laitance formed at the top surface of a lift shall be removed to expose coarse aggregates before setting of concrete at the proposed construction joint. As far as possible, construction joints shall not be kept at the location of laps in the vertical steining bars.

1206.3 The steining of the well shall be built in one straight line from bottom to top such that if the well is titled, the next lift of steining will be aligned in the direction of the tilt. The work will be checked carefully with the aid of straight edges of lengths approved by the Engineer. Plumb bob or spirit level shall not be used for alignment. After sinking of a stage is complete, damaged portions if any, of steining at top of the previous stage shall be properly repaired before constructing the next stage.

1206.4 The height of steining shall be calibrated by making at least 4 gauges (preferably in traffic direction and in a direction normal to traffic direction) distributed equally on the outer periphery of the well each in the form of a 100 mm wide strip painted on the well, with every metre mark shown in black paint. The gauges shall start with zero at the bottom of the cutting edge. Marking of the gauges shall be done carefully with a steel tape.

1206.5 After reaching the founding level, the well steining shall be inspected to check for any damage or cracks. The Engineer will direct and the Contractor shall execute the remedial measures before acceptance of the well steining. In case the well cannot be accepted even with any remedial measure, then the well shall stand rejected.

1207 WELL SINKING

1207.1 General

The well shall as far as possible be sunk true and vertical through all types of strata.

Sinking or loading of the well with kentledge shall be commenced only after the steining has been cured for at least 48 hours or as specified in the drawings.

No well shall be permitted to be placed in a pre-dredged hole.
The well shall be sunk by excavating material uniformly from inside the dredge hole. Use of water jetting, explosives and divers may be adopted for sinking of wells through difficult strata with prior approval of the Engineer.

Normally dewatering of well should not be permitted as a means for sinking the well. It shall never be resorted to if there is any danger of sand blowing under the well. Dewatering shall however be done when well is to be founded into rock. Pneumatic sinking may have to be resorted to where obstacles such as tree trunks, large size boulders, etc. are met at the bottom or when there is hard strata which cannot be removed by open dredging. The necessity for pneumatic sinking shall be decided by the Engineer.

Sinking history of well shall be maintained in the format given in Appendix 1200/

1207.1.1 Sand blows in wells

Dewatering shall be avoided, if sand blows are expected. Any equipment or men working inside the well shall be brought outside the well as soon as there are any indications of sand blow. Sand blow often can be minimized by keeping the level of water inside the well higher than the water table and also by adding heavy kentledge.

1207.2 Use of Kentledge as Sinking Load

Kentledge shall be placed in an orderly and safe manner on the loading platform and in such a way that it does not interfere with the excavation of the material from inside the dredge hole and also does not in any way damage the steining of the well.

Where tilts are present or there is a danger of well developing a tilt, the position of the load shall be regulated in such a manner as to provide greater sinking effort on the higher side of the well.

1207.3 Use of Water Jetting

Water jetting and jack down method may be employed for well sinking as per requirement.

1207.4 Use of Explosives

Mild explosive charges may be used as an aid for sinking of the well only with prior permission of the Engineer. Blasting of any sort shall only be done in the presence of the Engineer and not before the concrete in the steining has hardened sufficiently and is more than 7 days old. When likelihood of blasting is predicted in advance, protection of the bottom portion of the well shall be done as per these Specifications.

After blasting operations are completed, the well curb and steining should be examined for any cracks and remedial measures taken.

If blasting has been used after the well has reached the design foundation level, normally 24 hours shall be allowed to lapse before the bottom plug is laid.

The charges shall be exploded well below the cutting edge by making a sump so as to avoid chances of any damage to the curb or to the steining of the well. A minimum sump of 1 m depth should be made before resorting to blasting. Use of large charges, 0.7 kg or above, may not be allowed except under expert direction and with the permissions from the Engineer. Suitable pattern of charges may
be arranged with delay detonators to reduce the number of charges fired at a time. The burden of the charge may be limited to 1 m and the spacing of holes may normally be kept as 0.5 to 0.6 m.

All prevalent laws concerning handling, storing and using of explosives shall be strictly followed.

All safety precautions shall be taken as per IS:4081 “Safety Code for Blasting and related Drilling Operations”, to the extent applicable, whenever blasting is resorted to.

There should be no equipment inside the well nor shall there be any worker in the closed vicinity of the well at the time of exploding the charges.

If rock blasting is to be done for seating of the well, the damage caused by flying debris should be minimised by covering blasting holes by rubber mats before blasting.

1207.5 Use of Divers
Use of divers may be made both for the sinking purpose like removal of obstructions, rock blasting and for inspection. All safety precautions shall be taken as per any acceptable safety code for sinking with divers or any statutory regulations in force.

Only persons trained in the diving operation shall be employed and shall be certified to be fit for diving by an approved doctor.

They shall work under expert supervision. The diving and other equipments shall be of acceptable standard and certified to this effect by an approved independent agency. It shall be well maintained for safe use.

Arrangement for ample supply of low pressure clean cool air shall be ensured through an armoured flexible hose pipe. Standby compressor plant shall be provided in case of breakdown.

Separate high pressure connection for use of pneumatic tools shall be made. Electric lights where provided shall be at 50 volts (maximum). The raising of the diver from the bottom of wells shall be controlled so that decompression rate conforms to the rate as laid down in appropriate regulations.

1207.6 Use of Pneumatic Sinking

1207.6.1 General
The Engineer shall familiarize himself with particular reference to caisson diseases and working of the medical air-lock. A doctor competent to deal with cases of “Caisson Diseases” or other complications arising as a result of working under high pressure, shall be stationed at the construction site when pneumatic sinking is under progress.

The contractor shall provide complete facilities including the issuing of orders to ensure strict enforcement of the requirements outlined in these Specifications.

Safely provisions as contained in IS:4138 and in these Specifications shall be strictly followed. Pneumatic sinking shall be restricted to a depth of 30.0 m.

1207.6.2 Man-Locks and Shafts
Locks, reducers, and shaft used in connection with caissons shall be of riveted construction throughout. The material used in their manufacture shall be steel plate with thickness not less than 6 mm.
Shafts shall be subjected to hydrostatic or air pressure test of at least 0.5 MPa, at which pressure they shall be tight. The pressure at which testing has been done shall be clearly and visibly displayed.

Shaft shall be provided, with a safe, proper and suitable staircase for its entire length including landing platforms which are not more than 6 m apart. Where this is impracticable due to space constraint, suitable ladders along with landing platforms shall be installed. These shall be kept clear and in good condition at all times and shall be constructed, inspected and maintained to the entire satisfaction of the Engineer.

A 1.0 m wide platform with 1.0 m high railing shall be provided all around the caisson air locks.

Where 15 or more men are employed, caissons shall have two locks, one of which shall be used as a man lock.

Locks shall be located so that the lowest part of the bottom door shall not be less than 1 m above high water level.

The supply of fresh air to the working chamber shall at all times be sufficient to permit work to be done without any danger or excessive discomfort. All air supply lines shall be supplied with check valves and carried as near to the face as practicable.

A man-lock shall be used solely for the compression or decompression of persons, and not for the passage of plant and material and shall be maintained in a reasonably clean and sufficiently warm state. However, any hand tool or hand instruments used for the purpose of the work may be carried into the man-lock.

Where it is not reasonably practicable to provide a separate man-lock for use by persons only, the lock when it is in actual use for compression or decompression of a person or persons shall not be put, simultaneously, to any other use and shall be in a reasonably clean and sufficiently warm state.

1207.6.3 Valves

Exhaust valves shall be provided, having risers extending to the upper part of the chamber. These shall be operated, whenever necessary specially after a blast. Precautions shall be taken that men are not allowed to resume work after a blast until the gas and smoke are cleared.

1207.6.4 Medical supervision and certification

Every employee absent from work for 10 or more consecutive days due to illness or any other disability shall be required to pass the regular physical examination by the doctor before being permitted to return to work. After a person has been employed continuously in compressed air for a period of 2 months, he shall be re-examined by the doctor and shall not be permitted to work until such re-examination has been made and the report is satisfactory.

No person known to be addicted to the excessive use of intoxicants shall be permitted to work in compressed air.

The doctor shall, at all times, keep a complete and full record of examination made by him, which shall contain dates of examinations, a clear and full description of the persons examined, his age and physical condition at the time of examination and a statement as to the period such a person has
been engaged in such employment. Records shall be kept at the place where the work is in progress and shall be subject to inspection by authorized officers.

Every man lock shall always have a doctor or a responsible person in attendance. In case the person in charge is not a doctor, he must have positive means of promptly communicating with and securing the services of a competent doctor in case of emergency. Such arrangements shall invariably be subject to the approval of the Engineer.

If the air pressure exceeds 0.2 MPa gauge or if 50 or more men are employed, it is obligatory for the person in charge of medical lock to be a doctor experienced in this type of work. All cases of compressed-air illness shall be reported and copies of all such reports shall be kept in file at the place of work.

1207.6.5 Lighting

All lighting in compressed air chambers shall be operated only by electricity. Two independent electric lighting systems with independent sources of supply shall be used. These shall be so arranged that the emergency source shall become automatically operative in case of failure of the regularly used source.

The minimum intensity of light on any walkway ladder, stairway, or lower working level shall be one-quarter (1/4) candlepower. In all work places, the lighting shall always be such as to enable workmen to see their way about clearly. All external parts of lighting fixtures and electrical equipment lying within 2.5 m above the floor shall be constructed of non-combustible, non-absorbing insulating materials. If metal is used it must be effectively earthed. Portable lamp shall have non-combustible, non-absorbing insulating sockets, approved handles, basket guards and approved cables. The use of worn out or defective portable and pendant conductors, shall be prohibited.

1207.6.6 Safety against fire hazard

No oil, gasoline, or other combustible material shall be stored within 30 m of any shaft, caisson, or tunnel opening. However, oil may be stored in suitable tanks in isolated fireproof buildings, provided such buildings are not less than 15 m from any shaft, caisson, or tunnel opening or any building directly connected thereto.

Positive means shall be taken to prevent leaking flammable liquids from flowing into areas specifically mentioned in the preceding paragraph.

Where feasible, a fire hose connected to a suitable source of water shall be provided at the top of every caisson. Where fire mains are not accessible, water shall be stored in tanks near the top of every caisson, provided fire pails or suitable pumps are kept available. Approved fire extinguishers shall also be provided.

1207.6.7 Sanitation

Properly heated, lighted and ventilated dressing rooms shall be provided for all employees engaged in compressed air work. Such rooms shall contain lockers and benches and be open and accessible to person during intermissions between shifts. Adequate toilet accommodation of one for every twenty five employees shall be provided.

Care shall be taken to keep all parts of the caissons and other working compartments, including locker rooms, dry rooms, rest rooms, and other equipments in a good sanitary condition and free from refuse, decaying or other objectionable matter.

No nuisance shall be tolerated in the air chamber. Smoking shall be strictly prohibited and all matches and smoking materials shall be left out of the locker rooms.
A separate dry-room shall be provided where working clothes may be dried in a reasonable time.

1207.6.8 Protection against gases

In all cases where gas is expected including alluvium impregnated with decayed vegetable matter, the use of Davy Safety Lamp shall be compulsory.

1207.6.9 Additional safety provisions

a) The weight of the pneumatic platform and that of steining and kentledge, if any, shall be sufficient to resist the uplift from air inside, skin friction being neglected in this case. If, at any section the total weight acting downwards is less than the uplift pressure of air inside, additional kentledge shall be placed on the well.

If it is not possible to make the well heavy enough during excavation, “blowing down” may be used. The men should be withdrawn and air pressure reduced. The well should then begin to move with small reduction in air pressure. “Blowing down” should only be used when the ground is such that it will not heave up inside the chamber when the pressure is reduced. When the well does not move with the reduction in air pressure, kentledge should be added. “Blowing down” should be in short stages and the drop should not exceed 0.5 m at any stage. To control sinking during blowing down use of packing are recommended.

b) The pneumatic sinking plant and other allied machinery shall not only be of proper design and make, but also shall be operated by competent and well trained personnel. Every part of the machinery and its fixtures shall be minutely examined before installation and use. Availability of appropriate spares, standbys, safety of personnel as recommended in IS:4138 for working in compressed air must be ensured at site. Codes for safety and for working in compressed air and other labour laws and practices prevalent in the country, as specified to provide safe, efficient and expeditious sinking shall be followed.

c) Inflammable materials shall not be taken into air locks and smoking shall be prohibited. Wherever gases are suspected to be issuing out of dredge hole, the same shall be analysed by trained personnel and necessary precautions adopted to avoid hazard to life and equipment.

d) Where blasting is resorted to, it shall be carefully controlled and all precautions regarding blasting shall be observed. Workers shall be allowed inside after blasting only when a competent and qualified person has examined the chamber and steining thoroughly, and found the same to be safe.

1207.7 Precautions during sinking

a) When the wells have to be sunk close to each other and clear distance between them is not greater than the diameter of wells, sinking shall be taken up on all wells and they shall be sunk alternately so that sinking of wells proceeds uniformly. Simultaneous and even dredging shall be carried out in the wells in such a manner that the difference in the levels of the sump and cutting edge in the adjacent wells does not exceed half the clear gap between them. Plugging of all the wells shall be done together.

b) During sinking of dumb-bell or double D-shaped wells, the excavation in both the dredge holes should be carried out simultaneously and equally.
c) Bore chart shall be referred to constantly during sinking for taking adequate care while piercing different types of strata. The type of soil as obtained during the well sinking should be compared with bore chart so as to take prompt decisions.

d) Before seasonal floods, all wells on which sinking is in progress shall be sunk to sufficient depths below the designed scour level. Further, they shall be temporarily filled and plugged so that they do not suffer any tilt or shift during the floods.

e) All necessary precautions shall be taken against any possible damage to the foundations of existing structures in the vicinity of the wells, prior to commencement of dredging from inside the well.

f) The dredged material shall not be allowed to accumulate over the well. It shall be dumped and spread, as far away as possible, and then continuously and simultaneously removed, as directed by the Engineer. In case the river stream flows along one edge of the well being sunk, the dredged material shall not be dumped on the dry side of the bank but on the side on which the river current flows.

g) Very deep sump shall not be made below the well curb, as it entails risk of jumping (sudden sinking) of the well. The depth of sump shall be generally limited to one-sixth of the outer diameter/least lateral dimension of the well in plan. Normally the depth of sump shall not exceed 3.0 m below the level of the cutting edge unless otherwise specially permitted by the Engineer.

h) In case a well sinks suddenly with a jerk, the steining of the well shall be examined to the satisfaction of the Engineer to see that no damage has occurred to it.

i) In pneumatic sinking, the well shall not, at any time, be dropped to a depth greater than 500 mm by the method of “blowing down”.

j) Dewatering shall be avoided if sand blows are expected. Any equipment and men working inside the well shall be brought out of the well as soon as there are any indications of a sand-blow.

k) Sand blowing in wells can often be minimised by keeping the level of water inside the well higher than the water table and also by adding heavy kentledge.

l) In soft strata prone to settlement/creep, the construction of the abutment wells shall be taken up only after the approach embankment for a sufficient distance near the abutment has been completed.

1207.8 Tilts and Shifts

The inclination of the well from the vertical is known as tilt and the horizontal displacement of the center of the well at the founding level from its theoretical position is known as shift.

Unless otherwise specified, the tilt of any well shall not exceed 1 (horizontal) in 80 (vertical), and the shift at the well base shall not be more than 150 mm in any resultant direction.

Tilts and shifts shall be carefully checked and recorded in the format vide Appendix 1200/II regularly during sinking operations. For the purpose of measuring the tilts along the two axes of the bridge, reduced level of the marks painted on the surface of the steining of the well shall be taken. For
determination of shift, locations of the ends of the two diameters shall be precisely measured along the two axes, with reference to fixed reference points.

Whenever any tilt is noticed, adequate preventive measures like placing eccentric kentledge, pulling, strutting, anchoring or dredging unevenly and depositing dredge material unequally, putting obstacles below cutting edge. Water jetting etc., shall be adopted before any further sinking. After correction, the dredged material shall be spread out uniformly.

A pair of wells close to each other have a tendency to come closer while sinking. Timber struts may be introduced in between the steining of these wells to prevent tilting. Tills occurring in a well during sinking in dipping rocky strata can be safeguarded by suitably supporting the curb.

In the event of a well developing tilt or shift beyond the specified permissible values, the Contractor shall have to carry out, at his own cost, suitable remedial measures to the satisfaction of the Engineer, to bring the tilt and shift within permissible values.

If the resultant tilt and / or shift of any well exceeds the specified permissible values, generally it should not exceed 1 in 50 and 300 mm respectively. The well so sunk shall be regarded as not conforming to specifications and a sub-standard work. The Engineer in his sole discretion, may consider accepting such a well, provided:

i) Calculations for foundation pressures and steining stresses, accounting for the actual tilt and shift furnished by the Contractor show that the well is safe. Remedial measures required to bring the stresses within permissible values (such as increase in the dimension of the well cap, provision of dummy weights on the well cap etc.), shall be carried out by the Contractor at his own cost.

ii) The Contractor shall be subjected to reduction in rates as a penalty in accordance with Clause 1215(g).

In case the Engineer, in his discretion, rejects the well, the Contractor shall dismantle the rejected well to the extent directed by the Engineer and remove the debris. Further, the Contractor shall, at his own risk and cost complete the bridge with modified span arrangement acceptable to the Engineer.

1207.9 Floating caissons

Floating caissons may be of steel, reinforced concrete or any suitable material. They shall have at least 1.5 m free board above the water level and increased, if considered necessary, in case there is a possibility of caissons sinking suddenly owing to reasons, such as scour likely to result from lowering of caissons, effect of waves, sinking in very soft strata, etc.

Well caissons should be checked for stability against over-turning and capsizing while being towed and during sinking, due to the action of water current, wave pressure, wind etc. The floating caisson shall not be considered as part of foundation unless proper shear transfer at the interface is ensured.

1207.10 Seating of Wells

The well shall be uniformly seated at the founding strata. It shall be ensured by test borings that the properties of the soil encountered at the founding strata and upto a depth of one and a half times the well diameter is identical to that adopted in the design. The procedure for test borings shall satisfy the
provisions of these specifications. In case the soil encountered is inferior to that adopted in design, the well shall be re-designed by the Engineer adopting the soil properties actually encountered and the founding level intimated to the Contractor, who shall carry out the work accordingly.

In case of seating of wells in hard rocky strata, where the rock profile is steeply sloping, pneumatic methods of sinking may be adopted to seat the well evenly as directed by the Engineer. The decision of adopting pneumatic sinking shall be taken by the Engineer. The cutting edge may also be embedded for a suitable depth in the rocky strata, as decided by the Engineer keeping in view the quality of rock. As an additional measure of safety, the well shall be anchored to the rocky strata by anchor bars provided in the staining of the well, as shown on the drawing irrespective of the fact that tension develops or not at the base of the well under design loads. After the well has been evenly seated on good hard rock, arrangements shall be made to facilitate proper inspection in dry and visible conditions before the bottom plug is laid.

1208 BOTTOM PLUG

The bottom plug shall be provided in all wells and the top shall be kept not lower than 300 mm in the centre above the top of the curb, as shown in Appendix-3 of IRC:78. A suitable sump shall be below the level of the cutting edge. Before concreting the bottom plug, it shall be ensured that its inside faces have been cleaned thoroughly.

The concrete mix used in bottom plug shall have a minimum cement content of 330 kg per cu.m with a slump about 150 mm to permit easy flow of concrete through tremie to fill-up all cavities. Concrete shall be laid in one continuous operation till the dredge hole is filled to the required height. For under water concrete, the concrete shall be placed by tremie under still water condition and the cement content of the mix be increased by 10 percent. Admixtures, if required may be added to the concrete to achieve the required characteristics.

In case of grouted concrete, the grout mix shall not be leaner than 1:2. It shall be ensured that the grout fills up all interstices upto the top of the bottom plug by suitable means such as, controlling the rate of pumping etc.

Any dewatering required, shall be done 14 days after concreting of bottom plug. The concrete production equipment and placement equipment should be sufficient to enable under water concreting within stipulated time. Necessary standby equipment should be available for emergency situation.

Before commencing plugging, all loose material from the bottom of the well shall be removed.

Concreting shall be done in one continuous operation till the dredge hole is filled upto the required height and thereafter sounding shall be taken up to ensure that the concrete has been laid to the required height.

Least disturbance shall be caused to the water inside the well while laying concrete in the bottom plug. Concrete shall not be disturbed in any way for at least 14 days.

In order to check any rise in the level of the bottom plug soundings should be taken at the close of concreting and once every day for the subsequent 3 days.

The soundness of the bottom plug may be tested by dewatering the well by 5 m below the surrounding water level and checking the rise of water. The rate of rise shall preferably be less than
10 cm per hour. In case the rate is higher, suitable remedial measures as directed by the Engineer, shall be taken by the Contractor at his own cost.

1209 SAND FILLING

Sand filling shall commence after a period of 14 days of laying of bottom plug. Also, the height of the bottom plug shall be verified before starting sand filling.

Sand shall be clean and free from earth, clay clods, roots, boulders, shingles, etc. and shall be compacted as directed. Sand filling shall be carried out up to the level shown on the drawing or as directed by the Engineer.

1210 TOP PLUG

After filling sand up to the required level a plug of 300 mm thick concrete shall be provided over it as shown on the drawing or as directed by the Engineer.

1211 WELL CAP

A reinforced cement concrete well cap will be provided over the top of the steining in accordance with the drawing. Formwork will be prepared conforming to the shape of well cap. Concreting shall be carried out in dry condition. A properly designed false steining may be provided where possible to ensure that the well cap is laid in dry condition.

The bottom of the well cap shall be laid preferably as low as possible but not below the LWL, taking into account for this purpose, the water level prevalent at the time of casting. Where the bed level is higher than the LWL, the bottom of the well cap may be suitably raised.

Bond rods of steining shall be anchored into the well cap.

1212 TOLERANCES

The permissible tilt and shift shall not exceed 1 (horizontal) in 80 (vertical) and the shift at the well base shall not be more than 150 mm in any resultant direction.

For the well steining and well cap, the permissible tolerances shall be as follows:

a) Variation in dimension : +50 mm, –10 mm
b) Misplacement from specified position in plan : 15 mm
c) Surface irregularities measured with 3 m straight edge : 5 mm
d) Variation of level at the top : + 25 mm

1213 TESTS AND STANDARDS OF ACCEPTANCE

The materials shall be tested in accordance with these Specifications and shall meet the prescribed criteria.
The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

1214 MEASUREMENTS FOR PAYMENT

All quantities shall be measured from the drawing, or as ordered by the Engineer, excepting those required to be provided by the Contractor at his cost.

a) The cutting edge shall be measured in tonnes based on the net weight of metal used in it, as per Section 1900.

b) The concrete in curb, well steining and well cap shall be measured in cubic metres in each of the items as per Section 1700. The reinforcements shall be measured in tonnes separately in each of the items, as per Section 1600.

c) The measurement for well sinking shall be made in running metres for different depths and in different types of strata (for example, predominantly sand/clay soil, soft rock, hard rock, etc.) as specified in the Contract. The depth of sinking shall be measured from the level specified in the Contract. If no level has been specified in the Contract, sinking shall be measured from the low water level or from the level at which the cutting edge was laid, whichever is higher.

d) The quantity of concrete in bottom and top plug shall be measured in cubic metres as per Section 1700.

e) The quantity of sand filling shall be measured in cubic metres.

f) Pneumatic sinking, where required shall be paid as a separate item and shall be measured in cubic metres of material to be excavated.

1215 RATE

All quantities shall be measured from the drawing or as ordered by the Engineer, excepting those required to be provided by the Contractor at his cost.

a) The Contract unit rates of cutting edge shall cover all costs of labour, material, tools, plant and equipment, including placing in position, sampling and testing, and, supervision, all as per respective Section of Structural Steel Work and as described in this section.

b) The Contract unit rates for concrete in curb, steining, bottom plug, top plug and well cap, shall cover all costs of labour, material, tools, plant and equipment, formwork and staging including placing in position, sampling and testing, and, supervision, all as per respective Section of Structural Concrete and as described in this section.

c) The Contract unit rates for reinforcement in curb, steining, and well cap, shall cover all costs of labour, material, tools, plant and equipment, including bending to shape, placing in position, sampling, testing and supervision, all as per respective Section of Steel Reinforcement and as described in this section.
d) The Contract unit rates for sand filling shall cover all costs of labour, material, tools, plant and equipment, including placing in position, sampling testing and supervision, all as described in this section.

e) The Concrete unit rates for sinking shall cover the costs of labour, tools, and equipment and plant and for all operations and other incidentals for sinking of well including seating excepting provisions of pneumatic sinking as described in this Section. The unit rates shall specify the strata such as types of soil, rock, etc. The rate shall cover all testing and supervision required for the work.

f) The Contract unit rate of material to be excavated by pneumatic sinking shall cover all costs of labour, material, tools, plant and other equipment and other incidentals and safety provisions and supervision required for pneumatic sinking as per this Section.

g) Reduction in contract unit rates for sinking as a penalty, in pursuance of Clause 1207.8

If any well with tilt and/or shift exceeding the permissible values is accepted by the Engineer, the Contractor shall be subjected to a reduction in the rates as follows:

<table>
<thead>
<tr>
<th>S.No</th>
<th>Amount of tilt and/or shift</th>
<th>Per cent deduction on the rate (s) for sinking of whole well</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tilt exceeding the specified permissible value but equal to or within 1 in 60</td>
<td>5 percent</td>
</tr>
<tr>
<td>2</td>
<td>Tilt exceeding 1 in 60 but equal to or within 1 in 50</td>
<td>10 percent</td>
</tr>
<tr>
<td>3</td>
<td>Tilt exceeding 1 in 50</td>
<td>20 percent</td>
</tr>
<tr>
<td>4</td>
<td>Shift exceeding the specified permissible value but equal to or within 200 mm</td>
<td>2 percent</td>
</tr>
<tr>
<td>5</td>
<td>Shift exceeding 200 mm but equal to or within 300 mm</td>
<td>5 percent</td>
</tr>
<tr>
<td>7</td>
<td>Shift exceeding 300 mm</td>
<td>10 percent</td>
</tr>
</tbody>
</table>

Rates for excessive tilt and shift shall be reduced separately
INTERMODAL IWT TERMINAL AT VARANASI

SPECIFICATION FOR PILES

A) PILES

1.0 BORED CAST-IN-SITU CONCRETE PILE

1.01 General

This specification covers the piling work required for the construction of intermodal terminal at Varanasi. Geotechnical investigation for the area where on land facilities and jetty structure are coming have been completed. Report may be referred to for sub soil parameters. The area falls in “Indo gangotri plains” and soil at the project side belongs to indo gangotri alluvial and are river deposit of the river Ganga its tributaries. However general site stratigraphy is as follows:

In the river bank - Hard clayey silt
In the river - Hard clayey silt under lain with very dense silty sand

Tenderer may carry out additional investigation if felt necessary by him. Claims and objections of site and subsoil conditions shall not be entertained.

1.02.01 Codes

IS:2911 (Part 1/Section 2) – 1979 : ‘Code of practice for design & construction of Bored Cast – in Situ concrete piles’ shall be referred to in conjunction with this specification during the entire design & construction work. If for any material or workmanship, appropriate Indian Standards or Codes are not available or have not been adequately specified in the Technical Specification, such material & workmanship shall conform to other suitable & codes.

1.02.02 Design

The piles shall be bored cast-in-sity cylindrical type RCC piles and shall be founded on suitable approved strata to achieve the design capacity.

1.02.03 Materials

All the materials proposed to be used, shall be free from any objectionable substances, shall conform the following stipulation. Any testing required to prove the suitability of such materials should be carried out.

1.02.03.01 Reinforced Cement Concrete for Piles shall be with minimum Cement content of 425 kg/m³ for piles. The slump of concrete for piles shall be between 160 mm to 180 mm. the water-cement ratio shall not exceed 0.45. to achieve the specified slump using specified water cement ratio without compromising with strength, if required, suitable admixture shall be used subject to approval of the Purchaser.

1.02.03.02 Preliminary mix design shall be done in accordance with IS: 10262-1982 & SP:23 subject to approval of the Purchaser. Cube tests, Slump test & other relevant tests for preliminary mix design and Routine cube test, slump test for regular concreting shall be carried out at site/ site laboratory at for regular concreting shall be carried out at / site laboratory at contractor’s own cost. Concrete cube tests shall be done as per IS:516-1959. Frequency of cube test shall be guided by clause 15.2 of IS: ‘456-2000.’
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Slump tests (apparatus conforming to IS:IS: 7320 -1974) Shall be carried out at least once for each pile or more frequently, if desired by the Purchaser.

1.02.04 Equipment & Accessories

The equipment & accessories should be compatible with the type of sub-soil, method of installation, type of founding strata & required penetration in the founding strata.

The capacity of rig shall be adequate so as to bore upto required depth with specified diameter. Rig shall be equipped with suitable chisel to penetrate through any local obstruction/ hard strata.

1.02.05 Construction

1.02.05.01 The permissible positional deviation in horizontal direction shall not be exceed 1.5% form the designed location in more in case of piles having diameter more than 600mm.

1.02.05.02 Stabilisation of the side of borehole shall be done by the use of bentonite slurry. Direct Mud Circulation (DMC) process shall be adopted. In such cases the bentonite slurry must be used at least from the level of sub-soil water, as the hole shall then be always kept almost full with the fluid. The specific gravity of bentonite slurry shall be in the range of 1.05 to 1.10. This shall be checked regularly for each or at any change in its specified consistency. Pressure of slurry pump shall be sufficient enough to clear out all cuttings efficiently from the hole. Prevention of side collapse of boreholes shall be taken care by with use of temporary casing if necessary. At the last stage of boring or in intermediate hard layers chisel may be used. The piles shall be installed with due consideration for safely of adjacent structures by a method. Which leaves their strength unimpaired, and which develops and retains the required bearing resistance.

1.02.05.03 Reinforcement as required shall be made into stiff cages sufficiently welded to withstand handling without any damage or distortion. Reinforcement shall be placed immediately after cleaning and inspection of the bottom of bore holes. The reinforcement should be supported away from the sides of the shaft by means of suitable space block to ensure concentric alignment in the shaft. Steps shall be taken to ensure correct positioning during concreting of reinforcement in the piles without any distortion.

1.02.05.04 Immediately before placing or reinforcement and concreting, the bored hole shall be cleaned of all the loose material, debris and all the water shall be removed. The pile tip zone shall be thoroughly replace the old bentonite slurry used during the previous operations. This shall be carried out for about 45 minutes in two stages. Cleaning for about first 30 minutes shall be done before lowering of reinforcement cage & cleaning of about 2nd 15 minutes after lowering the reinforcement cage.

Concrete shall be so placed as to fill the entire volume of the tube or bore without the formation of voids caused be the faulty consolidation or entrapped air. Proper care shall be taken to ensure that the fluid alluvial soil does not penetrate between batches of the concrete.

In case of boreholes stabilized by bentonite slurry, concrete shall be placed by means of tenie pipe, which will be suitably closed at bottom at the start of concreting. The tremie pipe must extend upto the bottom of the borehole at the start and may be withdrawn in sections as the level of concrete rises in the borehole; but its discharge
end shall at all times be embedded in the concrete to a minimum depth of 2 m. placing of concrete should be continuous and the pile holes will be maintained full with the bentonite slurry where used throughout the concreting operation. Slurry displaced from the borehole by the concrete shall be channeled away or pumped into suitable mud pond for re-use or disposal to waste.

In case of cased holes. After the required founding level is encountered the bottom shall be sealed with concrete and the reinforcement cage shall be lowered. If the borehole is dry, concrete shall be deposited in such a manner so as to avoid any segregation of concrete followed by gradual withdrawal of casings. If water is present in the borehole, it shall be bailed out by bailer. If it is difficult to dewater by the bailer, concrete shall be placed under water by means of a placer. After the head of water has been neutralized by the head of the concrete. Excess water shall be bailed out and concrete shall then be deposited by direct pouring from the top. As is done, if the borehole is dry.

1.02.05.05 The concreted length of piles shall be measured from the toe of pile to cut off level of pile.

1.02.05.06 Temporary stoppage of work may be permitted only during boring stage. Thereafter right form boring or chiseling of final portion of pile length through subsequent activities of flushing, lowering of reinforcement cage, lowering of tremie, pre-concrete, lowering of reinforcement cage, lowering of tremie, pre-concrete flushing & upto concreting of full pile length, no halt whatsoever in the execution of work shall be permitted.

1.02.05.07 Boring for any pile shall not be carried out within a clear distance of four times of pile diameter form the adjacent pile, which has been freshly concreted within past 24 hours.

1.02.05.08 Concreting of Pile shall continue until the pile is fully formed upto a level of not less than 500 mm above cut off level of piles. Extraction of casing wherever used shall be done in such a way that no necking or shearing of the concrete in the shaft takes place. Pile length above cut off level shall not be measured for payment and shall be trimmed off free of cost. Trimming of pile top shall not be permitted before 7 days of concreting in case of mechanical chipping & 3 days in case of manual chipping.

1.02.06 Founding Strata

All the piles shall be founded in specified strata.

SPT Shall be carried out at founding level for at least one pile at every 10m distance subject to minimum of one test for every 25 piles or part thereof within a pile cap.

1.02.07 Pile Load Test

1.02.07.01 Maximum load in case of routing tests shall be limited to 1.05 times of the corresponding safe design load.

1.02.07.02 For all types of Routine load tests the testing arrangement, procedure & interpretation shall follow relevant criteria set out in IS: 2911 (part 4)- 1985 along with the following stipulations:

i) Load test shall be carried out after 28 days from the date of casting unless otherwise directed.
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ii) Test load shall be applied at cut-off level, if the test level is below the ground water table. Suitable arrangement for dewatering shall be made.

iii) Loading shall be applied by reaction method consisting of a hydraulic jack placed centrally against a suitable loaded platform / anchorage system. Reaction system shall be well designed & capable of taking 1.25 times of the maximum load to be applied.

iv) Test load shall be applied to pile in a static manner. Stage loading shall be applied in equal increments of 20% of estimated safe design load. Unloading may be done in higher decrements with at least 5 stages. For Cyclic load test, each stage of loading shall correspond to unloading upto zero load. At each stage of loading & unloading, deflection of pile top shall be recorded accurate to 0.02 mm at an interval of 1, 2, 4, 8, 15, 30, 60, 120 minutes upto a time when the deflection rate reduces to 0.1 mm in 30 minutes or 0.2 mm in one hour or till two hours whichever occurs earlier.

v) Increments of loads shall be continued upto maximum load of 1.5 times of safe design load for Routine test or failure (soil –pile yielding or structural failure) whichever occurs earlier.

vi) Where failure does not occur, the final test load shall be maintained for 24 hours and deflection records shall be taken at every 6 hours interval, including initial 2 hours detailed records, as mentioned earlier.

vii) Assessment of safe load for different types of test shall follow relevant clauses of IS: 2911 (part 4) – 1985.

viii) After completion of load test, the following records/ reports shall be furnished.

a) Tabular & Graphical representation of Load vs. Settlement during loading and unloading.

b) Tabular & Graphical representation of the Time vs. Settlement for each load.

c) Graphical analysis of initial cyclic load test results to separate skin friction & end-bearing as per Annexure .IS 2911 (part 4)

d) Remarks concerning any unusual occurrence (if any) during boring installation or testing or piles.

1.02.08 Standard of Acceptance

The piles shall be accepted as satisfactory only when the work has been executed in accordance with this specification. IS Codes and the standards stated hereinafter and instructions given by purchaser at site from time to time:

a) The total volume of concrete shall not be less than actual shaft volume and not more than 40% of the calculated volume, the calculated volume for this purpose shall be the cross sectional area in side the bore multiplied by the length of the shaft. The concrete shall show the specified strength as indicated by the cube test results.

b) The toe of pile shall be at approved bearing level in each case.
c) Tolerances specified in clause No. 02.05.01 shall be satisfied.

If an individual pile fails to meet the requirements specified in any of above clause/s, such pile shall be deemed to be defective. When any pile is found defective, one or more pole shall be installed as a replacement of defective pile as necessary.

1.02.09 Record

A record for each pile indicating the following data shall be maintained.

a) The date and time of commencement and completion of the piling operation.

b) The particulars of the equipment and method of boring and concreting.

c) The location and type of pile, pile number, with a reference to approved drawings.

d) The diameter of the pile and verticality.

e) Bored depth, concreted depth, empty boring and nature of stratum at founding level.

f) The volume of concrete poured, quantity of cement, w/o ratio used and slump of poured concrete.

g) Details of reinforcement provided.

h) The sequence of installation of pile groups.

i) During boring operation, a separate record for rate of advancement of borehole in terms of effective time vs. boring depth shall be maintained for each pile. The effective time implies the time required exclusively for boring operation barring the time for other activities such as temporary stoppage, cleaning of hole, in situ tests, if taken etc.
<table>
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<tr>
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<th>Item</th>
<th>Manufacturer's Name</th>
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<td>ACC, Ultratech, JK, India Cement, JP</td>
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<td>White Cement</td>
<td>J.K, Birla or equivalent</td>
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<td>Reinforcement Steel (TMT bars)</td>
<td>Tata, sail, Rashtriya ISP al Ispal Nigam (RINL).</td>
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<td>4</td>
<td>Structural Steel sections</td>
<td>Sail, Vizag, Tata</td>
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<td>5</td>
<td>Concrete Additives</td>
<td>Fosroc, Choksey, Kunal Conchem, SikKa</td>
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<td>6</td>
<td>Anti termite Chemical</td>
<td>Pest Control India Ltd., Pest Con India, or Equivalent</td>
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<td>Tile grouts, Joint Filler</td>
<td>Laticrete, “Roff Rainbow Tile Mate” of Roff, Construction Chemicals Pvt. Ltd., Mapei, Winsil 20, Silicon Sealant of GE Bayer Silicon, Matrix Group,</td>
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<td>Silicone Sealant</td>
<td>GE Bayer Silicone, Dow Corning, Wacker.</td>
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<td>Epoxy</td>
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<td>Formwork Release Agent</td>
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<td>Non Shrink grouts</td>
<td>Fosroc, Kunal Conchem, Choksey</td>
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<td>Non Metallic Floor Hardeners</td>
<td>Fosroc, Choksey, Kunal Conchem, STP</td>
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<td>16</td>
<td>Bitumen</td>
<td>Shalimar tar products, Mathura oil refinery</td>
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<td>17</td>
<td>Synthetic Enamel Paint</td>
<td>Berger, Nerolac, Asian, ICI Dulux</td>
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<td>18</td>
<td>Oil Bound Distemper</td>
<td>Berger, Nerolac, Asian, ICI Dulux</td>
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<td>Cement Paint</td>
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<td>Textured Coating</td>
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<td>Melamine</td>
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<td>Ceramic Tiles (Glazed, Matt, Others)</td>
<td>Kajaria, HR Johnson, Somany, Orient</td>
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<td>Vitrified Tiles</td>
<td>Kajaria, Rak, Somany, Nitco, Orient</td>
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<td>Laminated Wooden flooring</td>
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<td>29</td>
<td>PVC/Vinyl Flooring</td>
<td>Polyflor, Tarkett</td>
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<td>Terrazzo Tile</td>
<td>NITCO, Modern, Hindustan</td>
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<td>Interlock Tiles, Glass Paver Block</td>
<td>Nimco Prefab, Unistone, Modern</td>
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<td>MDF Grade-I as per IS-12406 &amp;</td>
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<td>Adhesive for wood work</td>
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<td>36</td>
<td>Pre Laminated Particle Board</td>
<td>Novopan, Bhutan, Kitlam, Greenlam, Century, Merino</td>
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<td>37</td>
<td>Plywood, Block Board, Soft Board</td>
<td>Century, Duro, Alpro, Greenply, Merino</td>
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<td>38</td>
<td>Paving Stones</td>
<td>Unistone, Nimco Prefab, Hindustan Tiles</td>
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<td>Item</td>
<td>Manufacturer’s Name</td>
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<td>Wax Polish</td>
<td>Mansion, Reckitt &amp; Colman</td>
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<td>Polyethylene Sealant</td>
<td>MBT, Choksey, Kunal Conchem, Fosroc, Pidilite</td>
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<td>41</td>
<td>Polyethylene Board, Back Up Rod</td>
<td>Supreme Industries or Equivalent</td>
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<td>42</td>
<td>Stainless Steel Hinges</td>
<td>Hettich, Doorset, Union, haflon</td>
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<td>43</td>
<td>Mirror &amp; Float Glass</td>
<td>Modi Float Glass, Asahi Glass, Saint Gobain</td>
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<td>Door Hardware, Closer</td>
<td>Godrej, Dorset, Dorma, Hettich</td>
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<td>45</td>
<td>Locks and Handles</td>
<td>Godrej, Dorset, Dorma, Hettich</td>
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<td>Aluminum Building Expansion Joints</td>
<td>Vexcolt, Watson Bowman, Acme, Z-Tech India, JMetco</td>
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<td>47</td>
<td>Water Stopper</td>
<td>Fixopan, Caliplast or equivalent</td>
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<td>Aluminum Composite Panel</td>
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<td>Asphalt Emulsion</td>
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<td>Saint Gobin, Boral</td>
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<td>Impregnated Fibre Board</td>
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<td>Joint Filler and Bitumen Products</td>
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<td>Metallic False Ceiling</td>
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<td>H.T. Bolts</td>
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<td>Steel Doors (General purpose)</td>
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<td>61</td>
<td>Steel Doors (Fire rated)</td>
<td>Global Fire Protection Company, Radiant safe Fire Doors, Godrej, Navair, Shakti Met-Dor</td>
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<tr>
<td>62</td>
<td>Fire Door (Wooden)</td>
<td>Navair, Aadhunic, Radient</td>
</tr>
<tr>
<td>63</td>
<td>Aluminum Sections</td>
<td>Jindal, Hindalco, or Equivalent</td>
</tr>
<tr>
<td>64</td>
<td>Rolling Shutter</td>
<td>Shivam, Milestones, Rama, Prakash</td>
</tr>
<tr>
<td>65</td>
<td>Pre-coated Roof Sheeting</td>
<td>Multicolor, BHP, Bluescope, Japan Metal Systems, Lloyds, CRIL</td>
</tr>
<tr>
<td>66</td>
<td>Glass wool and related products, Mineral wool</td>
<td>UP-Twiga, Owens Corning, Lloyds</td>
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<tr>
<td>67</td>
<td>Polycarbonate sheets</td>
<td>GE Plastics, Damplan, Sunlite, Coxwell domes</td>
</tr>
<tr>
<td>68</td>
<td>Self drilling Screws</td>
<td>Hilti, Builtex or equivalent</td>
</tr>
<tr>
<td>69</td>
<td>Logo, Signs, Name plates</td>
<td>D-Line or Equivalent</td>
</tr>
<tr>
<td>70</td>
<td>Pre-Engineered Building</td>
<td>Kirby Building, Tiger Steel or equivalent</td>
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<tr>
<td>71</td>
<td>Flush Doors</td>
<td>Duro, Greenlam, Century</td>
</tr>
<tr>
<td>72</td>
<td>MS Sliding Motorized Door</td>
<td>Shivam Associates - Beninca RIS24 K System or equivalent</td>
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<tr>
<td>73</td>
<td>Water proofing compound</td>
<td>Pidilite, Cico, Fosroc, Choksey, Mapei</td>
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<tr>
<td>74</td>
<td>Fasteners</td>
<td>Gun, Atul, Hilti, Canon</td>
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<tr>
<td>75</td>
<td>Aluminum fittings</td>
<td>Urgent, Classic, Nulite</td>
</tr>
<tr>
<td>76</td>
<td>Extruded vitrified clay tile</td>
<td>Uniteile, Dovetex, or Equivalent</td>
</tr>
<tr>
<td>77</td>
<td>External façade tiles</td>
<td>Faviton or Equivalent</td>
</tr>
<tr>
<td>78</td>
<td>POP</td>
<td>Sriram or equivalent</td>
</tr>
<tr>
<td>79</td>
<td>Outdoor furniture (sitting bench, dustbin)</td>
<td>Arihant or equivalent</td>
</tr>
<tr>
<td>S. No.</td>
<td>Item</td>
<td>Manufacturer's Name</td>
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</tr>
<tr>
<td>80</td>
<td>Modular furniture</td>
<td>Godrej, Wipro, B.P.Ergo (Blowplast)</td>
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<tr>
<td>81</td>
<td>Chairs and Sofas</td>
<td>Godrej, Geeken, Featherlite</td>
</tr>
<tr>
<td>82</td>
<td>Acoustical paneling</td>
<td>Armstrong, Anutone or equivalent</td>
</tr>
<tr>
<td>83</td>
<td>Modular Toilets</td>
<td>Merino, Green, Dorma</td>
</tr>
<tr>
<td>84</td>
<td>Mosaic tiles</td>
<td>Nitco, surya, Laxmi</td>
</tr>
<tr>
<td>85</td>
<td>Acoustical False Ceiling</td>
<td>Armstrong, Anutone or equivalent</td>
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<tr>
<td>86</td>
<td>Exterior tiles</td>
<td>Uniteile, Pavit or equivalent</td>
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<tr>
<td>87</td>
<td>Patch Fitting/ Spider Fitting</td>
<td>D-Line, Hattich, Dorma</td>
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<tr>
<td>88</td>
<td>UPVC Door &amp; Window</td>
<td>Fenesta or Equivalent</td>
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<tr>
<td>89</td>
<td>Acid and alkali resistant tiles</td>
<td>Somany, Restile, Durato</td>
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<tr>
<td>90</td>
<td>Ceramic Rainscreen ventilated faced tiles</td>
<td>Faveton, Moeding, NBK</td>
</tr>
<tr>
<td>91</td>
<td>Roller Blinds</td>
<td>Hunter Douglas or Equivalent</td>
</tr>
</tbody>
</table>

### A. ELECTRICAL HIGH SIDE EQUIPMENT

1. SOLAR POWER PANEL  
   - THEME SOLAR SYSTEM/ SOLAR HART/ KL SOLAR COMPANY/ APOLLO SOLAR/ AVANTE GLOBAL
2. UPS SYSTEM  
   - EMERSON/ PCI/ SOCOMAC
3. INVERTOR  
   - LUMINOUS / MICROTENK / SU-KAM

### B. ELECTRICAL SYSTEM/ PANELS

1. FUSES & SWITCH FUSE UNIT  
   - SIEMENS/ ABB/ SCHNEIDER/
2. ACB / MCCB / CONTACTOR  
   - SIEMENS/ ABB/ SCHNEIDER
3. METAL CLAD SOCKET  
   - SIEMENS/ MDS/ BHARTIA CUTLUR HAMMER
4. RISING MAINS / BUS DUCT  
   - TRICOLITE/ ABB / SPC ELECTROTECH /ADVANCE
5. LED'S LIGHT  
   - PHILIPS/ WIPRO/FUTURE LIGHT
6. ISOLATORS FOR MOTORS  
   - MDS/ SIEMENS/ SCHNEIDER/ ABB
7. CHANGE OVER SWITCH  
   - HH-ELCON/ HPL SOCOMAC / GE
8. CONTACTOR, TIMER, SINGLE PHASE PREVENTOR & OVER LOAD RELAY  
   - L&T/ ABB/ SIEMENS
9. METERS - DIGITAL TYPE  
   - AE/ L&T/ RISHAB/ GE
10. PROTECTIVE & APFC RELAYS  
    - ASLTM/ ASHIDA/ L&T
11. CT's / PT's- DRY TYPE-EPOXY  
    - AE/ KAPPA
12. INDICATING LAMP / PUSH BUTTON ACTUATERS - LED CLUSTER TYPE  
    - L&T/ SIEMENS/ BCH
13. ROTARY SWITCHES  
    - L&T/ KAYCEE/ BCH
14. TERMINAL BLOCK  
    - ELEMEX/ WAGO
15. LT PANELS  
    - TRICOLITE/ ABB / SPC ELECTROTECH /ADVANCE
16. LIGHTNING ARRESTER  
    - ERICO/ ESE
17. GAS FIRE SUSPESSION SYSTEM  
    - FIRE LINE/ TYCO FIRE

### C. CABLES/ TERMINATIONS/ ACCESSORIES

1. LUGS  
   - DOWELLS/ COMET
2. BRASS CABLE GLANDS  
   - COMMET/ BELIGA
3. LT POWER CABLE (ALUMINIUM/ COPPER)  
   - UNIVERSAL/ NICCO/ POLYCA B / SKYTONE/HAVELLS
4. CONTROL CABLE (COPPER)  
   - UNIVERSAL/ NICCO/ POLYCA B / SKYTONE/HAVELLS
5. HT XLPE CABLE  
   - UNIVERSAL / RPG CABLES / NICCO/SKYTONE
6. H.T. CABLE END TERMINATION  
   - BIRLA 3 M/ REYCHEM/ FRONTEC
<table>
<thead>
<tr>
<th>S. No.</th>
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# List Of Preferred Makes

