E-Tender on Design, Engineering, Procurement and Construction (EPC) basis for Proposed Construction of Investment Building (Basement+Ground+2 floors) at Suryanagar, Bhubaneswar, Odisha

BID- III

Of Bid No. : LICI/ECZO/Engg/2022-23/28

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CONTENTS

CONDITIONS OF CONTRACT

1. INTERPRETATIONS:

1.1 In construing these Conditions, the Specifications, the Priced Schedule of Quantities, Tender and Agreement, the following words shall have the meanings herein assigned to them except where the subject or context otherwise requires:

1.2 "Employer" shall mean THE LIFE INSURANCE CORPORATION OF INDIA and his (their) heirs, legal representatives, assignees and successors.

1.3 "Chief Engineer" shall mean the person occupying the post of head of the Zonal Engineering Department of the Corporation.

1.4 "Corporation's Engineers" shall mean such Deputy Chief Engineers, Superintending Engineers and/or Executive Engineers of the Corporation, who shall from time to time be appointed by the Chief Engineer for supervising the work carried out by the Contractor or for any purpose in connection therewith:

1.5 The term "Site Engineer" shall mean the person appointed and paid by the Employer, acting under the order of the Corporation's Engineer to superintend the work.

1.6 The Contractor shall mean the individual, firm or company whether incorporated or not, who is awarded the contract & shall include the legal representative of such individual or the persons composing such firm or company or the successors of such individual, firm or company & the permitted assignees of such individual, firm or company.

1.7 The "Site" shall mean the lands/buildings and/or other places on, in, into or through which work is to be executed under the contract or any adjacent land, path or street which may be allotted or used for the purpose of carrying out the contract.

1.8 "This Contract" shall mean the Articles of Agreement, ***Conditions of contract , the General Instructions to Contractor, Appendix to Condition of Contract, Special Conditions, Scope of work , Design basis reports, Detailed Specifications, Conceptual Drawings provided by LIC of India, vetted drawings submitted by Contractor and approved by LIC of India, Detailed Quantity Estimation & price schedule based on drawings, Stages of payment and allied documents pertaining to works provided by LIC of India and other related correspondence, etc.***

1.9 "Act of Insolvency" shall mean any act of insolvency as defined by the Presidency Towns Insolvency Act, or the Provincial Insolvency Act or any amending Statute.

1.10 "Notice in Writing" or written notice shall mean a notice in written, typed or printed characters, sent (unless delivered personally or otherwise proved to have been received) by registered post to the last known private or business address or registered office of the addressee and shall be deemed to have been received when in the ordinary course of post it would have been delivered.

1.11 Words importing persons include Firms and Corporations, words importing the singular only also include the plural and vice versa where the context so requires.

1.12 The titles of the Clauses shall not affect or alter the meaning of Clauses and are solely for the purpose of facilitating reference.

1.13 The following abbreviations shall be followed for the designations of various LIC Officers:

DESIGNATIONS	**ABBREVIATIONS**
Executive Director (Engineering)	E.D.(E)
Zonal Manager	Z.M.
Chief Engineer	C.E.
Chief Architect	C.A.
Deputy Chief Architect	D.C.A.
Deputy Chief Engineer	Dy.C.E.
Superintending Engineer	S.E.
Senior Architect	S.A.
Executive Engineer	E.E.
Deputy Senior Architect	D.S.A.
Asstt. Secretary	A.S.

1.14 Wherever the words "approved", "directed", "as required", "selected" or words of like effect are used, it is to be understood that the approval/direction, requirement or selection of the Corporation's Engineer are intended unless otherwise specified.

1.15 The words "as described" shall mean ***the description in the scope of work, Design basis Report, detailed Specifications, Special conditions, general Instructions, drawings both supplied by LIC of India and submitted by the Contractors of this tender.***

1.16 The words "allow" shall mean that the Contractor shall include in his rates for the particular matter referred to.

2. SCOPE OF CONTRACT:

2.1 The Contractor shall carry out and complete the works in every respect in accordance with this Contract and in accordance with the directions, **Detailed Scope of work given Separately, Design Basis Reports, Specifications and Drawings** and to the satisfaction of the Corporation's Engineer. The Corporation's Engineer may issue further written instructions, details, directions and explanation in regard to:

a. The variation or modification of the Design, quality of works or the addition or omission or substitution of any work;

b. Any discrepancy in the ***scope of work , Design basis report, detail Specifications*** **and Drawings*****provided by LIC of India.***

c. The removal from the site of any materials brought thereon by the Contractor and the substitution of any other material thereof;

d. The removal and/or re-execution of any work executed by the Contractor;

e. The dismissal from the work of any persons employed thereupon;

f. The opening up for inspection of any work covered thereupon;

g. The amending and making good of any defects under relevant Clause giving details of defects after completion.