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<th>Item</th>
<th>Manufacturer’s Name</th>
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<tbody>
<tr>
<td>D.</td>
<td>CONDUITING &amp; WIRING ACCESSORIES</td>
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<tr>
<td>1</td>
<td>MS CONDUIT / GI CONDUIT (ISI MARKED)</td>
<td>BEC / AKG / Atul</td>
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<tr>
<td>2</td>
<td>PVC CONDUIT (ISI MARKED)</td>
<td>BEC / POLYPACK / AKG / Atul</td>
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<tr>
<td>3</td>
<td>PVC INSULATED COPPER CONDUCTOR FRLS WIRE</td>
<td>FINOLEX / HAVELLS / SKYTONE</td>
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<tr>
<td>4</td>
<td>PLATE TYPE - SWITCHES / SOCKETS / TV &amp; TELEPHONE SOCKETS AND ALL OTHER WIRING ACCESSORIES</td>
<td>M.K / LEGRAND / ANCHOR-ROMA</td>
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<tr>
<td>5</td>
<td>ACCESSORIES FOR METALIC / GI CONDUIT (ISI MARKED)</td>
<td>SHRMA STEEL CORPORATION / PRAKASH ENGINEERING WORKS / SUPER SALES CORPORATION</td>
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<tr>
<td>6</td>
<td>PVC INSULATION TAPE</td>
<td>STEEL GRIP / ANCHOR</td>
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<td>7</td>
<td>PHENOL LAMINATED SHEET</td>
<td>HYLUM / FORMICA</td>
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<tr>
<td>8</td>
<td>RACEWAYS &amp; CABLE TRAY</td>
<td>PILCO / SLOTCO / VENUS / RICCO</td>
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<td>E.</td>
<td>LIGHTING DBs &amp; MCBs</td>
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<td>1</td>
<td>MCB,10KA</td>
<td>MDS / SIEMENS / HAGER / MERLIN GERIN</td>
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<td>DISTRIBUTION BOARD</td>
<td>MDS / SIEMENS / HAGER / MERLIN GERIN</td>
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<td>ELCB / ELMCB / RCCB</td>
<td>MDS / SIEMENS / HAGER / MERLIN GERIN</td>
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<td>F.</td>
<td>LIGHTING FIXTURES &amp; FANS</td>
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<tr>
<td>1</td>
<td>BULK HEAD FITTINGS</td>
<td>CROMPTON / PHILIPS / WIPRO / FUTURE LIGHT</td>
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<td>2</td>
<td>EXHAUST FANS / CEILING FAN / WALL MOUNTED FAN</td>
<td>CROMPTON / POLAR / ALMONARD</td>
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<td>LIGHTING FIXTURES</td>
<td>PHILIPS / FUTURE LIGHT / WIPRO</td>
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<td>4</td>
<td>LIGHTING CONTROL SYSTEM</td>
<td>SCHNIDER / PHILIPS / LUTRON</td>
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<td>5</td>
<td>EXTERNAL LIGHTING FIXTURES</td>
<td>PHILIPS / FUTURE LIGHT / SCHREDER</td>
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<td>G.</td>
<td>ELV- TELEPHONE/ CCTV/ DOOR ACCESS/ FIRE ALARM/ PUBLIC ADDRESS &amp; MISC. SYSTEMS</td>
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<tr>
<td>1</td>
<td>SMOKE DETECTORS</td>
<td>NOTIFIER / HONEYWELL(XLS-3000) / SIEMENS / COOPER</td>
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<td>2</td>
<td>HEAT DETECTORS</td>
<td>NOTIFIER / HONEYWELL(XLS-3000) / SIEMENS / COOPER</td>
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<td>3</td>
<td>MANUAL CALL BOX</td>
<td>NOTIFIER / HONEYWELL(XLS-3000) / SIEMENS / COOPER</td>
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<td>HOOTER / SOUNDER</td>
<td>NOTIFIER / HONEYWELL(XLS-3000) / SIEMENS / COOPER</td>
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<td>RESPONSE INDICATOR</td>
<td>NOTIFIER / HONEYWELL(XLS-3000) / SIEMENS / COOPER</td>
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<td>FIRE PANEL</td>
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<td>7</td>
<td>PA AMPLIFIER</td>
<td>BOSE / PHILIPS / AHUJA</td>
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<td>8</td>
<td>PA SPEAKERS</td>
<td>BOSE / PHILIPS / AHUJA</td>
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<td>9</td>
<td>LINE MATCHING TRANSFORMER</td>
<td>BOSE / PHILIPS / AHUJA</td>
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<td>10</td>
<td>GOOSE NECK MIKE</td>
<td>BOSE / PHILIPS / AHUJA</td>
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<td>11</td>
<td>INVERTER</td>
<td>TOPAZ INTERNATIONAL / LUMINOUS / HYTES</td>
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<td>12</td>
<td>CAMERA WITH ALL ACCESSORIES</td>
<td>HONEYWELL / PELCO / BOSCH</td>
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<td>13</td>
<td>ROAD BARRIER</td>
<td>NICE / MAGNETICS / GODREJ / GE</td>
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<td>14</td>
<td>CARD READER</td>
<td>SENSORMATIC-USA / MOTOROLA / HONEYWELL(XLS-3000)</td>
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<td>15</td>
<td>MONITOR</td>
<td>ALBA / LG / SAMSUNG</td>
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<td>VCR</td>
<td>BPL / PANASONIC</td>
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<td>17</td>
<td>MULTIPLIER</td>
<td>SENSORMATIC OR EQUIVALENT</td>
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<tr>
<td>18</td>
<td>SEQUENCER</td>
<td>ALBA / VANTAGE</td>
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<td>19</td>
<td>PROXIMITY CARD</td>
<td>MOTOROLA / HUGHES / HONEYWELL/ GE / SIEMENS</td>
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<td>TELEPHONE TAG BLOCK</td>
<td>KRONE / TVS R&amp;M / SYSTIMAX / SCHNEIDER / PANAUDIT</td>
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<td>21</td>
<td>TELEPHONE CABLES</td>
<td>DELTON / SKYTONE / CLIPSAL</td>
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<td>22</td>
<td>CO-AXIAL CABLES</td>
<td>FINOLEX / DELTON / SKYTONE</td>
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<td>23</td>
<td>EPABX</td>
<td>ALKATEL / SIEMENS / NORTEL</td>
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<td>24</td>
<td>CCTV SYSTEM</td>
<td>HONEYWELL / SIEMENS / PELCO</td>
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<td>25</td>
<td>IT &amp; TELECOM SYSTEM</td>
<td>SCHNEIDER / SYSTIMAX / PANAUDIT</td>
</tr>
<tr>
<td>26</td>
<td>FIRE ALARM SYSTEM</td>
<td>NOTIFIER / HONEYWELL(XLS-3000) / SIEMENS / COOPER</td>
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</table>
## List Of Preferred Makes

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<tr>
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<th>Manufacturer’s Name</th>
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<tbody>
<tr>
<td>27</td>
<td>ACCESS CONTROL SYSTEM</td>
<td>HONEYWELL/ SIEMENS/GE</td>
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### H. MISCELLANEOUS SYSTEMS

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<th>S. No.</th>
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<tbody>
<tr>
<td>1</td>
<td>BATTERIES</td>
<td>EXIDE/ STANDARD</td>
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<td>2</td>
<td>BATTERY CHARGER</td>
<td>KELTRON/ NELCO/ EXIDE/ HBL NIFE</td>
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<tr>
<td>1</td>
<td>DG/PANEL/TRANSFORMER</td>
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<tr>
<td>1</td>
<td>ALTERNATOR</td>
<td>STAMFORD/ CATERPILLAR/ KIRLOSKER/CROMPTON</td>
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<td>2</td>
<td>ENGINE</td>
<td>CUMMINS/ CATERPILLAR/ KIRLOSKER</td>
</tr>
<tr>
<td>3</td>
<td>HT PANELS</td>
<td>SIEMENS/ ABB/ AREVA</td>
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<tr>
<td>4</td>
<td>TRANSFORMER</td>
<td>VOLTAMP/ ABB/ AREVA / KIRLOSKER/SUDHIR</td>
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<td>5</td>
<td>UNITISED / COMPACT SUB‐STATION</td>
<td>ABB/SIEMENS/ SCHNEIDER/SUDHIR</td>
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### PLUMBING SYSTEM

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<tbody>
<tr>
<td>1</td>
<td>VITREOUS CHINA SANITARYWARE</td>
<td>PARRYWARE,ROCA ,HINDWARE</td>
</tr>
<tr>
<td>2</td>
<td>PLASTIC W.C.SEATS &amp; COVERS</td>
<td>PARRYWARE,ROCA ,HINDWARE</td>
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<tr>
<td>3</td>
<td>C.P. FITTINGS: BIB COCK (LONG BODY/SHORT BODY), Pillar Cock, Single Hole Basin Mixture, Wall Mixer, Shower Mixer, Angle Valve, Concealed Stop Cock, Shower With Wall Flange, C.P. Waste 32-40 mm Dia,Bottle Trap, Health Faucet With Steel Beeded Connecting Pipe.</td>
<td>JAQUAR /ESS ESS /GROHE</td>
</tr>
<tr>
<td>4</td>
<td>AUTOMATIC WATER TAPS, AUTOMATIC URINAL FLUSHING SYSTEM</td>
<td>JAQUAR /ESS ESS /GROHE</td>
</tr>
<tr>
<td>5</td>
<td>TOWEL RING, TOWEL ROD, TOWEL RACK, COAT HOOK etc. (304 Grade S.S.)</td>
<td>PARKO / JAQUAR /ESS ESS</td>
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<tr>
<td>6</td>
<td>CHROMIUM PLATED / STAINLESS STEEL / POLY VENIEL CHLORIDE GRATING</td>
<td>Cummun, Neer, Chilly</td>
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<tr>
<td>7</td>
<td>STAINLESS STEEL SINK</td>
<td>JAINA /NEELKANT/ANUPAM</td>
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<td>8</td>
<td>SAND CAST IRON SPUN PIPE,CENTIFUGALLY CASTED S &amp; S AS PER IS: 3989</td>
<td>NECO / RAJ IRON FOUNDRY/ RIF/SKF</td>
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<tr>
<td>9</td>
<td>CAST IRON PIPE, HORIZONTALLY / VERTICALLY CASTED S &amp; S AS PER IS:1729</td>
<td>NECO / RAJ IRON FOUNDRY/ RIF/SKF</td>
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<td>10</td>
<td>G.I. &amp; M.S. PIPES PART-I IS: 1239 UPTO 150 mm AND M.S. PIPES</td>
<td>TATA STEEL (TUBE DIVISION)/ JINDAL PIPES LIMITED</td>
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<tr>
<td>11</td>
<td>G.I. AND M.S. FITTINGS</td>
<td>UNIQUE./ ZOLOTO / KENT</td>
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<tr>
<td>12</td>
<td>uPVC PIPES &amp; FITTINGS 4 kg./sqm, 6 kg./sqm, 10 kg./sqm PRESSURE.</td>
<td>SUPREME INDUSTRIES LIMITED/ FINOLEX INDUSTRIES/ PRINCE PIPES &amp; FITTINGS PRIVATE LIMITED</td>
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<td>cPVC PIPES SDR12.5 SCHEDULE-40</td>
<td>ASTRAL POLYTECHNIC PRIVATE LIMITED/ ASHIRVAD ENTERPRISES PRIVATE LIMITED/ JAIN PLASTICS &amp; CHEMICALS LIMITED</td>
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<td>14</td>
<td>HDPE PIPE</td>
<td>JAIN PLASTICS &amp; CHEMICALS LIMITED/ CHEMI PLAST INDUSTRIES STUROY POLYMERS LIMITED/ KISAN GROUP OF COMPANIES</td>
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<tr>
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<td>Item</td>
<td>Manufacturer's Name</td>
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<td>15</td>
<td>C.I.CLASS LA PIPES</td>
<td>KESORMA SPUN PIPE &amp; FOUNDRIES, CALCUTTA/ SUPER ENTERPRISES/ INDIAN IRON &amp; CO. LTD. CALCUTTA.</td>
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<td>16</td>
<td>R.C.C. PIPES</td>
<td>PRAGATI CONCRETE UDYOG/ K.K. SPUN PIPES/ J.K. SPUN PIPES/ SOOD &amp; SOOD</td>
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<td>17</td>
<td>STONEWARE PIPES &amp; GULLY TRAP</td>
<td>DEVRAJ ANAND CERAMIC (P) LIMITED / PERFECT POTTERI JABALPUR (MP)/ BURN POTTERIES, JABALPUR</td>
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<tr>
<td>18</td>
<td>GUNMETAL VALVES (FULLWAY, CHECK, GLOBE AND NON RETURN VALVES)</td>
<td>LEADER VALVES LIMITED/ ARKAY SALSE CORPORATION DELHI</td>
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<tr>
<td>19</td>
<td>BALL VALVE</td>
<td>TBS ENGINEERS PVT. LTD./ VIRGO ENGINEERING LTD./ GOOJARMAL GANPATRAI/ AUDCO INDIA LIMITED</td>
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<td>20</td>
<td>BUTTERFLY VALVE (LEVER TYPE)</td>
<td>LEADER VALVES LIMITED/ CASTLE VALVES LIMITED/ AUDCO INDIA LIMITED</td>
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<tr>
<td>21</td>
<td>BUTTERFLY VALVE (GEAR TYPE)</td>
<td>LEADER VALVES LIMITED/ CASTLE VALVES LIMITED/ AUDCO INDIA LIMITED/ GOOJARMAL GANPATRAI</td>
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<td>22</td>
<td>C.I.DOUBLE FLANGED SLUICE VALVE &amp; GATE VALVES</td>
<td>KIRLOSKAR BROTHERS LIMITED/ AARKO MANUFACTURING COMPANY/ ARROW ENGG.LTD</td>
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<tr>
<td>23</td>
<td>FLOAT VALVE (GUNMETAL) UPTO 40M</td>
<td>SANT INDUSTRIAL CONTROLS (P) LIMITED/ BOMBAY METAL &amp; ALLOYS/ LEADER VALVES LIMITED</td>
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<td>24</td>
<td>FLOAT VALVE (CI) 50M AND ABOVE</td>
<td>LEADER VALVES LIMITED/ INDIAN VALVE CO. LTD.</td>
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<tr>
<td>25</td>
<td>FOOT VALVE / CHECK VALVES (BRASS)</td>
<td>LEADER VALVES LIMITED/ INDIAN VALVE CO. LTD. CALCUTTA/ ADVANCE VALVES (P) LIMITED/ GOOJARMAL GANPATRAI/ AARKO MANUFACTURING COMPANY</td>
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<td>26</td>
<td>AIR RELEASE VALVES (BRASS / CAST IRON)</td>
<td>LEADER VALVES LIMITED/ ADVANCE VALVES (P) LIMITED/ AARKO MANUFACTURING COMPANY/ GOOJARMAL GANPATRAI</td>
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<td>C.I. MANHOLES COVER &amp; G.I. GRATING</td>
<td>K.K. MANHOLE &amp; GRATING Co. PRIVATE LIMITED/ BANGAL IRON COMPANY WEST BANGAL/ SHINING ENGINEERING WORKS (FOUNDRY) AGRA.</td>
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<td>HAND DRIER (304 Grade S.S.)</td>
<td>THE VEERA TRADING COMPANY/ KOPAL ENGG. CORPN. NEW DELHI/ ASKON ENGINEERS BOMBAY</td>
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<td>LIQUID SOAP DISPENSER (304 Grade S.S.)</td>
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<td>TATA / JINDAL HISAR / PRAKASH</td>
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<td>FLOW METER</td>
<td>SCIENTIFIC EQUIPMENT. (P) LTD. SHALI BANDA HYDERABAD - 500263</td>
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### List Of Preferred Makes

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#### HVAC WORK

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<td>THERMAL HEAT RECOVERY WHEEL</td>
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<td>AIR WASHER UNIT</td>
<td>ZECO / ROOTS / EDGETECH / WAVES / AMBASSADOR</td>
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#### B. PIPING & VALVES

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<td>CHILLY / GMGR</td>
</tr>
<tr>
<td>42</td>
<td>MCB, DBs</td>
<td>MDS / LEGRAND / INDO ASIAN (GOLDLINE) HEGER</td>
</tr>
<tr>
<td>S. No.</td>
<td>Item</td>
<td>Manufacturer's Name</td>
</tr>
<tr>
<td>-------</td>
<td>-------------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>3</td>
<td>MANUAL BALANCING VALVE</td>
<td>ADVANCE / CASTLE / C &amp; R</td>
</tr>
<tr>
<td>4</td>
<td>AUTOMATIC BALANCING VALVE</td>
<td>FLOCON / T &amp; A / DANFOSS / BELL &amp; GOSSETT</td>
</tr>
<tr>
<td>5</td>
<td>BALL VALVE</td>
<td>RAPID CONTROL / ZOOTO / GG / LEADER</td>
</tr>
<tr>
<td>6</td>
<td>GUN METAL GATE VALVE</td>
<td>LEADER / ZOOTO</td>
</tr>
<tr>
<td>7</td>
<td>POT / Y-STRAINER</td>
<td>RAPID COOL / DS ENGG / EMERALD / LEADER</td>
</tr>
<tr>
<td>8</td>
<td>NON RETURN VALVE</td>
<td>ADVANCE / CASTLE / C &amp; R / AUDCO</td>
</tr>
<tr>
<td>9</td>
<td>BINDER’S TEST POINT</td>
<td>ANERGY OR EQUIVALENT</td>
</tr>
<tr>
<td>10</td>
<td>PRESSURE GAUGE</td>
<td>H-GURU / FEIBIG / JAPSIN</td>
</tr>
<tr>
<td>11</td>
<td>V-GROOVE THERMOMETER</td>
<td>H-GURU / EMERALD / JAPSIN</td>
</tr>
<tr>
<td>12</td>
<td>DIAL TYPE THERMOMETER</td>
<td>H-GURU / EMERALD / TAYLOR / STAR SCIENTIFIC</td>
</tr>
<tr>
<td>13</td>
<td>MODULATING / CONTROL VALVES</td>
<td>HONEYWELL / DANFOSS / SIEMENS / B &amp; G</td>
</tr>
<tr>
<td>14</td>
<td>AUTO AIR VENT</td>
<td>RAPID CONTROL / ANERGY</td>
</tr>
</tbody>
</table>

**C. DUCTS, GRILLS, DIFFUSERS & DAMPERS:**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Item</th>
<th>Manufacturer's Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GSS FOR SITE FABRICATED DUCT</td>
<td>SAIL / TATA / NIPPON / BHUSHAN</td>
</tr>
<tr>
<td>2</td>
<td>FIRE / SMOKE DAMPER</td>
<td>CARYAIRE / MAPRO / RAVISTAR</td>
</tr>
<tr>
<td>3</td>
<td>GRILLE, DIFFUSER &amp; DAMPERS</td>
<td>RAVISTAR / CARYAIRE / DYNACRAFT / MAPRO</td>
</tr>
<tr>
<td>4</td>
<td>SOUND ATTENUATORS</td>
<td>RAVISTAR / CARYAIRE / KRUGER / MAPRO</td>
</tr>
<tr>
<td>5</td>
<td>ANCHOR FASTENERS</td>
<td>HILTI / FISCHER</td>
</tr>
</tbody>
</table>

**D. INSULATION**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Item</th>
<th>Manufacturer's Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GLASS WOOL, FIBER GLASS</td>
<td>UP TWIGA / OWENS CORNING / KIMMCO</td>
</tr>
<tr>
<td>2</td>
<td>FRP TISSUE</td>
<td>UP TWIGA OR EQUIVALENT</td>
</tr>
<tr>
<td>3</td>
<td>EXPANDED POLYSTYRENE</td>
<td>BEARDSSELL / PR PACKAGING / CAPRICON</td>
</tr>
<tr>
<td>4</td>
<td>CLOSED CELL RUBBER INSULATION</td>
<td>ARMAFLEX / AEROFLEX / SUPERLON</td>
</tr>
<tr>
<td>5</td>
<td>PUF PIPE SUPPORT</td>
<td>MALLANPUR TECH / BEST PLASTRONICS / LLOYD</td>
</tr>
<tr>
<td>6</td>
<td>CPRX COMPOUND</td>
<td>SHALIMAR / ASIAN</td>
</tr>
<tr>
<td>7</td>
<td>PROTECTIVE COATING OVER INSULATION</td>
<td>PARAMOUNT POLYTREAT</td>
</tr>
</tbody>
</table>

**E. ELECTRICAL ITEMS**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Item</th>
<th>Manufacturer's Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ELECTRICAL MOTORS</td>
<td>SIEMENS / ABB / CROMPTON</td>
</tr>
<tr>
<td>2</td>
<td>LED LIGHT</td>
<td>ARTLITE / COLOUR DESIGN / FIBRE LITE / THORN</td>
</tr>
<tr>
<td>3</td>
<td>FUSES &amp; SWITCH FUSE UNIT</td>
<td>SIEMENS/ ABB/ SCHNEIDER / GE / L &amp; T</td>
</tr>
<tr>
<td>4</td>
<td>ACB / MCCB / CONTACTER</td>
<td>SIEMENS / ABB / SCHNEIDER / GE / L &amp; T</td>
</tr>
<tr>
<td>5</td>
<td>METAL CLAD SOCKET</td>
<td>MDS / NEPTUNE (BALS) / BCH</td>
</tr>
<tr>
<td>6</td>
<td>ISOLATORS FOR MOTORS</td>
<td>MDS / SIEMENS / L &amp; T</td>
</tr>
<tr>
<td>7</td>
<td>CHANGE OVER SWITCH</td>
<td>HH-ELCON / HPL SOCOMAC / GE / HAVELLS</td>
</tr>
<tr>
<td>8</td>
<td>CONTACTOR, TIMER, SINGLE PHASE</td>
<td>SIEMENS / ABB / GE / L &amp; T</td>
</tr>
<tr>
<td>9</td>
<td>METERS - DIGITAL TYPE</td>
<td>CONSERVE / AE / L &amp; T / RISHAB</td>
</tr>
<tr>
<td>10</td>
<td>PROTECTIVE &amp; APFC RELAYS</td>
<td>SIEMENS / GE / L &amp; T / ASLTM</td>
</tr>
<tr>
<td>11</td>
<td>CT’s / PT’s - DRY TYPE-EPoxy</td>
<td>AE / KAPPA / PRAGATI</td>
</tr>
<tr>
<td>12</td>
<td>INDICATING LAMP / PUSH BUTTON</td>
<td>SIEMENS / L &amp; T / BCH / GE</td>
</tr>
<tr>
<td></td>
<td>ACTUATERS - LED CLUSTER TYPE</td>
<td></td>
</tr>
<tr>
<td>S. No.</td>
<td>Item</td>
<td>Manufacturer’s Name</td>
</tr>
<tr>
<td>-------</td>
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<td>---------------------------------------------------------</td>
</tr>
<tr>
<td>13</td>
<td>ROTARY SWITCHES</td>
<td>L &amp;T / BCH / GE / KAYCEE</td>
</tr>
<tr>
<td>14</td>
<td>TERMINAL BLOCK</td>
<td>ELEMEX / WAGO</td>
</tr>
<tr>
<td>15</td>
<td>LT ELECTRICAL PANEL BOARDS</td>
<td>TRICOLITE / ADLEC / ADVANCE / VIDHYUT / EAP</td>
</tr>
<tr>
<td>16</td>
<td>CABLE TRAYS</td>
<td>PROFAB / PILCO / SLOTCO / VENUS</td>
</tr>
<tr>
<td>17</td>
<td>PVC INSULATION TAPE</td>
<td>FINEOLEX / POLYCB / SKYTONE / HAVELLS / DELTON</td>
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<tr>
<td>18</td>
<td>PVC INSULATED COPPER CONDUCTOR</td>
<td>STEEL GRIP / ANCHOR</td>
</tr>
<tr>
<td>19</td>
<td>SINGLE PHASE EXHAUST FAN</td>
<td>CROMPTON / KHAIAN / GEC / POLAR / ALMONARD</td>
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<tr>
<td>20</td>
<td>LT POWER / CONTROL CABLES</td>
<td>FINEOLEX / POLYCB / SKYTONE / DELTON / GRANDLAY</td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F.</td>
<td>MISCELLANEOUS:</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>FINE FILTER, HEPA FILTER</td>
<td>DYNA FILTERS / THERMODYNE / ANFILCO / PUROMATIC / PUROLATOR</td>
</tr>
<tr>
<td>2</td>
<td>DUCT SILENCER</td>
<td>CARYAIRE / KRUGER</td>
</tr>
<tr>
<td>3</td>
<td>THERMOSTAT / HUMIDISTAT</td>
<td>HONEYWELL / SIEMENS / JOHNSON / RANCO</td>
</tr>
<tr>
<td>4</td>
<td>WATER FLOW SWITCH, AIRSTAT</td>
<td>RAPID CONTROL / ANERGY</td>
</tr>
<tr>
<td>5</td>
<td>VIBRATION ISOLATOR</td>
<td>RESISTOFLEX / EMERALD</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LIFT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>LIFTS</td>
<td>OTIS / KONE / SCHINDLER / MITSUBISHI</td>
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<tr>
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<tr>
<td></td>
<td>BUILDING MANAGEMENT SYSTEM</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>BUILDING MANAGEMENT SYSTEM</td>
<td>HONEYWELL WEBS / SIEMENS / CARRIER ALC</td>
</tr>
<tr>
<td>2</td>
<td>IMMERSION TEMPERATURE SENSOR</td>
<td>HONEYWELL WEBS / SIEMENS / GREY STONE</td>
</tr>
<tr>
<td>3</td>
<td>DUCT TEMPERATURE SENSOR</td>
<td>HONEYWELL WEBS / SIEMENS / KELE</td>
</tr>
<tr>
<td>4</td>
<td>OUTSIDE AIR TEMPERATURE SENSOR</td>
<td>HONEYWELL WEBS / SIEMENS / GREY STONE</td>
</tr>
<tr>
<td>5</td>
<td>WATER FLOW METER</td>
<td>HONEYWELL WEBS / SIEMENS / CARRIER ALC</td>
</tr>
<tr>
<td>6</td>
<td>WATER FLOW SWITCH</td>
<td>HONEYWELL WEBS / SIEMENS / CARRIER ALC</td>
</tr>
<tr>
<td>7</td>
<td>THERMOSTAT / HUMIDISTAT</td>
<td>HONEYWELL WEBS / SIEMENS / JOHNSON</td>
</tr>
<tr>
<td>8</td>
<td>WATER FLOW SWITCH, AIRSTAT</td>
<td>RAPID CONTROL / ANERGY</td>
</tr>
<tr>
<td>9</td>
<td>VIBRATION ISOLATOR</td>
<td>RESISTOFLEX / EMERALD</td>
</tr>
<tr>
<td>10</td>
<td>VOLTAGE / CURRENT TRANSUDER</td>
<td>ENERCON / CONZERV / ELECTREX / SETO</td>
</tr>
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<td>11</td>
<td>FREQUENCY TRANSUDER</td>
<td>ENERCON / CONZERV / ELECTREX / SETO</td>
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<td>12</td>
<td>PERSONAL COMPUTER</td>
<td>HP / COMPAQ / IBM</td>
</tr>
<tr>
<td>13</td>
<td>PRINTER</td>
<td>EPSON / HP</td>
</tr>
</tbody>
</table>

**Note:** Contractors are requested to take approval from Engineer-in-Charge before procurement from the list of Preferred makes. However, if the listed makes is not available in market or due to shortage of supply, contractor may propose the equivalent make for approval of the Engineer-in-Charge. The decision of Engineer-in-Charge will be final and binding on contractors in this regard.
SPECIFICATIONS FOR ELECTRICAL WORKS

1.0 GENERAL

To provide a complete electrical system for the distribution of electric power from the point of supply (SEB), D.G.s to the utilization equipment, all as shown in the drawings and described in these specifications. The quantities mentioned in BOQ are tentative. It will be the bidder’s responsibility to work out the exact quantities from drawings or from work site, which trade provides said equipments, materials, tools and labour.

2.0 SCOPE

The bidder shall supply, install and commission along with requisite spare, maintenance tools and tackles the following equipments and system in the Building. The scope also covers the detailed engineering and calculations of the various equipments/system mentioned hereunder and the same shall be approved by the Owner /Architect prior to execution of the job.

- 6.6 KV Single panel H.T. Switchboard.
- 6.6 KV 315 KVA Dry type indoor Transformers
- Medium voltage switchgear.
- Battery and battery charger.
- Earthing.
- Lightning protection system.
- Capacitor with control panels.
- Laying and termination of H.T. cables.
- Laying and termination of L.T. cables.
- Distribution Boards / Sub-Distribution Board.
- Complete internal building wiring as per specification.
- Safety to personnel and equipment during both operation and maintenance.
- Reliability of Service.
- Minimum fire risk.
- Case of maintenance and convenience of operation.
- Automatic protection of all electrical equipment through selective relaying system.
- Electrical supply to equipment and machinery within the design operating limits.
- Adequate provision for future expansion and modification.
- Maximum interchange ability of equipment.
- Fail-safe feature.
- Suitability for applicable environmental factors.

This specification defines the basic guidelines to develop a suitable electrical system as necessary for the Non residential campus. All data required in this regard shall be taken into consideration to develop a detailed engineering of the system. Site conditions as applicable are mentioned elsewhere.

Compliance with these specifications and/or approval of any of the Contractor’s documents shall in no case relieve the Contractor of his contractual obligations.

All work to be performed and supplies shall be affected as a part of contract requires specific approval/review of Owner or his authorised representative. Major activities requiring approval/review shall include but not be limited to the following:

- The engineering activities shall comprise the submission for approval of the following:
  - Basic engineering documents e.g. overall single line diagram, area classification drawing, overall cable layout, testing, type test report, guaranteed particulars of all equipments and maintenance manuals.
  - Quality assurance procedures.
  - Field testing and commissioning procedures.
  - Basic engineering calculations viz. load analysis; load flow, fault level calculations, and voltage drop calculations during motor start-up/re-acceleration etc.
  - Control and protection schemes.
Intermodal (IWT) Terminal

- Load sharing and annunciation scheme,
- Sizing calculation for cable trays/cable trenches.
- Area-wise illumination level calculation and preparation of power supply distribution drawing.
- Calculation for earthing system and lightning protection.

**Bidder shall be responsible for:**

- Detailed co-ordination with other services, shop drawings for various electrical layouts such as equipment layout, lighting layouts, cabling layouts, earthing and lightning protection layouts, including equipment installation and cable termination details etc. prior to start of work.
- Preparation of bill of materials for cabling, lighting, earthing and miscellaneous items etc.
- Cable schedule.
- Lighting/power panel schedule.
- Interconnection drawing.
- Protection co-ordination drawings/tables for complete power system.
- Shop inspection and testing procedures.
- Field testing and commissioning procedures.
- Preparation of as built drawings for all services.

**Bidder shall also be responsible for:**

- Any other work/activity which is not listed above however is necessary for completeness of electrical system.

**3.0 CODES & STANDARDS**

The design engineering manufacturing and the installation shall be in accordance with established codes, sound engineering, practices, and specifications and shall conform to the statutory regulations applicable in the country. Contractor shall obtain all approvals from statutory authorities’ e.g. Electrical inspector, pollution control boards, SEB as applicable before commissioning of electrical/DGs.

- Indian Electricity Act.
- Indian Electricity Rules.
- Factory Act.
- Pollution Act.

- **IS-732** : Code of practice for electrical wiring installation system voltage not exceeding 650V.
- **IS-3043** : Earthing.
- **IS-2309** : Code of practice for the protection of buildings and allied structure against Lightning
- **IS-7689** : Guide for control of undesirable static electricity.
- **IS-3716** : Insulation co-ordination application guide.
- **IS-8130** : Conductors for insulated electrical cables and flexible cords.
- **IS-5831** : PVC insulation and sheath of electric cables.
- **IS-3975** : Mild steel wire, strips & tapes for armouring cable.
- **IS-3961** : Current rating of cables
- **IS-694** : PVC insulated (heavy duty) electric cables for working. Voltage up to and including 1100 volts.
- **IS-424-1475 (F-3)** : Power cable flexibility test.
- **IEC-439/IS-7098** : Specification for cross linked polyethylene insulated PVC sheathed cable for working voltage up to 1.1 KV.
- **IS-1554** : PVC insulated cables up to 1100 volts.
- **IS-10810** : Test procedures for cables.
- **IS-6121** : Cable glands.
- **IS-10418** : Cable drums.
- **IEC-754(1)** : FRLS PVC insulated cable.
- **ASTM-D-2863** : Standard method for measuring minimum oxygen concentration to support candle-like combustion of plastic (oxygen index).
Intermodal (IWT) Terminal

ASTM-D-2843: Standard test method for measuring the density of smoke from burning or decomposition.
ASTM E-662/IEC 754(A):
Standard test method for specific optical density of smoke generated by solid materials.
IEEE-383: Standard for type test class-IE, electric cables, field splicers and connections for power generation station.
IS 13947/IEC 947: Air circuit breaker/moulded case circuit breaker.
IS-8623: Specification for factory built assemblies of switch gear and control gear for voltage upto and including 1000vac/1200vdc
IS 1018: Switchgear and control gear selection/installation and maintenance
IS-1248: Direct acting indicating analogue electrical measuring instruments and testing accessories.
IS-13779: Digital measuring instruments and testing accessories.
IS-3156: Voltage transformer.
IS-2705: Current transformer for metering and protection with classification burden and insulation.
-IS-2147: Degree of protection provided by enclosures for low voltage.
PART 1,11,111 Switchgear and control gear
IS-3427: Metal enclosed switchgear and controlgear
BS-162: Safety clearance
IS-3202: Code of practise for climate proofing of electrical equipment.
IS-375: Marking and arrangement for switchgear, busbars, main connections and auxiliary wiring.
IS-722: Ac electric meters
IS-3231: Electrical relays for power system protection.
IEC-255
IS-5082: Electrolytic copper/aluminium bus bars
IS-2834: Capacitors
IS-2713: Steel tubular pole
IS-335: Specification for insulating oil
IS-3837: Specifications for accessories for rigid steel conduit for electrical wiring.
IS-20268&335: Distribution transformer
(PART I,III)GI/STEEL/PVC conduit pipe for electrical wiring.
IS-2274: Code of practise for electrical wiring installation system voltages exceeding 650 volts.
IS-6665: Code of practise for industrial lighting
IS-3646: Interior insulation part 1&2
IS-1944: Code of practise for lighting of public through fares.
IS-7752: Guide for improvement of power factor consumers installation.
IS-13346: General requirement for electrical for explosive gas atmosphere.
IS-13408: Code of practise for the selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres
IS-12360: Voltage and frequency for ac transmission & distribution system.
IS-5572: Classification of hazardous area for electrical installations.
IS-5571: Guide for selection of electrical equipment for hazardous area.
IS-4201: Application guide for Current Transformer
IS-4416: Application guide for Voltage Transformer
IS-10028: Code of practise for installation and maintenance of transformer
IS-8478: Application guide for on load tap changer
IS-10561: Application guide for power transformer
IS-1646: Code of practise for fire safety of buildings electrical installation
IS-3034: Code of practise for fire safety of industrial building-electrical generating and distribution station
IP-30: National electrical code (NEC) BIS publication.
IS-4722: Rotating electrical machines.
IS-4889: Method of determination of efficiency of rotating electrical machines.
IS-325: Three phase induction motors.
IS-4729: Measurement and evaluation of vibration of rotating electrical machines.
IS-900: Installation and maintenance of induction motors.
IS-4029: Air break switches.
Intermodal (IWT) Terminal

IS-2208-9224 : HRC cartridge fuses.
IS-2959 : Contactors.
IS-9537 : Rigid steel conduit.
IS-1601/ BS-649 : Performance & testing of Internal Combustion (IC) engines for general purpose.
AIEE-606(1959) : Recommended specification for speed governing of I.C. engine generator units.
BS-5514/IS-3046 8528(Part-2): Reciprocating IC engine driven A.C. generators.
Any other standard may be followed provided it is equivalent or more stringent than the standards specified above.

In case of any deviation / conflict of this specification with the codes & standards, the following order of precedence shall govern.

a) Specification, particular specification if any, and drawings.
b) Indian regulations/codes and standards.

4.0 SITE CONDITIONS

i) Design ambient  50 Deg.C. maximum
                2 Deg. C. minimum

ii) Relative Humidity  85% maximum

iii) Site environment  Normal

5.0 DESIGN CRITERIA

5.01 Electrical Details of Incoming Supply

a) Supply Voltage  6.6 KV as per SEB approved.
b) Fault level (sym.) at supply of point (designed)  750 MVA (to be confirmed from State Electricity Board by Tenderer).
c) Neutral Earthing  Solid Earthing
d) Voltage Regulation  ± 10%
e) Frequency Regulations  ± 3%
f) Combined  ± 10%

5.02 L.T. Power Distribution System

a) Voltage  415 V / 240 V
b) Frequency  50 Hz
c) Neutral Earthing  Grounded
d) Short Circuit Fault withstand Capacity  10 KA - 45 KA (1 Sec.) as per B.O.Q. and specification.

5.03 Emergency Lighting (Battery Operated With Self Charger)
5.04 Control Supply for Electrical System

The various supply voltage to be used in the control panels for main equipments are:

a) Spring Charge Motor 230 Volt A/C
b) Closing/Trip Coil 24 V DC / 230 V AC
c) Alarm/Indication/Relay 24 V DC/230 V AC
d) Heaters 230 V AC

5.05 POWER SUPPLY LOAD
CONTROL/DISTRIBUTION PANEL. 433 V TPN / 240 V 1 phase A.C. (other supply if required shall be derived by package vendor).

5.06 PAINTING OF PANEL. Powder coating of approved shade.

5.07 PAINTING OF CABLE TRAY AND STRUCTURE STEEL. Powder coated of approved shade.

6.0 CABLE DETAILS

<table>
<thead>
<tr>
<th>6.01</th>
<th>INTERNAL WIRING.</th>
<th>Copper conductor PVC insulated 1.1 KV grade as called for in BOQ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.02</td>
<td>POWER CABLES (L.T.).</td>
<td>XLPE insulated Al. Armoured/ Unarmoured Cable as called for in BOQ.</td>
</tr>
<tr>
<td>6.03</td>
<td>POWER CABLES (H.T.) 6.6 KV.</td>
<td>Aluminium conductor XLPE insulated armoured cable.</td>
</tr>
<tr>
<td>6.04</td>
<td>GROUNDING CONDUCTOR.</td>
<td>Copper/G.I. strip as called for in BOQ.</td>
</tr>
<tr>
<td>6.05</td>
<td>LIGHTNING CONDUCTOR.</td>
<td>G.I. Strip.</td>
</tr>
</tbody>
</table>

7.0 ACCURACY CLASS OF METERS

a) Revenue Metres. Class-0.5 or as per SEB approved.
b) Ammeter Voltmeter and Other Instrument. Class – I Digital Analogue as called for in BOQ.
SPECIAL CONDITIONS

1.0 GENERAL

The design and workmanship shall be in accordance with the best engineering practices, to ensure satisfactory performance and service life. The requirement offered by the contractor shall be complete in all respects. Any materials or accessories which may not have been specifically mentioned, but which are usual and necessary for the satisfactory and trouble free operation and maintenance of the equipment shall be provided without any extra cost of the purchaser. This shall also include spares for commissioning of the equipment.

2.0 PRICES

The rates quoted by bidder shall include supply, installation, Octoroi all taxes, Excise duty & levies work contract tax, testing & commissioning charges. Laid, shall not be responsible for omission of any item party or fully by the bidder Quantity can be increased or decreased by any level.

3.0

The contractor shall obtain all sanctions (electrical loads, approval of drawing/ESS/D.G.’s estimator/approval of meter room etc. from the concerned authorities and permits required for the electrical installation work. All actual fee payable in this regard will be reimbursed against receipt/documentary evidence. On completion of work, the contractor shall obtain NOC from SEB & Director of Safety of the concerned state; a copy of the same shall be delivered to the Owner through consultant. Contractor shall be responsible for handing over to SEB (BSES) and other authorities shall be responsibility of contractor till commissioning and getting electricity in the complex.

The Owner shall have full power regarding the materials or work got tested by independent agency at the electrical contractor’s expenses in order to prove their soundness and adequacy. The contractor will rectify the defects/suggestions pointed out by independent agency through Owner at his own expenses.

The installation shall comply in all respects with the requirements of Indian Electricity Act 1910, Indian Electricity Rules (IER) 1956 and other related Laws and Regulations (for F.F. etc.) as amended up to date, thereunder and special requirements, if any, of the State Electricity Boards etc. The bidder is liable to furnish the list of authorized licensed persons/employed/deputed to carry out the works/perform the assigned duties to fulfill the requirement of Rule No.3 of IER 1956 as amended up to date.

4.0 DRAWINGS

i) The list of drawings along with these specifications is given in Annexure. These drawings are meant to give general idea to bidder regarding the nature of work covered by these specifications.

ii) Any information/data shown/not shown in these drawings shall not relieve the contractor of his responsibility to carry out the work as per the specifications. Additional information required by the bidder for successfully completing the work shall be obtained by him.

iii) Shop Drawings
The contractor shall prepare detailed coordinated electrical shop drawing indicating lighting/lighting fixtures, convenience outlets, D.G.’s, H.T., Transformer, M.V. Panel Boards/Relay Panel, PCC, DB’s, Rising Mains, Cable Schedule with other relevant services and submit to the Owner for approval or the Engineer-in-Charge before commencing the work. The shop drawings shall indicate all setting out details and physical dimensions of all components with wiring and cable details including system operating write up in the system i.e. 6.6 KV Panel Board, Control and Relay Panel Package Substation, D.G.’s, PCC’s, MCC’s, cable schedule and routes, manhole trap and fixing details as well as for conduit indicating run and size of wire/cables, outlet/pull/junction boxes etc. with fixing details etc. for the above mentioned work. All work shall be carried out on the approval of these drawings. However, approval of these drawings do not relieve the contractor of his responsibility for providing maintenance free and fool proof system including any missing component/accessories to meet with the intent of the specifications. Contractor will submit 2 prints for preliminary approval and finally six prints for distribution.

iv) Completion Drawings/As Built Drawings

On completion of the work and before issue of certificate of virtual completion, the contractor shall submit to the consultant 4 sets along with soft copy of ‘As Built’ drawings of the work along with 01 Nos. cloth tracing originals including write up (trouble shooting, installation, operation and maintenance manual with instructions) incorporating all such changes and modifications during engineering and execution along with warrantee & guarantee certificates from manufacturers.

These drawings must provide:

- Run and size of conduit, inspection and pull boxes including routing and locations.
- Number and size of conductor in each conduit.
- Locations and rating of sockets and switches controlling the light and power outlet.
- A complete wiring diagram as installed and schematic drawings showing all connections in the complete electrical system.
- Location of outlets of various services, junction boxes, light fixtures.
- Location of all earthing stations route and size of all earthing conductors.
- Layout and particulars of all cables.
- Location and details of PCC’s, MCC’s, Feeder Pillars, capacitor control panels, PLC D.G. set panel, UPS panel, and relay panels with description detailed control wiring diagram.
- Location of transformer and its details and control wiring diagram.
- Location of Hume pipe and manhole including HT/LT cable layout and scheduling.
- Location of D.G.’s, exhaust and auxiliary equipments with schematic drawings.
- Layout of cable trays with support and their fixing details.
- Location of all earthing station, route and size of all earthing conductor.
- Layout and particulars of rising mains with fixing details.

v) Position of HT/LT Switch Boards/Transformer & D.G.’S

The recommended position of the switch boards transformer & D.G.’s as shown on the layout drawings will be adhered to as far as practicable.
The contractor shall submit 2 sets of samples of each type of accessories and apparatus, proposed to be used in the installation at site for approval (drawings or samples) as required shall be submitted by contractor and the choice of selection out of the approved list lies with the Owner. For all non-specified items, approval of the Owner/Consultant shall be obtained prior to procurement of the same. Owner shall in no way be liable for rejection of the any material due to poor quality, poor workmanship, poor material etc.

5.0 MANUFACTURER'S INSTRUCTIONS

Where manufacturers have furnished specific instructions, relating to the material/equipments to be used on this job, covering points not specifically mentioned in this document, manufacturers’ instructions should be followed.

6.0 MATERIALS AND EQUIPMENTS

All the materials and equipments shall be of the approved make and design. Unless otherwise called for any approval by Owner’s Engineer-in-Charge, only the best quality materials and equipment shall be used.

The contractor shall fill in the data sheet for capital equipment as attached elsewhere in this document. The Tender shall be rejected due to not giving / filling in the details of the said equipment.

7.0 GENERAL DETAILS

7.01 Space Heaters & Lighting.

One of more adequately rated heaters thermostatically controlled with On-Off switch and fuse shall be provided to prevent condensation in any panel compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation. CFL lamp shall be provided in any panel compartment.

7.02 Fungistatic Varnish

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

7.03 Ventilation Opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

7.04 Degree of Protection

The enclosures of the Control Cabinets, Junction Boxes and Marshalling Boxes, Panels etc. to be installed shall provide degree of protection as called for in specification / BOQ whenever it is not mentioned it shall be as given below.

- Installed out door: IP-55.
- Installed indoor in air-conditioned area: IP-52.
- Installed in covered area: IP-52.
Intermodal (IWT) Terminal

- Installed indoor in non air-conditioned area where possibility of entry of water is limited: IP-42.
- For L.T. switchgear (AC and DC distribution boards): IP-52.

The degree of protection shall be in accordance with IS: 13947 (Part-I)/IEC-947 (Part-I).
Type test report for degree of protection test, on each type of the box shall be submitted for approval.

7.05 Rating Plates, Name Plates and Labels

Main PCC, PCC’s, MDB and auxiliaries items installed in the building are to permanently attach to it in a conspicuous position. A rating plate of non-corrosive material with engraved manufacturer’s name, year of manufacture, equipment name, type or serial number together with details of the loading conditions of equipment in question has been designed to operate and such diagram plates as may be required by the purchaser. The rating plate of each equipment shall be according to IEC requirement.

All such nameplates, instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

7.06 First Fill of Consumables, Oil and Lubricants

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, welding/soldering/brazing material for all copper/G.I. earthing and essential chemicals etc. which will be required to put the equipment/scheme covered under the scope of the specifications, into successful operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these specifications and documents.

8.0 DESIGN IMPROVEMENTS

The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply.

If for any reason, Contractor wishes to deviate from specification, prior permission from Owner will be sought.

If any such agreed upon change is such that if affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly in the specification.

9.0 QUALITY ASSURANCE PROGRAMME

To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor’s works or at his sub-contractor’s premises or at the Purchaser’s site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be outlined by the Contractor and shall be finally accepted by the Purchaser after discussions before the award of Contract. A quality assurance programme of the contractor shall generally cover the following:

- His organization structure for the management and implementation of the proposed quality assurance programme.
- Documentation control system.
- Qualification data for bidder’s key personnel.
- The procedure for purchases of materials, parts components and selection of sub-contractor’s services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
System for shop manufacturing and site erection controls including process controls and fabrication and assembly control.

Control of non-conforming items and system for corrective actions.

Inspection and test procedure both for manufacture and field activities.

Control of calibration and testing of measuring instruments and field activities.

System for indication and appraisal of inspection status.

System for quality audits.

System for authorizing release of manufactured product to the Purchaser.

System for maintenance of records.

System for handling storage and delivery.

A quality plan detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

The Purchaser or his duly authorized representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Contractor/ his Vendor’s quality management and control activities.

10.0 QUALITY ASSURANCE DOCUMENTS

The Contractor shall be required to submit the following Quality Assurance Documents within three weeks after dispatch of the equipment.

- All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication and reports including radiography interpretation reports.
- Welder and welding operator qualification certificates.
- Welder’s identification list, listing welders and welding operator’s qualification procedure and welding identification symbols.
- Raw material test reports on components as specified by the specification and/or agreed to in the quality plan.
- Stress relief time temperature charts/oil impregnation time temperature charts.
- Factory test results for testing required as per applicable codes/mutually agreed quality plan/standards referred in the technical specification.
- The quality plan with verification of various customer inspection points (CIP) as mutually and methods used to verify the inspection and testing points in the quality plan were performed satisfactorily.

11.0 INSPECTION, TESTING AND INSPECTION CERTIFICATE

The Purchaser and the Consultant or duly authorized representative shall have at all reasonable times free access to the Contractor’s premises or works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the works
during its manufacture or erection, if part of the works is being manufactured or assembled at
other premises or works, the Contractor shall obtain permission to inspect as if the works
were manufactured or assembled on the Contractor’s own premises or works. Inspection may
be made at any stage of manufacture, dispatch or at site at the option of the Purchaser and
the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to
be rejected.

- All equipment being supplied shall conform to type tests and shall be subject to routine tests
  in accordance with requirements stipulated under respective sections. Bidder shall submit
  the type tests reports for approval. The Contractor shall intimate the Owner/Consultant the
detailed programme about the tests at least three (3) weeks in advance in case of domestic
supplies. If for any item type test is pending payment would be made on successful
completion of type/routine test(s) actually carried out as per Consultant/Owner instructions.

- The Contractor shall give the Consultant/Owner thirty (30) days written notice of any material
  being ready for testing. Such tests shall be to the Contractor’s account. The
Consultant/Owner unless witnessing of the tests is virtually waived will attend such tests
within thirty (30) days of the date of which the equipment is notified as being ready for
test/inspection, failing which the Contractor may proceed with the test which shall be deemed
to have been made in the presence of Owner/Consultant and he shall forthwith forward to the
Consultant duly certified copies of tests in triplicate.

- The Consultant/Owner shall within fifteen (15) days from the date of inspection as defined
  shall inform in writing to the Contractor of any objection to any drawings and all or any
equipment and workmanship which in his opinion is not in accordance with the Contract. The
Contractor shall give due consideration to such objections and make the necessary
modifications accordingly.

- When the factory tests have been completed at the Contractor’s or Sub-contractor’s works,
the Consultant/Owner shall issue a certificate to this effect within fifteen (15) days after
completion of tests but if the tests are not witnessed by the Consultant/Owner, the certificate
shall be issued within fifteen (15) days of receipt of the Contractor’s Test certificate by the
Consultant/Owner. Failure of the issue such a certificate shall not prevent the Contractor from
proceeding with the works. The completion of these tests or the issue of the certificate shall
not bind the Purchaser to accept the equipment should, it, on further tests after erection, is
found not to comply with the Specification. The equipment shall be dispatched to site only
after approval of test reports and issuance of clearance by the Owner/Architect.

- The contractor shall arrange all necessary instruction and testing facilities free of cost for this
purpose including air travel, lodging and boarding expenses.

- For tests whether at the premises or at the works of the Contractor or of any Sub-Contractor,
the Contractor except where otherwise specified shall provide free of charge such items as
labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be
required by Owner/Consultant or this authorized representative to carry out effectively such
tests of the equipment in accordance with the Specification.

- The inspection by Owner/Consultant and issue of Inspection Certificate thereon shall in no
way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality
assurance programme forming a part of the Contract.

- The Consultant/Owner will have the right of having at his own expenses any other tests(s) of
reasonable nature carried out at Contractor’s premises or at site or in any other place in
addition of aforesaid type and routine tests to satisfy that the material comply with the
specifications.
The Owner/Consultant reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipments for these tests shall be provided by the Contractor.

12.0 TESTS

12.01 Charging

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Owner/Consultant and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The pre-commissioning tests to be performed as per relevant I.S. given and shall be included in the Contractor’s quality assurance programme.

12.02 Commissioning Tests

- The available instrumentation and control equipment will be used during such tests and the Contractor will calibrate all such measuring equipment and devices as far as practicable. However, unmeasurable parameters shall be taken into account in a reasonable manner by the Contractor for the requirement of these tests. The tests will be conducted at the specified load points and as near the specified cycle condition as practicable. The Contractor will apply proper corrections in calculation, to take into account conditions, which do not correspond to the specified conditions.

- All instruments, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.

- Pre-commissioning test shall be carried out as per relevant IS and/or as specified in the relevant clause.

- The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning of the equipment. However necessary fee shall be reimbursed by Owner on production of requisite documents.

13.0 PACKAGING

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of availability of Railway wagon/truck/trailer sizes in India should be taken account of the Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. Owner takes no responsibility of the availability of any special packaging/transporting arrangement.

14.0 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

15.0 FINISHING OF METAL SURFACES

15.01 General
All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts and bolts and spring washers shall be electro galvanized. All steel conductors used for earthing/grounding (above ground level) shall be galvanized according to IS:2629.

15.02 Hot Dip Galvanizing

- The minimum weight of the zinc coating shall be 700 gm/sq.m and minimum thickness of coating shall be 85 microns.
- The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.
- After galvanizing drilling or welding shall be performed on the galvanized parts of the earthing materials. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.
- The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.
- Sharp edges with radii less than 2.5mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.
  - Coating thickness,
  - Uniformity of zinc,
  - Adhesion test,
  - Mass of zinc coating.
- Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

15.03 Painting

- All sheet steel work shall be degreased, pickled, phosphate in accordance with the IS-6005 “Code of practice for phosphating iron and sheet”. All surfaces which will not be easily accessible after shop assembly shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.
  - After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, staving type zinc chromate primer. The first coat may be “flash dried” while the second coat shall be shoved.
  - Powder coating/electrostatic painting of approved shade shall be applied.
- The exterior color of the paint shall be as per shade no.697 of IS-5 or as approved by Architect and inside shall be white or as approved by Architect. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments, if required.
In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures like electrostatic painting etc. the procedure shall be submitted along with the Bids for Owner’s review and approval.

16.0 HANDLING, STORING AND INSTALLATION

In accordance with the specific installation instructions as shown on manufacturer’s drawings or as directed by the Purchaser or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented.

Contractor shall follow the unloading and transporting procedure at site, as well as storing, testing and commissioning of the various equipment being procured by him separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer’s Engineer(s) and shall extend full co-operation to them.

In case of any doubt/misunderstanding as to the correct interpretation of manufacturer’s drawings or instructions, necessary clarifications shall be obtained from the Owner/Consultant. Contractor shall be held responsible for any damage to the equipment consequent for not following manufacturer’s drawings/instructions correctly.

Where assemblies are supplied in more than the one section, Contractor shall make all necessary connections between sections. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.

The Contractor shall submit to the Owner every week, a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.

The Contractor shall be fully responsible for the equipment/material until the same is handed over to the Owner in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken over by Owner, as well as protection of the same against theft, element of nature, corrosion, damages etc.

The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment, which require indoor storage.

The words ‘erection’ and ‘installation’ used in the specification are synonymous.

Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

The minimum phase to earth, phase to phase and section clearance along with other technical parameters for the various voltage levels shall be maintained as per relevant IS.

17.0 PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.
18.0 DESIGN CO-ORDINATION
The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

19.0 DESIGN COORDINATION MEETING
The Contractor will be called upon to attend design co-ordination meetings with the Engineer, and the Consultants of the Owner during the period of Contract. The Contractor shall attend such meetings at his own cost at New Delhi or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during those discussions.

20.0 TOOLS AND TACKLES
The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipments.
SPECIFICATIONS FOR ELECTRIFICATION

1. **6.6 KV H.T. SWITCHBOARD**

This specification covers the ‘General Requirements’ for the design, manufacture, supply performance, inspection, testing and commissioning including supply of indoor type high voltage switch boards upto 6.6 KV including necessary termination, cabling, bus work required for satisfactory operation.

Specific requirements shall be in accordance with single line diagram/specification/data sheet. In case of conflicting requirement between the Technical Data and General Specification the former shall prevail.

The technical parameters of switchgear equipments, transformers etc. shall be submitted by the Contractor for approval by the consultant/ client.

This specification shall cover both 6.6 KV and Single Panel as well as 3 Panel Board.

**STANDARDS**

All equipment, material and components shall comply with the requirements of the latest editions of Indian Standards with updated amendments. Standards and Regulations applicable in the area where equipment is to be installed shall also be followed.

The equipment offered complying with other standards, these standards shall be equal to or superior to those specified and full details of the differences shall be furnished along with the tender.

Some of the relevant Indian and British Standards are listed below:
- IS 13947 - A.C. Circuit Breakers (Relevant Parts/SCC)
- IS 13941 - High voltage Circuit Breaker (Relevant Parts/SCC)
- IS 13118 - Gas insulated Switchgear
- IS 3427 - Metal enclosed Switchgear & Control Gear
- BS 162 - Safety Clearances
- IS 2705 - Current Transformers (Parts 1 to 4)
- IS 3156 - Voltage Transformers (Parts 1 to 4)
- IS 3202 - Code of Practice for climate proofing of electrical equipment
- IS 375 - Marking & Arrangement for Switchgear Bus Bars, main connections and auxiliary wiring.
- IS 722 - A.C. Electric Meters
- IS 1248 - Direct acting Electrical Indicating Instruments
- IS 3231 - Electrical Relays for Power System Protection
- IS 2544 - Epoxy Cast Resin Insulators
- IS 5082 - Electrolytic Copper and Aluminium
- IS 5792 - High Voltage HRC fuses
- IEC 60694 - High Voltage Switchgear
- IEC 60947 - High voltage Circuit Breaker
- IEC 60056 - Gas insulated Switchgear
- IEC 60298 - Metal Enclosed High Voltage Switchgear
DETAIL OF DESIGN

CONSTRUCTION

The switch boards shall be cubicle type, suitable for indoor/outdoor installation, floor mounting and free standing. The design shall be totally enclosed, dust-tight, dam proof and vermin proof offering degree of protection not less than IP-42 for Indoor Application & IP-54 for Outdoor application.

Separate segregated compartments shall be provided for circuit breakers, bus bars, cable box, voltage transformers, wire ways, relays, and instrument and control devices. Switchgear cubicles/modules shall be provided with hinged doors in front with facility for padlocking door handles.

Vent openings shall be covered with grills so arranged that hot gases cannot be discharged through them in a manner that can injure the operating personnel. These vent openings shall be vermin proof.

All the High Voltage compartments i.e. Circuit Breaker, Bus Bar, and Cable Compartments shall be separated from each other by metallic partitions in line with IEC-600298. These compartments must have pressure relief flaps for exit of gas due to internal arc to ensure operators safety. All the HV design must ensure conformity to IEC-600298 and must be Type tested for Internal Arc Test. The supplier shall submit Type Test report from CPRI or other independent agency to prove the above.

All panels shall be of same height, width and depth. Panels shall be bolted together to form a continuous flush front switch board, suitable for front of board operation.

The switchgear cubicles shall be rigid and robust in design and construction, fabricated out of CRCA sheet steel. Cubicles shall be made from rigid welded structural frames made of structural steel sections or of pressed/formed sheet steel of not less than 2mm thickness. The frames shall be enclosed by sheet steel of at least 2mm thickness, smoothly finished, leveled and free from flaws. Stiffeners shall be provided wherever necessary. Height of the operating handle, push button etc. shall be restricted between 300 mm to 2000 mm from the finish floor level. Fixing screws and nuts shall be used. Self-tapping screws shall not be used in the construction.

All doors, panels, removable covers shall be provided with non deteriorating (neoprene) gaskets all around the perimeter.

All doors shall be removable and supported by concealed type hinges. The hinges shall be strong and braced to ensure freedom from sagging, bending and general distortion of panel or hinged part.

Floor mounted cubicles with minimum 75 mm high channel and 5 mm thick channel base frame. Approx 200 mm-blank space between the floor of the switchboard and bottom most unit shall be provided. The total height of the cubicle shall not exceed 2400mm.

BUSBARS & BUSBAR CHAMBER

Three phase bus bars shall be of high conductivity electrolytic copper as stated in B.O.Q. The bus bars shall be air insulated and housed in a separate compartment, which segregated from all other compartments, in case of Vacuum Circuit Breaker. In case of Gas Insulated Circuit Breaker the Bus Bars shall be housed in separate SF6 gas filled stainless steel tank. Current density of Cu. Bus-Bar shall not exceed 1.5 Amps / mm².
Bus bars & bus bar connections shall be of uniform cross section shall be suitable for carrying rated current continuously and short circuit current for specified duration without overheating. The bus bars connections shall be adequately supported on insulators to withstand dynamic stresses due to short circuit current specified. Normal operating temperature for bus bars shall be 85 Deg. C. Short circuit rating of the bus bars shall be 35 KA for 1 sec.

All bus bar joints and bus tap joints shall be silver or tin plated. Joints shall be bolted type and shall be insulated. Spring/Lock washers shall be provided to ensure good contact the joints.

Direct access to accidental contact with bus bars and primary connections shall be avoided by providing shrouds. All apertures and slots shall be protected by barriers to prevent accidental shorting of bus bars. To provide a tight seal between cubicles, bushings or insulating panels shall be provided for bus bars crossing from one cubicle into another.

All insulating materials used shall be non-hygroscopic and shall be treated for preventing fungus growth. Surface of insulators shall be highly glazed and treated with silicone compounds to minimize accumulation of dust, condensation and tracking.

CIRCUIT BREAKERS

The circuit breakers shall be Triple Pole double break type and the Insulation and Arc interruption medium shall be either Vacuum or SF6 gas medium. The Breaker shall be enclosed in a sealed Vacuum Tank or SF6 gas filled Stainless Tank. A pressure relief device along with Manometer shall be provided with the Tank in case of SF6 CB to release and monitor any excessive pressure and for testing purpose.

The circuit breakers shall be of horizontal draw out construction with horizontal/vertical isolation. The circuit breaker including its operating mechanism shall be mounted on a wheeled carriage moving on guides, designed to align correctly and allow easy movement on the circuit breaker. There shall be three discrete positions viz. Service, Test and Isolated. Locking facility in all three positions shall be available. Position indicator shall be provided on the panel to indicate the position of the circuit breaker. Test position shall offer testing of circuit breaker operation/interlocks without energizing the power circuit.

Circuit breakers shall have stored energy spring mechanism charged by manually operated handle as well as electrically operated mechanism. The closing mechanism of the circuit breakers shall be Motor operated, spring charged with a provision for manual charging.

The operating mechanism shall be mechanically and electrically trip free and non-pumping. Anti-pumping feature may be built in or separate anti-pumping relay may be provided. In case spring charged mechanism, spring charged indication shall be provided.

Local manual trip device shall be provided on the operating mechanism. The trip device shall be suitable for front operation and positive mechanical ‘ON-OFF’ indication shall be provided.

Main contacts of circuit breaker shall have ample area and adequate contact pressure to carry the rated and short time current without excessive temperature rise. The contacts shall be adjustable for wear and easily replaceable. Main contacts shall open before and close after the arcing contacts when these are provided. Arcing contacts shall be easily accessible for inspection and replacement in case of VCB.

Each breaker shall normally be provided with auxiliary contacts of 6 NO+6NC directly operated from breaker operating mechanism. These contacts shall be in addition to these used in circuit breaker internal wiring. These contacts shall be rated for 10 Amps at 240V AC and 20 Amp (inductive breaking) at 220V D.C. If more breaker auxiliary contacts are required latching relay shall be used to multiply the contacts.

Shunt trip coil as called for shall be provided for tripping the circuit breaker. The trip coil/s shall operate satisfactorily between 50% - 110% of rated control voltage. Wattage of trip coils
will be sufficiently high to prevent it from picking up or holding on with specified number of trip circuit supervisory indicating lamps wired in series.

It shall be possible to trip the breaker, in case of failure of control supply

Circuit breaker type duty and rating shall be submitted in Data Sheet by the Contractor.

Circuit breakers of similar rating shall be interchangeable.

**CURRENT TRANSFORMERS**

Current transformers shall be of ratio, burden (shall be worked out by panel supplier), class/accuracy as specified in Single Line Diagram/BOQ.

Current transformers shall conform to latest edition to relevant standards. Current transformers shall be epoxy resin cast with bar Primary or ring type.

CT core laminations shall be of high grade silicon steel. The design and construction shall be sufficiently robust to withstand thermal and dynamic stresses due to the maximum short circuit current of the circuit.

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

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

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

Current transformers (core) shall be used for metering and protection. Each CT shall be provided with rating plate indicating: Name and Make, Serial number, Transformer Ratio, Rated burden, Rated voltage and Accuracy class.

**POTENTIAL TRANSFORMERS**

Potential Transformers shall conform to latest edition of “IS-3156 (Part I, II & III) as applicable relevant standards.

Potential transformers shall be dry, cast epoxy resin type. The PTs shall be of single phase construction.

The PT shall be capable of operating continuously at 110% of the rated voltage without any damage. When star - star connection is required in non-effectively or ungrounded system, the PTs shall be suitable for continuous operation with a persistent phase to ground fault.

Maximum temperature rise of the transformer at rated burden and with rated primary voltage and frequency shall not exceed 40 Deg.C above an ambient of 45 Deg.C.

The PT’s shall be fixed at rear bottom / top of the panel as called for. An interlock or automatic shutters shall be provided to prevent access to live HV parts when PT is withdrawn.

HRC Fuses shall be provided both primary & secondary side. It shall be possible to replace PT fuses easily without having to de-energize the main bus bars. Prospective interrupting current rating of the fuses shall be same as the system fault level.
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Voltage transformer ratio, output and class shall be as specified in the BOQ and shall be stated in data sheet by the Vendor/Contractor. Nameplate as per relevant standards shall be provided on the PT.

PROTECTIVE RELAYS

Relays type and numbers shall be in accordance with the protective scheme required or as per drawings and B.O.Q.

Relays shall be digital microprocessor based or analogue type, as called for in BoQ. It shall be enclosed in rectangular shaped cases, suitable for flush mounting only, dust tight covers projecting from the front cover panel. The case shall be dust tight, damp proof and tropicalised. The relays shall be either self-powered or a 24V DC Power-pack of suitable capacity with charging device shall be provided within the HT panel.

Relays shall be accessible for setting from the front. Access to setting devices shall be possible only after removal of front cover.

Protective relays shall be drawing out type. Where it is not possible to provide protective relays of the drawout pattern, fixed type relays with facilities for plugging in a portable test plug shall be provided. Necessary test plugs shall be furnished along with the relays.

Relays shall be provided with positive action self reset type with indicator. The indicator/s shall be visible from the front.

Relays conform to relevant standards in all respects. Relays shall be provided with minimum two pairs of self or hand reset type contacts as specified. Auxiliary relays shall have the number of NO and NC contacts as required and shall be in data sheet by the Vendor / Contractor.

SAFETY/PROTECTION INTERLOCKS/FEATURES

Following interlocks and features shall be incorporated for equipment protection and personnel safety under mal-operation. No deviations on these interlocks and safety features are allowed. These interlocks and safety features shall be fail-safe, positive and full-proof.

a) It shall not be possible to plug-in or isolate a closed circuit breaker. An attempt to do so shall trip the breaker. (In case of breakers with vertical isolation, this will apply to raising and lowering). There shall be a positive locking facility to prevent closing of circuit unless it is in Service or Test position.

b) Closing and opening operations shall be possible only in discrete, well defined Test and Service positions and not in any position midway. An extension adapter cable with plugs and sockets shall be preferably be provided so that the closing and opening operation of the circuit breaker can be done in fully withdrawn position outside the cable.

c) Slow operation of circuit breakers shall be possible only in the circuit breaker in Test or Isolated position.

d) Isolating switches if provided shall be interlocked with respective circuit breakers to prevent them making or breaking the current.

e) 1 no. bus earthing truck shall be supplied with each panel to earth the outgoing cable of the VCB.

f) Automatic safety shutters for all openings which will lead to access to the live parts of the switchgear upon withdrawal or any operation the switchgear components/parts shall be provided, preferably with a padlocking facility.
Intermodal (IWT) Terminal

g) Spring of motor operated spring charged mechanism shall not discharge until they are fully charged and charging means are fully disconnected.

h) Where key interlocking is employed, tripping of a closed circuit breaker shall not occur if any attempt is made to remove the trapped key from the mechanism.

i) Annunciation window shall be provided for winding temperature trip / alarm as required.

j) Any other interlocks which manufacturer may deem to be required for safety and specifically specified separately required for the system shall be included.

k) All terminals, connections which may be live and exposed for accidental contact shall be adequately shrouded.

l) Components within cubicles shall be properly labelled to facilitate testing.

EARTHING

The switch board shall be provided at the bottom throughout its entire length with a earth bus of copper of adequate size to carry the fault current for the duration same as short time rating of the circuit breaker. Earth bus shall have two earthing connection facility at its both ends of earthing conductor.

All non-current carrying metal parts, frames and equipment mounted in the switchboard shall be bonded to earth bus.

Earthing of moving carriage of drawout equipment shall be achieved by scraping earthing device. The earthing device shall maintain positive earth continuity in all Service Test and Isolated positions.

It shall be possible to connect each circuit or set of three phase bus bars to earth either through earthing trucks or through the circuit breakers.

One earthing trolley suitable for earthing of cables or bus bars and common for all circuit breakers of the same type/rating shall be provided.

INSTRUMENT & METERS

Electrical indicating instruments shall be digital type with zero adjustment, probe from outside the cover.

Multi function meter of CL 1.0 accuracy with RS 485 port shall be provided.

Instruments/meters shall be suitable for flush mounting on the panel with flanges protecting outside the panel.

All meters shall be industrial grade with accuracy of class 1.0 unless specifically indicated.

CONTROL WIRING

All wiring for control, protection, alarm, indicating circuits and remote tripping mechanism on all equipment shall be carried out with at least 650V grade, PVC insulated, stranded, copper, 2.5 Sq.mm conductors.

All wiring shall be run on the sides of the panels and shall be neatly bunched and cleated without affecting access to equipment mounted in the panel. Where wiring enters or passes through compartments containing HT apparatus then they shall be in earthed metallic conduits or ducts.

All wiring shall be taken to terminal blocks without joints or tees in their run.
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All wiring shall be colour coded as follows:

<table>
<thead>
<tr>
<th>Circuit Type</th>
<th>Colour Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instrument Transformer AC circuit</td>
<td>Red, Yellow &amp; Blue determined by the phase with which the wire is associated.</td>
</tr>
<tr>
<td>AC Phase Wire</td>
<td>White</td>
</tr>
<tr>
<td>AC Neutral</td>
<td>Black</td>
</tr>
<tr>
<td>DC Circuits</td>
<td>Grey</td>
</tr>
<tr>
<td>Earth connections</td>
<td>Green</td>
</tr>
</tbody>
</table>

Engraved core identification ferrules, marked to correspond with the wiring diagram shall be fitted to each wire. Ferrules shall fit tightly on the wires, without falling off when wire is removed. Ferrules shall be of white colour with black lettering. Each wire shall be identified by letter to denote its function followed by a number to denote its identity at both ends.

All wiring for external connections shall be brought out to individual terminals on a readily accessible terminal block.

All unused auxiliary contacts of the circuit breaker and relays shall be wired upto terminal block.

FITTINGS AND ACCESSORIES

Indicating Lamps:

Neon type indicating lamps or LED indicators shall be provided everywhere except where low voltage filament type with series resistor called for.

Lamp covers shall be provided with interchangeable colored lenses of Perspex or equivalent unbreakable material. The lenses shall not discolor in course of time due to heat of the lamp.

Bulbs and lenses shall be interchangeable and replaceable from the front.

Following colors shall be used for the function indicated:

- Red: Circuit Breaker ‘ON’
- Green: Circuit Breaker ‘OFF’
- White: Continuous trip supply supervision
- Amber: Auto trip
- Blue: Spring charged
- R.Y.B: Potential indication
- Green: Earth

Push Buttons:

All push buttons shall be push to actuate the contact type.

Start & Stop push buttons shall be colored green and red respectively. Reset push buttons shall be yellow in color and test push buttons shall be blue in color. All other push buttons shall be black in color.

Emergency stop push buttons shall be lockable in the operated position, i.e. push to operate and key to release type. Push buttons for emergency stop shall be recessed/shrouded type to avoid accidental operation.

Control & Selector Switches:

Control and Selector switches shall be of rotary type, having enclosed contacts accessible only after removal of cover.

All control and selector switches for circuit breakers and instruments shall be mounted on the front of the panel. Control switches for space heater/s and control supplies shall be mounted inside the panel.
Circuit Breaker control switches shall be provided with pistol grip handles. Selector switches shall be provided with round, knurled handles. All handles shall be black in colour. Properly designated escutcheon plates clearly marked to show the operating positions shall be provided on all switches.

All other instruments and selector switches shall have stay put contacts.

Circuit breaker control switches shall normally have three positions close - Normal - Trip with spring return to normal position. Switch operating mechanism shall prevent the switch from being operated twice successively in the same direction. Circuit breaker control switch shall have one NO-NC contact along with other contacts as required.

Contacts of all control and selector switches shall be rated for 10 Amps at 240V AC or 20 Amps at 220V dc (inductive break). Switch for space heater supply and control voltage supply shall normally be two pole rated for 25A A.C.

**Control Terminal Blocks:**

Box - clamp type, 650V grade line up terminals of minimum 2.5 Sq.mm size shall be provided. Connection to terminals shall be from front.

Not more than one wire on each side shall be connected on any terminal. Where duplication of terminals block/s is necessary, suitable solid bonding links shall be incorporated. Terminal blocks at different voltage shall be segregated into groups and distinctly labelled. Current transformer secondary leads shall be brought to terminal blocks having facility for short circuiting and grounding the secondary.

Terminals shall be numbered for identification and grouped according to function. Engraved back on white PVC labels shall be provided on the terminal blocks describing the function of the circuit.

Separate terminal stems shall be provided for internal and external wiring.

Control terminal blocks shall be so located that control cables are fully segregated from power cables. Suitable insulated or earthed metal race ways shall be provided for control wiring. Separate undrilled removable gland plate shall be provided for the control cables at the bottom of each panel.

Minimum 10% of total number spare terminals shall be provided for future use.

**NAME PLATES AND LABELS**

One Name plate giving designation of the HV switchboard shall be affixed prominently on top of the switch board. Details of designation will be specified.

Labels giving following details shall be affixed on each feeder panel:

i) Feeder Name.

ii) Equipment reference no. & Description

iii) Rating (KVA/Amp.)

All components whether mounted inside or on the door shall be permanently and clearly labelled with reference number/letter or their function. Rating of fuse shall be part of fuse designation. Paper labels, stickers or labels fixed with adhesives are not acceptable. All labels shall be properly fixed by screws with provision to prevent distortion due to expansion.

All labels shall be non-corroding, preferably laminated plastic or rear engraved perspex with white letters on black background.

Labels for feeder panel designation fixed on front side shall be fitted with chrome plate, self tapping, and counter sunk head screws. These labels shall be of identical size to permit interchange.
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SPACE HEATERS:
Adequately rated anti-condensation space heaters shall be provided in each cubicle.
Space heater/s shall be trip type, rated with operation voltage of 240V, 50 Hz. AC supply.
Each space heater shall be complete with a 2P MCB, 10KA and a control thermostat.
The space heater shall be rated for maintaining the panel inside temperature 10 Deg.C above outside ambient temperature.

CUBICLE LIGHTING:
Each cubicle shall be provided with interior lighting by means of CFL light fixture. An ON/OFF switch/door switch shall be provided. The lighting fixture shall be suitable for operation from a 240V single phase, 50 Hz. A.C. supply.

AUXILIARY SUPPLY:
Auxiliary supply for control, indication, space heater etc. shall be made available at one point on the switch board. Vendor shall provide suitable auxiliary supply in the switch board.

FUSES:
All fuses in control, indication and metering circuit shall be HRC link type of approved make. Mounting of fuse fitting shall ensure adequate dissipation of heat generated and shall facilitate inspection and easy replacement of fuse.

CABLE TERMINATION:
The switch board panel shall be provided with separate compartment for cable termination complete with suitable cable end termination for XLPE insulated cables suitable for bottom entry. Cable and sealing box shall preferably be mounted inside the panel. Cable compartment doors shall be self-locking type, interlocked and shall have Arc withstand capability due to short circuit. The compartment shall be provided with cable testing facility in case of gas insulated medium. For XLPE cables adequate space and clearances shall be made for heat/cold shrinkable termination e.g. Reychem or cold flowing stress grading joints.

Two earthing terminals shall be provided in each panel in cable box/cabling chamber for earthing armour/screen.

Where more than one core is terminated on each phase, links suitably designed and properly supported shall be provided to avoid unnecessary bending of cable cores without decreasing the length of insulated cable tail. Electrical clearances which would normally be required when using one core per phase shall be maintained.

Where core balance type current transformers are provided on switchgear feeder circuit cable/s for earth fault protection sufficient space, clearance and support, mounting arrangement shall be provided for the CT.

PAINTING:
All steel work shall be pretreated in tanks and finally powder coated of approved shade of the levels not less than 100 microns.

TESTING & INSPECTION
Four copies of all test certificates and certificates from sub-vendor shall be furnished. After completion of all work at the manufacturer’s works the switchboards shall be inspected and
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tested in presence of Purchaser’s/Consultant’s representative. However, stage inspection may be carried out from time to time to check progress of work and workmanship. The following tests shall be carried out:

i) All routine tests specified in relevant Indian/British Standards shall be carried out on all circuit breakers.

ii) Test for protective relay operation by secondary injection method.

iii) Operation of all meters.

iv) Secondary wiring continuity test

v) Insulation test with 1000 Volts megger, before and after voltage test.

vi) HV test on secondary wiring and components on which such test is permissible (2 KV for one minute)

vii) Simulating external circuits for remote operation of breaker, remote indicating lights and other remote operations, if any.

viii) Measurement of power required for closing/trip coil of the breaker.

ix) Pick up and drop out voltages for shunt trip and closing coils.

x) CT Polarity test.

xi) Power frequency voltage withstand test.

Vendor shall provide all facilities such as power supply, testing instruments and apparatus required for carrying out the tests. Required copies of test certificates for all the tests carried out along with copies of type test certificates and certificates from Sub-Vendor for the components procured from them are to be submitted before dispatch of switch boards.

DRAWINGS AND INFORMATION

The Vendor shall furnish following drawings/documents in accordance with enclosed requirements:

i) General Arrangement drawing of the Switchboard, showing front view, plan, foundation plan, floor cut-outs/trenches for external cables and elevations, transport sections and weights.

ii) Sectional drawings of the circuit breaker panels, showing general constructional features, mounting details of various devices, bus bars, current transformers, cable boxes, terminal boxes for control cables etc.

iii) Schematic and control wiring diagram for circuit breaker and protection including indicating devices, metering instruments, alarms, space heaters etc.

iv) Terminal plans showing terminal numbers, ferrules markings, device terminal numbers, function etc.

v) Relay wiring diagrams.

vi) Equipment List.

vii) Bus bar sizing calculations.
Vendor shall furnish required number of copies of above drawings for Purchaser’s review, fabrication of switch boards shall start only after Purchaser’s clearance for the same. After final review, required number of copies and reproducibles shall be furnished as final certified drawings.

The information furnished shall include the following:

i) Technical literature giving complete information of the equipment.

ii) Erection, Operation and Maintenance Manual complete with all relevant information, drawings and literature for auxiliary equipment and accessories, characteristics curves for relays etc.

iii) A comprehensive spare parts catalogue.

TOOLS

One complete set of all special or non-standard tools required for installation, operation and maintenance of the switchboard shall be provided. The manufacturer shall provide a list of such tools individually priced with his quotation.

SPARES

Contractor shall also quote separately for the maintenance spares for 2 years normal operation for owner to decide for placement of order at a later date. The quote shall remain valid at least for 6 months. The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

QUALITY ASSURANCE

Quality Assurance shall follow the requirements of Owner/ Consultant as applicable. Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser’s requirements.

DEVIATIONS

Clause wise deviation for the specification must be stated in writing at the quotation stage. In absence of such a statement, it will be assumed that the requirements of the specifications are met without exception.
SPECIFICATION OF 6.6 KV / 433V, 3 PHASE, 50 Hz DRY TYPE TRANSFORMER

1.0 SCOPE

Covers the detailed requirements regarding design, manufacturing and testing & commissioning of resin cast transformer required for sub-station.

2.0 CODES AND STANDARDS

Transformers shall comply with the latest editions of Indian Standards no. IS: 2026 Part-I to Part-V (Power Transformers) and IS-11171 (Dry Type Power Transformers). In case the provision of Indian Standards is not directly applicable to Dry Type Transformers, the provision of latest IEC – 726 and any other relevant IEC shall apply. Latest Standards as applicable shall be followed for Insulating Materials, Bushing, Installation and Maintenance of Transformers.

3.0 SERVICE CONDITIONS

Altitude : Less than 1000 meters
Maximum Ambient Temp. : 50° C
Minimum Ambient Temp. : 0° C
Installation : Highly corrosive, dusty, humid and tropical

4.0 RATING AND TYPE

The transformer shall have core type construction, 3 phases and shall be suitable for Indoor / Outdoor service under the climatic conditions prevailing at site. The transformer shall be capable of withstanding thermal and mechanical effects of Short circuit at terminals of any winding with full voltage maintained on other winding as per IS – 2026.

5.0 WINDINGS

The windings shall be manufactured from high quality electrolytic grade copper conductor and fully insulated for rated voltage by nomex-calendered paper. The high and low voltage windings shall be totally encapsulated and should be Cast under vacuum in moulds with fiber glass reinforced epoxy resin laminate. Both HV & LV windings of each phase shall be separately cast as a rigid tubular coil with no mechanical & electrical connection between their co-axial arrangements. The transformer shall be free of partial discharges at least up to 1.1 times the rated voltage.

The windings shall absorb no moisture under the worst tropical conditions.

6.0 CORE

The core shall be built up with high quality, non-ageing, low loss & high permeability CRGO (Cold reduce Grain Oriented) Silicon Steel Lamination of very high magnetic properties. CRGO sheet shall be coated with inorganic material like carlite or equivalent insulation to reduce eddy current to minimum. After shearing, the laminations shall be treated to remove all burrs and shall be annealed to remove all the residual stresses.

Core framework and clamps shall be arranged and tightened to securely hold laminations in order to prevent any settling or displacement in case of heavy shocks during transport, handling or short circuits. All the iron parts, except the core shall be galvanized and treated with high temperature resistant paint. Core fastening bolts shall be insulated to reduce losses and avoid hot spots. Transformer shall be designed to withstand 10% over fluxing corresponding to rated voltage.

Suitable lugs shall be provided for lifting the complete core & coil assembly of the transformer.

7.0 INSULATION
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Inter-turn and inter coil insulation shall be designed such that the dielectric stress is uniformly distributed throughout the windings under all operating conditions. The windings shall be provided with Class ‘H’ insulation or better.

8.0 TEMPERATURE RISE

The temperature rise of the windings shall not exceed 90°C by resistance on continuous full load above maximum ambient temperature of 50°C and in no case shall reach value that may damage the core itself or other adjacent parts.

9.0 PARALLEL OPERATION

The transformers shall be suitable to operate in parallel among themselves.

10.0 VECTOR GROUP

Transformer shall have vector group of Dyn 11.

11.0 IMPEDANCE

The desired impedance shall be as mentioned in the IS – 2026.

12.0 FLUX DENSITY

The maximum flux density at any point in the core and the winding shall not exceed 1.6 Tesla on the normal rated tap voltage & frequency.

13.0 CURRENT DENSITY

The maximum current density at any point in the winding shall not exceed 2.2 Amps per sq.mm. at the rated full voltage & frequency.

14.0 COOLING

The transformer shall be designed for natural cooling (AN).

15.0 ENCLOSURE

Transformers shall be provided with a sheet steel enclosure with adequate provision for ventilation. The degree of protection of enclosure shall be IP – 21 for indoor installations. The sheet steel thickness of enclosure shall be minimum 2 mm CRCA.

16.0 END TERMINATION

Cable box shall be provided on HV side suitable for 6.6 KV XLPE Cable & LV side suitable for termination of cables / bus trunking.

17.0 UNDER CARRIAGE
Transformers shall be supported on structural base equipped with bi-directional rollers suitable for moving the fully assembled transformers.

**18.0 ACCESSORIES**

The following fittings shall be provided on the Dry Type Transformers:

i) Rating & Terminal marking plate  
ii) 4 nos. bi-directional flat rollers  
iii) 2 nos. earthing terminals with lugs on the transformer base channel on diagonally opposite ends  
iv) Lifting arrangement  
v) Extra Neutral point  
vi) 1 no. PT-100 sensor in each LV windings wired upto the winding temperature indicator scanner. The instrument shall have two sets of adjustable contacts for alarm & trip. Instrument shall have scanner to read and show temperature of all the three phases sequentially.

**19.0 TESTS**

Transformers shall be subjected to routine and type tests as specified in IS: 2026, IS: 11171, IEC – 726 & given below:

**19.1 Routine Tests:**

All routine test shall be carried out as per IS / IEC at manufacturer work type test certificate shall be furnished by manufacture after award of work.
3. **L.T. PANELS & SWITCHGEARS**

Medium voltage switch boards/distribution boards, the combination of both these and components shall conform to the equipments of the latest revision including amendments of the following codes and standards.

The drawings, specification and BOQ compliment each other and which is shown or called for one shall be interpreted as being called for on both. Material, if any, which may not have been specified but fairly required to make a complete assembly of switch gear as shown on the drawing, specifications shall be construed as being required and no extra charges shall be payable on this account.

**CODES & STANDARDS**

The design, manufacture and performance of equipment shall comply with all the currently applicable statues, safety codes, relevant Bureau of Indian Standards (BIS), British Standards (B.S.), International Dutro Technical Commission (IEC) Publication, NEMA, IDE & DEMA standard as ammended upto date.

a) IS:13947-1993/IEC 60947-1989
   Air circuit breaker/moulded case circuit breaker.

b) IS:3156
   Voltage transformers.

c) IS:2705 Part-I, II & III 1964
   Current transformers for metering and protection with classification burden and insulation.

d) IS:9224
   Low voltage fuse and protection.

e) IS:3231
   Specification for electrical relays for power system protection.

f) IS:8623
   Specification for factory built assemblies of switchgear and control gear for voltage upto and including 1000-V AC/1200 V-DC.

g) IS:4237
   General requirements for switch gear and control gear for voltage not exceeding gear.

h) IS:2147
   Degree of protection provided by enclosures for low voltage switch gear and control gear.

i) IS:1018
   Switchgear and control gear selection/installation and maintenance.

j) IS:1248
   Direct acting electrical indicating instruments.

k) IS:375
   Arrangement for switchgear, bus bars, main connections, auxiliary wiring and marking.

l) IS:2959
   AC contactors for voltage not exceeding 1000V.

m) IS:5578
   Guide for marking of insulated conductors.

n) IS:11050
   Guide for forming system of marking and identification of conductors & apparatus terminal.

o) IS:1248
   Direct acting indicating analogue electrical measuring instruments and
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Testing accessories.

p) IS:600 Code of practice for phosphating of iron & steel.

The board shall be metal enclosed single front, indoor, floor mounted, free standing type or wall mounting type as mentioned in BOQ. The panel shall be designed for a degree of protection of IP-55. However bus bar chamber shall have IP: 42 degree of protection incase bus bar rating exceed 1600 Amps. Keeping in view the operating height of the top switch 1750mm from finish floor. 400mm clear space shall be left throughout the panel at bottom. The cold rolled sheet steel will be of 2mm thick. The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 3mm thickness and 50mm height.

All cutouts and covers shall be provided with synthetic rubber gaskets (preferably neoprene).

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

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

ii) Complete enclosed switchgear compartment one for each circuit for housing air circuit breaker, MCCB/MPCB with starters etc.

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

iv) The panel shall have sufficient space at least 20% of outgoing feeders for future use.

The front of each compartment shall be provided with hinged single leaf door with locking facilities. Panel shall be provided with suitable lifting facilities. Isolators and MCCB/ACBs and accessories shall be of fixed/drawout type as per BOQ.

Each feeder shall have compartmentalised or non-compartmentalised for MCB feeders only. Ri-tall type with separate construction cable entry shall be from top/bottom (3mm thick gland plate with suitable numbers & sizes of knockout holes (as called for in schematic/ fabrication drawings) shall be provided.

The panel shall be provided with three phase buses & neutral bus bars of high conductivity electrolytic copper/Aluminium sections throughout the length of the panel & shall be adequately supported and braced to withstand the stressed due to the short circuit current of 35 KA rms. for 1 sec. as called for in BOQ/Data Sheet. Maximum temperature rise of bus bars and bus bar connection while carrying rated current shall not exceed 40 Deg.C over an ambient temperature of 50 Deg.C. The Current density of Bus Bar shall be 1.0 Amp/mm² for Aluminium and 1.5 Sq.mm/mm² for copper.

The minimum clearance in air between phases and between phases and earth for the entire run of the bus bar connections shall be 32mm minimum. Bus bars support insulators shall be made of non-hydroscopic non-combustible track resistant and high strength SMC or polyester fibreglass moulded material.

All bus bars shall be colour coded as per IS: 375.

Copper /G.I./Aluminium earth bus of suitable size shall be provided at the bottom of the panel throughout the length. Similarly suitable size of strip in each vertical section for earthing the individual equipment/accessories shall be provided and connected to main horizontal bus.

Sheet steel hinged lockable doors shall be interlocked with MCCB to prevent opening of the panel when MCCB is on position. Safety interlock with operating handle shall be provided.

Contactors shall be electro magnetic type with interrupted duty as per IS: 2959. The main contacts shall be of silver or silver alloy, provided with minimum 2 NO and 2 NC auxiliary contacts. The push button should be of shrouded type and each should be provided with 1 NO and 1 NC contact. Colour coding shall be as per IS: 6875 (Part-II).
ACB (IEC 60947-2; IS 13947)

The circuit breaker shall be of air break type in order to eliminate fire and explosion risk and shall comply with the IEC with a rupturing capacity of not less than 35 MVA at 415 volts or as specified elsewhere (The service short circuit breaking capacity shall be as specified and equal to the short circuit with stand value lcs = lc). The breaker shall be provided with variable microprocessor based releases with in built fault differentiation for integral overload, short circuit and earth fault & other protection as called for in BOQ, LED indication for type of fault, CT’s for protection and measurement class as called for in BOQ, and LCD display of curves and parameters. Electrical endurance without maintenance shall be greater than 2000 cycles.

Mechanical & electrical anti pumping devices shall be provided in breaker, as required.

The breaker shall have memory for logging history for type of fault, load, time & date and the Vendor shall mention in the data sheet for no. of loggings available in the breaker memory.

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

Self-aligning cluster type isolating contacts shall be provided on breaker for interlocking protection metering and for any other purposes. The breaker should have 3 distinct positions - SERVICE/TEST/ISOLATED within the cubicle.

The ACB shall be with molded housing class II front fuse and shall be suitable for Isolation as per the annexure 7.1.2 in the standard.

Breaker shall be provided with automatic safety shutters to screen the main live contact when the breaker is withdrawn. The frame of the circuit breaker could be positively earthed when the breaker is racked into the cubicle.

The following safety arrangements shall be provided for the safety of the personnel to prevent mal-operation.

i) Interlock to prevent the truck from being withdrawn or replaced except in the fully isolated position.
ii) Interlock to prevent earth connection from being made by the earthing device except breaker is open.
iii) Interlock to prevent the breaker being closed unless it is fully raised.
iv) Interlock to prevent the breaker from being made alive without its rack in position.

Protection Releases

Self powered & true RMS sensing microprocessor based release with following features.

a) Incomer ACB of Panels:

Long time short circuit protection with time delay. Instantaneous and earth fault protection with LCD display to show RMS current in all three phases, neutral (for 4pole) simultaneously. The other features of the release to be as under.

- The release should display distinct fault indication for each type of tripping for faster fault diagnosis and reduce down time & should protect ACB from over temperature and Phase unbalance.
• Release should provide contact wear indication in display no. of operation seen by the breaker for case of maintenance.

• The release shall be self diagnosis & should provide fault history including cause of fault as well as level of fault current. It should be possible to store minimum 20 last trip data with nonvolatile memory.

• The protection setting of release should be accessible to change locally.

• LCD display should be at least 4 line display and should be able to display current is all the 3 phases and neutral (4 pole) simultaneously.

b) For Outgoing ACB feeder:

Long time Short circuit protection with time delay (for discrimination), instantaneous. The other features of the release to be as under.

The release should have distinct fault indication for each type of tripping for faster fault diagnosis and reduced down time and shall protect ACB from over temperature and phase unbalance.

• Operation counter
• Alarm and warning indication

Type test certificate : The ACB’s shall be type tested ad certified for coplion is to IS 13947-equivalent / EC standard from Indian / Internation testing authority, supplier to submit certificate of the same.

MOULDED CASE CIRCUIT BREAKER (MCCB)

MCCB shall confirm to the latest IS13947-1993/IEC 60947. The Service Short Circuit Breaking Capacity (Ics at 415 VAC) should be as specified.

MCCB shall be Current Limiting and comprise of Quick Make – Quick Break switching mechanism & Double Break Contact system. The arc extinguishing device and the tripping unit contained in a compact, high strength, heat resistant, flame retardant, insulating molded case with high withstand capability against thermal and mechanical stresses. All MCCBs shall be capable of defined variable overload short circuit and earth fault adjustment with thermomagnetic releases upto 250A and with electronic release above 250A onwards.

The Service Short Circuit Breaking Capacity (Ics at 415 VAC) should be as called for in BOQ and is the required minimum value for that feeders/ panel, however if the rating of feeder mentioned is not available, the contractor shall used next higher rating without any extra charges. The service short circuit breaking capacity shall be equal to ultimate breaking capacity of MCCB, i.e. lcs= 100%lcu

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

The handle position shall give positive indication of ‘ON’, ‘OFF’ or ‘Tripped’ thus qualifying to disconnection as per the IS/IEC indicating the true position of all the contacts. In case of 4 pole MCCB the neutral shall be defined and capable of offering protection upto full rating. The remote tripping coil should be of continuous duty. The general-purpose control switch shall be provided for ON/OFF Auto/Manual. The switch shall be provided with engraving plates on the front with the complete inscription.
The switch shall be normally a fixed control box type heavy-duty unit.

Indicating lamps shall be of the panel mounting, LED type and shall have execution plates marked with its function wherever necessary. The color of the lamp cover shall be red for ‘ON’ and green for ‘OFF’ indicating lamps shall be provided with series resistor. MCCB shall be provided with interlocking devise for interlocking the door of switchboard. Following shall be included if specified in the drawing or in the schedule of quantities:

- Under voltage trip
- Shunt trip
- Alarm Switch
- Auxiliary switch

**CONTACTORS**

The contactors should comply with the latest IEC947-4 and the corresponding IS13947-4 standards. They shall have UL and CSA approval. The contactors should be rated for AC3 duty at 415V and 50Hz. The contacts should be fast closing and fast opening type. The making and breaking capacity values of the contactors should be as follows (as per IEC947-4):

**For AC3 Duty**

- Making Capacity equal to or more than 10 Ie
- Breaking Capacity equal to or more than 8 Ie

**For AC4 Duty**

- Making Capacity equal to or more than 12 Ie
- Breaking Capacity equal to or more than 10 Ie

The contactors should be capable of frequent switching and should operate without derating at 600C for AC3 applications. They should be climate proof as standard. The coil of the contactor should have class H insulation to support frequent switching.

The rated voltage of the contactor shall be equal or superior at 690 V, and rated insulation voltage shall be 690 V. The rated impulse voltage of the contactor should be 8 KV.

The contactor should be modular in design with minimum inventory requirements and built in mechanically interlocked 1NO 1NC auxiliary contact up to 32A. They should be suitable for the addition of auxiliary contacts and other electrical auxiliaries without any compromise on the performance or the operation of the contactors. The contactors from 4 KW to 400 KW will be associated with the same auxiliary contact block range.

Wherever D.C control is required, the contactor should have wide range (0.7 to 1.25Uc) D.C coil with built in interference suppression as standard.

The control and power terminals should be at separate layers preferably with colour coding (black for power and white for control)

All contactors power connection will be finger safe (IP2X) as standard.

They should be capable of being integrated into automated system (PLCs etc.) without any interposing components in minimum operating conditions.

The thermal over load relay if used will be directly mounting under the contactor without any specific connections.
NAME PLATES & LABELS

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

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

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

PAINTING

All steel work shall be pretreated in tanks and finally powder coated of approved shade.

WIRING

Control and protective wiring shall be done with copper conductor PVC insulated 1100 volts grade multi-stranded flexible wire of 2.5sq.mm cross section. The colour coding shall be as per latest edition of IS: 375.

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

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

Not more than one wire shall be connected to any terminal block. All doorframe of L.T. switchboard shall be earthed with bare braided copper wire.

TESTING & INSPECTION

After completion of all work at the manufacturer’s works the switchboards shall be inspected and tested in presence of Purchaser’s representative. However, stage inspection may be carried out from time to time to check progress of work and workmanship. The following tests shall be carried out:

i) All routine tests specified in relevant Indian/British Standards shall be carried out on all circuit breakers.

ii) Test for protective relay operation by primary or secondary injection method.

iii) Operation of all meters.

iv) Secondary wiring continuity test.

v) Insulation test with 1000 Volts megger, before and after voltage test.

vi) HV test on secondary wiring and components on which such test is permissible (2 KV for one minute)

vii) Simulating external circuits for remote operation of breaker, remote indicating lights and other remote operations, if any.

viii) Measurement of power required for closing/trip coil of the breaker.
ix) Pick up and drop out voltages for shunt trip and closing coils.

x) CT Polarity test.

Vendor shall provide all facilities such as power supply, testing instruments and apparatus required for carrying out the tests. Required copies of test certificates for all the tests carried out along with copies of type test certificates and certificates from Sub-Vendor for the components procured from them are to be submitted before despatch of switchboards.

**DRAWINGS AND INFORMATION**

The Vendor shall furnish following drawings/documents in accordance with enclosed requirements:

i) General Arrangement drawing of the Switchboard, showing front view, plan, foundation plan, floor cutouts/trenches for external cables and elevations, transport sections and weights.

ii) Sectional drawings of the circuit breaker panels, showing general constructional features, mounting details of various devices, bus bars, current transformers, cable boxes, terminal boxes for control cables etc.

iii) Schematic and control wiring diagram for circuit breaker and protection including indicating devices, metering instruments, alarms, space heaters etc.

iv) Terminal plans showing terminal numbers, ferrules markings, device terminal numbers, function etc.

v) Relay wiring diagrams.

vi) Equipment List.

Vendor shall furnish required number of copies of above drawings for Purchaser’s review, fabrication of switchboards shall start only after Purchaser’s clearance for the same. After final review, required number of copies and reproducibles shall be furnished as final certified drawings.

The information furnished shall include the following:

i) Technical literature giving complete information of the equipment.

ii) Erection, Operation and Maintenance Manual complete with all relevant information, drawings and literature for auxiliary equipment and accessories, characteristics curves for relays etc.

iii) A comprehensive spare parts catalogue.

**TOOLS**

One complete set of all special or non-standard tools required for installation, operation and maintenance of the switchboard shall be provided. The manufacturer shall provide a list of such tools with his quotation.

**SPARES**

The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.
QUALITY ASSURANCE

Quality Assurance shall follow the requirements of Owner/ Consultant as applicable.

Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser’s requirements.

DEVIANSTIONS

Deviation from specification must be stated in writing at the quotation stage.

In absence of such a statement, it will be assumed that the requirements of the specifications are met without exception.

5. BATTERY & BATTERY CHARGER

1. SCOPE

The specifications give details of the Battery Charger suitable for HT/ LT Panels. The batteries are housed in the Bottom Compartment of the Battery Charger. Sealed maintenance Free Batteries upto 24V – 200AH or Lead Acid Batteries upto 24V – 150AH can be housed in the Battery Compartment. The Battery Charger is a composite Battery Charger cum DC Distribution Board.

2. GENERAL

The Battery Charger shall be Float cum Boost type, Thyristor controlled. The Charger shall have selector switch for Auto Float – Boost/Manual Float/Manual Boost Mode of operation. During Auto Float – Boost Mode, Automatic Changeover shall take place from Float Mode to Boost Mode and vice – versa. This means that when the Batteries are fully charged the charging shall automatically change from Boost charge to Trickle charge.

Construction Feature

Float cum Boost Charger and DC Distribution Board shall be housed in Sheet Steel Cubicle with Panels of 1.6mm thickness, louvers for ventilation, gland plate will be provided for cable entry from bottom. The cubicle shall be painted in Siemens Grey Shade. The Battery Charger shall be divided into two Compartments. The Upper Compartment shall house the Battery Charger & DCDB with all the necessary controls. The Lower Compartment shall be suitable for housing the Batteries.

PERFORMANCE

a. The D.C. Output Voltage of Float/Boost Charger shall be stabilized to within ± 2% for A.C. Input variation of 230V ± 10%, frequency variation of 50 Hz ± 5% and D.C. Load variation of 0 – 100%. The Voltage Regulation shall be achieved by a constant voltage regulator having fast response SCR controlled. The ripple content in output shall be within 3% of D.C. Output Nominal Voltage.

b. There shall be provision to select Auto Float/Manual Float /Manual Boost Modes. During Auto Float Mode the Battery Charging shall automatically changeover from Boost Mode to Float Mode and vice – versa. During Manual Float/Boost Modes it shall be possible to set the output volts by separate potentiometers.

c. The Battery Charger shall have automatic output Current Limiting feature.

COMPONENTS

The Battery Charger shall essentially comprise of the following:

a. 1 No. Double Pole ON/OFF MCB at A.C. Input.
b. 1 No. Pilot Lamp to indicate Charger ON.

c. 1 No. MAIN TRANSFORMER: Double Wound, naturally air – cooled, having Copper winding.

d. 1 Set Single Phase full wave Bridge Rectifier consisting of 2 nos. Diodes and 2 nos. SCR’s, liberally rated, mounted on Heat Sinks and complete with Resistor/Condenser network for surge suppression.

e. 1 No. Rotary Switch to select AUTO FLOAT/MANUAL FLOAT/MANUAL BOOST. During Auto Float Mode Automatic Changeover shall take place from Float Mode to Boost Mode and vice – versa.

f. 1 Set Solid state constant potential controller to stabilize the DC Output Voltage of the Float cum Boost Charger at ± 2% of the set value for AC Input Voltage variation of 230V ±10%, Frequency variation of ± 5% from 50Hz and simultaneous Load Variation of 0 - 100% and also complete with Current Limiting Circuit to drop the Float Charger Output Voltage upon overloads to enable the Battery to take over.

g. 1 No. Electronic Controller to automatically changeover Battery Charging from Boost to Float and vice – versa.

h. 1 No. DC Ammeter and Toggle Switch to read Charger Output Current and Battery Charge / discharge current.

i. 1 No. Moving Coil DC Voltmeter to read the DC Output Voltage.

j. 2 Set Potentiometer to adjust the output Voltage during Manual / Auto Float and Boost Modes.

k. 1 No. Double Pole ON/OFF MCB at Charger Output.

l. Dc Distribution Board :-

   | INCOMER | 1 No. 63A DP MCB, as called for in BOQ. |
   | OUTGOING | Suitable No. 16A/20A DP MCB, as called for in BOQ. |

**Alarm Annunciation**
Visual and Audible Alarm with Manual Accept/Reset Facility shall be provided for the following:

a) A.C. Mains Fail.

b) Charger Fail.

c) Load/Output overvolt.

**RATING**

- **A C INPUT** : 230V ±10% AC 50 Hz Single Phase
- **D C OUTPUT** : To Float/Boost charge 24V / 100AH Batteries and also supply a continuous load
- **CURRENT RATING** : 15.0 Amps
- **FLOAT MODE** : 27.0 V Nominal (Adj. between 24.0 – 28.0V)
- **BOOST MODE** : 28.0 V Nominal (Adj. between 24.0 – 30.0 V)
Voltage Regulation : ± 2% of the set value

RIPPLE : Less than 3%.

For 24V / 100 AH Batteries the Charger Rating is given in the Specification for Batteries of other capacities refer to the Table as given below:

<table>
<thead>
<tr>
<th>BATTERY CAPACITY</th>
<th>CHARGING RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>24V / 40AH</td>
<td>10.0 Amp.</td>
</tr>
<tr>
<td>24V / 60AH</td>
<td>15.0 Amp.</td>
</tr>
<tr>
<td>24V / 100AH</td>
<td>15.0 Amp.</td>
</tr>
<tr>
<td>24V / 120AH</td>
<td>20.0 Amp.</td>
</tr>
<tr>
<td>24V / 150AH</td>
<td>25.0 Amp.</td>
</tr>
<tr>
<td>24V / 200AH</td>
<td>30.0 Amp.</td>
</tr>
</tbody>
</table>

6. EARTHING

All electrical equipment is to be earthed by connecting two earth tapes from the frame of the equipment to a main earth ring. The earthing ring will be connected via several earth electrodes. The cable armour will be earthed through cable glands. Earthing shall be in conformity with provision of rules 32, 61, 62, 67 & 68 of Indian Electricity Rules 1956 and as per IS-3843-1966.