2.2 The Contractor shall forthwith comply with and duly execute all works comprised in such Instructions subject to the provisions of relevant specific conditions of the Contract. In the event of any dispute or difference of opinion the contractor shall refer the matter within 7 (seven) days of the issue of such instruction to the Chief Engineer whose decision shall be final & binding.

3. DISCREPANCIES:

3.1 If there are varying or conflicting provisions made in any one document forming part of Contract, the Chief Engineer shall be the deciding authority with regard to the intention of the document and his decision shall be final and binding on the contractor.

3.2 The several documents forming the Contract are to be taken as mutually explanatory of one another, and the order of precedence shall be as follows;

a) Special conditions

b) ***Detailed specifications of the work***

c) General instructions

d) Conditions of contract

3.3 In case of discrepancies between ***the detailed specification of work given by LIC of India and detailed vetted drawings submitted by the contractor*** the following order of precedence shall be observed

(a) ***Detailed Vetted Drawings***

(b) ***Design basis report***

(c) ***Detailed specification***

(d) Indian Standard Specifications of `BIS'

4. DRAWINGS AND SCHEDULE OF QUANTITIES:

4.1 **Certain Drawings are provided by LICI including Basic Architectural Drawings with the Bid Documents. The Contractor to verify those drawings with the Scope of work, DBR and Technical Specifications and prepare Municipal submission drawings and subsequently on municipal sanctiomn generate all the working drawings required for execution of work including shop drawings, fabrications drawings in accordance with latest relevant BIS Codes / National Building Code. The Contractor needs to get acceptance of LICI to all the working drawings before actual commencement of work at Site. The Structural Drawings, Facade Drawings, MEP drawings and any other drawings as specified elsewhere shall be got vetted through the LICI approved Engineering Institute / Consultant by the Contractor before submitting the drawings to LICI for acceptance. The drawings accepted by LICI shall only be used in the execution of work.**

The Contractor Shall provide Four Sets of all the working Drawings with Soft Copy in AutoCAD to LICI before commencement of work. The Contractor shall maintain the Secrecy as regards to Drawings and shall not share the drawings to any third party without prior approval of LICI.

On successful completion of the work, the Contractor to submit all the copies of Drawings to LICI. All the Drawings will be property of LICI.

4.2 **As mentioned elsewhere in the Tender Document, the Contractor shall prepare and submit the Schedule of Quantities of all the items required for execution of the work in totality within 2 months, after finalization of drawings,as per Scope of Work, Drawings,**

DBR, Specifications and in compliance of requirements of all the Statutory Authorities, failing which the same should be done from out side agency on the risk and cost of the Contractor. For the Schedule of Quantities, the Rates shall be taken from latest CPWD DSR with applicable Cost Index. For non-DSR Items the Contractor shall prepare the Rate Analysis based on market rates of materials and labour wages etc with 15% Contractor's profit. The rate analysis shall be supported with Budgetary Quote/ Quotation of Specialized Agencies/ OEM etc for Specialized work.

5. CONTRACTOR TO PROVIDE EVERYTHING NECESSARY FOR EXECUTION OF WORK:

5.1 Contractor shall provide everything necessary for the proper execution of the work according to the intent & meaning of the Drawings, Priced Schedule of Quantities and Specifications taken together, whether the same may or may not be explicitly shown or described therein provided that the same can reasonably be inferred there from and if the Contractor finds any discrepancy therein he shall immediately and in writing refer the same to the CE whose decision shall be final and binding on the Contractor.

5.2 The Contractor shall supply, fix and maintain at his cost during the execution of any work all the necessary Centring, Scaffolding, Staging, Planking, Timbering, Strutting, Shoring, Pumping, Fencing, Boarding, Watching and Lighting by night as well as by day, required not only for the proper execution and protection of the said work but also for the protection of the Public and the safety of any adjacent Roads, Streets, Cellars, Vaults, Ovens, Pavements, Walls, Houses, Buildings and all other erections, matters or things and the Contractors shall take down and remove any or all such Centring, Scaffolding, Staging, Planking, Timbering, Strutting, Shoring, etc., as occasion shall require or when ordered to do so, and shall fully reinstate and make good all matters and things disturbed during the execution of the work to the satisfaction of the Corporation's Engineer.