The following shall be earthed:

1. Transformer & D.G. Set neutrals.
2. Transformer Housing.
3. H.T. Panels.
4. Non-current carrying metallic parts of electrical equipment such as switchgear, bus ducts, rising mains, panel boards, motor control centres, power panels, distribution boards, cable trays, metal conduits, welding sockets etc.
5. Generator & motor frames.
6. All fixtures, sockets outlets, fans, switch boxes and junction boxes etc. shall be earthed with PVC insulated copper wire as specified in item of work. The earth wires ends shall be connected with solderless bottle type copper lugs.
7. The third pin of Outlets on UPS shall be provided with a separate PVC insulated Cu. Wire (green with yellow stripe) as Isolated ground earth wire apart from the earthing of box.

The earth connections shall be properly made. A small copper loop to bridge the top cover of the transformer and the tank shall be provided to avoid earth fault current passing through fastened bolts, when there is a lightning surge, high voltage surge or failure of bushings.

The shop drawing for earthing system shall be prepared by the contractor and be got approved by Owner/Architect. The work shall be done in accordance with approved drawings.

All earth electrodes shall be given to a depth sufficient to reach permanently moist soil. Their location shall be marked and approval taken from Engineer-in-Charge before excavation for the same.
The earth electrodes shall be tested for earth resistance by means of a standard earth test ohms meter. All tests shall take place during the dry months, preferably after a protected dry spell.

The resistance between earthing system and the general mass of earth shall not be greater than 1 ohm.
The earth loop resistance to any point in the electrical system shall not be in excess of 1 ohms in order to ensure satisfactory operation of protective devices.
The resistance to earth shall be measured at the following: -

a) At each electrical system ground or system neutral ground.
b) At one point on each grounding system used to ground electrical equipment enclosures.
c) At one point on each grounding system used to ground wiring system enclosures such as metal conduits and cable seaths or armoured.

All earthing conductors shall be of high conductivity copper/ G.I. as per B.O.Q. and shall protected against mechanical damage. The cross-sectional area of earth conductors shall not be smaller than half that of the largest current carrying conductor. However, the contractor shall use the sizes specified in the bill of quantities of the Tender.

**Pipe Earth Electrode**

G.I. pipe shall be of medium class and of the size and dia as specified in BOQ. G.I. Pipe electrode shall be cut tapered at bottom and provided with holes of 12mm dia drilled not less than 7.5cm from each other upto 2m of length from bottom. The electrode shall be buried in the ground vertically with its top not less than 20cm below ground level.

**Plate Earth Electrode**

The plate earth electrode shall consist of copper plate or G.I. plate as per item of work. The plate electrode shall be buried in ground with its faces vertical and top not less than 2.5m below Ground level. The plate shall be filled with charcoal dust and common salt filling, extending 15cm around it on all sides.

A watering pipe as specified in BOQ, of medium class G.I pipe shall be provided. The top of the pipe shall be provided with a funnel and a G.I. mesh screen for watering the earth. In the case of pipe electrode a removable plug shall be provided as per drawing. This will be housed in a masonry sump (with cement plastering) of not less than 40 cm square and 40 cm deep. A C.I. frame with hinged with cover of 10mm thickness and locking arrangement shall be suitably provided over the sump. The earthing lead from electrode onwards shall be suitably protected from mechanical injury by a suitable dia medium class PVC/ HDPE pipe. The overlapping in G.I. strips in joints shall be rivetted with revets and welded in approved manner. The protection pipe within ground shall be buried at least 30 cm deep (to be increased to 60cm in case of road crossing and pavements). The portion within the building shall be recessed in walls and floors to adequate depth. In the case of plate earth electrode, two nos. 50mm x 6mm GI/Cu. Strip the earthing lead shall be securely bolted to the plate with two zinc passivated bolts, nuts, checknuts and washers. In case of pipe electrode, it shall be connected by means of a through bolt, nuts and washers and cable socket. Main earthing conductor is taken from the earth electrode with which the connection is to be made.

No earth pit shall be fixed within 2.5M of a wall of foundation. The location of the earth electrode will be such where the soil has reasonable chance of remaining moist. Effort shall be made to locate them in grass lawns or near flowerbeds or water taps. The distance between two earthing stations shall be at least 3.0 meters.

**Testing and Commissioning**
Testing and commissioning shall be done as per the programme/instructions to be given by Owner’s authorised representative. All testing equipments necessary to carry out the tests shall be arranged by the electrical Contractor.

Before the electrical system is made live, the electrical Contractor shall carry out suitable tests to the satisfaction of Owner that all equipment wiring and connections have been correctly done and are in good working condition and will operate as intended.

All tests shall be conducted in the presence of the Owner authorised representative by the electrical Contractor and shall be notified one week before tests are to take place.

All measurements shall conform to establish minimum acceptable test values. Owner’s Engineer reserves the right to approve all test results before circuit or equipments are energised for the first time.

7. LIGHTNING PROTECTION SYSTEM

Protection of buildings against lightning shall generally be done in accordance with latest IS-Code. The installation shall be done as per routes and location of equipment indicated on the drawing and bill of quantities. The conductors and the earth electrode conductor shall be fixed so that they are free to expand and contract. Special care shall be taken in the fixing of support to allow free movement.

The materials of lightning conductors, down conductors, earth termination etc. shall be reliably resistant to corrosion or be adequately protected against corrosion. All air terminations shall be GI and the conductors shall be GI.

The entire lightning protection system should be mechanically strong to withstand the mechanical forces produced in case of a lightning strike. The system shall be installed such that it does not spoil the architectural or aesthetic beauty of the buildings but on other hand at should meet IS code/safety code.

Horizontal air terminations should be so interconnected that no part of the roof is more than 9 metres away from the nearest horizontal conductor. For a flat roof horizontal air termination along the outer perimeter of the roof is used. For a roof of larger area a network of parallel horizontal conductors shall be installed. Horizontal air terminations shall be laid along contours such as ridges, parapets and edges of flat roofs and where necessary area flat surfaces in such a way as to connect each air termination to the rest and shall, they form a closed network.

All metallic finials, chimneys, ducts, vent pipes, railings, gutters, metallic flag staff, on or above the main surface of the roof of the structure shall be bonded to and form part of the air termination network. All air terminations shall be effectively recessed against over turning either by attachment to the object to be protected or by means to substantial braces and fixing which shall be permanently and rigidly attached to the buildings.

Down conductors shall be distributed around the outside walls of the structure. They shall preferably be run along the corners and other projection, due considerations being given to the locations of air terminations and earth terminations. Lift shafts shall not be used for fixing down conductors. Metal pipes leading rainwater from the roof to the ground may be connected to the down conductors but cannot replace them. Such conductors shall have disconnecting joints. All vertical conductors shall be plumbed before fixing. Insulation shall be provided between down conductors and wall.

The lightning protective system shall have as few joints in it as possible. Wherever joints in the down conductor above ground level are necessary they shall be mechanically and electrically effective. The joint overlap shall not be less than the width of the tape. In the down conductor below ground level there shall be no joint. The joints may be clamped, screwed, bolted, revitted, sweated, braced or welded. The bonding of the external metal forming part of
a structural or drain water pipe shall have a cross sectional area not less than that employed for the main conductors. Gas pipe, however, in no case shall be bonded to the earth termination system.

Conductors shall be securely attached to the building to be protected by fasteners, which shall be substantial in construction, not subject to breakage and shall be of steel. The conductors shall be secured at not more than 900mm apart for horizontal run and 750mm for vertical run.

Where tape are required to pass through roof asphaltiting or other waterproofing membranes, a special seal shall be used comprising a 38mm diameter plastic, copper or aluminium tube with 100mm diameter flange 50mm from the top of the tube. The tube length shall suit the thickness of the roof through which the conductor passes, allowing for the tube to protrude 50mm above the membrane. The seal is to be asphalted in position and the conductor shall be sealed in the tube by a setting waterproof compartment.

Each down conductor shall have an independent earth termination. The interconnection of all the earth termination shall be preferable. It should be capable of isolation for testing purpose by “testing joints” at position approachable easily for the meggar testing. The whole of the system could have a combined resistance to earth not exceeding 2 ohm before any bonding has been affected to metal in or on structure or two surfaces below ground.

8. CAPACITORS & CAPACITOR CONTROL PANEL

Power factor correction capacitors shall conform in all respects to IS 2834-1964. The capacitors shall be suitable for 3 phases 415V at 50Hz. frequency and shall be available in units as per B.O.Q. to form a bank of capacitors of desired capacity. All these units shall be connected in parallel by means of high conductivity electrolytic copper busbars of adequate current carrying capacity having S.C rating of 25 KA for 1 sec. Each capacitor bank shall be for PVC insulated aluminium conductor armoured cables. Two separate earthing terminals shall be provided for each bank for earth connection. The capacitor bank shall be housed indoor.

The capacitor bank shall be subject to routine tests as specified in relevant Indian Standard and the test certificate shall be furnished. The capacitor shall be suitable for indoor use upto 45 Deg.C over and above ambient temperature of 50degree C. The permissible overloads shall be as given below:

a) Voltage overload shall be 10% for continuous operation and 15% for 6 hours in a 24 hours cycle.

b) Current overloads 15% for continuous operation and 50% for 6 hours in a 24 hours cycle.

c) Overload of 30% continuously and 45% for 6 hours in a 24 hours cycle.

The capacitor banks shall be floor mounting type indoor housing using minimum floor space with protective guard or fencing. The capacitor bank shall be provided with 7% Detuned reactor filter to compensate third harmonics from being generated.

Capacitors shall be of aluminium foil and craft paper. Hermetically sealed in sturdy corrosion-proof sheet steel 2mm thick containers and impregnated with non-inflammable synthetic liquid and of low power loss version. Every element of each capacitor unit shall be provided with its own built in silvered fuse. The capacitor shall have suitable discharge device to reduce the residual voltage from crest value of the rated voltage to 50 V or less within one minute after capacitor is disconnected from the source of supply. The loss factor of capacitor shall not exceed 0.005 for capacitors with synthetic impregnants. The capacitors shall withstand voltage of 2500V AC supply for 1 minute.

The insulation resistance between capacitor terminals and containers when test voltage of 500V A.C. is applied shall not be less than 50 megohms.
Intermodal (IWT) Terminal

- Capacitor bank and switching equipments shall be housed in a cubicle having degree of protection IP-51 and constructed with sheet steel of minimum 2mm thickness.
- Capacitors shall be unit type having non-PCB, non-flammable non-toxic dielectric.
- Necessary discharge resistor shall be provided externally to reduce the terminal voltage to or less then 50V in 60 seconds of disconnection from supply.
- Testing shall be done as per applicable standards for shunt capacitors.

**Capacitor Control Panel**

The capacitor control panel shall general comprise of the following:

a) Automatic power factor correction relay.
b) Step controller with reversing motor.
c) Time delay and no-volt relays.
d) Protection MCCB / MCB.
e) Contactor (AC-3 duty) for individual capacitors of suitable rating.
f) Change over switch for either automatic operation or manual operation with push button control.
g) C.T.s with ammeter and selector switch as asked for in BOQ.
h) Voltmeter with selector switch.
i) Indicating lights RYB.

All the capacitors and contactors shall be interconnected with PVC insulated copper conductor wires of adequate size in a neat and acceptable manner. Three phases and neutral bus bar shall be provided in panel as required.

The above control gear, P.F. meter, Digital Microprocessor based P.F. correction relay, push button station etc. shall be housed in a sheet steel metal enclosure cubical type, free standing front operated with lockable doors. The panel shall be fabricated from MS sheet steel 2mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet steel shall be seam-welded. The panel shall be totally enclosed design completely dust tight and vermin proof. Gaskets between all adjacent units and beneath all covers shall be used to render the joints effectively.

All sheet steel material used in the construction of capacitor control panel should have undergone a rigorous rust proofing process comprising Alkaline Degreasing, descaling in dilute sulphuric acid and recognised phosphating process. The steel work should then receive two coats of primer before applying final coat of epoxy paint of approved shade.

**Quality Assurance**

Quality Assurance shall follow the requirement of Client/ Consultant. Q.A. documents as applicable.

Q.A. involvement will commence at enquiry and follow through to composition and acceptable thus ensuring total conformity to purchaser’s requirement.

**Deviations**

Deviations from the specification must be stated in writing at the quotation stage.

In the absence of such a statement it will be assumed that the requirements of the specifications are met without exception.
SPARES

The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

9. H.T. CABLE (XLPE) (6.6 KV)

The cross-linked polyethylene (XLPE) cable shall be aluminium conductor PVC outer sheath steel strip armoured over inner sheath construction. XLPE cable shall conform to testing in accordance with IS: 7098 (Part-I) 1977 and (Part-II) 1973. The screening shall be done on individual cover. The armouring applied over the common covering shall be flat steel wires. Each and every length of cable shall be subjected to routine test.

The termination and jointing techniques for XLPE cables shall be by using heat shrinkable or push on cable jointing kits.

While laying underground cables in ducts care should be taken so that any underground structures such as water pipes, sewerage lines etc. are not damaged. Any telephone or other cable coming in the way shall be properly protected as per instructions of the Engineer-in-charge. The H.T. cable shall be laid at least 900mm for cable upto 3 KV (E) below the ground level in a trench 450mm wide.

Insulation tests shall be done before and after laying of cables.

After laying and jointing work is completed a high POT test shall be performed in presence of Engineer and test results submitted for approval in order to ensure that they have not been damaged during or after the laying operation. In case, the test results are unsatisfactory, the cost of all repairs and replacement and all extra work of removal and relaying will be made good by the contractor without any extra cost.

10. L.T. CABLES & WIRE

a) Wires

The design manufacture, testing and supply of single core FRLS PVC insulated 1.1 KV grade multi-stranded twisted wires under this specification shall comply with latest edition of following standards.

- IS : 3961 Current rating for cables.
- IS: 5831 PVC insulation and sheath of electric cables.
- IS : 694 PVC insulated cables for working voltage upto and including 1100 volts.
- IEC: 754(i) FRLS PVC insulated cable.

Copper multi-stranded twisted conductor FRLS PVC insulated wires shall be used in conduit as per item of work.

The wires shall be colour coded R Y B, for phases, Black for neutral and Green for earth.

Progressive automatic in line indelible, legible and sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of wire.

b) Cables

The design, manufacture, testing and supply of the cable under this specification shall comply with latest edition of following standards:
IS: 8130  Conductors for insulated electric cables and flexible cords.

IS: 7098 XLPE insulation and sheath of electric cables.

IS: 3975 Mild steel wires, strips and tapes for armouring cables.

IS: 7098 Current rating of cables.

IS: 7098 XLPE insulated (heavy duty) electric cables for working voltage upto and including 1100 volts.

IS: 424-1475(F-3)  Power cable-flammability test.

Specification for cross-linked polyethylene insulated XLPE sheathed cable for working voltage upto 1.1 KV.

Specification for XLPE insulated (heavy duty) electric cables for working voltages upto and including 1100 volts.

ASTM-D: 2863 Standard method for measuring the minimum oxygen concentration to support candle-like combustion of plastics (Oxygen Index).

ASTM-D: 2843 Standard test method for measuring the density of smoke from the burning or decomposition.

IEEE : 383 Standard for type of test Class-IE, Electric cables, field splicers and connections for power generation station.


IS : 10418  Cable drums.

c)  **Technical Requirements:**

i)  The cables shall be suitable for laying in racks, ducts, trenches conduits and underground buried installation with uncontrolled back fill and chances of flooding by water.

ii) They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating condition.

iii) The aluminium/copper wires used for manufacturing the cables shall be true circular/sector in shape before stranding and shall be of uniformly good quality, free from defects. The conductor used in manufacture of the cable shall be of H2 grade.

iv) The cable should withstand 25 KA for 0.5 sec with insulation armour insulated at one end. Bidder shall furnish calculation in support of capability to withstand the earth fault currents. The current carrying capacity of armour and screen (as applicable) shall not be less than the earth fault current values and duration.

v) The fillers and inner sheath shall be of non-hygrosopic fire retardant materials and shall be suitable for the operating temperature of the cable. Filler and inner sheath shall not stick to insulation and outer sheath.

vi) Progressive automatic in line indelible, legible and sequential marking of the length of the cable in metres at every one metres shall be provided on the outer sheath of all cables and at every 5 metre ‘FRLS’ marking in case of ‘FRLS’ cables.
Intermodal (IWT) Terminal

vii) Strip/Wire armouring following method (b) mentioned in IS: 3975 shall only be acceptable. For single core cable aluminium wire armouring shall be used.

viii) Allowable tolerance on the overall diameter of the cables shall be + 2mm.

ix) The normal current rating of all XLPE insulated cables shall be as per IS: 7098.

x) A distinct inner sheath shall be provided by pressure extrusion process for all multicore armoured and unarmoured cables as per IS: 5831.

xi) Outer sheath shall be provided by extrusion process as per IS: 5831

xii) The breaking load of armour joint shall not be less than 95% of that armour wire. Zinc rich paint shall be applied on armoured joint surface.

xiii) In plant repairs to the cables shall not be accepted.

xiv) All the cables shall be supplied in non-returnable drums as per IS: 10418.

d) In Case of FRLS Cables

i) The outer sheath of cables shall have an oxygen index of not less than 29 as per ASIMD: 2863.

ii) The maximum acid gas generation by weight as per IEC: 754 (i) shall not be more than 20% for outer sheath material of all cables. Bidder shall also guarantee the maximum theoretical acid gas generation with 20% by weight of outer sheath.

iii) The cables outer sheath shall meet the requirement of light transmission of 40% (minimum and shall be tested as per ISTMD: 2843). In case the test for light transmission is conducted as per ASTME: 662. The bidder shall furnish smoke density values as per this standard and shall co-relate the anticipated light transmission when tested as per ASTMD: 2843.

iv) The cable shall pass the fire resistance test as per SS: 42, 41, 475 (I) and flammability test as per EEE: 383.

e) Inspection:

All cables shall be inspected on receipt of the same at site and checked for any damage during transit.

f) Joint in Cables

The contractor shall take care that the cables received at site are distributed to various locations in such a manner as to ensure maximum utilisation and avoidance of cable jointing. Cable shall be rechecked before cutting in lengths, where the joints are unavoidable, and the location of such joints shall be got approved from the Owner/Consultant. The joints shall be done by qualified jointer strictly in accordance with manufacturer’s instruction/drawings.

g) Joint Boxes for Cables

The cable joint boxes shall be of appropriate size suitable for type of cable of particular voltage rating.

h) Jointing of Cables
All straight through joints shall be done in epoxy mould boxes with epoxy resins. Straight through joints shall not be permitted unless the length of run is in excess of cable drum.

End terminations of cables more than 1.1 KV grade shall be done with epoxy mould boxed and epoxy resin. Cable glands shall be 1.1KV grade double compression type and made to tin plated heavy-duty brass casting and machine finished. Glands shall be of robust construction capable of clamping cable and cable armour, firmly without injury of cable.

All washers and hardwares shall be made of brass tinned. Rubber components used in the glands shall be made of neoprene of tested quality.

Cable lugs shall be tinned copper/aluminium solderless crimping type conforming to IS: 8309 suitable for aluminium or copper conductor.

Crimping of terminals shall be done by using Corrosion inhibitory compound, with crimping tool.

Fire resistant paint has to be applied 1 Metre on either side of cable joint.

The contractor shall liaise fully with all other contractors to achieve an efficient and properly coordinated installation where equipment has to be re-positioned due to lack of site liaison; no extra cost shall be incurred by the client.

i) Testing of Cables

Cables shall be tested at factory as per requirement of IS: 7098 Part-I. The tests shall incorporate routine tests, type tests and acceptance tests. Prior to laying of cables, following tests shall be carried out:

i) Insulation test between phases and phase to earth for each length of cable before and after jointing.

On completion of cable laying work, the following test shall be conducted in the presence of Architect/Owner.

ii) Insulation resistance test (Sectional and overall) 1000/5000V depending upon the voltage grade of cable.

iii) Continuity resistance test.

iv) Sheathing continuity test.

v) Earth test.

j) Laying of Cable

The cable drum shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming links. At all changes in directions in horizontal & vertical places, the cable shall be bent with a radius of bend not less than 8 times the diameter of cable.

The cable of 1.1KV grade shall be laid not less than 750mm below ground level in a 375mm wide trench (throughout), where more than one cable is to be laid in the same trench, the width of the trench shall be increased such that the interaxial spacing between the cables except where otherwise specified shall at least be 150mm minimum or as per site requirements or as approved by the Engineer-in-charge. Where single core cables are used in multiphase systems, the cables shall be installed in trefoil where possible.

In case the cables are laid in vertical formation due to unavoidable circumstance the depth per tier shall be increased by 200mm (minimum). Cable shall be laid in reasonably straight line, where a change in direction takes place a suitable cur-vature shall be i.e. either 12 times
the diameter of the cable or the radius of the bend shall not be less than twice the diameter of the cable drum or whichever is less. Minimum 3-meter long loop shall be provided at both sides of every straight through joint & 3 meters at each end of cable or as directed at site.

Greater care shall be exercised in handling the cable in order to avoid forming ‘Kinks’. The cable drum shall in-verbally convey on wheels and the cable unrolled in right direction as indicated on the drum by the manufacturer. The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains.

Cables laid in trenches in single tier formation, 10 cms. All around sand cushioning is provided below and above the cable before a protective cover is laid. For every additional vertical tier. The 30cm of sand cushion are provided over the initial tier. The cable shall be protected by 2nd class bricks of size not less than 230x115x75mm, stone tiles/RCC curved channel be placed on top of the sand breadth wise for the full length of the cable and where more than one cable is to be laid in the same trench the brick shall cover all cables and project at least 8 cms. Over the outer sides of the end cables.

Filling of trenches shall be done after the sand cushioning and laying of tiles or bricks are carried out to the satisfaction of the Engineer-in-charge (Refer drawing). Back fill for trenches shall be filled in layer not exceeding 150 mm. Each layer shall be properly rammed & consolidate before laying the next layer.

PVC pipe shall be provided for all road crossing. The size of the pipe shall be according to the cable and a minimum 100mm dia. pipe shall be provided. The pipe shall be laid in ground with special arrangement and shall be cement jointed and concreting with 1:5:10 shall be made as per relevant IS with latest amendment. Location of cables laid directly underground shall be indicated by cable marker at an interval of 30 meters & with change of direction. Aluminium strip cable tag of 20mm wide with engraved tag no. shall be provided at both ends of cable.

Where the cables are to be laid in ducts (pucca trenches) in side the building, they will have to be laid on MS rack/ on MS cable trays grouted in walls trenches. Cables sizing through floors shall be protected from mechanical damage by a steel channel to a height of one meter above the floor where cable pass through wall they shall be sleeved with PVC/steel conduit.

Where the cables are laid in open (in building) along walls, ceiling or above false ceiling, cable rack (ladder type) or cable tray shall be provided. The size of the cable tray or rack shall depend on the number of cables to pass over that rack. Cable tray/rack shall be properly supported through wall/ceiling according to the site conditions. Cable laid on tray & riser shall be neatly dressed &clamped at an interval of 1000 mm & 750mm for horizontal & vertical cable run respectively either side at each bend of cable. All power cables shall be clamped individually & control cables shall be clamped in groups of three or four cables. Clamps for multicore cables shall be fabricated of 25x3 GI flats. Single core power cable shall be laid in trefoil formation & clamped with trefoil clamps made of PVC/fibre glass.

Cable openings in wall/floor shall be sealed by the contractor suitably by hession tape & bitumen compound or by any other proven to prevent ingress of water.

After the cables are laid, these shall be tested as per IS and the results submitted to Architects/Engineer and in case the results found unsatisfactory, all the repairing/ replacing of cables will be done by the contractor free of charge.

k) Fire Seal System

i) All the floor/wall opening provided for cable crossing shall be sealed by fire seal system.

ii) The fire proof sealing system shall fully comply with the requirements of relevant IS/BS: 476 Part-B. The fireproof seal system shall have minimum one hour fire resistance rating.
iii) The fire proof seal system shall be physically, chemically, thermally stable and shall be mechanically secured to the masonry concrete members. The system shall be completely gas and smoke tight, antirodent and anti-termite.

iv) The material used in fireproof seal system shall be non-toxic and harmless to the working personnel.

v) Type of fireproof seal system shall be foaming type or flammemastic type compound or approved equivalent.

After laying and jointing work is completed, high voltage test should be applied to all cables to ensure that they have not been damaged during or after the laying operation and that there is not fault in the jointing.

Cables for use on low and medium voltage system (1.1KV grade cables) should withstand for 15 minutes a pressure of 3000V DC applied between conductors and also between each conductor and sheaths. In the absence of pressure testing facilities it is sufficient to test for one minute with a 1000V insulation tester In case the test results are unsatisfactory the cost of repairs and replacements and extra work of removal & laying will be made good by the contractor.

Cable shall be installed so that separation shown in the table below are observed.

| HV Cable (11 KV) - HV Cable (11 KV) | 50 mm |
| ELV & LV 230 V/433 V - ELV & LV cable 230 V/433 V | Equal to the diameter of the bigger cable. |
| HV cables (11 KV) - ELV & LV cables 230 V/433 V | 300 mm |
| LV cables 433 V - Telephone/Instrument cable | 350 mm |
| All cables - All hot pipe work | 200 mm |

l) Quality Assurance

Quality Assurance shall follow the requirements of Owner/Consultant as applicable. Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser’s requirements.

m) Deviations

Deviation from specification must be stated in writing at the quotation stage.

In absence of such a statement, it will be assumed that the requirements of the specifications are met without exception.

n) Spares for Commissioning Including Consumables

The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools and consumables. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

11. CABLE TRAYS

a. Ladder type Cable tray – for Power Cables only

Cable trays shall be ladder type fabricated out of mild steel/slotted angles and flats of required width as per design. Bends shall be prefabricated. The cable tray shall be hot dip galvanized or primed and painted with powder coating as asked for in BoQ or as approved by
Owner/Consultant. The minimum weight of the zinc coating shall be 460 gm/sq.m and minimum thickness of coating shall not be less than 75 microns.

b. **Perforated Cable tray** – for Power Cables & Low current service both

The perforated cable trays are fabricated out of 1.6mm thick CRCA sheet steel having minimum 50mm depth or as called for in BOQ, hot dip galvanized or epoxy coated of approved shade. Perforations are maximum 10mm spaced at maximum 20mm distance. The cables shall be tied with the cable tray with nylon strip/aluminium clamps/M.S. clamps as per requirements.

Suitable provision shall be made where a tray crosses expansion joints. The width of the tray shall allow for a suitable separation between cables the design shall allow for adequate bending radius for the sizes of cables. No sharp bend to be allowed in cable tray. Joints between sections shall be bolted.

The tray shall be suspended from the surface of the concrete slab by means of approved steel hangers spaced at a distance of not more than 125cms. Suitable bushes shall be provided where cables pass through apertures in the tray. Cables must be securely fixed to the tray with clamps or cable ties. In routing necessary barrier and spacing shall be maintained for cables of different voltages in case they lie side by side. Telephone cables shall cross the power cables only at about right angle and these two shall not run in close proximity. Full details of the tray shall be approved by the Consultant/Site Engineer before fabrication. Earth continuity shall be maintained between each section of cable tray and each total run of tray shall be effectively bonded to the nearest earth continuity conductor. All nuts and bolts used shall be of galvanised steel.

Depending on the size of cable trays space of 20-33% has to be maintained for future expansion.

Cable tray is manufactured to comply with the specifications of National Electrical Code (NEC) and National Electrical Manufacturer’s Association (NEMA).

12. **INTERNAL ELECTRICAL WORKS**

12.01 **Conducting (M.S Conduit)**

All conduits shall be of heavy gauge solid drawn ERW welded manufactured out of 16 (1.6mm) gauge MS Sheet up to 32mm dia and of 14 (2 mm) gauge for sizes higher than this. Both inner and outer surfaces shall be smooth without burrs, dents and kinks. Conduits shall be black stove enameled inside and outside. The cross section of conduit shall be uniform throughout. The welding shall be uniform such that welded joints do not yield when subjected to flattening test. Welded joint shall not break when threaded or bent at an angle. Conduit shall conform to specifications of IS: 9537 (Part-II) and the capacity of conduits shall be in accordance with the standards and shall never be exceeded. The minimum size of the conduit shall be 20mm dia. Care shall be taken to ensure that all conduits are adequately protected while stored at site prior to erection and no damaged conduit shall be used.

12.02 **PVC Conduit**

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

12.03 **Accessories**
Intermodal (IWT) Terminal

Conduit accessories such as normal bends, unions, circular junction boxes and pull boxes, locknuts etc. shall be heavy gauge type and approved make. Conduit accessories shall conform in all respects to IS: 3837-1966 with latest amendment. Wherever several conduits are running together, adequately sized adoptable boxes common to all runs shall be used to avoid inserting inspection boxes in the individual run. Where it is necessary to segregate wiring metal filler shall be fixed with in the box.

Conduits shall be laid before casting in the upper portion of a slab or otherwise, as may be instructed or in accordance with approved drawings, so as to conceal the entire run of conduits and ceiling outlet boxes. Vertical drops shall be buried in columns or walls. Wherever necessary, chases will be cut by the contractor with the help of chase cutting m/c or by hand. Nothing extra shall be paid to the contractor on this account. In case of exposed brick/ rubble masonry work special care shall be taken to fix the conduit and accessories in position along with the building work. Sufficient depth of the chases will be made to accommodate the required number of conduits. The chase will be filled with cement, coarse sand mortar (1:3) and properly cured by watering for one week.

If a chase is cut in an already finished surface the contractor shall fill the chase and finish it to match the existing finish. Contractor must not cut any iron bars to fix conduits. Conduits shall be kept at a minimum distance of 100mm from the pipes of other non-electrical services. Where the conduit is to be embedded in a concrete member it shall be adequately tied to the reinforcement to prevent displacement during casting, conduits in chases shall be held by steel hooks of approved design at maximum of 100 cm centres. The embedding of conduits in walls shall be so arranged as to allow at least 12mm plaster cover the same. All threaded joints of conduit pipes shall be treated with some approved ‘preservative compound’ to secure protection against rust.

Suitable expansion joints fittings of approved make and design shall be provided at all the points where the conduit crosses the expansion joint in the building. (Preferably with Pilca metallic watertight conduits). Conduits shall cross at right angles of the joints only.

Separate conduit shall be used for:

1) Normal light, fan call bell
2) 16 A power outlets
3) Emergency Light Point
4) Fire alarm System
5) Computer Outlets
6) P.A System
7) Telephone system
8) TV Network
9) Or any other services not mentioned here.

Wiring for short extensions to outlets in hung ceiling or to vibrating equipments, motors etc. shall be installed in flexible conduits. Flexible conduits shall be formed from a continuous length of spirally wound interlocked wire steel with a fused zinc coating on both sides. The conduit shall be provided with approved type adoptor. A separate and accessible earth connection shall bond across the flexible conduit.

Conduit runs on surfaces shall be supported with metal 1.2 mm thick saddles, which in turn are properly secured on to GI spacer to the wall or ceiling. Fixing screws shall be with round or cheese head and of rust proof materials. Exposed conduits shall be neatly run parallel or at right angles to the walls of the building and shall be painted in color matching the adjoining area. Unseemly conduit bends and offsets shall be avoided by using better appearance. Cross cover of conduits shall be minimum and entire conduit installation shall be clean and with good appearance. For surface work, the boxes shall be raised back pattern type, designed for use with distance saddles to give clearance of 6mm between the back of conduit and the fixing surface.
Where conduits are run on steel work, they will be fixed by means of purpose made GI Caddy clips in manner meeting with the approval of the Engineer prior to the installation being carried out. Other methods of fixing may be agreed in special circumstances, but approval must first be obtained from the site engineer.

The spacing of saddles shall be not more than 600mm centers for up to 32mm diameter conduits and at 750mm for conduit sizes of 40mm diameter and above in case of MS conduit and not more than 600 mm for PVC conduit. In addition, saddles shall be fixed at each side of any bend/Tee, or set at a distance of 200mm from the bend/Tee. The holes in the brickwork or concrete for fixing plugs shall be neatly drilled by means of a masonry drill of the appropriate size.

All the GI sheet steel /passivated boxes used for housing switches, plugs, fan regulator etc. shall be five sided conforming to IS: 5133 Part I-1969. Suitable size of boxes shall be provided a minimum of 2 adjustable fixing lugs on vertical sides. Suitable earth terminal inside each box shall be provided. All fixing lugs shall be threaded to receive standard machined chromium plated brass screws. Sufficient number of knockouts shall be provided for conduit entry. Conduits carrying wires of different circuit can terminate in common J.B having metal compartments. Necessary GI pull wires shall be inserted into the conduit for drawings wires. In case conduit pipe is required to cross any RCC beam special adopter boxes shall be provided for crossing & nothing shall be paid extra.

Where conduits are used for non air-conditioned space to air-conditioned space or into a fan chamber or duct, a junction box shall be installed to break the continuity of such conduit at the point of entry or just outside and conduit shall be sealed around the conductors.

Particular care shall be taken during the progress of the work to prevent the ingress of dirt and rubbish such as plaster droppings into erected conduits. Conduit which has become so clogged shall be entirely freed from these accumulations or will be replaced. Screwed plastic or metal caps or turned wooden plugs shall be employed to protect all open ends. Plugs of waste wood, paper, cotton or other fibrous matter shall not be used. All unused conduit entries shall be blanked off in an approved manner and where conduits terminate in adaptable boxes, all removable box covers shall be firmly secured to provide complete enclosure. If considered necessary by the Engineer-in-charge, the conduits shall be swabbed out by drawing swabs of rag through the conduit to remove moisture prior to any cables being drawn in.

All conduit installations must be completed and erected in their totality before they are wired and must be fully rewirable from outlets to distribution boards or trunking systems etc. to which they connect. No wiring of any part of the installation shall be commenced until instructions are received to do so by the Engineer-in-charge at such time as he is satisfied that the wiring will not be damaged due to building operations.

Conduits shall be installed so that they are self draining in the event of ingress of moisture due to condensation or any other reason. A suitable drainage hole shall be drilled at the bottom of the lowest conduit box in every 9-meter of horizontal run.

PVC bush of good quality shall be used in each conduit termination in a switch box, draw box, lighting fixtures and circular junction boxes.

Exposed conduits running above false ceilings shall be suitably clamped independently along with the dropped ceiling. Perforated straphangers or twisted attachment shall not be acceptable. In no case shall raceways be supported or fastened to other pipe for repair and maintenance. They shall be arranged symmetrically and in the cost compact design, in no way unduly criss-crossing each other. Proper spacing shall be maintained when two or more conduits run side by side. The layout of the pipes shall be co-ordinated with other services if any. The junction boxes and conduits used in hazardous areas shall be flameproof type with cast iron construction complete with threaded covers. The conduit of each circuit or section shall be completed before conductors are drawn in. The entire system of conduit after erection shall be tested for mechanical and electrical continuity throughout and permanently connected to earth conforming to the requirements by means of special approved type of
earthing clamp efficiently fastened to conduit pipe in a workman like manner for a perfect continuity between the earth and conduit.

The conduit system shall be so laid out that it will obviate the use of tees, elbows and sharp bends. No length of conduit shall have more than the equivalent of two-quarter bends from inlet to outlet. The conduit itself being given required smooth bend with radius of bends suiting to the site conditions but not less than 6 times overall diameter.

Outlet boxes shall be of heavy-duty sheet steel installed as to maintain continuity throughout. These shall be so protected at the time of laying that no mortar finds its way inside during concrete filling or plastering. For fluorescent fittings, the outlet boxes heavy duty shall be provided 300mm off centre for a 1200mm fitting and 150mm off centre for a 600mm fittings or as per B.O.Q.

Draw boxes of ample dimensions shall be provided at convenient points to facilitate pulling of long runs of cables. They shall be completely concealed with MS covers flush with plasterwork painted to match the wall. These boxes will be as few as possible and located where found suitable by the consultant.

**12.04 Switch Boxes**

The switch boxes shall be zinc passivated & shall not be less than 18 SWG thick or shall be as called for in BOQ. It will be so designed that accessories could be mounted on integral pedestals or on adjustable flat iron mounting straps with tapped holes by brass machine screw. Leaving ample space at the back and on the sides for accommodating wires and check nuts at conduit entries. These shall be attached to conduits by means of check nuts on either side of their walls. These shall be completely concealed leaving edges flush with wall surfaces. Earthing terminal inside box shall be provided.

Moulded plate switches screw less as specified in item of work shall be provided. No timber shall be used for any supports. Boxes, which come within concrete, shall be installed at the time of casting. Care shall be taken to fix the box rigidly so that its position is not shifted while concreting.

**12.2.0 Wiring**

All the wiring installation shall be as per IS: 732 with latest amendment. PVC insulated copper conductor cables as specified in bills of quantity shall be used for sub-circuit runs from the distribution boards to the points and shall be pulled into conduits. They shall be twisted copper conductors with thermoplastic insulations of 660/1100 volts grade. Colour Code for wiring shall be followed.

Looping system of wiring shall be used, wires shall not be jointed. Where joints are unavoidable, they shall be made through approved mechanical connectors with prior permission of the consultant. No reduction of strands is permitted at terminations. No wire smaller than 1.5 sq.mm shall be used and shall be as per B.O.Q. Wherever wiring is run through trunkings or raceways, the wires emerging from individual distributions shall be bunched together with cable straps at required regular intervals. Identification ferrules indicating the circuit and DB number shall be used for submains sub-circuit wiring. The ferrules shall be provided at both end of each submain and sub-circuit.

Where single-phase circuits are supplied from a three phase and a neutral distribution board, no conduit shall contain the wiring fed from more than one phase. In any one room in the premises where all or part of the electrical load consists of lights, fans and/or other single phase current consuming devices, all shall be connected to the same phase of the supply. Circuits fed from distinct sources of supply or from different distribution boards or through switches or MCBs shall not be bunched in one conduit. In large areas and other situations where the load is divided between two or three phase, no two single-phase switches connected to different phase shall be mounted within one box.
All splicing shall be done by means of terminal blocks or connectors and no twisting connection between conductors shall be allowed.

Industrial sockets shall be of moulded plastic BoQ and deeply recessed contact tubes. Visible scraping type earth terminal shall be provided. Socket shall have self-adjustable spring loaded protective cap. Socket shall have MCB/ELCB/RCCB as specified in the schedule of work.

Maximum number of PVC insulated 650/1100 V grade/copper conductor cable conforming to IS: 694-1990.

<table>
<thead>
<tr>
<th>Conduit size</th>
<th>20mm</th>
<th>25mm</th>
<th>32mm</th>
<th>40mm</th>
<th>50mm</th>
<th>60mm</th>
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<tbody>
<tr>
<td>Wire size in sq.mm.</td>
<td>S</td>
<td>B</td>
<td>S</td>
<td>B</td>
<td>S</td>
<td>B</td>
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<td>5</td>
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<td>-</td>
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<td>2</td>
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</tbody>
</table>

Notes:

1) The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.

2) The columns heads ‘S’ apply to runs of conduits which have distance not exceeding 4.25 m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns heads ‘B’ apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.

3) Conduit sizes are the nominal external diameters.

13. TELEPHONE SYSTEM AND LAN WIRING

Enhanced Category 5 UTP specifications

a) The UTP shall be 4-pair, with 24 SWG solid or standard copper conductors.

b) The UTP-based cabling system shall have a 160 MHz channel channel bandwidth over a maximum distance of 100m (328 ft) and a channel power sum attenuation-to-crosstalk ratio (PSACR) of 9.6 dB@ 100 MHz using an interconnect or BIX cross connect configuration.

c) The UTP-based cabling system shall use matched components from a single manufacturer, certified to deliver system performance over the lifetime of the application that the cabling system was originally designed to support.

d) All component used in the UTP-based cabling system shall be warranted for a period of 25 years from date of installation against defects in materials and workmanship.
e) The UTP-based cabling system shall comply with the following standards:
- Enhanced Category 5 – TIA/EIA Addendum
- Category 5 – ANSI/TIA/EIA-568, TIA/EIA TSB67
- Class D – CENELEC EN50173
- Class D – ISO/IEC 11801

**UTP Outlets**

a) The outlet UTP connection module and its optional cover shall be available in the following colors: grey, almond, white, black, orange, red, yellow, green, blue, purple and brown.

b) The outlet UTP connection module shall be Power Sum rated, with a power Sum NEXT performance equal to or better than ANSI/TIA/EIA-568 Category 5 pair-to-pair NEXT performance specifications, and shall have a PS5 marking to indicate compliance.

c) The eight-position outlet UTP connection module shall accommodation six-position modular plug cords without damage to either the cord or the module.

d) It shall be possible to inspect and/or re-terminate the UTP cable at the outlet through front access at the face plate.

e) The faceplate housing the outlet UTP connection modules shall have aperture plugs to cover any unused openings in the faceplate.

f) The faceplate housing the outlet UTP connection module in wall mounted single and dual-gang electrical boxes, utility poles and modular furniture (cubical) access points using manufacturer – supplied faceplates and/or adapters , equipped with front, side or angled-entry options for modular cords.

**UTP System Testing**

a) There are two primary field test parameters for an UTP-based end-to-end cabling system.
- These are continuity/wire mapping and a visual inspection, both to be performed by the vendor.

b) Continuity/wire mapping is used to verify consistency pair-to-pin terminations at each end of a given cable. It also checks for faulty connections in the run. For each of the eight conductors in the cable, continuity/wire mapping indicates:
- Continuity of the channel to the remote end.
- Shorts between any two or more conductors.
- Crossed pairs.
- Reversed pairs.
- Split pairs.
- Any other mis-wiring.

**TELEPHONE TAG BLACK (TTB / IDF)**

CAT-5e (enhanced) unshielded twisted pair cable in MS conduit shall be used to have modern structured cabling network for telephone system, to have latest facilities for Internet and also data cabling. All the telephone Jack must terminated on RJ-11 jacks and installed
Intermodal (IWT) Terminal

onto a dual Jack faceplate. Telephone RJ-11 Jacks must be terminated with a BLACK Connector/Jack.

For LAN CAT 6 UTP cables shall be used for interconnecting the RJ 45 outlets to Intermediate Switch (Hub) or directly to IT room, if the running length limit permits. These Intermediate switch shall be installed in a rack/cabinet and located in electrical room of the respective floors. Fibre Optic cable or CAT-6 UTP cable shall be used for backbone to interconnect the Intermediate switch to IT room’s Server rack, as per the design requirement of the specialised Vendor. All the Data Jack must terminated on an 8 wire, 8-position Jack. Each RJ-45 Data Connection will be terminated with a BLUE Data Jack

Only conduit routing & wiring shall be provided by the Electrical contractor and the configuration & wiring shall be done by the Vendor for the IT Networking.

EPABX system, with latest technology will be provided by a separate Vendor to provide Voice Mail & Call Accounting by costing of all calls made by telephones.

A small cabinet for Low current services shall be provided at the false ceiling level at entrance of guest room, to locate all the terminal points like Tel.Tag block, tap-off box for MATV etc., for interconnecting all the low current outlets (jacks) provided in the guest room. Each tel. outlet in guest room shall be provided a separate wire from the room tag block.

Similarly one CAT-5e wire from the floor TTB/IDF shall be provided for each Tel. Outlet proposed.

A Multi pair box as per BOQ Tel. Cable shall be laid from the Service gate to the Telephone switch room MDF for Direct lines from the Service provider. Some of the lines shall be bypassed to EPABX and shall be directly provided to Top management’s office & Telephone operators for direct communication to outside. Rest of the lines shall be routed through EPABX for the use of patrons & staff through extensions. The following area/desk shall have direct access to outside Tel. lines:

i. Telephone Operator’s room
ii. Telephone Switch room
iii. Security room
iv. Fire officer room

14. MATV SYSTEM

Co-Axial Cables

1.1 The co-axial cable shall be of wideband type with operation upto 860MHz capability, with PE dielectric and PVC jacket.

The cable shall meet or exceed the following specifications:
### Intermodal (IWT) Terminal

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>RG-6</th>
<th>RG-11</th>
</tr>
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<tbody>
<tr>
<td>1.1</td>
<td>IS Standard IS:14131</td>
<td>5CA4</td>
<td>7CA4</td>
</tr>
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<td>1.2</td>
<td>Centre Copper Conductor Dia</td>
<td>1.02mm</td>
<td>1.63mm</td>
</tr>
<tr>
<td>1.3</td>
<td>Dielectric Dia</td>
<td>4.57mm</td>
<td>7.11mm</td>
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<tr>
<td>1.4</td>
<td>Dielectric Material</td>
<td>Cellular PE</td>
<td>Cellular PE</td>
</tr>
<tr>
<td>1.5</td>
<td>Outer Dia</td>
<td>7.0mm</td>
<td>10.03mm</td>
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<tr>
<td>1.6</td>
<td>Bending Radius</td>
<td>&gt;75mm</td>
<td>&gt;115mm</td>
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<tr>
<td>1.7</td>
<td>Impedance</td>
<td>75 Ohms</td>
<td>75 Ohms</td>
</tr>
<tr>
<td>1.8</td>
<td>Return Loss</td>
<td>&gt;23 dB</td>
<td>&gt;23 dB</td>
</tr>
<tr>
<td>1.9</td>
<td>Attenuation at 20°C</td>
<td>Max dB/100Mtr</td>
<td>Max dB/100Mtr</td>
</tr>
<tr>
<td></td>
<td>5 MHz</td>
<td>1.9</td>
<td>1.25</td>
</tr>
<tr>
<td></td>
<td>45 MHz</td>
<td>5.25</td>
<td>3.5</td>
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<td>300 MHz</td>
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<td></td>
<td>450 MHz</td>
<td>14.45</td>
<td>9.02</td>
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<tr>
<td></td>
<td>550 MHz</td>
<td>16.1</td>
<td>9.97</td>
</tr>
<tr>
<td></td>
<td>860 MHz</td>
<td>20.1</td>
<td>12.52</td>
</tr>
</tbody>
</table>
15. DISTRIBUTION BOARDS & MCBs

15.1 General

Distribution boards shall be of standard make with MCBs as per approved make given. Distribution boards shall be constructed out of steel sheet all weld enclosure with double door IP42 protection and shall be powder coated. Ample clearance between the conductors of opposite pole, between conductors and sheet steel body shall be maintained in order to obviate any chance of short circuit. Removable conduits entry or knockouts plates shall be provided at top and bottom to facilitate drilling holes at site to suit individual requirements. Also on additional/separate adopter box of suitable length and size shall be provided to accommodate wires and cables. No. of conduits etc. and nothing shall be payable on this account. The MCBs shall be mounted on high-grade rigid insulating support and connected by electrolytic copper bus bars. Each incoming MCB isolator shall be provided with solderless cable sockets for crimping. Phase separation barriers made out of arc resistant materials shall be provided between the phases. Bus bars shall be colour coded for phase identification.

Distribution boards shall be recessed in wall nitch or if required mounted on the surface of the wall with necessary clamp bolts etc. The mounting height shall not exceed 1200mm from finished floor level. Distribution board shall be provided with proper circuit identification nameplate and danger sticker/plate as per requirements. All the distribution boards shall be provided with engraved nameplates with 'lighting', 'power' or 'UPS' with DB Nos., as the case may be. Each DB shall be provided with a circuit list giving details of each circuit. All the outgoing circuit wiring shall be provided with identification ferrules giving the circuit number & phase.

Each distribution board shall have a separate neutral connection bar and a separate earth connection bar mounted within the DB each having the same number of terminals as the total number of outgoing individual circuits from the distribution board. Conduit & cable armouring shall be bonded together & connected to the distribution board earth bar.

Where oversized cables are specified due to voltage drop problems, it shall be contractors responsibility to ensure that satisfactory terminal arrangements are provided without an extra cost.

15.02 Earth Leakage Circuit Breaker

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

15.03 Miniature Circuit Breaker

1. The MCB shall be current limiting type and suitable for manual closing and opening and automatic tripping under overcurrent and short circuit. The MCB shall also be trip free type.

2. Single pole/three pole versions shall be furnished as required.

3. The MCB shall be rated for 10 KA/15 KA fault level.
4. The MCB shall be suitable for its housing in the distribution boards and shall be suitable for connection at the outgoing side by tinned cable lugs and for bus-bars connection on the incoming side.

5. The terminal of the MCBs and the open and close conditions shall be clearly and indelibly marked.

6. The MCB shall generally conform to IS: 8828. -1996

7. The MCB shall have 20,000 electrical operation upto 63A.

8. The MCB shall have minimum power loss (Watts) as per I.S. / IEC.

16. SPECIAL CONDITIONS OF CONTRACT FOR D.G. SETS

1.1 DRAWINGS

The drawings, specifications and bill of quantities shall be considered, as a part of this contract and any work or materials shown on the drawings and not called for in the specifications or vice-versa, shall be executed as if specification called for in both. The contract drawings indicate the extent and general arrangement of various equipments and their wiring, etc. and are essentially diagrammatic. The drawings indicate the point of termination for conduit runs and broadly suggest the routes to be followed. The work shall be done as indicated on the drawings. However, any minor change if found essential to co-ordinate the installation of this work with other traders shall be made without any additional cost to the owners. The data given herein and on the drawings is as could be secured but its complete accuracy is not guaranteed. The drawings and specifications are for the assistance and guidance of the contractor. The exact location, distances and levels etc. will be governed by the space conditions. The contractor shall examine all Architectural, structural, Plumbing and Sanitary, Air-conditioning and electrical drawings before starting the work and report to the architect any discrepancies, which in his opinion appear, on them, and get them clarified. He shall not be entitled to any extras, for omissions or defects in electrical drawings or when they conflict with other works.

1.2 SHOP DRAWINGS

The Contractor shall prepare and submit to the Consultants/Architect/ Owner for their approval detailed shop drawings with in 30 days of signing of the contract or before 7 days of particular work or whichever is earlier. The shop drawings shall clearly indicate.

a) The general arrangement and schematic diagram of main D.G Panel, PLC Panel, clearly stipulating the material, size of sheet steel, bus bar, inter connections detail, make and rating of switchgear and other equipment etc.

b) Number, size and route of the Cable Tray, and fixing details.

c) Total number of cable runs, size make, material and type of cables with clear routing, trenches / treys detail, installation mode, starting and termination point of each and individual cable etc.

d) The shop drawings shall also show all setting out details and physical dimensions of all equipments components used in the system, location of manholes fixing, cutout details etc.

1.3 QUALITY

The Employer’s / Consultants decision with regard to the quality of the material and workmanship will be final and binding, any material rejected by the Employer / Consultant shall be immediately removed by the Contractor from the site. The Employer / Consultant or their representative shall at all reasonable times have free access to the works and / or to the workshops, factories or other places where materials are being prepared or constructed for the contract and also to any place where the material lying or form which they are being
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obtained, and the contractor shall give every facility necessary for inspection and examinations and test of the material and workmanship free of cost.

1.4 COST OF SAMPLES AND TESTS

The Contractor at his own cost shall supply all samples and the cost of making any test as per specifications shall be borne by the contractor. The Contractor shall submit four copies of all brochures, manufacturers’ description data and similar literature. One copy will be returned to the Contractor after approval.