6. AUTHORITIES NOTICES AND PATENTS:

6.1 The Contractors shall conform to the provisions of any Acts of the Legislature relating to the work and to the Regulations and Bye-Laws of any Authority and or any Water, Lighting and other Companies and/or Authorities with whose system the structure is proposed to be connected and shall before making any variations from the Drawings or Specifications that may be necessitated by so conforming give to the CE written notice specifying the variations proposed to be made and the reasons for making them and apply for instructions thereon. In case the Contractor shall not within 7 (seven) days receive such instructions, he shall proceed with the work conforming with the Provisions, Regulations or Bye-Laws in question.

6.2 In particular, the Contractors shall be responsible to Register themselves under the Contract Labour (Regulation & Abolition) Act 1970 and Rules there under and any amendment thereto; they must comply with and carry out all the provisions and obligations under the said Act and Rules and furnish all information to Employer as may be required by it and shall indemnify the Employer against any penalties/claims arising from any default on their part.

6.3 The Contractor shall arrange to give all notices required by the said Acts, Regulations or Bye-Laws to be given to any Authority and to pay to such Authority or to any Public Office all fee that may be properly chargeable in respect of the work and lodge the receipts with the Employer.

6.4 The Contractors shall indemnify the Employer against all claims in respect of patent, rights, and shall defend all actions arising from such claims unless he has informed the Chief Engineer before any such infringement and received his permission to proceed and shall himself pay all

royalties, licence fees, damages, costs and charges of all and every sort that may be legally incurred in respect thereof.

6.5 The Contractor should observe that his work shall not cause any nuisance to the Public in general and to the neighbouringoccupants in particular.

6.6 Should the Contractor desire to work on Sundays, Holidays and during night hours, permission in writing from the Corporation's Engineer must be obtained in time. It shall be the responsibility of the Contractor to obtain permission from Civil Authorities, if necessary.

7. SETTING OUT WORK:

7.1 The Contractor shall set out the work and shall be responsible for the true and perfect setting out of the same and for the correctness of the positions, levels, dimensions and alignment of all parts thereof. If at any time any error shall appear during the progress of any part of the work, the Contractor shall at his own cost rectify such error, if called upon, to the satisfaction of the Corporation's Engineer. The Contractor must not commence work until the outlines of the building and Centre line layout have been pegged out and approved by the Corporation's Engineer.

8. CONTRACTOR IMMEDIATELY TO REMOVE OFFENSIVE MATTER:

8.1 All soil, filth or other matter of an offensive nature taken out of any trench, sewer, drain, cesspool or other place shall not be deposited on the surface, but shall be at once carted away by the Contractor to some pit or place provided by him.

9. MATERIALS AND SAMPLES:

9.1 All the materials, stores and equipment required for the full performance of the Contract must be provided through normal trade channels and must include applicable import duties and all applicable taxes and other charges if any. They shall be of approved quality and the best of their kind available and the Contractor must be entirely responsible for the proper and efficient carrying out of the work. The Contractor shall order all materials required for the execution of the work from local as well as from outside sources if situation warrants so as early as necessary to the satisfaction of the Corporation's Engineer and to ensure that such materials are on site well ahead of requirement for use in the work. Non availability of materials in local market will not be an issue behind slow progress of work.

9.2 Before ordering such materials, the Contractor shall get samples of the materials approved well in time. Preference shall be given to ISI marked products and approved brands of requisite quality as mentioned in the tender. For materials, which are neither approved brands nor ISI marked, the same shall be got tested from approved laboratories at the Contractor's cost before approval. Approved brand and ISI marked product will also be tested if desired by the CE and if the test results are satisfactory, the cost of testing shall be borne by the Employer otherwise by the Contractor. No claim will be allowed for delay to the progress of work caused by test. If called upon by the Executive Engineer the Contractor shall produce proof for having arranged for the supply of materials well in time.

9.3 The Contractor shall furnish well in time before work commences at his own cost, any samples of workmanship that may be called for by the Corporation's Engineer for his approval and any further samples in case of rejection until such samples are approved. Such samples when approved shall be the minimum standard for the work to which they apply. In case of items like suspended ceiling, partitions, etc. typical sample panels or proto-types shall be erected in

position for approval before undertaking work. Rates quoted shall cover for such preliminary work.

10. ACCESS:

10.1 Any of the Corporation's Engineers or any persons authorised by any one of them shall at all reasonable time have free access to the work and/or the workshops, factories or other places where materials are being prepared or constructed for the Contract and also to any place where the materials are lying or from which they are being obtained and the Contractor shall give every facility to all of them necessary for inspection and examination and test of the materials and workmanship. Except the representatives of the Public Authorities, no person shall be allowed on the work at any time without the written permission of the Corporation's Engineer.