1.5 COMPLETION DRAWINGS

The Contractors shall submit to the Owner / Consultant, layout drawings drawn at approved scale in six sets and a reproductive (original) copy clearly showing.

a) Location of distribution and PLC Panel
b) All types of cables (L.T. / Control etc.) layout.
c) Layout of DG Room and switchgears and associated equipments.
d) Layout of Diesel Generator Sets.
e) Location of Fuel Tank, Cooling Towers, Pumps and fuel and water piping layout.
f) As built drawing with equipments operation and maintenance literature.

After the completion of the work and before issuance of certificate of virtual completion.

1.6 FOREMAN / SUPERVISOR

The Contractor shall employ a competent, licensed qualified full time electrical engg./ foreman / supervisors to direct the work of electrical installations in accordance with the drawings and specifications. The foreman / supervisor shall be available at all times on the site to receive instructions from the Architect / Engineer in the day to day activities throughout the duration of the Contract and as long as there after as the consultants may consider necessary until the expiration of the “Defect Liability Period”. The Foreman / Supervisor shall correlate the progress of the work in conjunction with all the relevant requirements of the supply authority.

The skilled workers employed for the work should have requisite qualifications and should possess competency certificate from the Electrical Inspectorate of the Local Government.

The Contractor shall on the request of the consultants immediately dismiss from the works any person employed there on who may, in the opinion of the consultants, be unsuitable or incompetent or who may misconduct himself and such person shall not be again employed or allowed on the work without the permission of consultants/Employee.

1.7 INSPECTION AND TESTING

Contractor shall employ a full time qualified Engineer who shall be available at all working hours at site for taking instructions and to look after the quality of the work. Instructions given to the Engineer of the contractor shall be construed as issued to the contractor.

Contractor shall maintain at site the following tools and instruments, but not limited to the list below in working conditions.

a) Clip-on Ammeter and voltmeter
b) 1000 V Meggar and 5 KV Meggar
c) Steel tapes of various lengths
d) Sprit Level
e) Hydraulic Crimping Tool
f) Earth Testing Meggar
g) Pipe bending Tool, thread-cutting die, bench vice etc.
h) Cable jointing kit
The contractor shall provide at least four permanent benchmark at site, which shall be preserved till the completion of works. These are essential for laying of cables at correct levels.

1.8 CLEARANCE FROM LOCAL AUTHORITIES

The Contractor shall get the entire installation tested inspected and approved by Local Authorities like Electrical inspectorate pollution control explosive clearance and any other agency required to take permission for commissioning of the installation. He will also undertake the Liaison work with local Electricity Supply Company for obtaining the Electrical Service Connection.

1.9 SCOPE

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

1.10 CONTRACTOR

The contractor shall be a licensed electrical contractor, possessing a valid electrical contractor’s in the state, employing licensed supervisors and skilled workers having valid permits as per the regulation of Indian Electricity Rules and Local Electrical Inspector’s requirements.

17. Preamble to BOQ for D.G. Set:

1. All items of work under this Contract shall be executed strictly to fulfill the requirements laid down under the specifications. Type of equipment, material specifications, methods of installation and testing, and type of controls shall be in accordance with the Specifications, approved shop Drawings and the relevant Indian Standards, however, capacity of each component and their quantities shall be such as to fulfill the above mentioned requirement.

2. The rate for each item of work included in the Bill of Quantities shall, unless expressly stated otherwise, include cost of:

   a. All materials, fixing materials, accessories, appliances, tools, plants, equipment, transport, labour and incidentals required in preparation for and in the full and entire execution, testing, balancing, commissioning and completion of the work called for in the item and as per Specifications and Drawings.

   b. Wastage on materials and labour.

   c. Loading, transporting, unloading, handling / double handling, hoisting to all levels, setting, fitting and fixing in position, protecting, disposal of debris and all other labour necessary in and for the full and entire execution and to fully complete the job in accordance with the contract documents, good practice and recognized principles.

   d. Liabilities, obligations and risks arising out of Conditions of Contract.

   e. All requirements of specifications, whether such requirements are mentioned in the item or not. The specifications and drawings where available, are to be read as complimentary to and part of the Schedule of Quantities and any work called for in one shall be taken as required for all.

   f. In the event of conflict between Bill of Quantities and other documents including the specifications, the most stringent shall apply and the interpretation of the consultants shall be final and binding.
3. The unit rate for each equipment or materials shall include cost in Rupees for equipment and material including the excise duty, and also including forwarding, freight and insurance up to Contractor’s store at site, storage, installation, testing balancing, commissioning and other works required.

The extension for (total) amounts against each item shall be based on the quantities indicated in this Schedule.

4. All equipment, quantities and technical data indicated in this Schedule are for the Contractors guidance only; these are based on the documents prepared by the Consultants. The contractor shall assess the required quantity of cables, cable trays, piping etc that are required for completion of the work. This schedule must be read in conjunction with these documents. The Contractor shall be paid for the actual quantity of work executed by him in accordance with the approved shop drawings at the contract rates.

5. The quantities given in this schedule are provisional, the Owner reserves the right to increase or decrease the quantities of work or to totally omit any items of work and the Contractor shall not be entitled to claim any extras or damages on these grounds. These variations shall be permitted until such time Contractors shop drawings are approved.

6. This schedule shall be fully priced and the extensions and totals duly checked. The rates for all items shall be filled in INK.

7. No alteration whatsoever is to be made to the text or quantities of this Schedule unless such alteration is authorized in writing by the Consultants. Any such alterations, notes or additions shall unless authorized in writing be disregarded when tender documents are considered.

8. In the event of an error occurring in the amount column of the Schedule, as a result of wrong extension of the unit rate and quantity, the unit rate quoted by the tenderer shall be regarded as firm and the extensions shall be amended on the basis of the rates.

9. Any errors in totaling in the amount column and in carrying forwarded totals shall be corrected. Any error, in description or in quantity or commission of items from this schedule shall not vitiate this contract but shall be corrected and deemed to be a variation required by the Consultants.

18. **D.G. SET**

250 KVA

The D.G. set shall be provided with Diesel Engine of Model no. & no. of Cylinder as given below, vertical 4 stroke cycle, Air cooled radiator having turbo charged after cooled Engine at 1500 RPM under NTP conditions of BS: 5514. The D.G. set shall be provided with electrical starting arrangement and shall give the electrical output of as given below at 0.8 power factor, 415 Volts at the alternator terminal.

<table>
<thead>
<tr>
<th>ELECTRICAL OUTPUT</th>
<th>Cumminium Engine</th>
<th>No. of Cylinder</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 KVA</td>
<td>CJ250D5P</td>
<td>6</td>
</tr>
</tbody>
</table>

Other accessories of the engine would be as under:

**COOLING SYSTEM**

- Thermostat
- Corrosion Inhibitor
- Self contained piping

**FUEL SYSTEM**
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- PT fuel pump
- Injectors
- Fuel filters
- Self contained piping

**LUBRICATING SYSTEM**

- Oil pump
- Strainer
- Lub oil cooler
- Oil filter
- Bypass filter
- Self contained piping

**AIR INTAKE SYSTEM**

- Dry type filter
- Air intake manifold with necessary connections
- Turbo charged after Cooled

**EXHAUST SYSTEM**

- Exhaust manifold
- Flexible piping
- Silencer (Hospital)

**GOVERNING SYSTEM**

- Electronic Governor

**STARTING SYSTEM**

- Starter, 24V, DC
- Battery charging Alternator
- With in-built Regulator

**ENGINE CONTROL PANEL (ECP) (it will display)**

- Lub oil pressure
- Jacket water temperature
- Engine RPM
- Battery voltage
- Engine Running Hours

**SAFETY SYSTEM**

- Low lub oil pressure
- High water temperature
- Over speed

**OTHER SYSTEM**

- Flywheel
- Flywheel housing

**ALTERNATOR:**

- Output i) 250 KVA
- Power factor : 0.8
- Rated Generating Voltage : 415 Volts
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<table>
<thead>
<tr>
<th>Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage regulation</td>
<td>+/- 1% all load between no load to full load &amp; factor 0.8 to unity</td>
</tr>
<tr>
<td>Frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>Speed</td>
<td>1500 RPM</td>
</tr>
<tr>
<td>Class of insulation</td>
<td>H</td>
</tr>
<tr>
<td>Winding connection</td>
<td>Star connection (all six leads will be brought out of stator frame)</td>
</tr>
<tr>
<td>Overload capacity</td>
<td>10% for one hour in any 12 hours of operation without exceeding temperature rise limits specified in BS:2613 or BS:5000 when corrected to ambient temperature at site.</td>
</tr>
<tr>
<td>Bearings</td>
<td>Long life single bearing</td>
</tr>
<tr>
<td>Enclosures</td>
<td>Drip proof &amp; screen protected IP-23</td>
</tr>
<tr>
<td>Parallel operations</td>
<td>All machines shall be suitable for operation in parallel. Damper winding shall be provided to facilitate parallel operation</td>
</tr>
</tbody>
</table>

### Power Command Paralleling Genset Controls (PCC3.3 of Cummins or equivalent)

The features shall be given as below:-

- Digital governing
- Digital Voltage regulation
- Amp Sentry Protection for true alternator O/C protection on PCC 3.3 for solo / paralleling applications.
- Analog/ Bargraph/ Digital AC output Metering
- Battery Monitoring System to sense and warn against a weak battery condition
- Digital Alarm and Status Message Display
- Genset Monitoring : Displays status of all critical engine and generator set functions
- Smart Starting Control System : Integrated fuel ramping to limit black smoke and frequency overshoot
- Advanced serviceability
- Synchronizers and load sharing controls
- KVAR and power factor controls
- Import / Export controls for paralleling with utility / main bus.

The alternator shall be of self-excited, self regulated, self ventilated in brush less design, provided with suitable automatic voltage regulator and shall conform to BS:2613 or BS : 5000 and shall give rated output at NTP conditions.

### ESSENTIAL ACCESSORIES:

One set of essential accessories shall be supplied with each D.G. Set. This set of accessories shall comprise of the following:

#### BASE FRAME:

One no. MS Fabricated adequately machine Channel Common Base Frame with lifting facility, pre-drilled foundation holes suitable for permanent installation on concrete foundation for direct grouting or on anti-vibration mountings which will be suitable to receive the offered engine and alternator duly coupled through a flexible coupling. A suitable coupling guard shall also be provided.

#### FUEL TANK:

One no. Daily fuel tank of 990 LITRES capacity / or as per OEM Supplier Specification for each DG set made out of 3 mm thick MS sheet complete with inlet and outlet connections,
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drain plug, manhole, etc. & suitable for mounting on floor with mounting pedestals. Wire-braided hoses shall also be supplied with fuel tank.

BATTERIES:

For electrical control circuit of 24 volt DC, 2 Nos. batteries of 12 volts 180 AH for each set respectively (dry and uncharged) of approved make with battery leads for electrical starting of each DG Set.

19. DIESEL GENERATING SET

1. DESIGN

1.1 The engine alternation set shall be capable of working at ambient temperature between 0°C to 50°C and relative humidity upto 95%.
The operating capacity of each set shall be arrived at after considering a load with power factor of 0.8 lagging, and after taking into consideration suitable derating on account of above parameters of the station.

1.2 The engine/alternator set shall be capable of taking 10% over-load for a period of one hour during any 12 hours period, while operating continuously at full rated load.

1.3 Nominal output voltage of engine/alternator set shall be 415 volts 50 Hz AC Supply with manual adjustment at all conditions of load with coarse and fine controls with a range of ±5%.
The frequency shall be maintained at 50 Hz ± 2% for the set.

1.4 The output wave-form shall be sinusoidal at all load conditions.

1.5 The engine/alternator set shall be selected for a high degree of performance with over all low fuel consumption for the normal life of the alternator set.

1.6 The engine/alternator set shall meet the requirements of all linear & non-linear loads, but over-sizing of the alternator in order to meet the non-liner characteristics of loads in not envisaged.

1.7 The Engine shall be capable to minimum 60% bulk load of the rating during transfer of the load from NO Load postion without tripping.

2. SYSTEM OPERATION

The set may be idle for a long time except for periodical test whenever there is a electrical supply failure, the set may required to run continuously for period even exceeding 24 hours.

3. SYSTEM FEATURE

The entire work shall confirm to Bureau of Indian Standards safety standards; British Standards, and C.P.W.D. specifications.

20 DETAILS OF ENGINE/ALTERNATOR

Scope

The scope of this section covers general requirement for reciprocating diesel engine and alternator complete with drive, safety controls, lubricating system, cooling system, instruments etc., including erection, testing and successful commissioning on load.
Diesel Engine

Diesel engine shall be multi-cylinder, 1500 RPM reciprocating, 4-stroke internal combustion conforming to BS 649 and shall be of welded construction or of fine grain cast iron. The crank case shall be of iron alloy, casting, crank shaft shall be of high tensile forging corresponding to medium carbon steel of 1045 (AISI) grade, Main B.E bearing shall be of high grade bearing material, connecting rod shall be of 1 beam high grade of drop forged steel corresponding to carbon steel of 1139 grade, cylinder liner shall be wet type cast alloy iron with specially machined groomed in the bores to serve as oil retaining surfaces, piston shall be of low expansion aluminum alloy with machined surfaces.

The engine shall be equipped with all required standard accessories:
- Fly wheel & housing
- Oil bath air cleaner
- Exhaust turbo charger & after coolers as called for.
- Flexible coupling and coupling guard
- Flexible connection between heat Exchanger and water pipe.
- Lubricating pump and fuel injection pump
- Nozzles

**Electronic / hydraulic Governor as called for in BOQ.**
- Oil pressure gauge and water temp gauge
- Fuel filter, fuel tank and fuel lines
- Turbo charged aspiration
- Water-cooled radiator/ Heat Exchanger as called for in BoQ.

**6 cylinders or as required.**
Other fittings as recommended by the manufacturer.

The lubricating system shall be positive pressure type for all moving parts. No moving parts shall require lubricating by hand, either prior to starting or while in operation.

The lubricating system shall consist of following major components.
- Oil pan
- Oil pump
- Oil filter
- Oil pipe/hose
- Oil cooler
- Piston cooling nozzle
- Oil temperature & gauge
- Oil pressure gauge
- By-pass filters.

Lubricating oil filter shall be provided for operation of 500 hour without any necessity of replacement or cleaning.

The engine shall be water cooled with Heat Exchanger. All standard accessories like inlet, outlet connection, fuel connection, drain plug etc. shall be provided.

Engines shall be suitable for running at 1500 RPM the speed of the engine shall be controlled by means of a governor which may sense the actual speed and make adjustment to the fuel system when required. The speed governing system shall be Class A hydraulic type as per BS 649. The maximum change in speed of engine shall be not more than 10% or 4% when the full load is either taken off or thrown ON temporary or permanently as the case may be.

The engine/alternator set shall be able to attain the steady speed within a time period of 3 seconds from the time load change takes place.

**Engine Starting**

The engine shall be self starting type. The starter motor shall conform to BS-2613-1970. Time required for starting of engine from cold conditions shall be 10-20 secs maximum.

**Fuel Tanks**

Fuel tank(s) shall be fabricated from 3 mm thick MS sheet and of 990 liters capacity. Fuel lines shall be of MS "C" class welded pipe & standard hose pipes. The fuel tank shall have all standard fittings like outlet, fuel return, drain & vent connection. The fuel tank shall also level indicator so as to indicate the quantity of fuel present in liters with calibration chart. It shall be
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provided with high & low level switches having potential free contacts for annunciation and also for auto control of fuel oil pump.

Exhaust System

Industrial type Air intake filter shall be provided in the turbo charger assembly of the engine unit. The exhaust system shall consist of turbo charger with cladded pipe inter connecting it with the cylinder head inlet. The exhaust manifold shall be suitably lagged and covered as well. The exhaust pipe shall discharge the exhaustible smoke at the top of the building.

The exhaust system, which carries away the products of combustion from the engine to the atmosphere, shall be such as to restrict the backpressure within prescribed limit (below 75 mm of Hg) to ensure proper engine operation. The exhaust system shall consist exhaust pipe, flexible pipe of minimum 30 cm length, and exhaust noise suppressor silencer, and catalytic converter.

The silencer shall be of hospital type, which can provide suppression in noise as per specifications. A test certificate to this effect shall be furnished.

The exhaust piping system shall have a provision of condensate trap with drain plug valves. Exhaust piping shall be insulated with a layer of 75 mm dia glass wool with aluminium cladding rope to minimize the heat radiated to the room.

DETAILS OF D.G.SET

Engine Instrumentation on Engine

- Speedometer with time totalizer.
- Lub oil pressure gauge.
- Lub oil temperature gauge.
- Cooling water temperature gauge.
- Battery Charger (Separate).
- Starting switch with key.
- Over speed relays.
- Run/Idle toggle switch

Alarms/Trip (Audio and Visual)

- Over speed.
- High Cooling water temperature.
- Low lub oil pressure.

Alternator

Screen protected, drip proof, 3 phase 415 Volts, 4 wire, 50 Hz, 0.8 p.f., 1500 RPM, self regulated, class H insulation, brushless alternator; continuous rating as per relevant Indian Standards, A removable gland plate shall be provided for the cables. Also an automatic voltage regulator at 415 Volts ± 2.5% shall be provided. Enclosure shall be as per IP-23. Rated voltage shall be 415 V suitable for 50° ambient temperature and overload capacity shall be 10% for one hour during 12 hours continuous running must have droop characteristics and others for synchronizing system and fine adjustment of voltages.

Exciter

Self excited, self regulated, providing alternator output regulation at plus or minus 2.5%, from no load to full load along P.F. between unity to 0.8 lagging, with 4% speed variable, of the engine. Solid state excitation system is preferred.

BATTERY CHARGING EQUIPMENT
Battery charging equipment should be incorporated in the generator control panel and shall comprise of:

AC and DC "ON" and "OFF" switches with HRC fuses.
Indicating lamps for indicating mains "ON" and battery charging.
Ballast to give charging.
Single phase double wound (copper conductor) impregnated natural air cooled mains transformer for rectifier stock.
Rotary switch to give step control.
Single phase full wave bridge connected silicon rectifier stack.
Moving coil ammeter to indicate charging current.
Moving coil Voltmeter with a selector switch to measure the battery/charger voltage.
Silicon blocking diodes connected to a suitable tap to maintain continuity of DC supply. Trickle and boost arrangement must be there.
AC and DC contactors of suitable rating as required

SPECIFICATION OF MATERIALS

Exhaust Silencer Piping
The exhaust silencer piping system shall be of heavy duty MS pipes confirming to Class C. Suitable length of flexible piping shall be used for connecting the exhaust piping to the engine as per the recommendations of the manufacturer. MS screwed flanges and bends shall be used as per site requirements.
Exhaust pipe inside the building shall be lagged with 75 mm dia glass wool with aluminium cladding and suitably bonded with asbestos cloth.

Water Piping and Oil Piping
Water Piping shall be of C class MS pipe. Oil piping shall be of MS or braided flexible type only. Cooling water and oil piping shall be tested in accordance with ASA-B 31.1 pressure piping code.

Wiring
All the wiring outside the panel shall be drawn to 16 gauge MS conduits.
The minimum size of wires outside the panel shall be 2.5 sq.mm stranded copper conductor.
The minimum size of control cables inside the panel shall be 1.5 sq.mm stranded copper conductor.
All the wires and cables suitable for 650/1100 Volts. As per IS-694-1990 latest amendment.

INSTALLATION OF GENERATING SET
The engine and alternator shall be mounted on specially designed common MS base plate and frame of extremely rigid welded construction, so as to provide no deflection.
The engine/alternator set shall be installed over the Dunlop-make, S-type anti-vibration cushion base in order to isolate the transmission of vibrations to the floor or building structures.
The exhaust system shall be designed and installed in such a manner that it avoids excessive stresses on the exhaust manifold of turbocharger, washing spray or any other source. The exhaust pipe shall pass through an oversized collar, filled with glass wool when crossing floor/wall. All exposed metal parts shall be suitably painted to prohibit corrosion under the climatic conditions at site. The installation of fuel piping, power distribution and control panels shall be carried out in accordance with the specification of respective items.

**PRELIMINARY TRIALS**

After completion of erection of generating sets and before carrying out main trials, preliminary trials shall be conducted in the presence of the ENGINEER-IN-CHARGE and the results shall be recorded in the test sheet at 30 minutes intervals. Alternator efficiencies as determined in works test shall be used as the basis of calculation for fuel consumption rate. A tolerance of 15% shall be allowed on the fuel oil consumption to cover possible errors of measurement.

Tests providing the satisfactory performance of all safety and operating controls shall be carried out. Governor trials shall be carried out as laid down in BS : 639. Alternator insulation resistance and commutation check shall be as per BS 2613/BS 5000. Starting time of sets shall be tested at least five times the sufficient time integral to allow for cold start. On completion of tests, inspection doors shall be removed and running gears inspected and alignment has to be checked. An further reasonable trial as suggested by the Client shall be carried out with no extra charges. All instruments, materials and labour required for carrying out the trials shall be provided by the Contractor. Test sheets of trials shall be forwarded in quadruplicate to ENGINEER-IN-CHARGE. The successful bidder has to submit a list of recommended spares to client for purchasing the same. A set of tools and tackles has to be supplied alongwith each set. List of recommended spares shall be indicated to client.

**DAY SERVICE TANK**

Day service tank shall be of 3mm thick MS sheet fuel oil storage tank of capacity 990 liters for each set with all accessories such as oil level indicator, inlet pipe connection, outlet pipe connection, with gun metal valve through to collect split oil, air vent pipe, manhole with cover, low level and full level float valve arrangements and interconnections between tanks and painting. The tank shall be provided with Suitable calibration scale. The tank shall be fabricated from 3mm thick MS sheet.

**FOUNDATION**

Foundation shall be casted as per the recommendations of the manufacturer in consultation with the Supplier and as per the requirements of the site. The successful bidder shall submit detailed foundation drawings within 7 days of award of work.

**PAINTING**

The Contractor shall paint all exposed metal parts and equipment supplied by him. All sheet metal work shall undergo a process of phosphating, passivating and then sprayed with high corrosion treatment of two coats of synthetic enamel paint of approved colour. All piping shall be colour coded.

**24 VOLTS DC BATTERIES & BATTERY CHARGER**

Lead acid type batteries, 2 x 12V - 25 plate : 180AH as required conforming to IS shall be provided for each set for starting purposes as per requirements. These batteries shall be fitted with electrolyte (specific gravity 1.280) and initially charged, discharged and recharged and placed in suitable enclosure, in ready to use shape.
**SHOCK TREATMENT CHART**

Shock treatment chart explaining the method of shock treatment in English, Hindi and local language shall be provided duly framed in glass in the diesel generating station.

**WIRING**

Providing conduits and drawing wires for the following:
- Control wiring between diesel generating set and the automatic mains failure panel.
- All wiring associated with the fuel oil transfer pump and including level controllers and circulating water pumps.
- All wiring associated with DC supply.
- All earthing conductors associated with this installation.
- All wiring and cables shall be PVC insulated stranded copper conductor wires and cables suitable for 660/1100 volts minimum size of wires for control wiring shall be 2.5 sq.mm and minimum size of wire for pumps shall be 4 sq.mm. The wires would be as per IS.

**CABLES**

MV cables shall be XLPE aluminum conductor armoured cables, laid in trenches between diesel generating set and DG panel. All power & control cables will be rated for 1.1 KV grade. Storing, laying, jointing procedures as same as that for the LT cables stated elsewhere.

**TEST PERFORMANCE**

**Scope**

This section lay down the procedure for conducting test on the installation. In general the procedure laid down here shall be followed. However, if manufacturer of the equipment has prescribed different procedure which is at variance, the same may be adopted. All required artificial load, testing equipment other required material required for testing purpose shall be supplied by agency.

**Physical Test**

- Particulars such as name plate details of all major component equipment shall be recorded and compared with what has been offered by the contractor as per agreement.
- Level of foundation.
- Firmness of mounting.
- Verticality of installed set.
- Tightness of nuts & bolts.
- Proper installation of exhaust pipe.
- Insulation of exhaust pipe with 75 mm dia glass wool with aluminium cladding.
- Provision of guard on engine/alternator set coupling joints.
- Termination of various cables.
- Rating of various fuses.
- Termination of earth leads on neutral & body.
Earth Resistance

The resistance shall be measured by isolating the connecting earth lead in respect of all earth stations.

Run Test

The engine shall be given a test run continuously for at least six hours with alternator supplying full rated load. During this run following observation shall be recorded.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>ITEMS</th>
<th>TIME AFTER START OF RUN/TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 Hr</td>
</tr>
<tr>
<td>1.</td>
<td>Lubricating oil pressure</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Exhaust gas colour</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Speed engine</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Output voltage</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Load current</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Load (KW)</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Noise Level (DB)</td>
<td></td>
</tr>
</tbody>
</table>

Stator Temperature Rise Test

The alternator shall be loaded of full rated load and stator (alternator) body temperature be recorded as under at intervals of 30 minutes till such time that there consecutive readings are the same.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>TIME (Hr)</th>
<th>AMBIENT TEMP (ºC)</th>
<th>STATOR TEMP (ºC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The temperature rise shall be maintained with in 60ºC above the ambient.

Fuel Consumption Test

Fuel consumption for half an hour shall be measured after the full load operation condition have stabilized.

During this measurement the load shall be maintained unchanged.

The fuel consumption shall be compared with values given in the technical particulars.

Over Load

Over load test to the extent of 10% over the rated load shall be conducted immediately after the full load run test.

The various parameters as in the case of run test shall regularly be monitored and recorded.

After the over load test, the load shall be normalized to rated value and all parameters recorded.

Insulation Test

Insulation test shall be conducted after testing the engine/alternator set at overload.

The insulation resistance between the starter coil and from shall be measure with 5000 volts meggar.

The insulation resistance of alternator winding shall be not below:
Rated output voltage + 1 Mega Ohms
\[
\frac{1000 \times \text{Rated out in KVA}}{1000 + \text{Rated out in KVA}}
\]
Intermodal (IWT) Terminal

- Insulation resistance of control wiring with 500 volts meggar shall be measured. Which shall not be less than one mega ohms.

**Regulation Test**
- The voltage regulation from no load to full rated load at 0.8 p.f. and from no load to half the rated load at 0.8 p.f. shall be measured between phase & neutral under automatic and manual regulation mode, which shall not exceed 0.5% of the nominal rated output voltage.
- In automatic regulation mode, the recovery line shall be noted which shall not exceed 3 seconds.
- The frequency of output supply of various load conditions shall be noted and recorded.
- The variation shall be compared with the accuracy standards specified.
- Change in speed of engine with change in load shall be observed and compared with standard reading for the speed governor.

**Data Sheet:**
Vendor’s shall fill in the performance data in the block columns of the attached Data sheets.

**21. ACCOUSTIC ENCLOSURE**

**Construction Details**

The Structure is fabricated using CRCA sheets of 14/16 SWG Thickness and steel members. The enclosure is fabricated on a MS Channel Frame work further strengthened by suitable cross members to make it robust and sturdy. Rock wool / Mineral wool of suitable thickness and density conforming to IS 8183 is used for acoustic insulation to reduce the sound level to 68 – 70 dB from the original sound level of 105 – 110 dB, when measured at 1mtr.distance from the D.G. Set. The acoustic enclosure consists of the following:

- **Acoustic Insulation:**
  - High density Fireproof Acoustic Enclosure Material i.e. resin bonded rock wool / fiber glass wool (75 – 100mm thick of 64Kg/m³ density) conforming to IS:8183 is provided on all doors and roof to absorb noise. The insulation material used is fire retardant. The insulation is covered with fiber glass cloth and is supported by perforated sheet. Sound attenuators / down stream silencers are provided at all openings for air inlet/outlet to facilitate free air flow but to absorb sound resulting in extremely low noise level. Detachable partitions are provided inside the enclosure to attain further noise attenuation of the engine.

- **Noise Suppressor:**
  - A suitably designed absorption type Hospital noise suppressor is provided which minimize the exhaust noise of the engine.

- **Exhaust System:**
  - The exhaust gas is taken out through a specially designed flexible pipe, which prevents any back pressure on the engine.

- **Thermal Insulation:**
  - The exhaust system and noise suppressor is provided thermal insulation by using glass wool & covering it with Aluminum sheet. This prevents it from radiating excess heat on the engine, makes it safe for the operator and enhances aesthetics.

- **Surface Treatment:**

---

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Intermodal (IWT) Terminal

The enclosure is surface treated and painted with high quality polyurethane epoxy paint with prior zinc oxide primer base, which make it weather proof and suitable for outdoor application. The paint is highly resistant to acids, alkaline, salt sprays, halogens, solvents, lubricants etc and has very good dielectric properties and is resistant to abrasion and cracking.

f) Air Circulation & Ventilation System:

A suitable forced air circulation and ventilation system is designed to maintain safe operating temperatures inside the enclosure. Requisite air circulation for engine aspiration combustion and cooling is provided by means of Exhaust fans or tube axial fan driven by a 3 phase squirrel cage induction motor according to need of engine.

g) Vibration Isolation:

The engine and alternator is mounted on Anti-Vibration Mounting pads to eliminate engine vibration.

h) Hardware:

Inlet and Outlet for cable, draining of lube oil and diesel etc. are provided. The doors are gasketed with high quality EPDN gaskets to avoid leakage of sound. All doors are lockable.

i) Testing / R&D:

The Gen set shall be thoroughly tested on load before it is dispatched from factory.

<table>
<thead>
<tr>
<th>Technical Data Sheet</th>
<th>Project:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel Generator (Alternator)</td>
<td>Date:</td>
</tr>
<tr>
<td>250 KVA</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Item</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Serial</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Type</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Make</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Voltage, Phase, Frequency</td>
<td>415V,3PHASE, 50Hz</td>
</tr>
<tr>
<td>5</td>
<td>Normal Continuous Rating</td>
<td>250KVA</td>
</tr>
<tr>
<td>6</td>
<td>Starting KVA</td>
<td>(PLEASE SPECIFY)</td>
</tr>
<tr>
<td>7</td>
<td>Manufacturer</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>MAXIMUM VALUE OF MOTORLOAD WHICH DOESNOTAFFECT STARTING</td>
<td>(PLEASE SPECIFY-minm. 60% of the rating)</td>
</tr>
<tr>
<td>9</td>
<td>Power Factor</td>
<td>0.8</td>
</tr>
<tr>
<td>10</td>
<td>Class of insulation</td>
<td>H</td>
</tr>
<tr>
<td>11</td>
<td>Efficiency &amp; losses at 0.8 p.f. and</td>
<td>AS REQUIRED / PER IS. Actual</td>
</tr>
</tbody>
</table>
**Intermodal (IWT) Terminal**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>1/4 th Full load</td>
</tr>
<tr>
<td>b)</td>
<td>½ th Full load</td>
</tr>
<tr>
<td>c)</td>
<td>¾ Full load</td>
</tr>
<tr>
<td>d)</td>
<td>Full load</td>
</tr>
<tr>
<td>12</td>
<td>OVERLOAD CAPACITY</td>
</tr>
<tr>
<td>13</td>
<td>Build up time for voltage from no load to full load</td>
</tr>
<tr>
<td>14</td>
<td>NO. of hours alternator can be run with no increase in temp under 10% over load</td>
</tr>
</tbody>
</table>

**Prepared by:**

**Name:**

**Date:**

**Format no:**

**Page 1 of 5**

**LIST OF PREFERRED MAKES OF MATERIALS of Electrical Works**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>6.6 KV HT Panel with VCB / SF6 Circuit Breaker</td>
</tr>
<tr>
<td></td>
<td>Kirloskar/ Siemens / Schneider / ABB/Tricolite/CGL/Advance/Areva</td>
</tr>
<tr>
<td>2</td>
<td>Dry Type Distribution Transformer 6.6KV/0.433 KV</td>
</tr>
<tr>
<td></td>
<td>Kirloskar/ Crompton Greaves / Siemens / Voltamp / BHEL</td>
</tr>
<tr>
<td>3</td>
<td>Hermetically Sealed Transformer;(11KV/0.433 KV)</td>
</tr>
<tr>
<td></td>
<td>Crompton Greaves/ Kotsons/ Danish/Sudhir IVL</td>
</tr>
<tr>
<td>4</td>
<td>Package Substation</td>
</tr>
<tr>
<td></td>
<td>Schneider / ABB / Voltamp/ Sudhir</td>
</tr>
<tr>
<td>5</td>
<td>Cubical Type PLC / L.T. Panel/ Synch. Panel</td>
</tr>
<tr>
<td></td>
<td>Tricolite / Adlec / L&amp;T / Zeta / Milestone / Advance/Schneider/C&amp;S</td>
</tr>
<tr>
<td>6</td>
<td>ACB with Variable Integral Releases for Protection</td>
</tr>
<tr>
<td></td>
<td>Schneider Electric / ABB/Siemens/Mitsubishi/ L&amp;T</td>
</tr>
<tr>
<td>7</td>
<td>MCCB with Variable (Static/T.M. Based Releases</td>
</tr>
<tr>
<td></td>
<td>ABB / L&amp;T / Schneider Electric/Siemens</td>
</tr>
<tr>
<td>8</td>
<td>By Pass Switch &amp; ATS</td>
</tr>
<tr>
<td></td>
<td>L&amp;T / GE / MDS / Schneider electric/Mitsubishi/ASCO</td>
</tr>
<tr>
<td>9</td>
<td>Measuring Instruments (Digital &amp; Analogue both)/ Dual type Energy Meter</td>
</tr>
<tr>
<td></td>
<td>AEI / Enercon / Secure/ Trinty/L&amp;T</td>
</tr>
<tr>
<td>10</td>
<td>Panel Accessories</td>
</tr>
<tr>
<td></td>
<td>Siemens / L&amp;T/Schneider/HPL</td>
</tr>
<tr>
<td>11</td>
<td>Protective Relays</td>
</tr>
<tr>
<td></td>
<td>ABB / Siemens- Epcos / L&amp;T / Areva.</td>
</tr>
<tr>
<td>12</td>
<td>Capacitor</td>
</tr>
<tr>
<td></td>
<td>ABB/ L&amp;T / Epcos/ Schneider/Ducati/Khatau/Asian</td>
</tr>
<tr>
<td>No.</td>
<td>Description</td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>13</td>
<td>APFC Relay (Digital Micro Processor Based)</td>
</tr>
<tr>
<td>14</td>
<td>Control Fuses with Base</td>
</tr>
<tr>
<td>15</td>
<td>Selector Switch</td>
</tr>
<tr>
<td>16</td>
<td>CT's (Cast Rasin)</td>
</tr>
<tr>
<td>17</td>
<td>Contactors</td>
</tr>
<tr>
<td>18</td>
<td>Terminal Strip</td>
</tr>
<tr>
<td>19</td>
<td>MCB, DB's &amp; Industrial Socket Outlets</td>
</tr>
<tr>
<td>20</td>
<td>Programmable Timer (Self Powered Electronic Digital)</td>
</tr>
<tr>
<td>21</td>
<td>Auxiliary Relays (Digital Type)</td>
</tr>
<tr>
<td>22</td>
<td>Switch Fuse Unit</td>
</tr>
<tr>
<td>23</td>
<td>Motor Starters</td>
</tr>
<tr>
<td>24</td>
<td>Microprocessor Based PLC Logic</td>
</tr>
<tr>
<td>25</td>
<td>11 KV Gang Operated Switch &amp; Drop Out Fuse</td>
</tr>
<tr>
<td>26</td>
<td>11 KV Insulator</td>
</tr>
<tr>
<td>27</td>
<td>XLPE Al. Conductor Cable 11 KV grade</td>
</tr>
<tr>
<td>28</td>
<td>XLPE Al. Conductor 1.1 KV Grade</td>
</tr>
<tr>
<td>29</td>
<td>Jointing Kit XLPE (11KV)</td>
</tr>
<tr>
<td>30</td>
<td>Brass Compression Gland (Heavy / Medium Duty)</td>
</tr>
<tr>
<td>31</td>
<td>Crimpling Lugs / Thimbles</td>
</tr>
<tr>
<td>32</td>
<td>Battery Charger</td>
</tr>
<tr>
<td>33</td>
<td>Sealed Maintenance Free Battery</td>
</tr>
<tr>
<td>34</td>
<td>Land Acid Battery</td>
</tr>
<tr>
<td>35</td>
<td>Cable Tray</td>
</tr>
<tr>
<td>36</td>
<td>G.I. Strip &amp; Earthing Material</td>
</tr>
<tr>
<td>37</td>
<td>PVC Conduit (ISI)</td>
</tr>
<tr>
<td>38</td>
<td>M.S. Conduit</td>
</tr>
<tr>
<td>39</td>
<td>Modular Plate Switch Socket with Switch Boxes.</td>
</tr>
<tr>
<td>40</td>
<td>Industrial Sockets Outlets</td>
</tr>
<tr>
<td>41</td>
<td>Copper Control Cable</td>
</tr>
</tbody>
</table>
## Intermodal (IWT) Terminal

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Approved Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>PVC Insulated Copper Wire 1.1 KV Grade (FRLS)</td>
<td>Finolex / Polycab/ Skytone/ Bonton/ Belden/RR Kable/ National/ Delton</td>
</tr>
<tr>
<td>43</td>
<td>Telephone Cable Multipair</td>
<td>Belden / Delton / Skytone / Bonton</td>
</tr>
<tr>
<td>44</td>
<td>CAT-5E / CAT-6E Wire</td>
<td>AMP / Delton / Skytone/ Belden</td>
</tr>
<tr>
<td>45</td>
<td>Co-axial TV Cable</td>
<td>Commscope / Belden/Skytone</td>
</tr>
<tr>
<td>46</td>
<td>Telephone Tag Block with Boxes</td>
<td>Krone (German) / Pouyet</td>
</tr>
<tr>
<td>47</td>
<td>Tap-Off/ Splitter</td>
<td>Zinwell/ Novatron</td>
</tr>
<tr>
<td>48</td>
<td>a) Luminaries (Flourescent)</td>
<td>Philips / Wipro / Bajaj/Havells/ Crompton</td>
</tr>
<tr>
<td>49</td>
<td>b) Luminaries (Incandescent)</td>
<td>Artlite / Decon / GE/Bajaj/ Crompton</td>
</tr>
<tr>
<td>50</td>
<td>Ceiling Fan</td>
<td>Crompton Greaves / Orient /Havells/GEC/Usha</td>
</tr>
<tr>
<td>51</td>
<td>Exhaust Fans</td>
<td>Crompton Greaves / GEC/ Havells</td>
</tr>
<tr>
<td>52</td>
<td>Inverter</td>
<td>Microtek / Luminous / Su-kam</td>
</tr>
<tr>
<td>53</td>
<td>UPS</td>
<td>Emerson / A.P.C /Socomec</td>
</tr>
<tr>
<td>54</td>
<td>Poles</td>
<td>Bajaj/ Transrail/Reputed</td>
</tr>
<tr>
<td>55</td>
<td>Hand Gloves &amp; Rubber mat</td>
<td>ISI Approved</td>
</tr>
<tr>
<td>56</td>
<td>Fire Extinguisher</td>
<td>Ceasefire/Exflame/Minimax/Life guard/Safex</td>
</tr>
<tr>
<td>57</td>
<td>DG Set</td>
<td>JACKSON/SUDHIR/STERLING&amp;WILSON/ SUPERNOVA</td>
</tr>
<tr>
<td>58</td>
<td>MS &amp; GI Pipes</td>
<td>TATA/GST/Jindal</td>
</tr>
<tr>
<td>59</td>
<td>Fire Alarm Panel</td>
<td>System Sensor/ Cease Fire/ GST</td>
</tr>
<tr>
<td>60</td>
<td>Detectors &amp; Hooters &amp; Accessories</td>
<td>System Sensor/ Cease Fire/ GST</td>
</tr>
<tr>
<td>61</td>
<td>Lighting High Mast</td>
<td>Bajaj/Crompton/Philips</td>
</tr>
</tbody>
</table>

### NOTE:

Contractors are requested to take approval from Engineer-in-Charge before procurement from the list of preferred makes. However, if the listed makes is not available in market or due to shortage of supply, contractor may propose the equivalent make for approval of the Engineer-in-Charge. The decision of Engineer-in-Charge will be final and binding on contractors in this regard.
Cranes Specification

02. 3Ton Single Girder Under Slung crane

Technical Specification:

- Crane Type: SINGLE GIRDER UNDERSLUNG CRANE.
- Main Hoist Safe Working Load: 3Ton
- Span: 12 m
- Height of Lift: 6 mtrs.
- Bay Length: 30 m
- Class of Duty: II as per IS 807/3177
- Operation: Floor Operated from Pendant Push Button control Station.
- Location: Indoor
- Main Hoisting Speed: 3 m/min.
- Cross Travel Speed: 12 m/min
- Long Travel Speed: 12m/min
- Main Hoist Motor Rating: 3 HP
- Cross Travel Motor Rating: 0.5 HP
- Long Travel Motor Rating: 0.5HP x 2Nos.
- All Motors Type: Sq. cage, Crane Duty Motors,40% CDF,150 Siemens. for L.T. only
- Main Hoist, Cross Travel & Long Travel Brake Type: Electromagnetic D.C Brake
- Main Hoist Wire Rope Diameter: 13 mm..
- Main Hoist Number of Falls: 2 fall
- Wire Rope Construction: 6x36, FMC.
- All Wheels: Single Flange for CT & LT.
- Soft Starter for Long Travel: EMCO - KIMO
- Hook: Single shank, forged as per IS: 3815, Swiveling type
- Limit Switches (Hoisting / Cross Traverse / Long Traverse): Included
- Polyethylene Buffer on Long Traverse: Included
- Power / Control Voltage: 415V, 3Phase, 50Hz / 110V, 1Ph, 50HZ
- Power Supply for L.T.: GI – 4 Way Shrouded bus bar
- Painting / Surface treatment: 1. Scrubbed with wire brush .
2. Surface cleaned with cleaner Solutions.
3. Two coats of reinforced polymer based paint.
- Wire Rope: Usha Martin.
- LT motion: Twin Drive
- Platform: N.A.
- Gear & Pinion Material: EN-9 and EN-31
- MPCB: L&T / Siemens.(not included ).
- CONTACTORS: L&T / Siemens.
- VFD: L&T / Yasakawa make.
01.01 GENERAL AND INTENT OF SPECIFICATION

01.01.01 It has been envisaged to install a Double Girder EOT Crane having class III duty in the operation of loading and unloading at the IWAI terminal.

01.01.02 The specification of the DG EOT Crane as envisaged is indicated in this document and the enclosed tender drawings.

01.02 SCOPE OF WORK

01.02.01 The scope of work of the Tenderer shall consist of design, manufacture, fabrication, procurement, inspection, shop testing, assembly, painting, supply and transportation to site, erection, testing & commissioning of Double Girder EOT Cranes complete with electrical equipment and standard accessories with attachments as per technical parameters.

01.02.02 Supply of DSL system along with fixing brackets and accessories for power supply to the crane.

01.02.03 The tenderer shall include necessary commissioning spares in his scope and submit the list of the same. If any more spares other that those indicated are required during commissioning, the same shall be supplied by the tenderer without any cost implication to the Purchaser.

01.02.04 The Tenderer shall also quote separately itemwise price for the supply of spares for 2 years of normal operation and maintenance for each crane. The list of such spares shall also be furnished along with the tender.

01.02.05 The scope of supply shall cover the required quantity of initial fill of lubricants, hydraulic fluid, other consumables as well as their replenishment necessary during erection, testing and commissioning of the crane.

01.02.06 The scope of supply shall cover all maintenance tools and tackles with tool box for normal maintenance or testing/inspection of the crane. A list of maintenance tools and tackles shall be furnished along with the tender. The price of same shall be included on the price of the equipment itself.

01.02.07 The scope of supply shall cover required quantity of paints for intermediate, final coat and retouching. All cranes shall be painted as per specification prior to dispatch.

01.02.08 Obtaining statutory clearance from statutory authorities shall be the responsibility of the supplier of the crane.

01.02.09 Supply of drawings and documents shall be as per instructions indicated in Clause No. 01.05.

01.02.10 Supply of insurance spares. (list to be furnished)

01.02.11 The scope of work shall stand supplemented by stipulations mentioned elsewhere in this specification or anywhere else in the tender document.
01.03 TECHNICAL SPECIFICATION OF DOUBLE GIRDER EOT CRANE

01.03.01 General

01 EOT Cranes shall be designed, manufactured and tested in accordance with the latest revision of IS:807-1976, 3177-1999 and 4137-1985.

02 The crane components shall be standardized to keep the number of spares to the minimum.

03 All parts requiring replacement or inspection or lubrication shall be easily accessible without the need of dismantling of other equipment or structures. All electrical cables shall be so laid that they are not liable to be damaged and can be easily inspected and maintained.

04 All components for cranes of identical capacity and duty shall be interchangeable. Cranes of the same capacity and duty shall be identical in all respect unless otherwise required.

05 No cast iron parts shall be used except for electrical equipment and no wood or other combustible material shall be used unless specifically mentioned otherwise. Deviations, if any, to this clause shall be permitted only with the specific approval of the Purchaser.

06 All machinery or equipment included under this specification must be equipped with safety devices and clearances to comply with recognized standards and Purchaser’s requirements along with safety codes and statues prevalent at the place of installation of the equipment.

07 For welded construction such as that of bridge girders, end-carriages, rope drums, gear boxes etc., steel shall be as per IS:2062-1992 quality.

08 All wheels, couplings, open gears etc. shall be provided with covers, opening on strong hinges. All heavy covers, shall be provided with inspection windows.

09 Where down shop leads are located below runway rails, guards shall be provided on the crane to prevent the hoist ropes from coming in contact with down shop leads.

10 All bolts except those with nyloc nuts shall be provided with grip lock nuts or spring washers.

11 For outdoor cranes all electrical and mechanical equipment which are exposed to weather shall be completely covered or made weather proof. The covers shall be segmental to facilitate easy dismantling and assembly.

12 The end-carriages shall be fitted with substantial safety stops to prevent the crane from falling more than 25mm in the event of breakage of track wheel, bogie or axle. These stops shall not interfere with the removal of wheels.

13 Fasteners for pedestal blocks, motors, gear boxes etc. shall be easily removable from the top. Studs of body bound bolts shall not be used as fasteners for mechanical items except for fixing cover.

14 Power & control cables shall be clamped in groups separately. All trailing cables shall be clamped with PVC or non metallic clamps. Group derating factor shall be appropriately taken according to the recommendations of the cable manufactures based on the method of laying and number of cables being laid together.
15 Guards of approved design, which will push forward any object placed across the track, shall be attached to each end of the end carriages.

16 Parts of steel frames carrying machinery shall be provided with doubling plates of adequate thickness, riveted or welded & machined to true surface.

17 Defects in the material like fractures, cracks, blow holes, lamination, pitting etc. are not allowed. Rectification of any such flaw is permissible only with the approval of the Purchaser.

01.03.02 **Structural Details**

i) The crane bridges shall be of welded double/single web box construction and shall be designed as per IS: 807-1976 and/or AISE No. 6. The materials of construction shall be weldable mild steel in compliance with the relevant standard. However, high strength weldable structural steel also may be used wherever required in compliance with the relevant standards.

In case the design of structures is based on IS: 807-1976, the following forces shall also be taken into consideration

a) Vertical reaction on trolley rail arising from surge load.

b) Skewing force.

c) Collision force due to buffer impact.

d) Additional vertical force due to tilting of trolley in case of rigid mast crane.

e) Torsional moment due to cantilever load, eccentric wheel load (in case of wide BOX girder), starting / stopping of LT motor.

f) Local bending stress of the flange.

Note: While calculating the allowable stress in compression, effective length of the compression flange the girder shall be taken as 0.85 of the span only.

ii) The crane bridge girders upto 12m span shall be in one piece. Girders above 12m span may be spliced. The number of such splices shall not exceed 2 upto 36m span. Beyond 36m span, Beyond 36 m span, the number of splices may be 3. Splices shall be designed to resist all the forces and moments to which it is subjected to, plus 50% thereof.

However, in no case the strength developed by the splice shall be less than 50% of the effective strength of the material.

Splices shall be proportioned and arranged so that the gravity axis of the splice is in line with the gravity axis of the members joined so as to avoid eccentricity of the loading.

iii) Black bolts shall not be used in the main structure of the cranes.

iv) Cross travel rail shall be fixed to the bridge girders by clamping only and not by welding. Full length wearing plates or resilient pads of min. 10m thick shall be provided under the trolley rails.

v) Transverse fillet welding on load carrying members shall be avoided. All butt welds on tensile zone shall be X-rayed.
vi) Plates, bars, angles and where practicable other rolled sections used in the load bearing members of structures shall not less than 6 mm in thickness.

vii) The end-carriages shall be of double web plate box construction and shall be connected to the girders by welding at shop of by large gusset plates and fitted bolts to ensure maximum rigidity. Drop stops & jacking pads built-in features of the cranes. Full length chequered plate platforms shall be provided along both sides of the cranes in order to ensure easy access to crane crab, long travel gears and other parts. Safety railings shall be provided on crane bridges and crab frame. Access to the operator's cabin shall be via stair cases only and not through ladders. Platforms to facilitate inspection and dismantling of long travel wheels and main current collectors, shall be provided.

viii) The crab frame shall be made of steel plates and rolled sections in welded construction. Crab frame shall be fabricated in one piece if there are no transport limitations. If the trolley is fabricated in more than one piece due to transport limitation, the design of the splice shall be such that one unit of mechanism mounted on one part of the trolley, does not come over the other part.

ix) Foot walks shall be of sufficient width to give at least 500 mm clear passage at all points except between railing and bridge drive where this clearance may be reduced to not less than 400 mm.

x) The platforms along the bridge girders and over the crab shall allow convenient access for replacement, inspection, lubrication etc. for different mechanical and electrical components.

xi) The minimum thickness of chequered plates shall be 6 mm O/P for indoor cranes & 8 mm O/P for outdoor cranes.

01.03.03 Mechanical Details

i) Rope drums
Rope drum shall be of cast steel or fabricated out of rolled steel plates. Fabricated drum shall be stressed relieve before machining. The grooves of the drum shall be smooth finished. Rope drum shall be flanged at both ends.

ii) Rope sheaves
Rope sheaves shall be of cast steel or fabricated out of rolled steel plates.

iii) Wire ropes
The rope shall be hemp cored for all the cranes except hot metal cranes (where these shall be steel cored). Hot metal cranes shall be provided with double rope system, each system capable of sustaining full load safely. Also the ropes, working under water and in corrosive atmosphere, shall be galvanized and shall have steel core. Rope shall be regular right hand lay as per IS:2266-1989. The construction of the ropes shall be 6 x 37 upto 16 mm diameter and 6 x 36 above 16mm diameter.
iv) **Hook Block**
The sheaves shall be fully encased in the close fitting guards fabricated out of steel plates. Smooth opening shall be provided in the guards to allow the free movement of rope and holes shall be provided for drainage of the oil;

v) **Gears and gear-boxes**
Straight and helical spur gearing shall be used for all motions. Worm and bevel gearing may be used in exceptional cases with the specific approval of the purchaser. All first reduction gears shall have helical teeth. All pinion shall be integral with the shaft.

All gears shall be hardened and tempered alloy steel having metric module. Overhung gears shall not be used.

Surface hardness for pinion shall be 255 to 300 BHN and for gears it shall be 215 to 260 BHN. Difference in hardness of pinion and gear shall not be less than 20 BHN. All cast steel gear shall be tested by German Ray. All gear shall be enclosed in oil tight gear boxes. Gear boxes shall be of high grade cast iron/cast steel or fabricated and split at each shaft centre lines. Fabricated gear boxes shall be stressed relieved before machining. For cross travel and long travel motion, vertical gear boxes with 'T' split may be used. Hosting motion of hot metal and four rope grab cranes shall be preferably by means of planetary gear box.

vi) **Connection between rope drum and gearbox.**
One of the following arrangements shall be adopted for connecting the rope drum with the gearbox.

a) Flexible joint, incorporating flexible geared coupling housed within the drum.
b) Fully flexible geared coupling between the drum & gearbox.

Drive of the drum by means of spur ring mounted on the drum shall be avoided as far as practicable.

vii) **Wheels**
Crab/Crane wheels shall be double flanged. Wheels shall be mounted in anti-friction roller bearing housed in ‘L’ shaped bearing brackets for easy removal during maintenance. Flangeless wheels with the guide rollers are also acceptable.

Solid wheels shall be forged rolled/cast steel. Wheels from 400mm diameter and above may consist of hardened, rolled/forged steel tyre of not less than 60mm thickness, shrunk on to cast iron/cast steel centre.

viii) **Coupling**
Motor shaft be connected to the gear box with input shaft through flexible shock absorbing coupling excepting pin bush type. Rotating parts shall be suitably covered by 3.15 mm thick sheet steel hinged covers for safety. In case of single motor central drive for long travel motion, output shaft of the gear box shall be connected to the line shift through half geared couplings. Intermediate length of the line shaft may be connected through solid flange couplings. Half geared couplings with floating shaft shall be provided between the wheel and the line shaft.
ix) **Bearing & bearing housing**

Anti-friction bearings shall be used throughout except where required otherwise for technical reasons.

xi) **Buffers**

Spring loaded type buffers shall be provided on all the 4 corners of the bridge girders and the end carriages for the cross and long travel motions respectively. For cranes of M1, M2 and M3 duty class, rubber buffer may be used.

xii) **Brakes**

The brakes shall be provided for all motions on the high speed pinion shaft of the gear train. For hot metal hoists, two brakes shall be used per motor.

xii) **Lubrication**

Duel line hand operated grease lubrication system shall be used for all the bearings for class M5 to M8 duty cranes. Grouped lubrication system shall be used for the class M1 to M4 duty cranes. Lubrication of the gears and pinions in the gear boxes shall be splash fed from the sump. In case of three stage reduction or more, vertical mounted gear-box (having limited motion), are used, an oil pump shall be fitted to ensure lubrication of all gears.

01.03.04 **ELECTRICALS DETAILS**

i) **Scope of Supply**

The scope of supply covers all electrical equipments commencing from MCC feeder including the cables, isolators DSL and all electrical items beyond the main current collectors of the crane i.e. DSL main current collectors, power disconnecting switch on bridge platform after main current collectors, protective and control switch gear, motors, control and brake panels, resistors, brakes, limit switches, all power and control cables, socket outlets, lighting distribution panel and lighting fixtures with lamps, festoon cable system for crane trolley magnet/grab and cable reeling drum, if specified for grab/magnet, master controllers, indicating lamps, push buttons, earthling materials etc. The scope of work also includes complete assembly and wiring of crane and testing at manufacturer’s works, erection, testing and commissioning of all electrical equipment, supply of all commissioning spares with minimum quantities as indicated in the clause no. 01.02.03 of this T.S.

All sundry erection materials required for installation and connecting up of electrical equipment with cable laying and fixing accessories shall be included in scope of supply by Tenderer.

ii) **Standards**

The design, manufacture, assembly and testing as well as performance of the equipment shall conform to the IPSS in respect of items for which IPSS have been issued, otherwise, to the relevant IS specifications ( latest revision). In case the Tenderer is not in a position to comply fully with certain IPSS/BIS specifications, or in respect of certain items for which there are no IPSS/BIS specifications, the Tenderer may base his proposals on IEC
recommendations or other reputed national or international standards subject to the approval of the Purchaser.

All equipment supplied and all work done including system design and detailed engineering shall also comply with the statutory requirements of the Government of India and the Government of Gujarat and with the Indian Electricity rules.

iii) **Climatic Conditions**

The equipment offered shall be suitable for smooth, efficient and trouble free service in the tropical humid climate prevailing at site and under the ambient temperature conditions indicated above for the different shops and areas. In hot areas of higher temperature conditions, the equipment shall be adequately protected against damage from radiant heat and hot air.

iv) **Power supply and Standard voltage levels**

The following standardized voltage levels shall be adopted:

a) LTAC: 415V, 3 phase, 50Hz, 4 wire solidly earthed system. Power supply be made available at this voltage only. Other voltages shall be obtained by providing transformer/transformer – rectifier unit with MCBs on both primary and secondary side and ± 5% and ± 10% taps on transformers secondary.

b) AC control and signaling voltage: 240V, 110V

c) Socket outlets for Hand lamps: 110V, single phase, 50Hz, AC obtained through suitable transformers

Hand tools: 240V, 15A, 2 pin plus earth with plug interlocked switch

d) Electro-magnetic brakes: 220V, DC obtained through individual brake control panels

e) Illumination/ lighting: 240V, AC

The three phase symmetrical short-circuit ratings of the switch gear at 415 V shall be 50kA for 1 second.

The system / unit/ equipment shall be designed so as to be suitable for the following variations in voltage and frequency:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>± 10%</td>
<td>± 3% &amp; - 6%</td>
</tr>
</tbody>
</table>

Permissible variations with rated performance, rated current and control effectiveness maintained

Permissible variations for control and regulation equipment with rated performance and control quality maintained
Voltage dip on the starting of largest LT motor shall be limited to 20% of the nominal voltage at the motor terminals. Total voltage dips on starting of large motors on crane shall be limited to 3% on crane and 6% in DSL system.

v) Trolley lines and power supply arrangements for cranes (DSL system)

01. Trolley power conductors

SFU shall be provided for at the incomer feed point to crane DSL by the tenderer. Supply and laying of incoming cable to DSL is included in the scope. Purchaser shall provide necessary feeder in the MCC at 0.00 floor.

Isolator panels shall be provided for the repair section for maintenance by the Purchaser. Necessary DSL arrangement for repair section shall be provided by Tenderer.

Boarding or access platform shall be arranged within the limits of each repair section for approach to be crane.

The conductors shall be supported at 3000mm intervals by insulators mounted on brackets welded to crane girders. Typical drawings indicating details of trolley line power conductors, supporting insulators, brackets, expansion joints, parallel aluminum bus, signal lamp assemblies etc. shall be furnished to successful Tenderer.

Trolley power conductors shall be of mild steel angle sections. The section shall be straight, unbranded and smooth on the running surface. Joints between lengths of angles shall be welded and all welds shall be finished flush with parent metal. The conductors shall be painted with anticorrosive paint, except for contact surface. Parallel aluminum buses shall be provided as specified. The maximum continuous length of power conductor section shall not exceed 30m without an expansion joint in between. The power conductors shall be made from standard rolling length. The jointing of standard lengths shall be made by 100% but welding and top surface finished smooth by grinding to get free movement of the current collectors.

In order to provide electrical continuity across the expansion joints the power conductors on both sides of the joints shall connected by stranded aluminum conductor jumper, fitted with steel aluminum strap and lugs suitable for the steel angle sections.

02. Insulators and trolley line holders

The insulators used for the manufacture of trolley line holders shall be preferably steatite, tufnol or porcelain insulation material having substantial mechanical strength specifically against blows and vibrations. They shall be capable of withstanding the impact and shocks resulting from operation of the machine. The creepage distance of the insulators shall not be less than 80mm.

The insulators used shall have flash over values and mechanical strength not less than the following:

- Dry flashover voltage : 25kV
- Wet flashover voltage : 12kV
Ultimate mechanical strength : 1000kA

The trolley line holders shall generally conform to the design shown in the drawing to be furnished to the successful Tenderer. All sharp edges shall be ground smooth. The porcelain insulators shall be manufactured and tested as per IS: 1445-1997.

03. Supporting Brackets

The trolley line conductors shall be mounted on holders. The holders shall be bolted on to brackets which in turn shall be welded on to crane girder at stiffeners at regular intervals. In normal run, intermediate type of brackets shall be used, but when sectionalizing gaps or expansion joints are provided, sectionalizing type of brackets shall be provided.

04. Steel to Aluminum Straps

These are meant for connecting parallel aluminum bus at expansion joints, power supply cables from load break switch. They shall be complete with MS cadmium coated bolt nuts, spring washers, lugs etc.

05. Signal lamp assembly

Signal lamp assembly shall be industrial, heavy duty dust tight and water proof in construction suitable for indoor or outdoor locations. The units shall comprise three lamps for three phase with red glass lens and reflectors. The lamp shall be provided with dropper resistance connected in series with the lamp and the resistance shall be rated for continuous inclusion in the circuit. Alternatively, a built-in transformer may be provided to suit the lamp voltage.

06. Aluminum Parallel Bus

These buses shall be of E.C. grade aluminum. They shall be free from any deformity in profiles.

vi) Current Collectors

2 nos. per trolley line shall be provided. The collector shoe will be of heavy duty design and chamfered at both ends, each rated for 100% of total crane rating. Double collectors on each earth trolley line shall be provided and these shall be different from those on power trolley line. Collector shall be multi hinged for self-aligning. Collector will be designed in such a way that load is transmitted not on the insulators but on the insulator stud to avoid damage to insulators.

vii) Power distribution on crane

One adequately rated load break manual isolator with locking facility shall be provided immediately after current collectors on incoming line on the crane.

Power from the isolator shall be taken to the MCCB/ SFU to be provided in protective panel located at bridge platform.

The MCCB shall be provided with under voltage, over load and short circuit releases. The breaker can be closed only when:
- All master controller handles are in neutral position
- None of the stator or directional contractors are in closed positions
- Emergency corner switches not operated
- Door/Gate switch are not actuated.
- Gravity limit switch for hoist motion not operated
- Power for lighting and magnet circuits shall be tapped from the incoming side of isolators near current collectors.

viii) Power supply for C.T. motion

Flexible trailing cable systems mounted on retracting support system shall be used. The system shall consist of insulated multi-conductor or several single conductor cable with permanent termination on the bridge and on the trolley. The flexible trailing cables shall have ample length and shall be supported by means of properly designed movable clamps. These clamps shall be fitted with rollers and shall run freely on a guide rail allowing relative movement of bridge and trolley without undue stress or wear on the suspended cable. Provision shall be made for inclusion spare cable at a later stage in case of necessity. The flexible cable shall be butyl rubber or EPR insulated CSP sheathed type.

ix) Meters

Ammeter and voltmeter with selector switches shall be provided on the incoming line in operator's cabin.

Ammeter and voltmeter shall be provided on DC side for Electromagnets.

x) Control features

All controls shall be fully magnetic, operated through master controllers. All travel motions shall be provided with plain rotor resistance control with plugging. For long travel drives, the electrical control shall be grouped for the individual pair or motors separately in case of four motor drive and each pair of motors shall be able to drive the crane at reduced acceleration and speed. As an anti-skewing measure, out of a pair of motors for L.T., if one drive motor trips, the other drive motor shall also be switched off. For pendant control, plugging shall be avoided for travel motion.

Brakes shall not be used for speed control.

Synchronization of separate drives where required shall be done with the use of solid state thyristor control.

For all hoist motions, except where creep speed is required, plain rotor resistance control shall be provided on all master controller notches in the hoisting direction. The rotor resistance shall be cut out gradually when moving from lower to higher notches such that current peak of 2 times the rated current is not exceeded. In the lowering direction of the motion, controlled lowering shall be provided using one/two plugging notches, one single phasing notch and one/two super synchronous power lowering notches. For obtaining creep speed, conventional methods like planetary gear system, D.C. injection (where requirement calls for creep speed in lowering direction only) etc. may be offered.
Hoist control circuit shall also be provided with anti-drop feature i.e. whenever the master controller is brought back to zero position from higher notches in both directions, the motor shall automatically be connected to hoisting direction for some time (time adjustable through timers) to avoid the downward drift of the load. Brakes shall be clamped in zero position of the master controller.

**Drives**

Slip ring motor with rotor resistance control/ Thyristor control shall be provided for main hoist and auxiliary hoist motions. Control shall be achieved through master controllers for each direction. Rated speeds are to be provided in each direction i.e., hoisting and lowering. If slip ring motor with rotor resistance control is used for hoist motions then thyristor control shall not be used.

Speed control of the slipring motor shall be achieved through regulation of stator voltage with resistance in the rotor circuit, if necessary. The reversal of direction shall be through magnetic contactors which shall open and close at zero current.

The continuous rating of the thyristor shall be at least 2.5 times the motor rated current and the converter shall be designed and rated for load requirement taking care of peak currents during acceleration, normal operation and regeneration conditions. The dv/dt and di/dt rating of the thyristors shall be suitably selected.

The repetitive PIV rating of semi conductor devices shall not be less than 2.25 times the peak of normal system voltage. Thyristor bridges shall include Rx-Cx snubber circuits across the thyristor, high speed semi-conductor fuses with micro-switches for monitoring of failure. Closed loop regulation suitable for the system with various feedback such as speed, current etc. shall be provided. Speed feedback shall be through tacho-generator of permanent magnet type mounted on the non-driving end of the motor shaft. The regulation shall include ramp generators, potentiometers for various setting, various regulators, signal conditioners, logic command module, sequence module, trigger module, zero and over speed monitor, torque less protection module etc. as per the requirements. The control and regulation equipment shall be able to maintain their rated performance and control quality even under conditions of variation of -10% and – 15% in voltage and ± 5% in frequency. A zero current sensing device shall be incorporated. The reversing of stator contactor shall be done at zero current. Braking down to zero speed shall be electrical with mechanical brake setting only at zero speed. Protective features like anti-drop etc. shall be incorporated to prevent load setting. The circuitry shall also provide for the protection against failure of motor torque such that the mechanical brake sets in such cases. All other features of conventional crane controls shall also be built into the scheme. The following shall also be provided on the A.C. side:

- Surge suppressor
- Over current protection
- Overload protection
- Single phase protection
- Phase sequence protection
- Ammeter and voltmeter with selector switches
- Isolating switches
Control and auxiliary supply shall be provided with separate transformer and under voltage protection.

The test shall be performed as per IEC:146.

Details of the system offered shall be furnished along with necessary single line diagrams and block diagrams.

All the control modules shall be grouped in a sheet steel enclosure. The control module cards shall be made of epoxy glaze and suitable for plugging into the racks. The cards shall be locked into the rack, which carries a sealing bar and assists locking of the cards thereby cutting down on the wear of the printed circuit connector contacts which can be subjected to high rate of vibration and further avoid the disconnection of cards from the connector. The thyristor panel shall be suitably mounted so that little vibrations are reflected to the components and connection.

The cables for the thyristor controller and associated equipment shall be laid and clamped separately on the crane.

**xii) Panels**

All panels shall be of free-standing floor-mounting construction, suitable to withstand vibrations encountered on crane. Hinged doors shall be provided for closed type panels. Panels shall be front wired. Front wired live points of bottom most equipment shall be mounted at least 350 mm above the bottom cover of the panel. Panel shall be fabricated from 2.0mm thick steel sheet.

Power and control terminals shall be segregated. 10% spare terminals shall be provided in each panel.

Equipment in the panel shall be so mounted that their removal or replacement from the front is easy.

Separate control panel for each motion shall be provided.

Panels shall be of closed type when mounted on bridge platform.

Sufficient clearances shall be provided between the panels. A minimum clearance shall be provided in front of the panels for walkway and approach as per I.E. rules. The panels shall be suitably supported in the back to avoid vibrations. Open type panels may be used for installation inside the box girders. In this case, adequate lighting and ventilation shall be provided for the room.

**xiii) Switchgears**

Each mechanism motor shall be provided with MCCB, contactors on stator and rotor sides, oil dash pot type over load relays and suitably rated rotor resistances. In case of thyristor controlled drive, each mechanism motor shall be provided with breaker/switches, transformer, thyristor, rotor resistances, contactors on stator and rotor side etc. Each motor shall be fitted with a tachogenerator for speed feedback. The overload capacity of thyristors shall be 200% for 2 minutes. The speed range shall be 0-160% of rated speed.
MCB shall be provided in the control circuit of each motion.

Each brake circuit shall be provided with a suitable contactor.

Rating of contactor selected for any mechanism shall be at least 50% higher than the respective motor full load current for the mechanism duty cycle. The minimum rating of the contactor used shall be 30A and the life of each contactor shall not be less than 10,000 hrs. of operation.

Reversible directional contactors shall be interlocked both mechanically and electrically.

**Motors**

Heavy duty reversible crane service, totally enclosed fan cooled, foot mounted, wound rotor motor conforming to latest edition of IS:325-1996 shall be used for various drives. Class of insulation shall be F/F (Stator/ Rotor) with temperature rise limited to that for ‘B’. Pullout torque to be not less than 275% of full load torque corresponding to 40% CDF.

Motor selection shall be done as per IS: 3177-1999.

The main motor shall have following speed ranges:

a) Class M1, M2, M3 & M4 duty cranes:
   - Main & auxiliary hoist : 750 rpm
   - Long & cross travel : 1000 rpm

b) Class M5, M6, M7 & M8 duty cranes:
   - Main & auxiliary hoist : 600 rpm
   - Long & cross travel : 750-1000 rpm

All motors shall have the terminal box at top. Frame sizes shall conform to IEC Standards.

Horizontal foot mounted and with tapered shaft extension.

While selecting the motor rating following shall also be taken into consideration:

- Duty type S4 & S5
- Cyclic duty factor
- Number of switchings per hours
- Type of controls used
- Inertia of the motor and mechanism
- Ambient correction factor
- Service factor
- Derating for thyristor control
- Wind pressure

The following no. of switching per hour shall be considered for selection of motors.

- For M1 duty - 60 starts/ hour
- For M2 duty - 60 starts/ hour
- For M3 & M4 duty - 61-150 starts/ hour
- For M5 & M6 duty - 151-300 starts/ hour
- For M7 & M8 duty - 300-600 starts/ hour
Maximum permissible operating speed shall be 250% of synchronous speed or 2000 rpm whichever is less. Over load capacity 150% of full load current for 2 minutes without damage or permanent deformation.

xv) Brakes

Brakes shall be D.C. electromagnetic type.

Brakes shall be designed to fail safe whenever the current is interrupted either intentionally or by failure of the main supply.

Brake circuit forcing shall be provided for D.C. brakes, D.C. brake circuit shall be switched off on D.C. circuit for quick operation of brake.

A separate set of parking brake of L.T. motion shall be provided for each outdoor crane. Power supply for these brakes shall be obtained from protective panel.

xvi) Limit Switches

Roller lever operated, resetting limit switches shall be provided for all travel motions. For each hoist motion, a rotary cam type over hoist and over lower, self resetting limit switch shall be provided. This limit switch shall have independently adjustable cams for hoisting and lowering motion. The cams shall have adjustability such that end limit can be set to within 100mm of the hoisting or lowering motion. In addition to this, a backup ultimate limit switch of series/ shunt gravity type shall be provided to prevent over hoist. The later shall be of manual reset type. In case of cranes handling hot metal, the gravity limit switch shall essentially be of series type. Provision shall be made to bridge the gravity type limit switch contact by push button/ switch or any other means to lower the load. An indication shall be provided to the operator whenever this limit switch has operated. Suitable limit switch shall be provided for slack rope, gate/ door opening, slew mechanism, grab closing/ opening etc. wherever necessary.

xvii) Anti-Collision Devices

In shops where two or more cranes are operating in the same bay (at same or different level) all cranes shall be provided with suitable Anti-collision system. Anti-collision device shall be electronic type.

A sound signal shall be provided to the crane operator when they are at certain safe distance apart (distance to be adjusted as a function of speed at site) and crane shall stop. After few seconds, it shall be possible to run the cranes towards each other (or only one crane can move towards the other) till buffers of the cranes meet by providing “by pass” in the operator's cabin.

Anti-collision shall also be provided on trolley for twin trolley cranes along with suitable by pass arrangement.

xviii) Resistances

Air cooled, robust, heavy duty, corrosion resistant punched stainless steel grid type. Resistance shall be in single phase execution.
Rated for 10 minutes duty. Continuous duty rating of resistances shall be provided in case of hoist motions controlled by thyristor converters.

Max\textsuperscript{m} temperature of resistor elements shall be limited to 275\degree C (measured by resistance method) at desired duty. Suitable tapping points shall be provided.

Resistance boxes shall be mounted in racks that permit independent removal of any selected box.

**xix) Master Controller**

Cam type master controller with joy stick type lever shall be used.

Separate master controllers for hoist, LT & CT shall be provided. Duel master controller operated with single handle shall not be used.

Master controller for each motion controls shall have four/ five notches in each direction.

**xx) Lighting, socket outlets, bells etc.**

Lighting shall be provided in operator’s cabin, staircases, platforms and working areas.

Min\textsuperscript{m} 4 nos. 500 Watts high pressure sodium vapor flood lights equally spaced (under crane girders) about the crane span shall be provided along with shock absorbing and anti-swing suspension arrangements. More numbers of fittings shall be provided if required for cranes with longer span and/ or longer height of lift. Fluorescent lamps with necessary fittings shall be used for operator’s cabin, staircases, platforms etc.

Adequate number of hand lamp socket outlets (2 Pin, 10A, 24V) and power socket outlets (3 Pin, 20A, 240V) shall be provided along with switches. A hand lamp along with sufficient length of cable with a plug shall also be provided for each crane.

An alarm bell shall be provided on each crane.

**xxi) Pendant unit**

a) Following shall be included on the pendant unit:

- **Push button for**: Hoist slow, hoist fast, lower slow, lower fast, left cross traverse, right cross traverse, forward long, travel, backward long travel, emergency stop conditions.

- **Switch for**: Lights and bells

- **Lamps for**: Power ‘ON’ indication and emergency corner switch operation.

**xxii) Enclosure Class**

a) For indoor operations
   - Resistance boxes : IP:11
   - Motors : IP:55
   - All other electric equipment : IP:54

b) For outdoor operations
- Resistance boxes : IP:33 with canopy
- Motors & panel : IP:55 with canopy
- All other electrical equipment : IP:65 with canopy

xxiii) **Cables**

All cables shall have stranded copper conductors. Control wiring shall be with 2.5 mm² copper; minimum size of power cable shall be 4.0 mm² copper. Fixed wiring on cranes shall be carried out with PVC insulated. PVC sheathed armoured cable or EPR insulated CSP sheathed cable or better.

All flexible cables (i.e cables for magnet, trolley, feed, pendant unit etc.) shall have copper conductor, EPR insulation and CSP sheathing or better.

All cable shall be suitable de-rated for grouping & higher ambient temperature.

All cables shall be of 1100 Volts grade.

All accessories like cable glands, lugs, clamps, pipes, wire and terminal marks etc. shall also be provided.

Cable laying and terminations shall be such that the chances of cables getting damaged is remote.

In all passages and on trolley the cable shall be laid in trays and shall be covered by similar trays and properly clamped & fixed.

.01 LT Power Cable

1.1kV, heavy duty power cable, 4/3.5 core with stranded sector shaped (sm) or with compact circular stranded (rm/V) or circular stranded (rm) Copper conductors as applicable, PVC insulated suitable for 70°C operation as per IS:5831-1984, core stranded together provided with a common covering of PVC inner sheath, galvanized round steel wire armoured and PVC outer sheathed, multi core conforming to IS:1554 (Part-I) – 1988. Type TWY.

.02 Control Cables

1.1 kV, circular stranded (rm), annealed copper conductor, PVC insulated suitable for 70°C operation, as per IS:5831-1984, cores stranded together provided with a common covering of PVC inner sheath, galvanized round steel wire armoured and PVC outer sheathed, multi-core similar to IS:1554- (Part-I) – 1988, Type YWY.

.03 Flexible Trailing Cable

xxiv) **Earthing**

A ring Earthing system shall be provided on the crane. Each and every electrical equipment shall be connected to this earthing at least at two points. However, the electronic circuit insulated earth wire shall run in panel and terminate at main earth connection only at one point. The earthing shall be connected to the fourth trolley line in DSL system through 2 nos of current collector. Additionally, current collectors shall also be provided on crane rails for earthing on crane. All these collectors shall be connected to earthing ring.

An earth core shall be provided in trolley feed cable. The cable reeling drum shall have a separate slipring for earthing purpose.

It shall conform to general specification for earthing.

Rubber mattings shall be provided in front of the protective and control panels. All bonds between earth conductors and crane parts shall be welded if possible, or rivetted and soldered. Where screwed bonds are made, care shall be taken that there is satisfactory contact surface and nuts shall be locked to prevent their loosening. Earth connections to equipment shall be made by means of multi strand flexible conductor of adequate section.

The earth ring on the crane/machine shall be connected to the plant earthing system through gantry rails. Each end of each gantry rail shall be bonded to the plant earthing system.

In addition, intermediate earthing bond shall be provided on the rails at every 60 m in case of linger tracks.

Flexible copper bonds shall be provided across any gap in the running gantry rail.

**01.04 TECHNICAL PARAMETERS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>Main Hoist – 25T</td>
</tr>
<tr>
<td></td>
<td>Auxiliary Hoist-5t</td>
</tr>
<tr>
<td>Span</td>
<td>15m</td>
</tr>
<tr>
<td>No. off</td>
<td>01 (one)</td>
</tr>
<tr>
<td>Duty class</td>
<td>M5 as per IS:3177, 807</td>
</tr>
<tr>
<td>Gantry rail level</td>
<td>+ 8.0M</td>
</tr>
<tr>
<td>Speed (m/min.)</td>
<td></td>
</tr>
<tr>
<td>Main Hoist</td>
<td>10</td>
</tr>
<tr>
<td>Aux. Hoist</td>
<td>15</td>
</tr>
<tr>
<td>Cross Travel</td>
<td>30</td>
</tr>
<tr>
<td>Height of lift</td>
<td></td>
</tr>
<tr>
<td>Main Hoist</td>
<td>22.0m</td>
</tr>
<tr>
<td>Aux. Hoist</td>
<td>22.0m</td>
</tr>
<tr>
<td>Type of operation</td>
<td>pendant operated</td>
</tr>
<tr>
<td>Type of hook</td>
<td>single shank swivelling type</td>
</tr>
<tr>
<td>Ambient Temp.</td>
<td>55°C</td>
</tr>
</tbody>
</table>
Maxm. Wheel load : 17.0T
Gantry rail size : CR-80
LT Wheel base : 5600mm
Over buffer : 7200mm
Hook approach : MH:1000/1300 mm from end of girder towards riverside / land side
AH:2250/2550mm from end of girder towards riverside/land side
Overhung of crane
From CL of rail : 300mm
Top of trolley form rail : 2500mm
Power supply : 415V±10%, 3 Phase, AC, 50Hz+ 3%-6%
Control voltage : 110V, 1phase, AC

01.05 DOCUMENTATION

01.05.01 Information to be furnished by the Tenderer along with the tender:

The Tenderer shall submit adequate number of technical drawings & technical data/information with tender for crane without which the tender shall be considered as incomplete & may not be considered for acceptance.

1. General arrangement drawings/clearance diagram of the crane
2. The questionnaire properly filled in.
3. Deviations from tender documents.
4. List of commissioning spare, list of spares for two (2) years normal operation and list of insurance spare for each crane as per clause no. 01.02.03, 01.02.04 and 01.02.10
5. List of special/maintenance tools & tackles as per clause no. 01.02.06.
6. Other supporting documents
7. Un-priced copy of list of equipment.
8. List of Makes.

01.05.02 List of drawings/ documents to be furnished by the successful Tenderer

1. Drgs. & documents to be submitted for approval within one month of placement of order.
2. Drgs and documents to be submitted after approval
3. Copies of drawings for approval of statutory authority (if required) shall be submitted at least 3 months prior to first shipment of crane. Obtaining statutory clearance from statutory authorities shall be the responsibility of the crane supplier.
4. Specification of oils and lubricants and other consumables and their quantity and frequency of change.
6. Instruction for storage and re-conservation.
7. Test and inspection certificate.
8. List of spares for 2 years normal maintenance.
9. Ordering specification for operating consumables/supplies.
10. Motor list
11. Technical details of thyristor converters. If any
12. Single line diagrams of control panels. Thyristor converters. LDBs etc.
13. Connected load and 30 minute maximum demand.
List of drawings/documents to be submitted along with equipment by the successful Tenderer

1. GA drawings, complete assembly and sub assembly drawings of the equipment
2. Drawings of all equipment/component received from sub supplier.
3. Test and warranty certificate for each item of equipment.
4. Test reports and inspection reports.
5. Instruction manuals for testing and commissioning.
6. Operation, maintenance and safety manuals.
7. Requirement of special tools and tackles, if any, for subsequent maintenance.
8. Detail drawing list and specifications of all wearing out parts and parts subject to breakage during normal operating conditions.
9. List of space parts with drawings, sketches, specifications and manufacturer’s catalogue.

QUESTIONNAIRE

1. DPR/TPR/ Crane No.
2. No. Of
3. Type of Crane
4. Supplier/ Make
5. Capacity (t)
6. Span (m)
7. Duty Class
8. Speed (normal & Creep) m/min
   a) Main hoist & creep
   b) Aux. Hoist & creep
   c) Cross travel
   d) Long travel
   e) Slew (rad./min.)
9. Height of lift (m)
   a. Main hook
      Above floor
      Below Floor
   b. Aux hook
      Above floor
      Below floor
10. Crane rail height above floor (m)
11. Max wheel load (t) (without impact)
12. Type of cabin
13. Type of hook:
   a) Main hook
   b) Aux hook
14. Location (Indoor/Outdoor)
15. Hook approaches (m)
   a) Main hook (DSL side/Opposite Side)
   b) Aux hook (DSL side/ Opposite Side)
16. No of rope falls, dia, construction, & breaking strength for
   a) Main hoist
   b) Aux hoist
17. Gantry rail size
18. Crab rail size
19. Over buffer dimension (m)
20. Wheel base
21 Wheel diameter for
   a) LT wheel
   b) CT wheel
22 Handling attachments
23 Special features (weighing device etc)
24 Motor: (Type, KW, rpm, starts/hr, enclosure class, insulation etc)
   a) Main hoist
   b) Aux hoist
   c) Cross travel
   d) Long travel
25 Type of control for each motion with corresponding characteristic curve:
26 Method of obtaining creep speed:
27 Power supply
   - Power supply S.L.D:
   - Electric equipment specification
28 Control voltage
29 Ambient temp/Environment
30 Total weight of the crane (t)
31 Break up of crane weight (t)
   a) Structural
   b) Mechanical
   c) Electrical
32 Total weight of the crab (t)
33 Code of design
34 General arrangement drawing, incorporating the front and side elevations, plan, hook
   approaches, location of cabin/pendant, down shop lead, clearance dimension,
   handling attachments/wheel load diagram and other relevant characteristics of the
   crane.
35 List of deviation from the Purchaser’s specification
36 Any other information

01.07 PAINTING

All parts of the machines shall be thoroughly cleaned of loose mill scales, rust or foreign
matters. The surface cleaning shall conform to standards as indicated in Tender
Specification.

ALL parts excepting motors, resistors, gears etc. shall be painted at shop and at site.

All parts inaccessible after assembly shall be painted and assembled while the paint is wet.

After erection, the damaged portion of the painted surface shall be retouched and an
intermediate coat/ final coat shall be applied as per Tender Specification.

Colour scheme shall be as per choice of the purchaser/ approved by the purchaser or his
consultant.

01.08 QAP, INSPECTION AND TESTING OF EQUIPMENT

QAP, inspection and testing of equipment shall be as per Tender Specification.

01.09 PERFORMANCE TESTS & GURANTEE

After erection and Commissioning of Equipment, Performance tests shall be carried out to
prove the performance of the system and equipment.
These tests shall be binding on both the parties of the contract determine compliance of the equipment/system with the performance guarantee.

All the equipment, tools and tackles required for successful completion of the performance tests shall be supplied by the successful Tenderer.

All the instruments for the performance tests, as required, shall be supplied by the successful Tenderer and shall retained by him till the satisfactory conclusion of all tests at site. All cost associated with the supply, calibration, installation and return of test equipment shall be included in the scope of supply. All test instruments shall be as per standards approved by the Purchaser.

If the successful Tenderer fails to achieve the guarantee and performance parameter, he shall investigate the causes shall rectify and/or replace, free of cost to the Purchaser the defects of the equipment/system within a period of 1 (one) month from the date of commencement of performance and guarantee tests and again prove the guarantees. In such cases, the cost of modifications including labour, materials, and cost of additional testing etc., shall be borne by successful Tenderer.

If even after necessary alteration and modifications are affected, the performance guarantees are not fulfilled, the Purchaser reserves the right to reject the equipment. In the event of exercising this right, the successful Tenderer shall replace the defective equipment/system with the equipment/system that meets the performance guarantee parameters. The cost of replacement inclusive of labour, materials and repeat testing to prove compliance with the performance guarantees shall be borne by the successful Tenderer.

01.09.01 The following basic performance parameters shall be concluded:

a) All equipment shall operate at rated capacity without undue vibration and undue noise etc.

b) Measurement of noise and vibration levels.

c) Measurement of power consumption of various drive motors while operating at performance guarantee levels.

d) Continuous run system performance test.

e) All other parameters of the equipment or system indicated in the specification.

01.09.02 The equipment shall be guaranteed for a period of 12 months from the date of successful commissioning or 18 months from the date of last supply whichever is earlier.
01. 25/5 Ton EOT crane

Technical Specification

A. GENERAL:

1. Type of Crane : Double girder, E.O.T Crane complete in all respects including structural, Mechanical and electrical equipments.

2. Quantity : ONE No.

3. Location : Outdoor.

4. Lifting Capacity of Crane : Main Hoist : 25 Metric Tonnes
   Aux Hoist : 5 Metric Tonnes

5. Span : 15 meters

6. Design : IS : 3177 and IS : 807

7. Duty Classification : Class II Medium duty as per IS: 3177.

8. Operating : Cabin Operated

9. Ambient Temperature : 45 deg. C

10. Type of Girder : Welded Plate box girder

B. HOIST:

1. i) Main Hoist Safe working load : 25 MT.
   Auxillary Hoist Safe working load : 5 MT

   ii) Test Load : 125% of rated load as per IS 3177 whichever is higher.

2. Main Hoisting Speed : 3 M/Min. (with Speed regulation through VFD Drive)
   Aux Hoisting Speed : 5 M/min (with speed regulation through VFD Drive)

3. Wire Rope
   Type : 6 x 36 Fibre Core
   Make : Usha Martin
Size (Main Hoist) : 22 mm, 8 fall
(Aux Hoist) : 12 mm, 4 Fall

4. Rope Drum : Mild Steel Fabrication
               made up of seamless pipe.

5. Motor:

   a) Make & Type:
      i) Type : Squirrel cage type crane duty
                with Thermal Relay and overload
                relay for Safety devices will be
                provided.
      ii) Make : Kirloskar/ Alstom/ Crompton/ Bharat Bijlee/ABB

   b) RPM : 960 RPM.

   c) Cycle Duty Factor : 40%.

   d) No. of starts and stops
      Per hr. : 150

   e) Pull out torque : Min. 275% of computed torque.

   f) Enclosure : TEFC.

   g) Insulation : Class F.

   h) Main Hoist HP : 25 HP
                    Aux Hoist HP : 9 HP

6. Type of brake. : Electro hydraulic Thruster.

Make of Brake : Rolex/Anand Systems/ Crane Control

7. Limit Switch:

   Type : Rotary Limit Switch.
   Make : Rolex/Anand Systems/ Crane Control

8. Torque Rating : 150% of full load torque.

9. Bearings : ZKL or equivalent.

10. Gear Box. : Crane duty, Helical, Splash lubricated

11. Couplings : Geared couplings on the output between
                motor and gear box.
C. **TROLLEY:**

1. Speed : 30 m/min

2. Wheels  
   Size : 320 mm  
   Materials : Forged Steel  
   Surface hardness : 250 – 300 BHN.

6. Motor
   ii) Make : Kirloskar/ Alstom/ Crompton/ Bharat Bijlee/ABB  
   No. of Motor : One.  
   All other parameters same as Hoist Motor.  
   Motor HP : 5 HP

8. Brake:
   Type : Electro hydraulic thruster

8. Torque rating (brake) : 100% of full load torque.

9. Gear box. : Helical gear Box (Vertical alignment).


11. Coupling : Geared Flexible Coupling on the output.

D. **BRIDGE:**

1. Speed : 10-15 M/min

2. Wheels  
   Size : 500 mm  
   Material : Forged Wheels.  
   Surface hardness : 250 – 300 BHN.

3. Motor  
   i) Specification same as for hoist Motors.  
   ii) No. of Motors : 2 Nos.  
   Motor HP : 2 x 7.5 HP

5. Brake:
   Type : Electrohydraulic Thruster  
   Make : Rolex/Anand Systems/ Crane Control

6. Limit Switch:
   Type : Two way lever type complete with actuator.  
   Make : Rolex/Anand Systems/ Crane Control
7. Bearings : ZKL / Equivalent

8. Walkway Platform.
   a) Bridge : Full length non-skid type 6mm thick chequered plates, 1000mm wide on one side along with hand railings.
   b) Trolley : Trolley floor will be covered with 6mm thick chequered plates. Hand railings shall be provided on the sides of the trolley.


E. ELECTRICALS:

1. Controls:
   a) Type : ThroughMaster Controllers
   b) Location of Control Panels : Platform.
   c) Control Voltage : 110 Volts AC. 50 C/S.

2. Make of Electrical:
   a) Switch Gears : L&T/BCH/ Telemechanique./ABB SIEMENS.
   b) Cables Make : Reputed ISI compliant

F. PAINTING : Will be carried out : one coat of zinc chromate primer and two coats of synthetic enamel paint.

G. ANTI-VIBRATION DESIGN : The Box girders of the crane will be so designed as to limit the natural vibration damping time to minimum.

H. Total Crane Weight : 35 Ton - Structural 20 T
                           Mechanical 12 T
                           Electrical 3 T

I. LT Wheel load : 22 Ton at 5 m distance.
## 03. Diesel Forklift Truck

### Technical Specification

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rated Capacity</strong></td>
<td>3000 Kg at 500mm Load center</td>
</tr>
<tr>
<td><strong>Capacity</strong></td>
<td>3000 Kg at 500mm Load center at Ground Level &amp; Upto 3300mm Lift Height without attachments.</td>
</tr>
<tr>
<td></td>
<td>Refer Leaflets for derated capacity at higher MFH.</td>
</tr>
<tr>
<td><strong>Mast</strong></td>
<td>Type of Mast : HVT 4500</td>
</tr>
<tr>
<td></td>
<td>Overall Mast Height : 2180 mm</td>
</tr>
<tr>
<td></td>
<td>Maximum Fork Height : 4500 mm</td>
</tr>
<tr>
<td></td>
<td>Free Fork Height : 1525 mm</td>
</tr>
<tr>
<td></td>
<td>Overall Extended Mast Height with LBR : 5750 mm</td>
</tr>
<tr>
<td></td>
<td>Tilt angle (Forward/Backward) : 6 / 6</td>
</tr>
<tr>
<td><strong>Major Dimensions</strong></td>
<td>Length to Face of forks : 2720 mm</td>
</tr>
<tr>
<td></td>
<td>Overall width : 1225 mm</td>
</tr>
<tr>
<td></td>
<td>Turning Radius : 2460 mm</td>
</tr>
<tr>
<td><strong>Forks</strong></td>
<td>Length x Width x Thickness : 1070 x 125 x 45</td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td>Travelling Speed : 17 / 19 (laden / unladen)</td>
</tr>
<tr>
<td></td>
<td>Hoisting Speed : 400 / 450 (laden / unladen)</td>
</tr>
<tr>
<td></td>
<td>Gradability : 18 % (laden / unladen)</td>
</tr>
<tr>
<td><strong>Engine</strong></td>
<td>37 KW, 2650 RPM</td>
</tr>
<tr>
<td><strong>Transmission</strong></td>
<td>Automatic</td>
</tr>
<tr>
<td><strong>Steering</strong></td>
<td>Hydrostatic Power.</td>
</tr>
<tr>
<td><strong>Tyres</strong></td>
<td>Solid. Front – 2 nos / Rear – 2 nos.</td>
</tr>
<tr>
<td><strong>Standard Accessories</strong></td>
<td>Pair of 1070mm long forks.</td>
</tr>
<tr>
<td></td>
<td>Set of Lights (2-Front / 2-Rear)</td>
</tr>
<tr>
<td></td>
<td>Signal Lights (2-Front/2-Rear)</td>
</tr>
<tr>
<td></td>
<td>Load Back Rest</td>
</tr>
<tr>
<td></td>
<td>Reverse Alarm</td>
</tr>
<tr>
<td></td>
<td>Seat Belt</td>
</tr>
<tr>
<td></td>
<td>Tow Coupler</td>
</tr>
<tr>
<td></td>
<td>Tool Kit</td>
</tr>
<tr>
<td></td>
<td>Cloth Tarpulin</td>
</tr>
<tr>
<td></td>
<td>Overhead Guard</td>
</tr>
</tbody>
</table>
# 04. 23 Ton Hydraulic Mobile Crane

<table>
<thead>
<tr>
<th>Technical Data</th>
<th>TRX P-2000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engine</strong></td>
<td>KIRLOSKAR 6R 1080 NA, 6 cylinder Water cooled diesel engine Rated power for crane 122 BHP @ 2500 RPM or equivalent engine</td>
</tr>
<tr>
<td><strong>Transmission</strong></td>
<td>Hydrostatic transmission, 4 forward, 4 reverse speed Travel speed 40 Kmph without load</td>
</tr>
<tr>
<td><strong>Steering</strong></td>
<td>Articulated power steering through steering wheel upto 40°</td>
</tr>
<tr>
<td><strong>Brakes</strong></td>
<td>Pneumatically assisted hydraulic brakes Air brakes Spring loaded brake, air-released on rear axle</td>
</tr>
<tr>
<td><strong>Track</strong></td>
<td>Front 2150 mm (center of twin wheels) Rear 2150 mm (center of wheels)</td>
</tr>
<tr>
<td><strong>Tyres</strong></td>
<td>Front 12.00x24-20 PR (four nos.) Rear 12.00x24-20 PR (two nos.)</td>
</tr>
<tr>
<td><strong>Boom</strong></td>
<td>Four part boom, 3 part hydraulically powered &amp; fully synchronised 4th part manually extended Through double acting jacks:</td>
</tr>
<tr>
<td><strong>Hoist Mechanism</strong></td>
<td>Hydraulic winch Six falls (winch capacity 12 T) Rope dia 13mm</td>
</tr>
<tr>
<td><strong>Hydraulic System</strong></td>
<td>Axial piston pump (close loop circuit) Bent axis variable displacement motor (close loop circuit) Tandem vane pump Proportional control valve hydraulically actuated through joy stick. High pressure 10 micron in travel circuit while auxiliary circuit has 25 micron full flow filter</td>
</tr>
<tr>
<td><strong>Electrical System</strong></td>
<td>Type 12V single battery, negative earth</td>
</tr>
<tr>
<td><strong>Capacities</strong></td>
<td>Fuel Tank 212 Ltrs. Hydraulic Tank 176 Ltrs.</td>
</tr>
<tr>
<td><strong>Operating Weight (Kg)</strong></td>
<td>17600</td>
</tr>
</tbody>
</table>

### Safety System
Safety brakes on hoist, hose protection failure device

### Standard Accessories
All weather cabin, front bumper, reflectors, tools & tackle box, rear view mirror, turn & reverse lamp, instrument cluster, battery cut-off

### Optional Accessories
Fly jib 2.6 m length, fire extinguisher, spark arrester.
air conditioned cabin, extra hooks, man carrying basket, forks, rhino hook, stepney, safe load indication system

All Dimensions and Weights are variable within +/- 5%
A. TECHNICAL SPECIFICATIONS FOR PLUMBING & FIRE FIGHTING WORKS

Section I General Requirements

1 Scope of work

1.1 The form of Contract shall be according to the "Conditions of Contract". The following clauses shall be considered as an extension and not in limitation of the obligation of the Contractor.

1.2 Work under this Contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the plumbing and other specialised services as described hereinafter and as specified in the schedule of quantities and/or shown on the plumbing drawings.

1.3 Without restricting to the generality of the foregoing, the sanitary installations shall include the following:-

A. Plumbing Works
- Sanitary Fixtures
- Soil, Waste, Vent, Rainwater Pipes & Fittings
- Water Supply System
- Garden Irrigation System
- Sewerage & Storm Water Drainage

B. Fire Suppression Works
- Wet riser System
- Hand Appliances
- Fire Pumps at Pump Room

C. Water supply Pumps
- Pumps & Allied Equipment

1.4 Services rendered under this section shall be done without any extra charge.

2 Specifications

2.1 Work under this Contract shall be carried out strictly in accordance with specifications attached with the tender.

2.2 Items not covered under these specifications or due to any ambiguity or misprints, or additional works, the work shall be carried out as per specifications of the latest Central Public Works Department with up to date amendments as applicable in the Contract.

2.3 Works not covered under Para 2.1 and 2.2 shall be carried out as per relevant Codes & Bureau of Indian Standards and in case of its absence as per British Standard Code of Practice.
3 Execution of work

3.1 The Contractor should visit and examine the site of work and satisfy himself as to the nature of the existing roads and other means of communication and other details pertaining to the work and local conditions and facilities for obtaining his own information on all matters affecting the execution of work. No extra charge made in consequence of any misunderstanding, incorrect information on any of these points or on ground of insufficient description will be allowed.

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

3.3 The Contractor shall cooperate with all trades and agencies working on the site. He shall make provision for hangers, sleeves, structural openings and other requirements well in advance to prevent hold up of progress of the construction schedule. All supports to the civil structure shall be provided with dash fasteners.

3.4 On award of the work, Contractor shall submit a schedule of construction in the form of a PERT chart or BAR chart for approval of the Project Manager/Architect/ Consultant. All dates and time schedule agreed upon shall be strictly adhered to within the stipulated time of completion/commissioning along with the specified phasing, if any.

4 Drawings

4.1 Contract drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the architectural and other services drawings.

4.2 Architectural drawings shall take precedence over plumbing or other services drawings as to all dimensions.

4.3 Contractor shall verify all dimensions at site and bring to the notice of the Project Manager all discrepancies or deviations noticed. Decision of the Project Manager shall be final.

4.4 Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small scale drawings.

4.5 Any drawings issued by the Architects/Consultant for the work are the property of the Architects/Consultant and shall not be lent, reproduced or used on any works other than intended without the written permission of the Architects/Consultant.

5 Inspection and testing of materials

5.1 Contractor shall be required, if requested, to produce manufacturers test certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Bureau of Indian Standards.

5.2 For examination and testing of materials and works at the site Contractor shall provide all testing and gauging equipment necessary but not limited to the following:

a) Steel tapes
b) Weighing machine
c) Plumb bobs, sprit levels, hammer
d) Micrometers  
e) Hydraulic machine

5.3 All such equipment shall be tested for calibration at any approved laboratory, if required by the Project Manager. All testing equipment shall be preferably located in special room meant for the purpose.

5.4 Samples of all materials shall be got approved before placing order and the approved samples shall be deposited with the Project Manager.

6 Metric conversion

6.1 All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.

6.2 Any weights, or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost.

7 Reference points

7.1 Contractor shall provide permanent bench marks, flag tops and other reference points and check that with other agencies to confirm the same reference point for all the proper execution of work and these shall be preserved till the end of the work.

7.2 All such reference points shall be in relation to the levels and locations, given in the architectural and plumbing drawings.

8 Reference drawings

8.1 The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site. All important drawings shall be mounted on boards and placed in racks indexed. No drawings shall be rolled.

8.2 All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion drawings to be submitted by the contractor in fulfilment of the conditions of this contract.

8.3 On award of the work the contractor shall be issued four sets of consultant’s working drawings stamped “good for construction” by the Project Manager. The consultant’s drawings shall be the basis of contractor’s shop drawings. In addition, the Project Manager shall also issue one copy of the Interior Designer’s; Electrical & HVAC approved shop drawings relevant to his work

8.4 Shop drawings are detailed working drawings which incorporate the contractor’s details for execution of the work and incorporate equipment manufacturer's details and dimensions to ensure that the same can be installed in the space provided.
8.5 All shop drawings should detailed pipe routing and levels, showing location of other services at crossings etc., cable runs, route cable trays and all allied works and must be fully co-ordinated with other services and approved by the Project Manager before execution of the works. Project Manager shall arrange to issue two copies/prints of services drawings from the respective contracting agencies. Additional copies/prints may be provided on payment of actual cost of the copies/prints. **All drawings will valid only when stamped and issued by the Project Manager.**

8.6 Shop drawings shall also be furnished for detailed layout of all equipment, foundation, bolting and vibration elimination details along with information on dead and dynamic load, vibration etc.

8.7 Six sets of manufacturer's equipment drawings, roughing in and wiring diagrams shall be submitted.

8.8 Contractor shall submit shop drawings furnishing all details of MCC panels, cable routes, wiring diagrams and connection details as required.

8.9 Three copies of each set of shop drawings shall be submitted for initial scrutiny, discussion and approval.

8.10 Each submission shall be accompanied by contractor's certificate stating that the shop drawings meet all the contract requirements and that the piping and equipment can be satisfactorily installed without any obstructions in the space available.

8.11 On approval of the above the contractor shall furnish six sets of the approved shop drawings for execution of the work.

9 **Completion drawings**

9.1 On completion of work, Contractor shall submit one complete set of original tracings and two prints of "as built" drawings to the Project Manager. These drawings shall have the following information.

a) Run of all piping, diameters on all floors, vertical stacks and location of external services.

b) Ground and invert levels of all drainage pipes together with location of all manholes and connections up to outfall.

c) Run of all water supply lines with diameters, locations of control valves, access panels.

d) Location of all mechanical equipment with layout and piping connections and mechanical equipment.

e) All shop drawings shall be updated from time to time for the purpose of making completion drawings.

No completion certificate shall be issued unless the above drawings are submitted.

9.2 Contractor shall provide four sets of catalogues, service manuals, manufacturer's drawings, performance data and list of spare parts together with the name and address of the manufacturer for all electrical and mechanical equipment provided by him.
9.3 All "warranty cards" given by the manufacturers shall be handed over to the Project Manager.

10. **Contractor's rates**

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

10.2 Rates quoted are for all heights and depths and in all positions as may be required for this work.

10.3 All rates quoted must be for complete items inclusive of all such accessories, fixtures and fixing arrangements, nuts, bolts, hangers as are a standard part of the particular item except where specially mentioned otherwise.

10.4 All rates quoted are inclusive of cutting holes and chases in walls and floors and making good the same with cement mortar/concrete/water proofing of appropriate mix and strength as directed by the Project Manager. Contractor shall provide holes, sleeves, recesses in the concrete and masonry work as the work proceeds. All hot and cold water supply pipes crossing masonry walls shall be provided with G.I. pipe sleeves. The annular space between the pipe and sleeve shall be filled up with fire proof sealant after testing. Contractor shall give the pipe sleeves to the civil contractor well in time so that the same can be fixed along with civil works. Any co-ordination gap shall be of contractor's responsibility.