If any work is to be done at a place other than the site of the work, the Contractor shall obtain the written permission of the Corporation's Engineer for doing so and allow inspection of the same.

11. CONTRACTOR'S SUPERVISION & MINIMUM REQUIREMENT OF TECHNICAL STAFF:

11.1 The Contractor shall either himself supervise the execution of the contract or may appoint a Competent Agent approved by the CE to act in his stead.

11.2 Where the contractor is not a qualified Engineer or even if he is so qualified, he cannot in the opinion of C.E., give his full personal attention to the works, he shall at his own expense employ person(s) possessing the qualification and experience as described hereunder as his accredited agent to supervise the works and to receive instructions from Corporation's Engineers. Any directions, instructions or notices given by the Corporation's Engineer to such supervisor(s) shall be deemed to be given to the contractors.

a. FOR WORKS COSTING UPTO Rs.100 LAKH :

A qualified resident Engineer having a Governmentrecognised Diploma in Civil Engineering and minimum of 2 years experience on building construction site.

b. FOR WORKS COSTING MORE THAN Rs.100 LAKH & UPTO Rs.200 LAKH:

A qualified resident Engineer having a Recognised Degree in Civil Engineering or equivalent qualification and minimum of 2 years experience on building construction site/s or a recognised Diploma in Civil Engineering with minimum 5 years experience on such construction jobs.

c. FOR CIVIL WORKS COSTING MORE THAN Rs.200 LAKH :

i) A qualified resident Engineer having a Recognised Degree in Civil Engineering and minimum of 3 years' experience of such major construction site/s or a recognised diploma in Civil Engineering with 8 years' experience.

ii) In addition the contractor shall employ suitable number of supervisors with recognised degree / diploma in the relevant branches or recognised qualification & experience in the relevant trades for proper execution of the work as approved by the Chief Engineer.

d. The CE may vary any of the above qualification / experience at his discretion if so warranted by conditions prevailing and applicable to any particular work such as Air-conditioning, HT, Interiors etc.

e. RECOVERY FOR NON DEPLOYMENT OF ENGINEER/S AT THE SITE

If the contractor fails to employ suitable person(s) to supervise the work or fails to appoint replacement(s) when necessitated, amount as stipulated in the Appendix to the conditions of

contract shall be recovered from the contractor for each Engineer and each supervisor for the period of non-employment.

12. DISMISSAL OF WORKMEN:

12.1 The Contractor shall, on the instruction of the Corporation's Engineer, immediately dismiss from the work any person employed thereon, who may, in the opinion of the Corporation's Engineer, 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 the Corporation's Engineer.

13. DATES OF COMMENCEMENT AND COMPLETION:

13.1 The "Date of Commencement" shall be as stated in the Work Order and the Contractor shall thereupon and forthwith begin the work and shall regularly proceed with and complete the same on or before the "Date of Completion" stated in the Work Order, subject to the provisions for extension of time hereinafter contained.

14. ASSIGNMENT:

14.1 The whole of the work included in the Contract shall be executed by the Contractor and the Contractor shall not directly or indirectly transfer, assign or underlet the Contract or any part, share of interest therein nor shall he take a new partner without the written consent of the CE and no subletting shall relieve the Contractor from the full and entire responsibility of the Contract or from the active superintendence of the work during its progress.

15. DEVIATION, VARIATION, EXTRA/DEVIATED ITEMS AND PRICING:

15.1 The Contractor should note that unless otherwise stated, ***the tender is strictly on Lump sum basis as per the scope of works stipulated in the tender. The quantities in the schedule of quantities submitted by the contractor is considered to be approximately indicative of the total extent of work and no variation i.e. addition, omission of subtraction shall vitiate the contract. No liability shall attach to employer for any error therein or variation therefore. In other words it is intended to convey herewith that building has to be completed and made functional in the quoted price as per the scope of work, design basis report, detailed specification and drawings provided by LIC of India .***

15.2 The contractor may when authorized and shall when directed, in writing by the CE or the Corporation's Engineers, whom the CE may for that purpose appoint, add to, omit from, make alterations in, substitutions for, or vary the works shown upon ***the vetted drawings submitted by the contractor and approved by the employer or described in specifications provided by Employer or included in priced Schedule of Quantities submitted by the contractor*** but the Contractor shall make no additions, omissions, alterations, substitutions or variations without such authorization or direction. A verbal authority or direction by the CE, if confirmed by the contractor in writing within 7 (seven) days, be deemed to have been given in writing. ***The addition, deletion, substitution in the project may be necessitated due to unforeseen circumstances and/or due to change in regulation etc.***