10.5 The Contractor shall furnish the Project Manager with vouchers & test certificates, on request, to prove that the materials are as specified and to indicate that the rates at which the materials are purchased in order to workout the rate analysis of non tendered items which he may be called upon to carryout.

11 **Testing**

11.1 Piping and drainage works shall be tested as specified under the relevant clauses of the specifications.

11.2 Tests shall be performed in presence of the Project Manager and test records for the tests shall be duly signed by Contractor and the Project Manager.

11.3 All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.

11.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet municipal or other bye-laws in force.

11.5 Contractor shall provide all labour, equipment and materials for the performance of the tests.
12  Site clearance and cleanup

12.1  The Contractor shall, from time to time, clear away all debris and excess materials accumulated at the site.

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

12.3  On completion of all works, Contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done by the Project Manager at the Contractor’s risk and cost. Cost of the cleanup shall be deducted from the contractor’s bills on pro-rata basis in proportion to his contract value.

13  Licence permits and authorities

13.1  Contractor must hold a valid plumbing or any other as required licence by the municipal authority or other competent authority under whose jurisdiction the work falls.

13.2  Contractor must keep constant liaison with the local development, municipal/statutory authority and obtain approval of all drainage, water supply, fire suppression and other works carried out by him.

13.3  Contractor shall obtain, from the municipal and other authorities 'C' & 'D' & other forms as required for approval of drainage and water supply works during execution and the completion certificate with respect to his work as required for occupation of the building. Contractor shall obtain permanent water supply and drainage connections from authorities concerned. CLIENT shall re-imbrues the fees paid to the authorities towards the connection charges on production of receipts for money paid.

13.4  Contractor shall get any materials tested from the appropriate authority if so required with no cost to the CLIENT.

14  Recovery of cost for materials issued to Contractors free of cost

If any material issued free of cost by the CLIENT to the contract for use on the work and the same is lost, stolen, pilfered or broken while in contractor’s possession, the cost of the same shall be recovered from the Contractor on the basis of actual cost to CLIENT. The cost shall include the cost paid, freight, transportation, excise duty, sales tax, octroi, import duty and other levies, plus 100% as penalty. The decision on the actual cost given by the CLIENT shall be final and binding on the Contractor.

14.1  Contractor has to keep full records of material issued by the CLIENT with reference and challans etc. Contractor has to give account of all such materials to the Project Manager.

15  Cutting of Water Proofing Membrane:

No walls terraces shall be cut for making and opening after water proofing has been done without written approval of project manager. Cutting of water proofing membrane shall be done very carefully so as other portion of water proofing is not damaged. On completion of work at such place the water proofing membrane shall be made good and ensured that the opening/cutting is made fully water proof as per specifications and details of water proofing approved by Project Managers.
16 Cutting of structural members

No structural member shall be chased or cut without the written permission of the Project Manager.

17 Materials supplied by CLIENT.

The Contractor shall verify that all materials supplied by the CLIENT conform to the specifications of the relevant item in the tender. Any discrepancy found shall be brought to the notice of the Project Manager.

18 Materials

18.1 Unless otherwise specified and expressly approved in writing by the Project Manager, only materials of makes and specification as mentioned in the list of approved makes attached with the specifications shall be used.

18.2 If required, the Contractor shall submit samples of materials proposed to be used in the works. Approved samples shall be kept in the office of the Project Manager.

End of section 1
Section II  Sanitary Fixtures

1  Scope of work

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

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

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

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

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

2  General requirements

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

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

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

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

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

2.6 Contractor shall seal all fixtures fixed near wall, marble and edges with an approved type of poly-sulphide sealant appropriate for its application.
3 **European W.C**

3.1 **European W.C.** shall be wash down or syphonic type floor or wall mounted set flushed by means of porcelain/plastic flushing cistern, which will be an integral part of the WC system. **Framework, walling and finishing will not form a part of the contractor's work.** Where applicable flush pipe/ bend shall be connected to the W.C. by means of a suitable rubber adapter. Wall hung W.C. shall be supported by C.I. floor mounted chair.

3.2 Each W.C. set shall be provided with a plastic seat shall be with rubber buffers and chromium plated hinges.

3.3 Plastic seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C. Each W.C. shall be suitable for flushing in low volume of water 3-6 litres.

3.4 Flushing cistern when provided shall be provided with all internal flushing mechanism, 15 mm dia ball cock with unbreakable polythene float and overflow pipe. Any frame work required for fixing cistern has to be provided by the contractor.

4 **Urinals**

4.1 Urinals shall be white glazed vitreous china of size, shape and type specified in the Schedule of Quantities.

4.2 **Bowl urinals** shall be provided with 15 mm dia C.P. spreader, 32 mm dia stainless steel domical waste and C.P. cast brass bottle trap with pipe and wall flange, and shall be fixed to wall by C.I. brackets and C.I. wall clips as recommended by manufacturers complete as directed by Project Manager.

4.3 Urinals shall be fixed with C.P. brass screws and shall be provided with 32 mm dia domical waste leading to urinal's trap.

4.4 **Flush pipes** shall be G.I. pipes concealed in wall chase but with chromium plated bends at inlet and outlet or as given in Schedule of Quantities.

4.5 Urinals shall be flushed by means of fully automatic no-touch flush valve with solenoid valves.

4.6 **Waste pipes for urinals** shall be G.I pipes (Medium class) to IS: 1239 or uPVC class III (6 kg/sqcm) conforming to IS: 4985 as given in schedule of quantities.

Waste pipes may be exposed on wall or concealed in chase as directed by the Project Manager. Specifications for waste pipes shall be same as given in Section II.

5 **Wash Basins**

5.1 Wash basins shall wall mounted type or Counter top type as specified in the BOQ.

5.2 Each basin shall be supported on MS galvanised or CI brackets and clips and the basin securely fixed to wall or on the counter. The design of the brackets shall suit the basin selected and as recommended by the manufacturer.
5.3 Each basin shall be provided with 32 mm dia C.P. waste with overflow, pop-up or standard waste with rubber plug and chain, 32 mm dia C.P. brass bottle trap with CP pipe to wall and flange.

5.4 Each basin shall be provided with a Hot & cold CP mixer with pop-up waste fittings, 32 mm dia. CP cast brass bottle trap with outlet pipe and wall flange.

5.5 Some of the selected wash basins as identified in the BOQ shall be similar to the one described above but the supply tap shall be a Magic Eye Infrared operated automatic hot and cold mixing fittings.

5.6 Washbasins shall be fixed at proper heights as shown on drawings. If height is not specified, the rim level shall be 79 cms or as directed by Project Managers.

6 Accessories

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

6.2 All C.P. accessories shall be fixed with C.P. 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 Project Manager.

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

7 Urinal partitions

7.1 Urinal partitions shall be white glazed vitreous china, marble, granite or any other material selected by the Project Manager.

7.2 Urinal partitions shall be fixed at proper heights with C.P. brass bolts, anchor fasteners and M.S. clips as recommended by the manufacturer and directed by Project manager.

8 Measurement

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

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

End of Section II
SECTION III: SOIL, WASTE, VENT & RAINWATER PIPES & FITTINGS

1. SCOPE OF WORK

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

1.2 Without restricting to the generality of the foregoing, the soil, waste & vent and rainwater piping system shall include the following:-

a) Vertical and horizontal soil, waste & vent and rainwater pipes and fittings, joints, clamps and connections to fixtures.

b) Connection of all pipes to sewer lines as shown on the drawings at ground floor levels.

c) Floor and urinal traps, cleanout plugs, inlet fittings and rainwater heads.

d) Testing of all pipe lines.

2. GENERAL REQUIREMENTS

2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of Engineer-in-Charge.

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

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

2.4 Pipes shall be securely fixed to walls and ceilings by suitable clamps a intervals specified.

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

3. CAST IRON PIPES & FITTINGS

3.1 Pipes

3.1.1 Soil, waste, vent and anti-siphon age pipes shall be cast iron pipes. All pipes shall be straight and smooth and inside free from irregular bore, blow holes, cracks and other manufacturing defects. Pipes shall be centrifugally spun iron soil pipes conforming to I.S. 3989-1970 as given in schedule of quantities.

3.1.2 Standard weight, dimensions and pig lead required for joints shall be as follows:-

<table>
<thead>
<tr>
<th>S. N.</th>
<th>Nominal diameter</th>
<th>thickness overall Weight 6'length</th>
<th>internal diameter of socket</th>
<th>depth of lead</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nominal diameter</td>
<td>thickness</td>
<td>overall Weight 6'length</td>
<td>internal diameter of socket</td>
</tr>
<tr>
<td></td>
<td>in</td>
<td>mm</td>
<td>mm</td>
<td>Kg</td>
</tr>
<tr>
<td>1.</td>
<td>2</td>
<td>50</td>
<td>3.5</td>
<td>8.5</td>
</tr>
<tr>
<td>2.</td>
<td>3</td>
<td>75</td>
<td>3.5</td>
<td>12.7</td>
</tr>
<tr>
<td>3.</td>
<td>4</td>
<td>100</td>
<td>4.0</td>
<td>19.2</td>
</tr>
<tr>
<td>4.</td>
<td>6</td>
<td>150</td>
<td>5.0</td>
<td>35.5</td>
</tr>
</tbody>
</table>
3.1.3 Tolerance: Acceptable tolerance for pipes to IS : 3989 and IS : 1729 shall be as follows:

a) Wall thickness -15%
b) Length +/- 20 mm
c) Weight -10%

4. UPVC PIPES & FITTINGS

4.1 Pipes

4.1.1 uPVC pipes for drainage system shall be un-plasticized (rigid) PVC pipes conforming to I.S.: 4985 as specified in schedule of quantities.

4.1.2 Fittings for the pipes shall be injection molded with approved type of sockets and 'O' rings joints/solvent welded joints as per recommendations of the manufacturers.

4.1.3 Jointing shall be done as per the manufacturers recommendation. The pipes and fittings must have matching dimensions for a perfect joint. Loose or excessively tight joints in the system shall not be accepted. Fittings must have sufficient gap (approx. 10 mm) for permissible thermal expansion of pipes.

4.1.4 uPVC pipes shall be clamped to the wall with approved type uPVC saddle clamps.

4.2 Fittings

4.2.1 Fittings shall conform to the same Indian Standard as for pipes. Contractor shall use pipes and fittings of matching specifications.

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

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

4.3 Fixing

4.3.1 All vertical pipes shall be fixed by M.S. clamps truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard).

4.3.2 Horizontal pipes running along ceiling shall be fixed on structural adjustable clamps of special design shown on the drawings or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them.

4.3.3 Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the building Contractor for making such omissions in the structure as necessary. All damages shall be made good to restore the surfaces.
5. **CLAMPS**

5.1 Holder bat clamps shall be of standard design and fabricated from M.S. flats 40x3 mm thick and 12 mm dia M.S. Rod and 6 mm nuts and bolts. They shall be painted with two coats of black bitumen paint before fixing. Holder bat clamps shall be fixed in cement concrete 1:2:4 mix blocks 10x10x10 cms deep.

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

5.3 Structural clamps shall be fabricated from M.S. structural members e.g. rods, angles, channels flats as per detailed drawing or as directed. Contractor shall provide all nuts, bolts, welding material and paint the clamps with one coat of red oxide and two or more coats of black enamel paint.

5.4 Slotted angle/channel supports on walls shall be provided wherever shown on drawings. Angles/channels shall be of sizes shown on drawings or specified in schedule of quantities. Angles/channels shall be fixed to brick walls with bolts embedded in cement concrete blocks and to RCC walls with suitable anchor fasteners. The spacing of support bolts horizontally shall not exceed 1 m.

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

6. **TRAPS**

6.1 Nahni trap or floor traps: Nahni traps or floor traps shall be cast iron, 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 1:2:4 mix (1 cement :2 coarse sand :4 stone aggregate 20 mm nominal size) and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30x30 cms of the required depth.

6.2 Urinal traps: Urinal traps shall be cast iron P or S traps with or without vent and set in cement concrete block specified in Para above without extra charge.

6.3 Floor trap inlet: Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type Galvanized iron inlet fitting hoper fabricated from 100 mm GI (IS:1239 -Medium class) pipe without or with one, two or three inlet sockets to receive the waste pipe (s). Joint between waste and hopper inlet socket shall be lead caulked. Hopper shall be connected to a C.I. P or S trap with at least 50 mm seal (hopper and traps shall be paid for separately.) Floor trap inlet hoppers and the traps shall be set in cement concrete blocks as specified in Para above without extra charge.

6.4 Floor Trap Grating: Floor and urinal traps shall be provided with 75-150mm square or round C.P./Stainless steel grating, with rim of approved design and shape. Minimum thickness shall be 4 mm (for C.P. brass) or 1.2 mm (for SS), as specified in the Schedule of Quantities.
7. **JOINTING**

7.1 Soil, waste vent, anti-syphonage and rainwater pipes shall be jointed with refined pig lead conforming to I.S.27-1977. leave a minimum space for the pig lead as given in Para 3.1.2 to be poured in. After the pouring the lead shall be caulked into the joint with caulking tool and hammer. all surplus lead shall be cut and joint left flush with the rim of the socket neatly.

8. **CLEANOUT PLUGS**

8.1 Contractor shall provide cast brass cleanout plugs as required. Cleanout plugs shall be threaded and provided with key holes for opening. Cleanout plugs shall be fixed to the pipe by a G.I. socket and lead caulked joint.

9. **WASTE PIPE FROM APPLIANCES**

9.1 Waste pipe from appliances e.g. washbasins, sinks and urinals shall be of galvanized steel or P.V.C. as given in the Schedule of Quantities.

9.2 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:-

<table>
<thead>
<tr>
<th>G.I. pipes</th>
<th>Vertical</th>
<th>horizontal</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 cms</td>
<td>240 cms</td>
<td></td>
</tr>
<tr>
<td>P.V.C. pipes</td>
<td>180 cms</td>
<td>120 cms</td>
</tr>
</tbody>
</table>

9.3 Galvanized pipes: Pipes shall be galvanized steel tubes conforming to I.S.1239-1979 (medium class) and quality certificates shall be furnished. Pipes shall be provided with all required fittings e.g. tees, couplings, bends, elbows, unions, reducers, nipples, plugs. All G.I. waste pipes shall be terminated at the point of connection with the appliance with an outlet of suitable diameter. Pipes in chase shall be painted with two coats of black bitumen paint and exposed pipes with one coat of red oxide primer and two or more coats of synthetic enamel paint or as given in the Schedule of Quantities.

10. **KHURRAS**

10.1 The khurras shall be constructed before the brick masonry work in parapet wall is taken up and it shall be 45cmx45cm unless otherwise specified in the description of the item and shall be formed of cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) or other mix as stipulated in the description of the item.

10.2 Laying:

10.2.1 A PVC sheet 1mx1mx400 micron shall be laid under the khurras and then cement concrete shall be laid over it to average thickness of 50mm with its top surface lower than the level of adjoining roof surface by not less than

a) 20mm in case of roof surface finished with lime concrete terracing.

b) 70 mm in case of roof surface finished with lime concrete terracing covered with brick tiles.

c) 50mm in case of roof surface finished with mud phuska with brick tile covering.

10.2.2 The concrete shall be laid to a size greater than the stipulated size of the khurras in such a way that the adjoining terracing whether of lime concrete or of the tile brick shall overlap
the concrete on its three edges by not less than 7.5 cm. The concrete will slope uniformly from the edges to the outlets the slope as being as much as possible and in no case less than 20mm cement concrete at outlet. The concrete shall be continued at the same slope through the width of the wall into the outlet opening to ensure a water tight joint.

10.2.3 The khurras and the side of the outlet shall than be rendered with 12mm coat of cement plaster 1:3 mix (1 cement:3 coarse sand) or other mix as stipulated in the description of the item. This shall be done when the concrete is still green and shall be finished with floating coat of neat cement. The sides of the khurras and the sides of the outlet opening shall be well rounded. The size of the finished outlet opening shall be 10cm wide by 20 cm high or as directed by Engineer -in-charge.

10.2.4 As a safeguard against choking of rainwater outlet through rain water pipes at terrace level, Cast Iron rainwater outlet fitting with aluminum ring and aluminum domical head (fixed with SS screw) of size 250x100 mm shall be provided as directed by the Engineer in-Charge.

11. CAST IRON PIPES FOR DRAINAGE

11.1 All drainage lines passing under building, floors, in exposed position above ground e.g. basement ceiling shall be cast iron pipes. Position of such pipes shall generally be shown on the drawings.

11.2 Cast iron pipes shall be centrifugally spun iron pipes conforming to I.S. 1536-1967. Quality certificates shall be furnished.

11.3 Fittings

a) Fittings used for C.I. drainage pipe shall conform to I.S.1538-1967. Wherever possible junction from branch pipes shall be made by a Y tee.

b) Cleanout plugs shall be provided on head of each drain and at location indicated on plans or directed by Engineer-in-Charge. Cleanout plugs shall be of size matching the full bore of the pipe. Plugs shall be made out with G.I. coupling caulked into the socket of the pipe or fittings. The end shall be provided with a brass screwed plug with suitable key for opening.

11.4 Laying

a) All cast iron pipes and fittings shall be jointed with best quality soft pig lead (conforming to I.S. 27-1977) which shall be free from impurities. in wet trenches joints shall be made from lead wool. Nothing extra will be paid for lead wool joints. Depth of pig lead and weight for joints shall be as per I.S. code.

b) The spigot of pipe or fittings shall be centered in the adjoining socket by caulking. Sufficient turns of tarred gasket will be given to leave unfilled the required depth of socket for depth of 45 mm when the gasket has been caulked tightly home. Joining ring shall be placed round the barrel and against the face of the socket. Molten pig lead shall then be poured to fill the remainder of the socket. This shall then be done in one pouring. The lead shall then be solidly caulked with suitable tools and hammers weighing not less than 2 kg.

c) For lead wool joints the socket shall be caulked with tarred gasket, as explained above. The lead wool shall be inserted into the sockets and tightly caulked home skein by skein with suitable tools and hammers of not less than 2 kg weight until joint is filled.
11.5 Testing: All cast iron pipes for drainage shall be tested to a hydraulic test of 3 meter head. A test register shall be maintained which shall be signed and dated by Contractor, Engineer-in-Charge and representative of Architect/Consultant.

12. CEMENT CONCRETE

12.1 Cast iron soil and waste pipes under floor in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement :2 coarse sand :4 stone aggregate 12 mm size) 75 mm in bed and all-round. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height at intervals of 1.8 m. Rate for concrete round pipes shall be inclusive of pillars, supports, shuttering and centering.

13. PAINTING

13.1 Soil, waste vent, anti-syphonage and rainwater pipes in exposed location in shafts and pipe spaces shall be painted with two or more coats of synthetic enamel paint to give an even shade.

13.2 Paint shall be of approved quality and shade. Where directed pipes shall be painted in accordance with approved pipe colour code.

13.3 G.I. waste pipes in chase shall be 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.

13.4 C.I. soil and waste pipes below ground and covered in cement concrete or lead pipes shall not be painted.

14. CUTTING AND MAKING GOOD

14.1 Pipes shall be fixed and tested as building proceeds. Contractor shall provide all necessary holes cut outs and chases in structural members as building work proceeds. Wherever holes are cut or left originally, they shall be made good with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) or cement mortar 1:2 (1 cement: 2 coarse sand) and the surface restored as in original condition.

15. TESTING

15.1 Before use at site all C.I. soil pipes shall be tested by filling up with water for at least 10 minutes. After filling, pipes shall be struck with a hammer and inspected for blow holes and cracks. All defective pipes shall be rejected and removed from the site within 48 hours. Pipes with minor sweating may be accepted at the discretion of the Engineer-in-Charge.

15.2 Pipes shall be tested after installation, by filling up the stack with water. All opening and connections shall be suitably plugged. The total head in the stack shall be however not exceed 3 m.
15.3 Alternatively Contractor may test all soil and waste stacks by a smoke testing machine. Smoke shall be pumped into the stack after plugging all inlets and connections. The top end shall, however, be left open. The stack shall then be observed for leakages and all defective pipes and fittings removed or repaired as directed by the Engineer-in-Charge.

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

16. **MEASUREMENTS**

16.1 General

16.1.1 Rates for all items quoted shall be inclusive of all work and items given in the above mentioned specifications and Schedule of Quantities and applicable for the work under floors, in shafts or at ceiling level at all heights and depths.

16.1.2 All rates are inclusive of cutting holes and chases in RCC and masonry work and making good the same.

16.1.3 All rates are inclusive of pre testing and on site testing of the installations, materials and commissioning.

16.2 Pipes (Unit of measurement: Linear meter to the nearest centimeter)

16.2.1 All uPVC & C.I. soil, waste, vent, anti-syphonage and rain water pipes shall be measured net when fixed correct to a centimeter including all fittings along its length. No allowance shall be made for the portions of pipe lengths entering the sockets of the adjacent pipes or fittings. The above will apply to both case i.e. whether pipes are fixed on wall face or pillars or embedded in masonry or pipes running at ceiling level.

16.2.2 G.I., pipes shall measured per running metre correct to a centimeter for the finished work which shall include fittings e.g. bends, tees, elbows, reducers, crosses, sockets, nipples and nuts. The length shall be taken along centre line of the pipes and fittings. All pipes and fittings shall be classified according to their diameter, method of jointing and fixing substance, quality, and finish. The diameters shall be nominal diameter of internal bore. The pipes shall be described as including all cutting and waste. In case of fittings of un equal bore, the largest bore shall be measured.

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

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

16.5 Fittings: Unit of measurement shall be the number of pieces. All urinal traps, trap gratings, hoppers, cleanout plugs shall be measured by number per piece and shall include all items described in the relevant specifications and Schedule of Quantities.

16.6 Painting: Painting of pipes shall be measured per running metre and shall be inclusive of all fittings and clamps. No deduction for fittings shall be made.
16.7 Excavation for soil, waste, anit-siphonage and rainwater pipes: no extra payment shall be admissible with respect to excavation, refilling and disposal of surplus earth for cast iron and uPVC pipes.

16.8 Khurras shall be counted in numbers. The rate for each completed khurra of the specified size shall include the cost of all materials and labour involved in forming the khurra an the outlet opening as described in specifications above, except for the rainwater head grating, which shall be paid separately.

END OF SECTION III
Section IV  Water Supply System

1.  Scope of work

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

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

   a)  Distribution system from main supply headers to all fixtures and appliances for cold & hot water.
   b)  Cold water supply lines from city water connections to Under Ground Water Tank.
   c)  Garden irrigation system
   d)  Excavation and refilling of pipes trenches.
   e)  Pipe protection and painting.
   f)  Control valves, masonry chambers and other appurtenances.
   g)  Connections to all plumbing fixtures, tanks, appliances and municipal mains
   h)  Inserts for R.C.C. tanks

2  General requirements

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

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 elbows shall be restricted for short connections.

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

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

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

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

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

3  Water Supply System

3.1  Contractor should study the site plan and the water supply systems one for domestic water supply.

3.1.1  Source

Water supply will be acquired from Municipal Corporation water mains (as available) to a service connection and collected in water storage tanks located underground.
3.1.2 The system has been connected to a gravity feed system from overhead tanks to all parts of the building.

3.1.3 It is proposed to provide flushing cistern for all WCs. Infra red NO-TOUCH flush valves shall be provided for Urinals. These will be fed from over head tank by gravity.

3.1.4 Domestic water supply shall be provided with cold water system only. Hot water provisions to kitchen and all toilets connected to a local electric hot water storage geyser other than add on solar system at terrace for inlet of geyser in kitchen etc.

4 (CPVC) G.I. pipes, fittings & valves

4.1 All pipes inside the buildings for domestic hot and cold water supply shall be CPVC conforming to CTs SDR-13.5 at a working pressure of 320 PSI at 23 deg.C. and 80 PSI at 82 deg. C.

4.2 Solvent welded CPVC fittings etc. tees, elbows, couplers, unions, reducers, brushing etc. including transition fittings (connection between CPVC and metal pipes/G.I. ie. Brass adopters conforming to ASTM D-2846) shall be provided.

4.3 All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. G.I. pipes inside toilets shall run above false ceiling with vertical drop in wall chases for all fixtures. No pipes to run inside sunken floor as far as possible. Pipes may run under the ceiling or floors and other areas as shown on drawings.

4.4 Joining Pipes & Fittings

a) Cutting

Pipes shall be cut either with a wheel type plastic pipe cutting or hacksaw blade and care shall be taken to make a square cut. All burrs should be removed for proper contact between pipe and fittings during jointing.

b) Solvent Cement Application

Only CPVC solvent cement conforming to ASTM-F-493 should be used for joining pipe with fittings. An even coat of solvent cement should be applied on the pipe end and a thin coat inside the fitting socket.

c) Assembly

After applying the solvent cement on both pipe and fitting socket, pipe should be inserted into the fitting socket within 30 seconds, and rotating the pipe ¼ to ½ turn while inserting so as to ensure even distribution of solvent cement with the joint. The assembled system should be held for 10 seconds (approximately) in order to allow the joint to set up.

d) Testing

The system should be hydrostatically pressure tested at 150 psi (10 Bar) for one hour. During pressure testing, the system should be fitted with water and if a leak is found, the joint should be cut out the replaced with new one.
4.5 Transition of Flow guard CPVC in metals

When making a transition connection to metal threads, special brass/plastic transition fitting (Male and female adapters) should be used. Plastic threaded connections should not be over torque.

4.5.1 Threaded sealants
Teflon tape shall be used to make threaded connections leak proof.

4.5.2 Solvent Cement

Only CPVC solvent cement conforming to ASTM F 493 should be used for joining pipe with fittings and valves.

4.6 Hangers and supports

For Horizontal runs, support should be given at 3 feet (90 cms) intervals for diameters of one inch and below and at 4 feet (1.2 m) intervals for larger sizes.

Supports should be as per the below mentioned table:

<table>
<thead>
<tr>
<th>Size of pipe</th>
<th>20°C</th>
<th>49°C</th>
<th>71°C</th>
<th>82°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inch</td>
<td>Ft.</td>
<td>Ft.</td>
<td>Ft.</td>
<td>Ft.</td>
</tr>
<tr>
<td>½”</td>
<td>5.5</td>
<td>4.5</td>
<td>3.0</td>
<td>2.5</td>
</tr>
<tr>
<td>¾”</td>
<td>5.5</td>
<td>5.0</td>
<td>3.0</td>
<td>2.5</td>
</tr>
<tr>
<td>1”</td>
<td>6.0</td>
<td>5.5</td>
<td>3.5</td>
<td>3.0</td>
</tr>
<tr>
<td>1¼”</td>
<td>6.5</td>
<td>6.0</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>1½”</td>
<td>7.0</td>
<td>6.0</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>2”</td>
<td>7.0</td>
<td>6.5</td>
<td>4.0</td>
<td>3.5</td>
</tr>
</tbody>
</table>

4.7 Anchor Fasteners

4.7.1 All pipe supports, hangers and clamps to be fixed on RCC walls, beams, columns, slabs and masonry walls 230mm thick and above by means of galvanised expandable anchor fasteners in drilled holes of correct size and model to carry the weight of pipes. Drilling shall be made only by approved type of power drill as recommend and approved by manufacturer of the anchor fasteners. Failure of any fastening devices shall be the entire responsibility and contractor shall redo or provide additional supports at his own cost. He shall also compensate the DPL for any damage that may be caused by such failures.

4.8 Unions

Contractor shall provide adequate number of unions on all pipes to enable easy dismantling later when required. Unions shall be provided near each gunmetal valve, stop cock, or check valve and on straight runs as necessary at appropriate locations as required and/or directed by Project Manager.
4.9 Flanges

Flanged connections shall be provided on pipes as required or where shown on the drawings, all equipment connections as necessary and required or as directed by the Project Manager. Connections shall be made by correct number and size of GI nuts, bolts & washers with 3 mm thick gasket. Where hot water connections are made insertion gasket shall be of suitable high temperature grade and quality approved by the Project Manager. Bolt hole dia for flanges shall conform to match the specification for C.I. sluice valve to I.S. 780. and C.I. butterfly valve to IS: 13095.

4.10 Trenches

All water supply pipes below ground shall be laid in trenches with a minimum cover of 60 cms. The width and depth of the trenches shall be as follows:

<table>
<thead>
<tr>
<th>Dia of pipe</th>
<th>Width of trench</th>
<th>Depth of trench</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 mm to 50 mm</td>
<td>30 cms</td>
<td>75 cms</td>
</tr>
<tr>
<td>65 mm to 150 mm</td>
<td>45 cms</td>
<td>100 cms</td>
</tr>
</tbody>
</table>

4.11 Sand filling

G.I. pipes in trenches shall be protected with fine sand 15 cms all round before filling in the trenches.

4.12 Painting (Painting for CPVC pipes not required)

4.12.1 All pipes above ground shall be painted with one coat of red lead and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard colour code given in this documents or specified by Project Manager.

4.13 Pipe protection (Protection for CPVC pipes not required)

4.13.1 All G.I. pipes in wall chase /below floors or laid under ground shall be protected against corrosion by the application of two coats of bitumen paint covered with polythene tape and a final coat of bitumen paint.

4.13.2 G.I. waste pipes buried in ground or sunken slab shall be protected with multilayer bitumen membrane tape 3mm thick with a final coat of hot or cold applied bitumen. Pypkote or equivalent.

4.14 Valves

4.14.1 Ball Valves

Valves upto 40 mm dia. shall be screwed type Ball Valves with stainless steel balls, spindle, teflon seating and gland packing tested to a hydraulic pressure of 20 kg/cm², and accompanying couplings and steel handles.(to BS 5351)
4.15 Butterfly Valves

4.15.1 Valves 50 mm dia and above shall be cast iron butterfly valve to be used for isolation. The valves shall be bubble tight, resilient seated suitable for flow in either direction and seal in both direction with accompanying flanges and steel handle.

4.15.2 Butterfly valve shall be of best quality conforming to IS: 13095.

4.16 Non Return Valve (Slim Type)

Where specified non return valve (swing check type) shall be provided through which flow can occur in one direction only. It shall be single door swing check type of best quality.

4.16.1 Each Butterfly and Slim Type Swing Check (NRV) Valve shall be provided with a pair of flanges screwed or welded to the main line and having the required number of galvanised nuts, bolts and washers of correct length.

4.16.2 Storage tanks Underground & Overhead Tank. (Accessories & Connections)

4.16.6 Storage tanks for water supply shall be in reinforced cement concrete built by the building Contractor.

4.16.4 Each tank shall be provided with lockable type manhole cover fabricated from M.S. sheets. Manhole covers shall be 450-500 mm dia and fully galvanised after fabrication or as approved by the Project Manager.

4.17 Storage Tanks

4.17.1 Underground

Underground storage tanks for water supply shall be reinforced cement concrete built by the building contractor.

Each tank shall be provided with lockable type manhole cover fabricated from M.S. sheet or standard cost iron tank covers. Manhole covers shall be 450-500 mm dia or as approved by local municipal authority.

4.18 Outlets and overflow

All nozzles for puddle flanges in RCC tank for inlet, outlet, overflow and scour etc. shall be provided by civil contractor or as given in the Schedule of Quantities. Further connections and accessories shall be provided under this contract.

4.19 Testing

4.19.1 All pipes, fittings and valves after fixing at site, shall be tested by hydrostatic pressure of 1.5 times the working pressure or 10 kg/cm² whichever is more. Pressure shall be maintained for a period of at least thirty minutes without any drop.

A test register shall be maintained and all entries shall be signed and dated by Contractor (s) and Project Manager.

4.19.2 In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains.
He shall rectify all leakages and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and fixtures shall be made good by the Contractor during the defects liability period without any cost.

4.19.3 After commissioning of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

4.20 Measurement

a) CPVC or G.I. pipes above ground shall be measured per linear meter (to the nearest cm) and shall be inclusive of

b) all fittings e.g. coupling, tees, bends, elbows, unions, flanges and U clamps with nuts, bolts & washers fixed to wall or other standard supports.

c) Jointing with teflon tape, white lead and insertion gasket of appropriate temperature grade.

d) Cutting holes, and chases in walls, floors, any pipe support required for pipes below ground & making good the same.

e) Excavation, back filling, disposal of surplus earth and restoring the ground & floor in original condition.

4.21 Pipe Supports.

Fabricated and galvanised supports shall be measured by weight. Weight for each type of clamp shall be calculated on basis of the quantity of structural and MS used from the theoretical weight calculated on basis of the components theoretical weight of the sections.

4.21.1 Rate quoted for supports & hangers shall be inclusive of:-

a) Expandable anchor fastens.
b) Galvanising of all supports & hangers.
c) Cutting holes in walls, ceilings on floors and making good where permitted.
d) Nuts, bolts and washers for fixing and assembling.
e) Wooden/PVC pipe saddles for vertical or horizontal runs.

4.21.2 Valves

Gunmetal, cast iron, butterfly and non return valves and puddle flanges shall be measured by numbers and shall include wheels/caps, GI nuts, bolts, washers and insertion gasket.
4.21.3 Painting/pipe protection/insulation

Painting/pipe protection/insulation for pipes shall be measured per linear metre over finished surface and shall include all valves and fittings for which no deduction shall be made. No extra payment shall be made for fittings, valves or flanges.

End of Section IV
Section V  Garden Irrigation System

Scope of Work

Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to install garden hydrants and sprinklers and drip Irrigation water supply system as required by the drawings, specified hereinafter and as given in the Schedule of Quantities (BOQ).

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

a) Connections from the water supply system to all hydrants, sprinklers and drip irrigation points.

b) Garden hydrants, surface sprinklers & pipe emitters.

c) Excavation and refilling of pipes trenches.

d) Control valves, masonry chambers and other appurtenances.

e) Connections to all pumps & appliances.

6.2 The System

6.2.1 The garden hydrant and sprinkler irrigation system will be new and fully working system in the complex.

6.2.4 System components shall be pipes, valves, controllers, various types of sprinklers and drip irrigation lines with emitters as approved by the Project Manager.

6.3 General requirements

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

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

6.3.3 Short or long bends shall be used on all main pipe lines as far as possible. Use of elbows shall be restricted for short connections.

6.3.4 Pipes shall be laid in a manner as to provide as far as possible easy accessibility for repair and maintenance. Pipes under roads shall be laid in RCC pipe sleeves.

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

6.4 HDPE Pipes and Fittings.

6.4.1 Garden hydrant mains shall be HDPE pipes conforming to IS: 4984 of class specified. If class is not mentioned in the schedule of quantities the same shall be Material Grade PF100, unless other materials like uPVC schedule 40 or uPVC as per IS 4985 in accordance to specifications given above are specified in the BOQ.
6.4.2 Fittings for HDPE pipes shall be injection molded fitting suitable for thermal weld joints. Fittings must have suitable provision for expansion and shall be rated for the same working pressure as the pipeline, unless other materials like uPVC schedule 40 or uPVC as per IS 4985 in accordance to specifications given above are specified in the BOQ.

6.4.3 Thermal Joints shall be made in an approved manner as recommended by the manufacturer.

6.4.4 Provide flanges at intervals of 20-25 m. for all pipes 65 mm dia and above.

6.4.5 Provide suitable adapters for connection between pipes & valves.

6.4.6 Provide cement concrete supports and anchor blocks at all bends, tees and other locations as directed by the Project Manager. Connections at garden hydrant outlet, near valves must also be anchored.

6.4.7 Drip Irrigation Pipes

Pipes shall be LLDPE pies of UC 7510 resin conforming to ASAE S-435 standard.

6.4.8 G.I. Pipes & Fittings

Vertical connection for garden hydrant points shall be galvanised steel tubes to IS12:1239 (medium class) with matching malleable iron fitting of approved make.

6.5 Sprinklers

Pop-up Sprinklers Pop-up sprinklers shall be underground with rugged plastic high impact case with precision jet spray guide arm control with brass head, Sprinklers shall be suitable for pressure and coverage given in the schedule of quantities.

END OF SECTION V
SECTION VI - EXTERNAL SEWERAGE & EXTERNAL RAIN WATER DISPOSAL

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 all the drainage system as required by the drawings and specified hereinafter or given in the Schedule of Quantities.

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

   a) Sewer lines including excavations, pipe lines, manholes, drop connections and connections to the municipal or existing sewer.
   b) Storm water drainage, excavation, pipe lines, manholes, catch basins and connections to the existing municipal storm water drain.

2. GENERAL REQUIREMENTS

2.1 All materials shall be of the best quality conforming to specifications and subject to the approval of the Engineer-in-Charge.

2.2 Drainage lines and open drains 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 system from the municipal or any other competent authority.

2.5 Location of all manholes, etc. shall be got confirmed by the Engineer-in-Charge before the actual execution of work at site. As far as possible, no drains or sewers shall be laid in the middle of road unless otherwise specifically shown on the drawings or directed by the Engineer-in-Charge.

3. EXCAVATION

3.1 Alignment and grade: The sewer pipes shall be laid to alignment and gradient shown on the drawings but subject to such modifications as shall be ordered by the Engineer-in-Charge from time to time to meet the requirements of the works. No deviations from the lines, depths of cutting or gradients of sewers shown on the plans and sections shall be permitted except by the express direction in writing of the Engineer-in-Charge.

3.2 Excavation in tunnels: The excavation for sewer works shall be open cutting unless the permission of the Engineer-in-Charge for the ground to be tunneled is obtained in writing. Where sewers have to be constructed along narrow passages, the Engineer-in-Charge may order the excavation to be made partly in tunnel and in such cases the excavated soil shall be brought back later on for refilling the trenches or tunnel.

3.3 OPENING OUT TRENCHES: In excavating the trenches, etc. The solid road metalling, pavement, kerbing, etc. And turf is to be placed on one side and preserved for reinstatement when the trenches or other excavation shall be filled up. Before any road metal is replaced, it shall be carefully sifted.
The surface of all trenches and holes shall be restored and maintained to the satisfactions of the Engineer-in-Charge and of the owners of the roads or other property traversed and the Contractor shall not cut out or break down any live fence of trees in the line of the proposed works but shall tunnel under them, unless the Engineer-in-Charge shall order to the contrary. The Contractor shall grub up and clear the surface over the trenches and other excavations of all trees, stumps roots and all other encumbrances affecting execution of the work and shall remove them from the site to the approval of the Engineer-in-Charge.

3.4 **OBSTRUCTION OF ROADS**: The Contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall then be left for public and private transit, he shall remove the materials excavated and bring them back again when the trench is required to be refilled. The Contractor shall obtain the consent of the Engineer-in-Charge in writing before closing any road to vehicular traffic and the foot walks must be clear at all times.

3.5 **REMOVAL OF FILTH**: All night soil, filth or any other offensive matter met with during the execution of the works, immediately after it is taken out of any trench, sewer or cess pool, shall not be deposited on to the surface of any street or where it is likely to be a nuisance or passed into any sewer or drain but shall be at once put into the carts and removed to a suitable place to be provided by the Contractor.

3.6 **EXCAVATION TO BE TAKEN TO PROPER DEPTHS**: The trenches shall be excavated to such a depth that the sewer shall rest on concrete as described in the several clauses relating there to and so that the invert may be at the levels given in the sections. In bad ground, the Engineer-in-Charge may order the Contractor to excavate to a greater depth than that shown on the drawings and to fill up the excavation to the level of the sewers with concrete, broken stone, graven or other materials. For such extra excavation and concrete, broken stone, gravel or other materials, the Contractor shall be paid extra at rates laid down for such works in the schedule, if the extra work was ordered by the Engineer-in-Charge in writing, but if the Contractor should excavate the trench to a greater depth than is required without a specific order to that effect in writing of the Engineer-in-Charge the extra depth shall have to be filled up with concrete at the Contractor's own costs and charges to the requirements and satisfactions of the Engineer-in-Charge.

3.7 **REFILLING**: After the sewer or other work has been laid and proved to be water tight, the trench or other excavations shall be refilled. Utmost care shall be taken in doing this, so that no damage shall be caused to the sewer and other permanent work. The filling in the haunches and up to 75 cms above the crown of the sewer shall consist of the finest selected materials placed carefully in 15 cms layers and flooded and consolidated. After this has been laid, the trench and other excavation shall be refilled carefully in 15 cms layers with materials taken from the excavation, each layer being watered to assist in the consolidation unless the Engineer-in-Charge shall otherwise direct.

3.8 **CONTRACTOR TO RESTORE SETTLEMENT AND DAMAGES**: The Contractor shall, at his own costs and Charges, make good promptly during the whole period the works are in hand, any settlement that may occur in the surfaces of roads, beams, footpaths, gardens, open spaces etc. Whether public or private caused by his trenches or by his other excavations and he shall be liable for any accidents caused thereby. He shall also, at his own expense and Charges, repair and make good any damage done to buildings and other property.
If in the opinion of the Engineer-in-Charge he fails to make good such works with all practicable dispatch, the Engineer-in-Charge shall be at liberty to get the work done by other means and the expenses thereof shall be paid by the Contractor or deducted from any money that may be or become due to him or recovered from him in any other manner according to the law of the land.

3.9 DISPOSAL OF SURPLUS SOIL: The Contractor shall at his own costs and charges provide places for disposal of all surplus materials not required to be used on the works. As each trench is refilled the surplus soil shall be immediately removed, the surface properly restored and roadways and sides left clear.

3.10 TIMBERING OF SEWER AND TRENCHES:

a) The Contractor shall at all times support efficiently and effectively the sides of the sewer trenches and other excavations by suitable timbering, piling and sheeting and they shall be closed, timbered in loose or sandy strata and below the surface of the sub soil water level.

b) All timbering, sheeting and piling with their walling and supports shall be of adequate dimensions and strength and fully braced and strutted so that no risk of collapse or subsidence of the walls of the trench shall take place.

c) The Contractor shall be held responsible and will be accountable for the sufficiency of all timbering, bracings, sheeting and piling used as also for, all damage to persons and property resulting from improper quality, strength, placing, maintaining or removing of the same.

3.11 SHORING OF BUILDINGS: The Contractor shall shore up all buildings, walls and other structures, the stability of which is liable to be endangered by the execution of the work and shall be fully responsible for all damages to persons or property resulting from any accident.

3.12 REMOVAL OF WATER FROM SEWER, TRENCH ETC:

a) The Contractor shall at all times during the progress of the work keep the trenches and excavations free from water which shall be disposed of by him in a manner as will neither cause injury to the public health nor to the public or private property nor to the work completed or in progress nor to the surface of any roads or streets, nor cause any interference with the use of the same by the public.

b) If any excavation is carried out at any point or points to a greater width than the specified cross section of the sewer with its envelope, the full width of the trench shall be filled with concrete by the Contractor at his own expenses and charges to the requirements of the Engineer-in-Charge.

3.13 WIDTH OF TRENCH: The Engineer-in-Charge shall have power by giving an order in writing to the Contractor to increase the maximum width in respect of which payment will be allowed for excavation in trenches for various classes of sewer, manholes, and other works in certain lengths to be specifically laid down by him, where on account of bad ground or other unusual conditions, he considers that such increased widths are necessary in view of the site conditions.
3.14 **RECOMMENDED WIDTH OF TRENCHES AT THE BOTTOM SHALL BE AS FOLLOWS:-**

<table>
<thead>
<tr>
<th></th>
<th>100 mm dia pipe</th>
<th>55 cms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>150 mm dia pipe</td>
<td>55 cms</td>
</tr>
<tr>
<td>2</td>
<td>225-250 cms dia pipe</td>
<td>60 cms</td>
</tr>
<tr>
<td>3</td>
<td>300 mm dia pipe</td>
<td>75 cms</td>
</tr>
</tbody>
</table>

Maximum width of the bed concrete shall also be as above. No additional payment is admissible for widths greater than Specified.

4. **SALT GLAZED STONEWARE PIPES**

4.1 Stoneware pipes shall be of first class quality salt glazed and free from rough texture inside and outside and straight. All pipes shall have the manufacturers name marked on it and shall comply to I.S. 651-1971 approved makes Perfect or Burn.

4.2 Laying and jointing of stoneware salt glazed pipes

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

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

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

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

4.3 Jointing of pipes

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

b) The remainder of the socket shall be filled with stiff mix of cement mortar (1 cement: 1 clear sharp washed sand). When the socket is filled, a fillet should be formed round the joint with a trowel forming an angle of 45 degrees with the barrel of the pipe. The mortar shall be mixed as needed for immediate use and no mortar shall be beaten up and used after it has begun to set.
c) After the joint has been made any extraneous materials shall be removed from inside of the joint with a suitable scraper of "badger". The newly made joints shall be protected until set from the sun, drying winds, rain or dust. Sacking or other materials which can be kept damp shall be used. The joints shall be exposed and space left all round the pipes for inspection by the Engineer-in-Charge. The inside of the sewer must be left absolutely clear in bore and free from cement mortar or other obstructions throughout its entire length, and shall efficiently drain and discharge.

4.4 Testing

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

b) Sewer lines shall be tested for straightness by:

(i) inserting a smooth ball 12 mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball should roll down the invert of the pipe and emerge at the lower end,

(ii) means of a mirror at one and a lamp at the other end. If the pipe line is straight the full circle of light will be seen otherwise obstruction of deviation will be apparent.

c) The Contractor shall give a smoke test to the drains and sewer at his own expense and charges, if directed by the Engineer-in-Charge.

d) A test register shall be maintained which shall be signed and dated by Contractor, Engineer-in-Charge and representative of Architects/Consultants.

4.5 Gully traps: Gully traps shall be of the same quality as described for stoneware pipes in clause 5. Gully traps shall be fixed in cement concrete 1:5:10 mix and a brick masonry chamber 30x30 cms inside in cement mortar 1:5 with 15x15 cms grating inside and 30x30 cms SFRC cover as per standard drawing. Where necessary, sealed cover shall be replaced with C.I. grating of the same size (1 cement : 5 coarse sand: 10 stone aggregate 40 mm nominal size).

5. REINFORCED CEMENT CONCRETE PIPES

5.1 All underground storm water drainage pipes and sewer lines where specified (other than those specified cast iron) shall be centrifugally spun RCC pipes of specified class. Pipes shall be true and straight with uniform bore, throughout. Cracked, warped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, when directed a certificate to that effect from the manufacturer.

5.2 Laying: R.C.C. spun pipes shall be laid on cement concrete bed or cradles as specified and shown on the detailed drawings. The cradles may be precast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12 mm below the invert level of the pipe properly placed on the soil to prevent any disturbance. The pipe shall then be placed on the bed concrete or cradles and set for the line and gradient by means of sight rails and bonding rods etc. Cradles or concrete bed may be omitted, if directed by the Engineer-in-Charge.
5.3 Jointing: After setting out the pipes the collar shall be centered over the joint and filled in with tarred gaskin, so that sufficient space is left on either side of the collar to receive the mortar. The space shall then be filled with cement mortar 1:2 (1 cement: 2 fine sand) and caulked by means of proper tools. All joints shall be finished at an angle of 45 degrees to the longitudinal axis of the pipe on both sides of the collars neatly.

5.4 Testing: All pipes shall be tested to a hydraulic test of 1.5 m head for at least 30 minutes at the highest point in the section under test. Test shall also be carried out similar to those for stoneware pipes given above. The smoke test shall be carried out by the Contractor, if directed by the Engineer-in-Charge, at the expense and charges of the Contractor. A test register shall be maintained which shall be signed and dated by Contractor/Engineer-in-Charge and representative of Architects/Consultant.

6. CEMENT CONCRETE AND MASONRY WORKS (FOR MANHOLES AND CHAMBERS ETC.)

6.1 Materials

a) Water: Water used for all the constructional purposes shall be clear and free from oil, acid, alkali, organic and other harmful matters, which shall deteriorate the strength and/or durability of the structure. In general, the water suitable for drinking purposes shall be considered good enough for constructional purpose.

b) Aggregate for concrete: The aggregate for concrete shall be in accordance with I.S.383 and I.S. 515. In general, these shall be free from all impurities that may cause corrosion of the reinforcement. Before actual use these shall be washed in water, if required as per the direction of Engineer-in-Charge. The size of the coarse aggregate shall be done as per I.S.383.

c) Sand: Sand for various constructional purposes shall comply in all respects with I.S. 650 and I.S. 2116. It shall be clean, coarse hard and stone, sharp, durable, uncoated, free from any mixture of clay, dust, vegetable matters, mica, iron impurities soft or flaky and elongated particles, alkali, organic matters, salt, loam and other impurities which may be considered by the Engineer-in-Charge as harmful for the construction.

d) Cement: The cement used for all the constructional purposes shall be ordinary Portland cement or rapid hardening Portland cement conforming to I.S.269.

e) Mild steel reinforcement: The mild steel for the reinforcement bars shall be in the form of round bars conforming to all requirements of I.S. 432 grade I.

f) Bricks: Brick shall have uniform colour, thoroughly burnt but not over burnt, shall have plain rectangular faces with parallel sides and sharp right angled edges. They should give ringing sound when struck. Brick shall not absorb more than 20% to 22% of water, when immersed in water for 24 hours. Bricks to be used shall be approved by the Engineer-in-Charge.

g) Other materials: Other materials not fully specified in these specifications and which may be required in the work shall conform to the latest I.S.. All such materials shall be approved by the Engineer-in-Charge before use.

6.2 Cement concrete (plain or reinforced)

a) Cement concrete pipes bedding, cradles, foundations and R.C.C. slabs for all works shall be mixed by a mechanical mixer where quantities of the concrete poured at one time permit. Hand mixing on properly constructed platforms may be allowed for small quantities by the Engineer-in-Charge. Rate for cement concrete shall be inclusive of all shuttering and centering at all depth and heights.

b) Concrete work shall be of such thickness and mix as given in the Schedule of Quantities.

c) All concrete work shall be cured for a period of at least 7 days. Such work shall be kept moist by means of gunny bags at all times. All pipes trenches and foundations shall be kept dry during the curing period.
6.3 Masonry work: Masonry work for manholes, chambers, septic tanks, and such other works as required shall be constructed from 1st class bricks or 2nd class as specified in the Schedule of quantities in cement mortar 1:5 mix (1 cement: 5 coarse sand). All joints shall be properly raked to receive plaster.

6.4 Cement concrete for pipe support:

a) Wherever specified or shown on the drawings, all pipes shall be supported in bed all round or in haunches. The thickness and mix of the concrete shall be given in the Schedule of Quantities. Width of the bedding shall be as per Para 4.14.

b) Unless otherwise directed by the Engineer-in-Charge cement concrete for bed, all round or in haunches shall be laid as follows:-

<table>
<thead>
<tr>
<th></th>
<th>upto 1.5 m depth</th>
<th>upto 3 m depth</th>
<th>beyond 3 m depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stoneware pipes all round in haunches all round in open ground (no sub soil water)</td>
<td>(1:5:10)</td>
<td>(1:5:10)</td>
<td>(1:5:10)</td>
</tr>
<tr>
<td>R.C.C or S.W. All round in haunches in sub soil water</td>
<td>(1:3:6)</td>
<td>(1:3:6)</td>
<td>(1:3:6)</td>
</tr>
<tr>
<td>C.I. Pipes all round in haunches in haunches</td>
<td>(1:3:6)</td>
<td>(1:3:6)</td>
<td>(1:3:6)</td>
</tr>
<tr>
<td>R.C.C. Pipes all round all round all round or C.I. pipes</td>
<td>(1:3:6)</td>
<td>(1:3:6)</td>
<td>(1:3:6)</td>
</tr>
</tbody>
</table>

c) R.C.C. pipes or C.I. pipes may be supported on brick masonry or precast R.C.C. or in situ cradles. Cradles shall be as shown on the drawings.
d) Pipes in loose soil or above ground shall be supported on brick or stone masonry pillars as shown on the drawings.

7. MANHOLES AND CHAMBERS

7.1 All manholes, chambers and other such works as specified shall be constructed in brick masonry in cement mortar 1:4 (1 cement: 4 coarse sand) or as specified in the Schedule of Quantities.

7.2 All manholes and chambers, etc. shall be supported on base of cement concrete of such thickness and mix as given in the Schedule of Quantities or shown on the drawings. Where not specified, manholes shall be constructed as follows:-

<table>
<thead>
<tr>
<th>Size of manhole (all dimensions internal clear in cms)</th>
<th>90x80</th>
<th>120x90</th>
<th>90 dia</th>
<th>140 dia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Rect</td>
<td>Rect</td>
<td>Conical</td>
<td>Conical</td>
</tr>
<tr>
<td>Maximum depth</td>
<td>150</td>
<td>240</td>
<td>250</td>
<td>500</td>
</tr>
<tr>
<td>Average thickness of R.C.C slab</td>
<td>15</td>
<td>15</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Size of cover and frame</td>
<td>60x45</td>
<td>50 dia</td>
<td>50 dia</td>
<td>50 dia</td>
</tr>
<tr>
<td>Weight of cover and frame</td>
<td>As per IS: 12592 requirements</td>
<td>As per IS: 12592 requirements</td>
<td>As per IS: 12592 requirements</td>
<td>As per IS: 12592 requirements</td>
</tr>
</tbody>
</table>

7.3 All manholes shall be provided with cement concrete benching in 1:2:4 mix. The benching shall have a slope of 10 cms towards the channel. The depth of the channel shall be full diameter of the pipe. Benching shall be finished with a floating coat of neat cement. (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nom. Size)
7.4 All manholes shall be plastered with 12/15 mm thick cement mortar 1:3 (1 cement: 3 coarse sand) and finished with a floating coat of neat cement inside. Manhole shall be plastered outside as above but with rough plaster.

7.5 All manholes with depths greater than 1 m. shall be provided with 20 mm square plastic foot rests set in cement concrete blocks 25x10x10 cms in 1:2:4 mix 30 cms vertically and staggered.

7.6 All manholes shall be provided with SFRC covers and frames and embedded in reinforced cement concrete slab. Weight of cover, frame and thickness of slab shall be as specified in the Schedule of Quantities or given above.

8. **MAKING CONNECTIONS**

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

9. **MEASUREMENT**

9.1 Excavation

9.1.1 Measurement for excavation of pipe trenches shall be made per linear meter under the respective category of soil classification encountered at site.

a) Ordinary soil
b) Hard soil (hard moor & soft rock)
c) Hard rock requiring chiseling
d) Hard rock requiring blasting.

9.1.2 Trenches shall be measured between outside walls of manholes at top and the depth shall be the average depth between the two ends to the nearest cm. The rate quoted shall be for a depth up to 1.5 m or as given in the Schedule of Quantities.

9.1.3 Payment for trenches more than 1.5 m in depth shall be made for extra depth as given in the schedule of quantities and above the rate for depth up to 1.5 m.

9.1.4 Timbering and Shoring: Timbering and shoring as described above shall be measured per sq.m and paid for as per the type of timbering of shoring done at site and as per the relevant item in the Schedule of Quantities. Rate for timbering and shoring shall be for all depths and types of soil classifications including saturated soil.

9.1.5 Saturated Soil: No extra payment for pumping and bailing out water shall be made for excavation with an average depth of 1.5 m in saturated soil, surface water from rain falls or broken pipes lines, or sieves and other similar sources. An extra rate as quoted in the schedule of quantities shall be paid for excavation in saturated soil for pipe trenches above average depth of 1.5 m. No payment is admissible for water collected from surface sources and broken pipe lines or sewers.

9.1.6 Refilling, Consolidation and Disposal of Surplus Earth: Rate quoted for excavation of trenches shall be inclusive of refilling, consolidation and disposal of surplus earth within a lead of 200 m.
9.2 Stoneware Pipes/RCC/C.I. pipes: Stoneware R.C.C./C.I. pipes shall be measured for the finished length of the pipeline per linear metre ie.

a) Lengths between manholes shall be recorded from inside of one manhole to inside of other manhole.

b) Length between gully trap and manhole shall be recorded between socket of pipe near gully trap and inside of manhole. Rate shall include all items given in the schedule of quantities and specifications.

9.3 Gully Traps: Gully traps shall be measured by the number and rate shall include all excavation, foundation, concrete brick masonry, cement plaster inside and outside, C.I. grating and sealed cover and frame.

9.4 Cement Concrete for Pipes: Cement concrete in bed and all round or in haunches shall be paid per running metre between the outside wall of manholes at bottom of the trench. No additional payment is admissible in respect of concreting done for widths greater than specified, for shuttering or centering and concreting in sub soil water conditions.

9.5 Manholes:

a) All manholes shall be measured by numbers and shall include all items specified above and necessary excavation, refilling & disposal of surplus earth.

b) Manholes with depths greater than specified under the main item shall be paid for under "extra depth" and shall include all items as given for manholes. measurement shall be done to the nearest cm. Depth of the manholes shall be measured from top of the manhole cover to bottom of channel.

9.6 Making Connections: Item for making connection to municipal sewer shall be paid for by number and shall include all items given in the Schedule of Quantities and specifications.

End of Section VI
Section VII  Fire Hydrant System and Sprinkler System

1  Scope of work

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

1.2 Without restricting to the generality of the foregoing, the work shall include but not limited to the following:

   a) Piping for wet riser hydrant systems and for yard hydrants.
   a) Landing valves, canvas hose pipes, hose reels, hose cabinets & connections to mains.
   b) Fully automatic sprinkler system
   d) Isolation valves, non-return valves, installation valves, flow control switches and accessories.

2.  General

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

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

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

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

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

2.6 The rules and regulations of Local Fire Authority as per the statutory regulations applicable for obtaining the occupation certificate from the Local Development / Fire Authority.

2.7 Drawings issued with the tenders are schematic and indicate the concept. Contractor shall make his shop drawings on basis of Architectural and Interior design drawings issued by the Engineer-in-Charge. Work will be executed only as per approved shop drawings.

2.8 It is the contractor's responsibility to ensure the competence of design to meet the above requirements.

3  Pipes

All pipes within and outside the building in exposed locations and shafts including connections buried under floor shall be M.S. pipes confirming to IS : 1239 Heavy Class
4  **Pipe Fittings**

Pipes and fittings means tees, elbows, couplings, flanges, reducers etc. and all such connecting devices that are needed to complete the piping work in its totality.

Screwed fittings shall be approved type malleable or cast iron with reinforced ring on all edges of the fittings suitable for screwed joints.

Forged steel fittings of approved type with "V" groove for welded joints.

Fabricated fittings shall be not being permitted for pipe diameters 50 mm and below. When used, they shall be fabricated, welded and inspected in workshops whose welding procedures have been approved by the TAC as per TAC rule 4102 for sprinkler system and applicable to hydrant and sprinkler System under the supervision of Project Manager. For "T" connections, pipes shall be drilled and reamed. Cutting by gas or electrical welding will not be accepted.

5  **Jointing**

5.1  **Screwed (50 mm dia pipes and below)**

Joint for black steel pipes and fittings shall be metal to metal thread joints. A small amount of red lead may be used for lubrication and rust prevention. Joints shall not be welded or caulked.

5.2  **Welded (65 mm dia and above)**

Joints between M.S. pipes and fittings shall be made with the pipes and fittings having "V" groove and welded with electrical resistance welding in an approved manner. Butt welded joints are not acceptable.

5.3  **Flanged**

a) Flanged joints shall be provided on:

b) Straight runs not exceeding 30 m on pipe lines 80 mm dia and above.

c) Both ends of any fabricated fittings e.g. bend tees etc. of 65 mm dia or larger diameter.

d) For jointing all types of valves, appurtenances, pumps, connections with other type of pipes, to water tanks and other places necessary and required as per good engineering practice.

e) Flanges shall be as per I.S. with appropriate number of G.I. nuts and bolts, 3 mm insertion neoprene gasket complete.

5.4  **Unions**

Approved type of dismountable unions on pipes lines 65 mm and below in similar places as specified for flanges.
6 Excavation

6.1 Excavation for pipe lines shall be in open trenches to levels and grades shown on the drawings or as required at site. Pipe lines shall be buried to a minimum depth of 1.2 meter or as shown on drawings.

6.2 Wherever required contractor shall support all trenches or adjoining structures with adequate timber supports.

6.3 On completion of testing and pipe protection, trenches shall be refilled with excavated earth in 15 cms layers and consolidated.

6.4 Contractor shall dispose off all surplus earth within a lead of 200 m or as directed by Project Manager.

Anchor Thrust Blocks

a) Contractor shall provide suitably designed anchor blocks in cement concrete to encounter excess thrust due to water hammer & high pressure.

b) Thrust blocks shall be provided at all bends & tees & such other location as determined by the Project Manager.

c) Exact location, design, size and mix of the concrete block shall be approved by the Project Manager prior to execution of work.

7 Valves

7.1 Gunmetal Valves

7.1.1 Valves 65 mm dia & below shall be heavy gunmetal full way valves or globe valves conforming to I.S. 778-1971 class II with female screwed ends. Valves shall carry I.S. certifications mark.

7.1.2 All valves shall be approved by the Project Manager before they are allowed to be used on work.

7.2 C.I. Butterfly Valves/Sluice Valves

7.2.1 All valves 80 mm dia and above shall be C.I. double flanged butterfly valves. Each sluice valve shall be provided with wheel for valves in exposed positions and cap top for underground valves. Contractor shall provide suitable operating keys for Sluice Valves with cap tops.

7.2.2 Butterfly valves shall be of best quality conforming to I.S.13095 of class specified and sluice valves shall conform to IS: 780.

7.3 Non-return valves (Check Valves)

Non-return valves shall be cast iron double flanged with cast iron body and gunmetal internal parts conforming to IS: 5312.
7.4 **Air valves**

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

7.5 **Orifice Flanges**

Orifice flanges fabricated from 6 mm thick stainless steel plate shall be provided to reduce pressure on individual hydrants to restrict the operating pressure to 3.5 kg/cm² and allow a discharge of 560 lpm. The contractor shall submit design of the orifice flanges for approval before installation.

7.6 **Drain Valve**

50 mm dia black steel pipe to IS: 1239 (heavy class) with 50 mm gunmetal fullway valve shall be provided for draining any water in the system in low pockets.

7.7 **Pressure Gauge**

Pressure gauge shall be provided near all connections to hydrant system and isolation valves of sprinkler system and where required. Pressure gauge shall be 100 mm dia gunmetal Bourden type with gunmetal isolation cock, tapping and connecting pipe and nipple. The gauge shall be installed at appropriate level and height for easy readability.

8 **Hydrant/valve chambers**

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

8.2 Valve chambers shall be of following size:-

for depths 100 cms and beyond 120x120 cms.

9 **Fire brigade connections**

As shown on drawings separate gunmetal 2-3 way collecting head Fire brigade connection each with two or three 63 mm instantaneous type inlets with built in check valves and 150 mm dia inlet/outlet connected to the fire and sprinkler main as given in BOQ shall be provided. Both shall be installed on a stand post and provided with horizontal C.I. reflux valve and location to be approved by Project Manager. Etched gunmetal label plates with 80 mm high letters shall be fixed along with necessary enclose cabinet. The plates should be firmly fixed to the FB connection and any support system.
10 Fire hydrants

10.1 External hydrants

10.1.1 Contractor shall provide stand post type external hydrants. The hydrants shall be controlled by a cast iron sluice valve installed in underground lockable chambers. Hydrants shall have instantaneous type 63 mm dia outlets. The hydrants valve shall be single outlet conform to I.S.5290 with C.I duck foot bend and flanged riser of required height to bring the hydrant to correct level above ground.

10.1.2 Contractor shall provide for each external fire hydrant two numbers of 63 mm dia. 15 m long controlled percolation type hose pipes with gunmetal male and female instantaneous type couplings machine wound with G.I. wire (hose to I.S. 636 Type 2 and couplings to I.S. 903 with M.S. certification), gunmetal branch pipe with nozzle to I.S. 903.

10.2 Internal hydrants

10.2.1 Contractor shall provide on each landing and other locations as shown on the drawings one single headed gunmetal oblique landing valves with 63 mm dia outlet mounted on a common 80 mm inlet conforming to I.S.5290-1969. Landing valve shall have flanged inlet and instantaneous type outlets as shown on the drawings.

10.2.2 Instantaneous outlets for fire hydrants shall be of standard pattern approved and suitable for fire brigade hoses.

10.2.3 Contractor shall provide for each internal fire hydrant station two numbers of 63 mm dia. 15 m long rubberized fabric linen hose pipes with gunmetal male and female instantaneous type coupling machine wound with G.I. wire (hose to I.S. 636 Type 2 and couplings to I.S. 903 with I.S. Certification), fire hose reel conforming to IS:884, gunmetal branch pipe with nozzle I.S. 2871 and Fire man's axe conforming to IS: 926.

10.2.4 Each hose box shall be conspicuously painted with the letters "FIRE HOSE".

11 Fire hose reels

Contractor shall provide standard fire hose reels with 20 mm dia high pressure Dunlop or equivalent rubber hose 36.5 m long with gunmetal nozzle and control valve, shut off valve, all mounted on circular hose reel of heavy duty mild steel construction and cast iron brackets. Hose reel shall be connected directly to the wet riser. Hose reel shall conform to IS: 884-1969 and rubber hose to IS: 5132.

12 Hose Cabinets

12.2 All internal fire hydrants shall be enclosed in M.S. glazed cabinet. Hose cabinets shall be fabricated from 16 gauge M.S. sheet of fully welded construction with hinged double front door partially glazed with locking arrangement stove enameled fire red paint with "FIRE HOSE" written on it prominently. (Sizes are as given in the Bill of Quantities).
13  **Pipe protection**

a) All pipes above ground and in exposed locations shall be painted with one coat of zinc chromate primer and two or more coats of synthetic enamel paint of approved shade.

b) Pipes in chase or buried underground shall be painted with two coats of zinc chromate primer and wrapped with one layer of 4 mm thick PYPKOTE mutilayer sheet as per standard manufacturer’s specifications.

14  **Pipe Supports**

2.16.1 All pipe clamps and supports shall be galvanised steel. When fabricated from M.S. steel sections, the supports shall be factory galvanised before use at site. Welding of galvanised clamps and supports will not be permitted.

2.16.2 Pipes shall be hung by means of expandable anchor fastner of approved make and design (Dash Fastners or equivalent). The hangers and clamps shall be fastened by means of galvanised nuts and bolts. The size/diameter of the anchor fastner and the clamp shall be suitable to carry the weight of water filled pipe and dead load normally encountered.
## 4.4 Pipe Spacing Table

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### 15 Cables

15.1 Contractor shall provide control cables from supervisory valves and switches to the annunciation panels.

15.2 All control cables shall be copper conductor PVC insulated armoured and PVC sheathed 1100 volt grade.

15.3 All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer's name.

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

15.5 Cable Trays

15.6 All cables shall be routed in approved locations in coordination with all other services in a proper manner.

### 16 Cable Trays

16.1 All cables shall be routed in approved locations in coordination with all other services in a proper manner.

16.2 Cable trays shall be of galvanized steel and hung from the ceiling by galvanised rods supported by appropriate size and type of expandable expansion fasteners drilled into the slabs and walls by an electric drill.
17  Measurement

17.1  Mild steel pipes shall be measured in linear metres of the finished length correct upto one cm.and shall include all fittings, flanges, welding, jointing, clamps for fixing to walls or hangers, anchor fasteners, painting and testing complete in all respects.

17.2  Sluice and fullway valves, check valves, installation valves, air valves & flow switches shall be measured by numbers and shall include all items necessary and required for fixing and as given in the specifications and bill of quantities.

17.3  Fire hydrants, hose reels, fire brigade connections, orifice flanges shall be measured by number and include all items given in the specifications and bill of quantities.

17.4  Fire hose and boxes specified shall be measured by number and include all items given in specifications and Bill of Quantities.

17.5  Cables and cable trays shall be measured in linear metre correct upto cm shall include clamps, hangers, anchor fasteners complete in all respects.

End of Section VII
Section VIII  Hand Appliances

1  Scope of work

1.1  Work under this section shall consist of furnishing all labour, material, appliances and equipment necessary and required to install fire extinguishing hand appliances.

1.2  Without restricting to the generality of the foregoing the work shall consist of the following:-

   Installation of fully charged and tested fire extinguishing hand appliances CO₂ foam, dry chemical powder type as required by these specifications and/drawings.

2  General requirements

2.1  Fire extinguishers shall conform to the following Indian Standard Specifications and shall be with ISI approved stamp as revised and amended up to date :-

2.2  Fire extinguishers shall be installed as per Indian Standard "Code of Practice for Selection, Installation and Maintenance of Portable First Aid Appliances" I.S.2190-1962.

2.3  Hand appliances shall be installed in readily accessible locations with the appliance brackets fixed to wall by suitable anchor fasteners.

2.4  Each appliance shall be provided with an inspection card indicating the date of inspection, testing, change of charge and other relevant data.

2.5  All appliances shall be fixed in a true workmanlike manner truly vertical and at correct locations.

3  Measurement

Fire extinguishers shall be measured by numbers and include installation and all items necessary and required and given in the specifications.

End of Section VIII
1. **Scope of Work**

1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install electrically operated and diesel engine driven pumps as required by the drawings and specified hereinafter or given in the schedule of quantities.

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

a) Pressure gauges with isolation valves & piping.

b) M.S. pipes, valves, suction strainers, delivery and suction headers & accessories.

c) Foundations, vibration eliminator pads and foundation bolts.

2 **General Requirements**

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

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

2.3 All pump connections shall be standard flanged type with appropriate number of bolts. In case of non standard flanges companion flanges shall be provided with the pumps.

2.4 Manufacturer’s instructions regarding installation, connections and commissioning shall be followed with respect to all pumps and accessories.

2.5 Contractor shall provide necessary test certificates and performance charts with NPSH requirement of the pumps from the manufacturer. The Contractor shall provide facilities to the Project Manager or their authorised representative for inspection of equipment during manufacturing and also to witness various tests at the manufacturer’s works without any cost to the DPLs.

2.6 Each pump shall be provided with a pressure gauge, isolation cock and connecting piping, bleed and block valve.

2.7 Adequate vibration eliminating pad and connectors for each pump shall be provided.

2.8 The Contractor shall submit with this tender a list of recommended spare parts for two years of normal operation and quote the prices for the same.

3 **Fire Pumps**

3.1 **Pumping Sets**

3.1.1 Pumping sets shall be single stage horizontal centrifugal single outlet with cast iron body and cast iron impellers. Connecting shaft shall be stainless steel with bronze sleeve and grease lubricated bearings.
3.1.2 Pumps shall be connected to the drive by means of spacer type love joy couplings which shall be individually balanced dynamically and statically.

3.1.3 The coupling joining the prime movers with the pump shall be provided with a sheet metal guard.

3.1.4 Pumps shall be provided with approved type of mechanical seals.

3.1.5 Pumps shall be capable of delivering not less than 150% of the rated capacity of water at a head of not less than 65% of the rated head. The shut off head shall not exceed 120% of the rated head.

3.1.6 The pump shall meet the requirements of the Tariff Advisory Committee and the unit shall be design proven in fire protection services.

4 Electric drive

4.1 Electrically driven pumps shall be provided with totally enclosed fan cooled induction motors. For fire pumps the motors should be rated not to draw starting current more than 3 times normal running current.

4.2 Motors for fire protection pumps shall be atleast equivalent to the horse power required to drive the pump at 150% of its rated discharge and shall be designed for continuous full load duty and shall be design proven in similar service.

4.3 Motors shall be wound for class B insulation and winding shall be vacuum impregnated with heat and moisture resistant varnish glass fibre insulated.

4.4 Motors for fire pumps shall meet all requirements and specifications of the Tariff Advisory Committee.

4.5 Motors shall be suitable for 415 ±10% volts, 3 phase 50 cycles a/c supply and shall be designed for 38°C ambient temperature. Motors shall conform to I.S. 325.

4.6 Motors shall be designed for two start system.

4.7 Motors shall be capable of handling the required starting torque of the pumps.

4.8 Contractor shall provide inbuilt heating arrangements for the motors for main pumps to ensure that motor windings shall remain dry.

4.9 Speed of the motor shall be compatible with the speed of the pump.

5 Vibration Eliminators

On all suction and delivery lines double flanged reinforced neoprene flexible pipe connectors shall be provided. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connector shall be as per manufactures details.
6. Measurements:

6.1 Fire pumps shall be measured by numbers and shall include all items as given in the specifications and schedule of quantities.

6.2 Sluice valves, non return valves, vibration eliminators, flanges and suction strainer shall be measured by numbers and shall include all items as given in the schedule of quantities and specifications.

6.3 Pump headers, shall be measured per linear metre and shall include all items given in the specifications and schedule of quantities.

End of Section IX
Section X  Commissioning and Guarantees

1 Scope of work

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

2 General requirements:

2.1 The rates quoted in this tender shall be inclusive of the works given in this section.

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

2.3 On award of work, contractor shall submit a detailed proposal giving methods of testing and gauging the performance of the equipment to be supplied and installed under this contract.

3 Pre-commissioning

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

A Fire protection system:

i) Check all hydrant valves and close if any valve is open. Also check that all suction and delivery connections are properly made.

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

B Pipe work

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

ii) Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specifications. If any leakage is found, rectify the same and retest the pipes.

4 Commissioning & testing

A. Fire hydrant system

1 Pressurise the fire hydrant system by running the main fire pump and after attaining the required pressure shutoff the pump.

2 Open byepass valve and allow the pressure to drop in the system. Check that the jockey pump cuts-in and cuts out at the pre-set pressures. If necessary adjust the pressure switch for the jockey pump. Close bye-pass valve.

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

B. Handing over
1. All commissioning and testing shall be done by the contractor to the complete satisfaction of the Project Manager, and the job handed over to the Project Manager, or his authorised representative.

2. Contractor shall also handover, to the Project Manager, all maintenance & operation manuals and all other items as per the terms of the contract.

C. Guarantees

1. The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.

2. The form of warranty shall be as approved by the Project Manager.

3. The warranty shall be valid for a period of one year from the date of commissioning and handing over.

4. The warranty shall expressy include replacement of all defective or under capacity equipment. Project Manager may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.

5. The warranty shall include replacement of any equipment found to have capacity lesser than the rated capacity as accepted in the contract. The replacement equipment shall be approved by the Project Manager.

End of Section X
Section XI  Electrical Installations

1  Scope:

The scope of this section comprises of fabrication, supply, erection, testing and commissioning of electric control panels, wiring and earthing of all pump room equipment, components and accessories, including supply, installation and wiring of remote control-cum-indicating light panel.

2  General:

Work shall be carried out in accordance with the Specifications, Local Rules, Indian Electricity Act 1910 as amended up to date, and rules issued thereunder, Regulations of the Fire Insurance Company and relevant BIS Code of Practice.

3  Wiring System:

All power wiring shall be carried out with 1100 volts grade PVC insulated, armoured overall, PVC sheathed aluminium conductor cables for sizes above 6 mm². For sizes 6 mm² and below the power wiring shall be of copper conductor only. Cables shall be sized by applying proper derating factor. All control wiring shall be carried out by using 650 volts PVC insulated copper conductor wires in race ways or in conduit. Minimum size of control wiring shall be 1.5 mm² PVC insulated copper conductor wires. Minimum size of conductor for power wiring shall be 4 mm² 1100 volts grade PVC insulated copper conductor wires in conduit.

4  Construction Features:

The control panel shall be metal enclosed sheet steel cubicle, indoor type, dead front, floor mounting/wall mounting type. The control panel shall be totally enclosed and vermin proof. Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust proof. Control panels shall be arranged in multi-tier formation. All doors and covers shall be suitable for double padlocking. All mild steel sheets used in the construction of control panels shall be 14 SWG thick for floor mounted and 16 SWG for wall mounting and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all welding slag grounded off and welding pits wiped smooth with Plumber metal.

All panels and covers shall be properly fitted and square with the frame and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with hank nuts. Self threading screws shall not be used in the construction of control panels. Base channel of 75 mm x 75 mm x 5 mm thick shall be provided at the bottom. Minimum clear space of 200 mm between the floor of control panel and bottom most unit (MCB or Bus Bar) shall be provided.

The control panels shall be of adequate size with a provision of 25% spare space to accommodate possible future additional switch gear. Knockout holes of appropriate size and number shall be provided in the control panels in conformity with the location of incoming and outgoing conduits / cables. All equipment such as meters and indicating lamps etc. shall be located adjacent to the unit with which it is associated and care shall be taken to achieve a neat and symmetrical arrangement. Facility shall be provided for termination of cables from top of the control panel. Clamps shall be provided to support the weight of the cables.
All power wiring inside the control panel shall be colour coded and control wiring ferruled for easy identification. Circuit diagram showing the arrangement of circuits shall be pasted on the inside of panel door and covered with transparent plastic sheet and all labelling shall be provided in engraved anodized aluminium/bakelite strips on the front face of the panel board.

5 **Circuit Compartment:**

Each circuit breaker, contactor and relay shall be housed in a separate compartment and shall have steel sheets on top and bottom of compartment. Sheet steel hinged lockable door shall be duly interlocked with the breaker in the ‘ON’ position. Safety interlocks shall be provided to prevent the breaker or contactor from being drawn out when the breaker is in ‘ON’ position. The door shall not form an integral part of the draw out portion of the panel. Sheet steel barriers shall be provided between the tiers in a vertical section.

6 **Instrument Accommodation:**

Adequate space shall be provided for accommodating instruments, indicating lamps, control contactors and control fuses etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker and bus bar.

7 **Bus Bars and Bus Bar Connections:**

The bus bar and interconnections shall be of aluminium and of rectangular cross sections suitable for full load current for phase bus bars, and half rated current for neutral bus bar and shall be extensible on either side. The bus bars and interconnections shall be insulated with PVC sleeve / tapes and shall be color coded. Alternatively special insulating paints/materials may be used for the purpose.

All bus bars shall be supported on unbreakable, non hygroscopic insulated supports at regular intervals, to withstand the forces arising in case of short circuit in the system. All bus bars shall be provided in separate chamber and properly ventilated. All bus bars connections, in main control panels shall be done by drilling holes with cadmium plated/hot dipped galvanized bolts, nuts and washers.

All bus bars connections in smaller control panels shall be done by drilling hole and connecting by brass bolts and nuts.

All connections between the bus bar and breaker and between breaker and contactor shall be through copper strips of proper size to carry rated current and shall be insulated with PVC sleeves.

8 **Raceways:**

A horizontal race way with screwed covers shall be provided at the top to take interconnecting control wiring between different vertical sections.

9 **Cable compartments:**

Cable compartment of adequate size shall be provided in the control panels for easy termination of all incoming and outgoing cables entering from bottom or top. Adequate and proper supports shall be provided in cable compartments to support cables.

10 **Indications**
10.1. ‘ON’ lamps shall be provided on all outgoing feeders.

10.2. Cable alley and bus chamber shall be identified on all panels.

11 Rubber Mat

Rubber mat shall be provided to cover the full length of front of all panels and rear of panels where back space shall be available for working from the rear.

12 Materials:

All materials shall be of the best quality complying with the BIS (Bureau of Indian Standards) specifications. Materials used shall be subject to the approval of the CLIENT’s site representative and samples of the same shall be furnished where required.

12.1 Moulded Case Circuit Breaker

MCCB shall comprise of switching mechanism, contact system are extinguishing device and the tripping unit, Contained in a Compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stress.

Switching mechanism shall be of Quick Make- Quick Break type and the trip command shall override all other commands. MCCB shall employ maintenance free contact system to minimize the let thru energies while handling abnormal currents.

The handle position shall give positive indication of ‘ON’ ‘OFF’ or tripped.

MCCB shall conform to IS- 2516 (Part I & II/Sec.1) 1985.

12.2 MINIATURE CIRCUIT BREAKER

Miniature circuit breakers shall be quick make and break type, and shall conform to Relevant Indian Standards. The housing shall be heat resistant and having high impact strength. The fault current shall not be less than 9 KA at 230 V and shall be BIS approved. MCBs shall be flush mounted and shall be provided with trip free manual operating liver and ‘ON’ and ‘OFF’ indications. The contacts shall be provided to quench the arc immediately. MCB shall be provided with magnetic thermal releases for over current and short circuit protection. The over load or short circuit device shall have a common trip bar in the case of D P, TP and TPN miniature circuit breakers.

12.3 Rotary Switches:

Switches upto 60 amps shall be rotary type with compact and robust construction, built up from one or more stacks with contacts and a positioning mechanism with stop as required. Rotary switches shall have HRC fuse fittings of appropriate rating.
12.4 **Selector Switch**

Where called for selector switches of rated capacity shall be provided in control panels, to give the choice of operating equipment in selective mode.

12.5 **Starters**

Each motor shall be provided with a starter of suitable rating. Starters shall be in accordance with relevant BIS Codes. All Star Delta and ATS Starters shall be fully automatic.

Starter contactors shall have 3 main and 2 Nos. NO/NC auxiliary contacts and shall be air break type suitable for making and breaking contact at minimum power factor of 0.35. For design consideration of contactors the starting current of connected motor shall be assumed to be 6 times the full load current of the motor in case of direct-on-line starters and 3 times the full load current of the motor in case of Star Delta/Reduced Voltage Starters. The insulation for contactor coils shall be of class "B".

Operating coils of contactors shall be suitable for 230/415 ±10% volts AC, 50 cycles supply system. The contactors shall drop out when voltage drops to 90% of the rated voltage. The housing of the contactors shall be heat resistant and having high impact strength. Each starter shall have thermal overload protection on all three phases.

12.6 **Over Load Relays**

Contactors shall be provided with a three element, positive acting ambient temperature compensated time lagged hand-reset type thermal over load relays with adjustable setting. Hand-reset button shall be flush with the front door for resetting with starter compartment door closed. Relays shall be directly connected for motors upto 35 HP capacity. C.T operated relays shall be provided for motors above 35 HP capacity. Heater circuit contactors may not be provided with overload relays.

12.7 **Current Transformers**

Current transformers shall be of accuracy class I and suitable VA burden for operation of the connected meters and relays. These shall be resin bonded and epoxy coated.

12.8 **Single Phase Preventer**

Single phase preventer shall be provided as per Schedule of Quantities and shall be in conformity with relevant BIS Standards. Single phase preventer shall act when the supply voltage drops down to 90% of the rated voltage or on failure of one or more phases.

12.9 **Time Delay Relays**

Time delay relays shall be adjustable type with time delay adjustment from 0-180 seconds and shall have one set of auxiliary contacts for indicating lamp connections.
12.10 **Indicating Led (22 mm dia) and Metering**

All meters and indicating lamps shall be in accordance with BS 37 and BS 39. The meters shall be flush mounted and drawout type. The indicating lamp shall be of LED type. Each main panel shall be provided with voltmeter 0-500 volts with three way and off selector switch, CT operated ammeter of suitable range with three Nos. CTs of suitable ratio with three way and off selector switch, phase indicating lamps and other indicating lamps as called for. Each phase indicating lamp shall be backed up with 5 amps fuse. Other indicating lamps shall be backed up with fuses as called for.

12.11 **Toggle Switch**

Toggle switches where called for, shall be in conformity with relevant BIS Codes and shall be of 5 amps rating.

12.12 **Push Button Stations**

Push button stations shall be provided for manual starting and stopping of motors/equipment as called for. Green and Red colour push buttons shall be provided for ‘Starting’ and ‘Stopping’ operations. ‘Start’ or ‘Stop’ indicating flaps shall be provided for push buttons. Push buttons shall be suitable for panel mounting and accessible from front without opening door, Lock lever shall be provided for ‘Stop’ push buttons. The push button contacts shall be suitable for 6 amps current capacity.

12.13 **Conduits**

Conduits shall be of mild steel and shall be Hard drawn, stove enameled inside and outside with minimum wall thickness of 1.6 mm for conduits upto 32mm diameter and 2 mm wall thickness for conduits above 32 mm diameter. GI pull wires shall be installed in the conduit while laying the conduit.

12.14 **Cables**

M.V. cables shall be PVC insulated aluminium conductor and armoured cables conforming to BIS Codes. Cables shall be armoured and suitable for laying in trenches, duct, and on cable trays as required. M.V Cables shall be termite resistant. Control cables and indicating panel cables shall be multi core PVC insulated copper conductor and armoured cables.

12.15 **Wires**

1100 volts grade PVC insulated copper conductor wires in conduit shall be used.

13 **CABLE LAYING:**

Cable shall be laid generally in accordance with BIS Code of Practice. Cables shall be laid on 14 gage perforated MS sheet cable trays and cable drops/risers shall be fixed to ladder type cable trays fabricated out of steel angle. Access to all cables shall be provided to allow cable withdrawal/ replacement in the future. Where more than one cable is running, proper spacing shall be provided to minimise the loss in current carrying capacity. Cables shall be suitably supported with Galvanized saddles when run on walls/trays. When buried, they shall be laid in 350 mm wide and 750 mm deep trench and shall be covered with 250 mm thick layer of soft sifted sand & protected with bricks, tiles. Special care shall be taken to ensure that the cables are not damaged at bends. The radius of bend of the cables when installed
shall not be less than 12 times the diameter of cable 1.1 KV cable shall be buried 600 mm below ground level.

14 WIRE SIZES:

For all single phase/3 phase wiring, 1100 volts grade PVC insulated copper conductor wires shall be used. The equipment inside plant room and AHU room shall be connected to the control panel by means of insulated aluminium conductor wires of adequate size. An isolator shall be provided near each motor/equipment wherever the motor/equipment is separated from the supply panel through a partition barrier or through ceiling construction. PVC insulated single strand aluminium conductor wires shall be used inside the control panel for connecting different components and all the wires inside the control panel shall be neatly dressed and plastic beads shall be provided at both the ends for easy identification in control wiring.

The minimum size of control wiring shall be 1.5 mm² PVC insulated stranded soft drawn copper conductor wires drawn through conduit to be provided for connecting equipment and control panels. Power wiring cabling shall be of the following sizes:

i. Upto 5 HP motors/5 KW heaters. 3 x 4 mm² Cu conductor wires.

ii. From 6 HP to 10 HP motors 6 KW to 7.5 KW heaters. 3 x 6 mm² Cu conductor wires.

iii. From 12.5 HP to 15 HP motors. 2 Nos. 3 x 6 mm² Cu conductor wires.

iv. From 20 HP to 25 HP motors. 2 Nos. 3 x 10 mm² Al conductor armoured cables.

v. From 30 HP to 35 HP motors. 2 Nos. 3 x 16 mm² Al conductor armoured cables.

vi. From 40 HP to 50 HP motors. 2 Nos. 3 x 25 mm² Al conductor armoured cables.

vii. From 60 HP to 75 HP motors. 2 Nos. 3 x 50 mm² Al conductor armoured cables.

viii. 100 HP motors. 1 No. 3 x 150 mm² Al conductor armoured cables.
All the switches, contactors, push button stations, indicating lamps shall be distinctly marked with a small description of the service installed. The following capacity contactors and overload relays shall be provided for different capacity motors.

<table>
<thead>
<tr>
<th>TYPE OF STARTER</th>
<th>CONTACTOR CURRENT CAPACITY</th>
<th>OVERLOAD RELAY RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 HP Motors</td>
<td>D O L</td>
<td>16 amps</td>
</tr>
<tr>
<td>7.5HP Motors</td>
<td>D O L</td>
<td>16 amps</td>
</tr>
<tr>
<td>10 HP Motors</td>
<td>D O L</td>
<td>32 amps</td>
</tr>
<tr>
<td>12.5HP Motors</td>
<td>Star Delta</td>
<td>16 amps</td>
</tr>
<tr>
<td>15 HP Motors</td>
<td>Star Delta</td>
<td>25 amps</td>
</tr>
<tr>
<td>20 HP Motors</td>
<td>Star Delts</td>
<td>32 amps</td>
</tr>
<tr>
<td>25 HP Motors</td>
<td>Star Delta</td>
<td>32 amps</td>
</tr>
<tr>
<td>30 HP Motors</td>
<td>Star Delta</td>
<td>40 amps</td>
</tr>
<tr>
<td>35 HP Motors</td>
<td>Star Delta</td>
<td>40 amps</td>
</tr>
<tr>
<td>40 HP Motors</td>
<td>Star Delta</td>
<td>40 amps</td>
</tr>
<tr>
<td>45 HP Motors</td>
<td>Star Delta</td>
<td>63 amps</td>
</tr>
<tr>
<td>50 HP Motors</td>
<td>Star Delta</td>
<td>63 amps</td>
</tr>
<tr>
<td>60 HP Motors</td>
<td>Auto Transformers</td>
<td>125 amps</td>
</tr>
<tr>
<td>75 HP Motors</td>
<td>- do-</td>
<td>125 amps</td>
</tr>
<tr>
<td>100 HP Motors</td>
<td>- do-</td>
<td>200 amps</td>
</tr>
</tbody>
</table>

15 **Earthing**: shall be copper strips/wires the main panel shall be connected to the main earthing system of the building by means of 2 Nos. 25 mm x 3 mm copper tapes. All single phase metal clad switches and control panels be earthed with minimum 2 mm diameter copper conductor wire. All 3 phase motors and equipment shall be earthed with two numbers distinct and independent copper wires/tapes as follows:

i. Motors upto and including 10 HP rating 2 Nos 3 mm dia copper wires.

ii. Motors 12.5 HP to 40 HP capacity 2 Nos.4 mm dia copper wires.

iii. Motors 50 to 75 HP capacity 2 Nos 6 mm dia copper wires.

iv. Motors above 75 HP. 2 Nos 25 mm x 3 mm copper tapes.

All switches shall be earthed with two numbers distinct and independent copper wires/tapes as follows:

| i.  | 3 phase switches and control panels upto 60 amps rating. | 2 Nos 3 mm dia copper wires. |
| ii. | 3 phase switches and control panels 63 amps to 100 amps rating. | 2 Nos 4 mm dia copper wires. |
| iii.| 3 phase switches and control panels 125 amps to 200 amps rating. | 2 Nos 6 mm dia copper wires. |
| iv. | 3 phase switches, control panels, bus ducts, above 200 Amps rating | 2 Nos 3 mm x 25 mm copper tapes. |

The earthing connections shall be tapped off from the main earthing of electrical installation. The over - lapping in earthing strips at joints where required shall be minimum 75 mm. These straight joints shall be riveted with brass rivets & brazed in approved manner. Sweated lugs of adequate capacity and size shall be used for all termination of wires. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substance and properly tinned.
16 **Drawings:** Shop drawings for control panels and wiring of equipment showing the route of conduit/cable shall be submitted by the contractor for approval of Project Manager/Consultant before starting the fabrication of panel and starting the work. On completion, four sets of complete "As-installed" drawings incorporating all details like, conduits routes, number of wires in conduit, location of panels, switches, junction/pull boxes and cables route etc. shall be furnished by the Contractor.

17 **Testing:** Before commissioning of the equipment, the entire electrical installation shall be tested in accordance with relevant BIS Codes and test report furnished by a qualified and authorised person. The entire electrical installation shall be got approved by Electrical Inspector and a certificate from Electrical Inspector shall be submitted. All tests shall be carried out in the presence of Supervisor.

18 **Painting:** All sheet steel work shall undergo a process of degreasing, thorough cleaning, and painting with a high corrosion resistant primer. All panels shall then be backed in an oven. The finishing treatment shall be by application of synthetic enamel paint of approved shade.

19 **Label and Tags**
Engraved PVC labels shall be provided on all incoming and outgoing feeders switches. Circuit diagram showing the arrangements of the circuit inside the control panel shall be pasted on inside of the panel and covered with transparent plastic sheet. All cables terminations at panels and at equipments shall be provided with tags as approved by Project Manager.

20 All panels to have provision for padlocking and all MCCB's/MCB's to have provision for locking in off position.

21 **Measurement of Electrical Control Panels:** Panels shall be counted as number of units. Quoted rates shall include as lump sum (NOT measurable lengths) for all internal wiring, power wiring and earthing connections from the control panel to the starter and to the motor, control wiring for inter-locking, power and control wiring for automatic and safety controls, and control wiring for remote start/stop as well as indication as per the specifications. The quoted rate for panel shall also include all accessories, switchgear, fuses, contactors, indicating meters and lights as per the specifications.

*End of Section XI*
Section XII  Specification for Water Supply, Flu/ Irrigation Pumps & Equipment

1. Scope of work

Work under this section shall consists of furnishing all labour, materials, equipment and appliances necessary and required to supply install and commission the water supply and drainage pumps as described hereinafter and given in the schedule of quantities and/or shown on the drawings.

2. General requirements

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

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

2.3 All equipment shall be installed on suitable foundations true to level and in a neat workmanlike manner.

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

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

2.6 Each pumping set shall be provided with a butterfly valve on the suction and delivery side and a flap type non return valve on the delivery side.

2.7 All pump couplings and belt guards for air compressors shall be totally enclosed with 5 mm mesh.

3.0 System of Water Supply

3.1 The water supplied by the authorities will be stored in the domestic U.G. tank.

3.2 Water from this U.G. tank shall be pumped to O.H. Tanks at terrace of each building by separate pumps.

3.3 Each toilet and kitchen shall be fed with water from terrace tanks by gravity.

Specifications for Pumps

4 Water Transfer Pumps

4.1 Water supply pumps shall be suitable for clean filtered water. Pumps shall be single stage, monobloc vertical/horizontal, centrifugal pumps with cast iron body and cast iron impeller, stainless steel shaft and mechanical seal and coupled to a TEFC electric motor. Each pump should be operating to a curve required by the operating conditions.

4.2 All parts in contact with water shall be corrosion resistant stainless steel DIN-Nr.1.4401.

4.3 Each pump shall be provided with a totally enclosed fan cooled induction motor of suitable H.P. The motors shall be suitable for 410 volts, 3 phases, 50 cycles A.C. power supply and shall conform to IS 325 operating at 2900 RPM nominal speed.
4.4 Each pumping set shall be provided with 100-mm dia gunmetal “Borden” type pressure gauge with gunmetal valve and connecting piping.

4.5 Pump or the whole set shall be stable on rubber vibration eliminating pads appropriate for each pump as recommended by the manufacturer and accepted by the Project Managers.

6 Submersible pumps

6.1 Submersible pumps for clear water transfer shall be single stage, submersible centrifugal Pump of closed coupled construction with C.I. casing and C.I. impeller connected to a fully submersible water/oil cooled motor.

6.2 Stuffing box shall be provided with mechanical seals

6.3 Each pump shall be provided with water cooled squirrel cage induction motor suitable for 380-415 volts, 3 phase, 50 cycles AC power supply.

6.4 Each pump shall be provided with liquid level controller for automatic operation of the pump between predetermined levels. Operation of level controller shall be similar to as discussed in subsequent paras below.

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

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

7 Pipe & Fittings (for Headers and Connections)

7.1 Pump suction and delivery headers shall be Galvanized iron pipes/MS heavy class with matching fittings. The pipe joints shall be threaded as per manufacturer’s instructions.

7.2 Vibration Eliminators

All suction and delivery lines as shown on the drawings shall be provided with double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connectors shall be as per site requirements in accordance with manufacturer details.
7.3 Valves

7.3.1 Butterfly Valves

Butterfly Valves shall be cast iron body with following details:-

a) Disc shall be CI heavy duty electrolyses nickel plated abrasion resistant.

b) The shaft be EN-8 Carbon Steel with low friction nylon bearings.

c) The seat shall be drop tight constructed by bonding resilient elastomer inside a rigid backing.

d) Built in flanged rubber seals.

e) Actuator to level operated for valves above ground and T Key operated for valves below ground.

f) Built in flanges for screwed on flanged connections.

Manufacturer’s details on fixing and installation will be followed.

7.3.2 Non Return Valves (NRV)

a) Non return valves will be used at location to allow flow only in one direction and prevent flow in the opposite direction.

b) NRV shall be cast iron slim type with cast iron body and gunmetal internal parts and accompanying flanges. Valves shall conform to the relevant BIS code.

8 Painting and cleanup

a) On completion of the installation contractor shall scrub clean all pumps, piping, filters and equipment and apply one coat of primer.

b) Apply two or more coats of synthetic enamel paint of approved make and shade on steel pipes.

c) Provide painted identification legend and direction arrows on all equipment and piping as directed by engineer-in-charge.

d) On final completion of the work, contractor should cleanup the site, filter room of all surplus materials rubbish and leave the place in a broom-clean condition.

9. Cables

9.1. Contractor shall provide all power and control cables from the motor control centre to various motors, level controllers and other control devices.

9.2. Cables shall conform to I.S. 1554 and Carry ISI mark.

9.3. Wiring cables shall conform to IS 694.

9.4. All power and wiring cables shall be aluminum conductor PVC insulated armoured and PVC sheathed of 1100 volts grade.
9.5. All control cables shall be copper conductor PVC insulated armoured and PVC sheathed 1100 volts grade.

9.6. All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer’s name.

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

10. **Earthing**

All equipment installed by the contractor shall be suitably earthed by making proper connection by means of G.I. Wires to the main earthing system laid by the electrical contractors.

11. **Motor control centres**

11.1. Switchboard cubicles of approved type shall be fabricated from 16 gauge M.S. Sheet with dust and vermin proof construction. It shall be painted with stove enamelled paint of approved make and shape. It shall be fitted with suitable etched plastic identification plates for each motor. The cubicle shall comprise of the following: (switchgear as given in the schedule of quantities).

   a) Incoming main switch fuse unit of required capacity.
   b) Isolation switch fuse unit, one for each motor.
   c) Fully automatic DOL/star delta starters suitable for motor H.P. with push buttons one for each motor and on/off indicating neon lamps.
   d) Single phasing preventer of appropriate rating for each motor.
   e) Rotary duty selector switch.
   f) Panel type ampere meters one for each motor.
   g) Panel type voltmeter on incoming main with rotary selector switch to read voltage between phase to neutral and phase to phase.
   h) Neon phase indicating lamps and indicating lamp for each motor.
   i) Rotary switch for manual or auto operation for each pump.
   j) Fully taped separate aluminium bus bars of required capacity for normal and emergency supply where specified.
   k) The panel shall be prewired with colour coded wiring. All interconnecting wiring from incoming main to switch gear, meters and accessories within the switch board panel.

11.2 All switch gears and accessories shall be approved make.

11.3. Switchboard cubicles shall be floor or wall mounted type as recommended by manufacturers.
12 Measurement

12.1 General

12.2 Unit rate for individual items, e.g., Pumps, MCC and level controller are for purposes of payments only. Piping, headers, valves, accessories, cabling and MCC to measured separately in this contract only.

12.3 All items must include all accessories fittings as described in the specifications, BOQ and shown on the drawings.

12.4 Piping Work

12.4.1 Suction and delivery headers for each pumping system shall be measured per linear meter of finished length and shall include all items as given in the schedule of quantities. Painting shall be included in rate of headers.

12.4.2 G.I. pipes between various equipment’s shall be measured per linear meter of the finished length and shall include all fittings, flanges, jointing, clamps for fixing to walls or hangers and testing. Flanges shall include 3 mm thick insertion rubber gasket, nuts, bolts and testing.

12.4.3 Water Tank, Vibration eliminators, “Y” strainers, butterfly valves, slim non return valves shall be measured by numbers and shall include all items as given in the schedule of quantities and specifications.

End of Section XII
Section XIII  Installation, Commissioning & Guarantees

1. **Installation**

1.1. Contractor shall supply three copies of foundation drawings giving weight, vibration and other loads required for the proper designing of the foundations.

1.2. All equipment shall be installed in a true workman like manner true to level and grade in accordance with the best current practice.

1.3. Contractor shall employ sufficient and proper equipment for lifting and placing of heavy equipment and in a manner which shall not strain or cause damage to the existing structures. If any damage is done, the same shall be made good to the satisfaction of the Project Manager without any additional cost.

1.4. All equipment and pipes shall be painted with one coat of red oxide before dispatch to the site.

2. **Commissioning**

2.1. On completion of the work in all its aspects, the contractor shall start up the equipment in a manner normally done for the continuous operation for a period of not less than 48 hours and shall rectify and adjust the equipment for leakages and balancing the system.

2.2. After satisfactory commissioning of the plant, the contractor shall conduct performance tests on the equipment to satisfy the Project Manager that all equipment is performing to the rated outputs. Any or all equipments shall be rectified or replaced if the same is not performing in accordance with the specifications.

3. **Guarantees**

3.1. On completion of the work contractor shall submit a guarantee covering the quality and performance of all materials supplied and installed under the contract. This guarantee shall cover each and every material whether manufactured by the contractor or not.

3.2. Contractor shall specify a suitable procedure to test the rated performance of the equipments and shall provide all necessary equipments, gauges etc. for conducting such tests.

3.3. The guarantee shall cover a period of one year from the date of installation and handing over.

4. **Completion**

4.1. On completion of the job, the contractor shall hand over to the Project Manager the following:-

4.2. One flow chart drawn in ink on thick paper and mounted in a glass frame showing the flow diagram of the process including legend showing valves to be normally open or closed and instructions for back washing, operation and maintenance of chlorination & other chemical feeding pumps and other equipments.
4.3 Five sets of operating and maintenance instructions with spare parts list and their manufactures and/or suppliers.

4.4 Five sets of catalogues and drawings for all equipment supplied.

End of Section XIII
Section XIV  Technical Information

Please furnish full details separately

All information should be on this format

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description</th>
<th>Domestic water</th>
<th>Irrigation</th>
</tr>
</thead>
</table>

1. Design basis
1.1 Quantity/ No. of units offered
1.2 Capacity lit/lpm
1.3 Flow Range
1.4 Pumping Head (where applicable)
1.5 Make & Model No.
1.6 Power
1.7 Pump Type
1.8 Material (body)
1.9 Material (Impellars)
1.10 Material (shafts)

2. Accessories

3. Valves
3.1 Type
3.2 Material (body)
3.3 Material (Internal parts)
3.4 Material (Lining)

4. Pipes
4.1 Type
4.2 Material
4.3 Max. working pressure
4.4 Max. test pressure

End of Section XIV
### Section XV  
**Pipe Colour Code**

*This Colour Code is as per I.S. 2379.*

![Diagram of Colour Coding](image)

<table>
<thead>
<tr>
<th>Pipe lines</th>
<th>Ground Colour</th>
<th>1st Colour</th>
<th>2nd Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Drinking water (all cold water lines after filter)</td>
<td>Sea green</td>
<td>French blue</td>
<td>Signal red</td>
</tr>
<tr>
<td>2. Treated water (soft water)</td>
<td>Sea green</td>
<td>Light orange</td>
<td></td>
</tr>
<tr>
<td>3. Domestic hot water</td>
<td>Sea green</td>
<td>Light grey</td>
<td></td>
</tr>
<tr>
<td>4. Drainage Sewer /SWD</td>
<td>Black</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Fire services</td>
<td></td>
<td>Fire red</td>
<td></td>
</tr>
</tbody>
</table>

*This Colour Code is as per I.S. 2379.*

**Final design for colour coding will be of CLIENT only**

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*End of Section XV*