15.3 The rates of such altered, additional or substituted works shall be determined in accordance with the following.

a. If the rate for altered, additional or substituted item of work shall be priced on the basis of coefficients of labour and materials as given in the latest CPWD rate analysis handbook and rates for labour and materials wherever applicable shall be the market rate prevailing at the time of execution subject to that the labour rates are not less than minimum wages declared by Government of India.

b. Where such co-efficients are not available in C.P.W.D. rate analysis, the actual Labour/Materials involved and recorded by the Executive Engineer in executing the items shall be considered.

c. Where extra work cannot be properly measured or valued, the Contractor shall be allowed "Day Work" prices at the net rates stated in the Tender or the Priced Schedule of Quantities or, if not so stated, then in accordance with the local "Day Work" rates and wages for the district, provided that in either case vouchers specifying the date and time (and if required by the EE the names of workmen employed) and materials incorporated be delivered for verification to the EE or his representative at or before the end of the week following that in which the work has been executed. The EE is not bound to recognize the cost of materials furnished in vouchers; the CE at his discretion will fix the price of such materials based upon market value.

d. While fixing rates of extra items 15% (Fifteen percent only) shall be allowed over and above the basic rates of material (without GST), T &P , water charges and labour to cover all supervision, overheads and profits and all other applicable taxes /cess. GST on works contract will be paid separately.

e. For all extra items of work, the contractor should submit to the concerned Corporation's Engineer the necessary particulars along with his analysis and the rate he proposes to claim for consideration within a period of 4 (four) weeks from the time of cropping up of any authorized extra / deviated item. He shall also ensure that all the authorized claims are included in the final bill. If the contractor fails to submit his claim within the stipulated period or the period duly extended by the Corporation's Engineer, then the CE shall proceed to fix the rate for the item(s) and the same shall be final and binding on the contractor.

f. The Contractor shall note that Extra/Deviated items claim and/or any other claim whatsoever if submitted after submission of his Final Bill, will not be entertained and considered by the Employer. The Contractor shall not be allowed to make any Additions/ Alterations/ Revisions / Changes/ Modifications/ Variations in the final bill, after the final bill is submitted by him.

16. SUB-CONTRACTORS:

16.1 Deleted

17. THIRD PARTY LIABILITY, DAMAGE TO NEIGHBOURING PROPERTY, LOSS OF MATERIAL AND WORKMEN'S COMPENSATION:

17.1 The Contractor shall be responsible for all injury to persons, animals or things, and for all damage to structural and/or decorative part of property which may arise from the operations or neglect of himself or of any Sub-contractor or any of his Sub-Contractor's employees, whether such injury or damage arise from carelessness, accident or any other cause whatsoever in any way connected with the carrying out of his Contract. This Clause shall be held to include inter-alia, any damage to Building, whether immediately adjacent or otherwise and any damage to roads, streets, footpaths, bridges, or ways as well as all damage caused to the building, and the works forming the subject of this Contract by frost, rain, wind or other inclemency of the weather. The Contractor shall fully indemnify the Employer and hold him harmless in respect of all and any expenses arising from any such injury or damage to persons or property as aforesaid and also in respect of all and any claim made in respect of injury or damage under any acts of Government or otherwise and also in respect of any award or compensation or damages consequent upon such claim.

17.2 The Contractor shall fully indemnify the employer against any loss, damage or deterioration for whatever reason, of all materials brought at site and especially material supplied by or paid for partly or wholly by the employer.

17.3 The Contractor shall reinstate all damage and loss of every sort mentioned in this Clause so as to deliver up the whole of the Contract works complete and perfect in every respect and so as to make good or otherwise satisfy all claims for damage to the property of the third parties.

17.4 The Contractor shall fully indemnify the Employer against all claims which may be made against the Employer by any member of the Public or other third party in respect of anything which may arise in respect of the works or in consequence thereof.

17.5 The contractor shall at his own expense arrange to effect from the date of commencement & maintain till the date of virtual completion of contract, with any licensed general insurance company, a ***POLICY OF INSURANCE (Contractor's All Risk Policy)*** to cover all such risks detailed above viz. loss, damage &third party liability etc. The policy shall be of an amount as mentioned in Appendix to Conditions of Contract and in the joint names of the employer & contractor and shall be deposited with the employer and renewed as required from time to time during the currency of the contract.

17.6 The Contractor shall also fully indemnify the Employer against all claims which may be made upon the Employer, whether under the ***WORKMEN'S COMPENSATION ACT*** or any other ***STATUTE*** in force during the currency of this Contract or at Common law in respect of any Employee of the Contractor or any Sub-Contractor and shall at his own expense effect and maintain until the Virtual completion of the work, with "licensed General Insurance Company" a ***POLICY OF INSURANCE*** of adequate amount in the joint names of the Employer and the Contractor against such risks and deposit such policy or policies with the employer & renew the same as required from time to time during the currency of the Contract.

17.7 The Contractor shall be responsible for anything, which may be excluded from the Insurance Policies above referred to, and also for all other damage to any property arising out of or incidental to the negligence or defective carrying out of the Contract.

17.8 The amount of insurance to be taken for the above policies will be jointly decided between the contractor and the employer before issue of acceptance letter based on the tendered cost, nature of work, location of site, local hazards etc.

RECOVERY FOR NON EXTENSION OF INSURANCE POLICIES (WORKMEN'S COMPENSATION AND CONTRACTOR'S ALL RISK POLICY INCLUSIVE OF THIRD PARTY LIABILITY)

17.9 In default of the Contractor insuring as provided above, or having insured, failing to renew the same, as required, the Employer, on his behalf may so insure/renew and may deduct the premiums paid from any monies due or which may become due to the Contractor together with penalty amounting, for each extension of such policy.

17.10 The Contractor shall also fully indemnify the Employer in respect of any costs, charges or expenses arising out of any claim or proceedings at law and also in respect of any award of compensation of damages arising there from.

17.11 The Employer shall be at liberty and is hereby empowered to deduct fully the amount of any damages, compensation costs, charges and expenses arising or accruing any such claim of damage from any sum or sums due or to become due to the Contractor.

18. DELAY AND EXTENSION OF TIME:

18.1 If the works be delayed due to any of the following:

(a) by force majeure ,

(b) by reason of any exceptionally inclement weather,

(c) by reason of proceedings taken or threatened by, or disputes with, adjoining or neighbouring owners, or public authorities,

(d) by reason of any additional work or instruction ordered by the employer,

(e) by reason of Civil Commotion, local commotion of workmen or strike or lock-out affecting any of the building trades,

(f) in consequence of the Contractor not having received in due time necessary instructions from the CE for which he shall have specifically applied in writing,

(g) from other causes which the CE may certify as beyond the Control of the Contractor,

(h) by reason of non-payment of interim certificate at specified time,

then upon the happening of any such event causing delay the contractor shall immediately, give notice thereof in writing to the Corporation's Engineer, but shall nevertheless use constantly his best endeavours to make good this delay.

18.2 Request for extension of time shall be made by the contractor at the earliest of the event causing delay**.**

18.3 In case of strike or lockout the Contractor shall give written notice thereof to the CE as soon as possible but he shall nevertheless constantly use his endeavors to prevent delay and shall do all that may reasonably be required to the satisfaction of the CE to proceed with the work.

18.4 The CE shall make a fair and reasonable assessment of the delay and grant extension of time accordingly. Such extension shall be communicated to the contractor by the Corporation's Engineer immediately within 30 (Thirty) days of the date of receipt of request for extension. Non-application by the contractor for extension shall however not be a bar for giving fair and reasonable extension which shall be as decided by the CE.

18.5 The decision of the CE as communicated by the Corporation's Engineer to the contractor on the extension of time shall be final & binding.

18.6 No claim in respect of compensation or otherwise, howsoever arising, as a result of extension granted under the above conditions shall be admissible.

18.7 ***REWARD FOR EARLY COMPLETION:***

If contractor completed the works 3 months in advance in all respects, **0.5% of final contract sum compatible with original contract amount shall be rewarded.**

If contractor completed the works less than **3 months in advance, 0.1% of the final contract completion value compatible with the original contract amount shall be rewarded.**

19.1 ***COMPENSATION IN THE FORM OF PENALTY FOR DELAY OF WORK;***

The contractor shall submit a Time and Progress Chart (CPM/PERT/Quantified Bar Chart) along with priced Schedule of Quantities **within 10 (Ten) days of Letter of Acceptance** and get it approved by the Chief Engineer, LIC of the Zone. The Milestone Chart shall be prepared as produced below in direct relation to the time stated in the contract documents for completion of items of works. It shall indicate the forecast (milestones) 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 ChiefEngineer, LIC and the Contractor within the limitations of time stipulated in the Contract documents and further to ensure good progress during the execution of work, the contractor shall in all cases in which the time allowed for any work exceeds one month (save for special jobs for which a separate programme has to be agreed upon) complete as under:-

SCHEDULE OF MILESTONE FOR COMPLETION OF PROJECT:

Completion Time : For Planning, Designing, Getting NOC for commencement and– 6 months, for proposed Commercial Building – 15 months

Sl No	Activity	Completion Date.
1.	Planning , Drawing & Design based on conceptual drawings, Structural Design, Preparation of Final Submission drawings, obtaining NOCs from all Satatutory authorities	Zero date + 6.0 Months.
2.	Obtaining Municipal Sanction, Vetting of Structural design and drawings	
3.	Preparation of all Architectural, Structural and all Services (MEPF) Working Drawingsfor execution of projects and getting approval of the same from LIC of India, Preparation of Quantity Estimation and Priced Schedule of Quantities at CPWD and analysed rates and obtaining commencement Certificate, if required.	
4.	Registration for Green Building Rating with GRIHA/ IGBC	
5.	**WORK COMPLETION PERIOD FOR COMMERCIAL BUILDING**	
a	RCC Work of Foundation and upto Basement roof level.	Zero Date + 9 Months.
b	Balance RCC work complete upto Mumty	Zero Date + 13 Months
c	Masonry work up to Top Floor	Zero Date + 16 Months
d	Internal Plaster, Flooring, upto Top Floor, Basement Water-proofing	Zero Date + 18 Months

e	Internal Electrical Work upto Top Floor	Zero Date + 19 Months
f	External Plaster / Terrace Waterproofing	
g	Doors / Windows/ Grills	
h	Fire Fighting work	Zero Date + 19 Months
i	Lift Installation	
j	Sanitary / Plumbing Fixtures, Electrical Fixtures	Zero Date + 21 Months
k	Internal &External painting, Cladding work	
l	Electrical HT work, Solar PV, Sensor, all other Miscellaneous and leftover work, all other remaining works like borewell, horticulture etc.	
m	Obtaining Building Occupancy Certificate and Green Building Rating Certificate	Zero Date + 23 Months.

Please note that the completion period of the project in all respect is 21 (Twenty One) months and 2 (two) months shall be given for extra beyond completion of the project for obtaining the Building Occupancy certificate and Green Building Rating Certificate from appropriate authorities.

Note: (1) The miscellaneous works / various stagewise approvals / clearances of Statutory Authorities shall have to be completed parallelly.

The physical progress report including photographs shall be submitted by the contractor in the prescribed format & the intervals (not exceeding one month) as decided by the Chief Engineer. The compensation for delay as per clause shall be leviable at intermediate stages also. In case the required progress is not achieved to meet the above time deadlines of the completion period and/ or milestones of time and progress chart, provided always that the total amount of compensation in the form of Penalty for delay to be paid under this condition shall not exceed 10 % of the tendered value of work mentioned in bid documents.i.e **0.5% of the contract sum per week maximum of 10% of the contract sum .**

The amount of compensation in the form of Penalty shall be adjusted or set-off against any sum payable to the contractor under this or any other contract with LIC. In case, the contractor does not achieve a particular milestone mentioned elsewhere in the tender document, or the re-scheduled milestone(s), the amount shown against the milestone shall be withheld and to be adjusted against the compensation levied at the final grant of Extension of Time if needed. With-holding of this amount or failure to achieve a milestone, shall be automatic without any notice to the contractor. However, if the contractor catches up with the progress of work on the subsequent milestone(s), the withheld amount shall be released. In case the Contractor fails to make up for the delay in

subsequent milestones, amounts mentioned against each milestone missed subsequently also shall be withheld. However, no interest whatsoever shall be payable on such withheld amount.**The amount withheld against the non-achievement of milestone shall be adjusted against Compensation in the form of Penalty for Delay, if any levied on final completion. If Extension of Time is granted without any LD, the withheld amount shall be released to the contractor. However, the decision of LICI shall be final and binding in this matter.**

20. FAILURE BY CONTRACTOR TO COMPLY WITH CE'S INSTRUCTIONS :

20.1 If the Contractor after receipt of written notice from the CE, requiring compliance with such further Drawings and/or his instructions, fails within 7 (seven) days to comply with the same the CE may employ and pay other persons to execute any such work whatsoever as may be necessary to give effect thereto and all additional costs incurred in connection therewith shall be deducted from any money due or to become due to the Contractor.

21 MEASURING OF THE WORK EXECUTED

21.1 ***Contractor need to provide all detailed working drawings* with measurements satisfying the overall dimension of the building as given in the drawings provided by LIC of India. These detailed drawings have to be compared with work executed at site to ascertain whether works have been executed as per the drawings. these verifications have to be jointly carried out by authorized representative of the Contractor and employer. After verification, copy of these drawings which are used for verification shall be jointly signed by the authorized representatives of the contractor and Employer. This joint verification shall be carried out from time to time during the progress of work. If any observation recorded during verification of works are objected by any one of the party a note shall be made to that effect with reason, signed by both parties and referred to Employer's engineer whose decision in the matter shall be final and binding.***

Detailed working drawing shall include bar bending scheduled proposed for reinforcement of various concrete eleme

21.2 *The Contractor shall, without any extra charge provide all assistance with every appliance, labour and other things necessary for carrying out verification by any personauthorised by the Employer.*

21.3 **All hidden/concealed items of work such as work in foundations including masonry, concrete etc. steel in all R.C.C. work, pipe to be encased etc. shall be jointly verified by the Site Engineer or his authorised representative and the Contractor's Site Engineer, before they are covered up. Immediately after the work is ready for inspection, Contractor will give specific notice to the Site Engineer for such verification. For all hidden work /concealed work certification to be done in writing with joint signature of Contractor's andLICI's Authorized Representative before concealing of the work. Adequate number of Photographs to cover all the concealed work shall be taken and submitted to LICI. If necessary, Videography shall be done. No work shallbe covered up without the permission of LICI's Engineer in charge**

22. PAYMENTS:

22.1 The Contractor shall be paid by the Employer, from time to time, by instalment under Interim Certificate to be issued by the Corporation's Engineer to the Contractor on account of the work executed, ***as per stage wise payment mentioned elsewhere in this tender*** subject to recoveries under this Contract. The Interim Certificate shall be based upon Interim Bills or

Running Account Bills to be prepared by the Contractor and supported***by the detailed verification drawings jointly signed by both parties.*** Adequate references, sketches and cross references wherever necessary are also to be provided with detailed measurements. The Corporation's Engineer may allow inclusion in the Interim Certificate such amount as he may consider proper on account of materials delivered upon the site by the Contractor for use in the work but not incorporated in it.

22.2 Provided always that the issue by the Corporation's Engineer of any Certificate during the progress of the works or after their completion shall not relieve the Contractor from his liability in cases of fraud, dishonesty or fraudulent concealment relating to the work or materials or any matter dealt with in the Certificate in case of all defects and insufficiencies in the work or materials which a reasonable examination would not have disclosed. No Certificate of the Corporation's Engineer shall in itself be conclusive evidence that any work or materials to which it is related are in accordance with the Contract;

22.3 Payment upon the Corporation's Engineer's Certificate shall be made within the periods named in the Appendix "Period for honouring Interim Certificate" after such a Certificate has been delivered to the Employer;

22.4 The CE shall have power to withhold any Certificate if the work or any parts thereof are ***for any inferior quality of work based on valuation as per rates in priced schedule of quantities submitted by the contractor or based on DSR latest Revision if it is not covered in priced schedule of work submitted by the contracto***r. However, if the final certificate is not issued within the period as mentioned under Clause No.22.5, 26 due to Audit para by CTE etc., the amount involved for such items of deficient work as decided by Chief Engineer would be with held. The same would be allowed as agreed upon by the CTE & the Chief Engineer and the final certificate would accordingly be issued and final bill passed. For such with held amount, a simple interest @ 6% per annum shall be paid to the contractor along with the said payment. Such interest will be calculated from the last date (as mentioned in Appendix to Conditions of Contract) for honouring final certificate till the date of payment.

22.5 ***The verifications and valuation in respect of contract shall be completed within the period of final verification*** stated in the Appendix or if not so stated then within six months of the completion of the contract works as defined in Clause (26) hereof. No further claim shall be made by the contractor after submission of the final bill and these shall be deemed to have been waived and extinguished.

22.6 The final certificate shall be based on the submission of ***overall execution of entire works as per drawings(drawings provided by Employer and vetted drawings submitted by the contractor), priced schedule of quantities submitted by the contractor, additional works as directed by Employer, Submission of certificates and warranty of all infrastructures provided in the project, submission of details of fittings and fixtures provided in the building along with working manual. Final certificate shall be issued if the completion certificate of the building is obtained from concerned appropriate authority along with NOC for fire Lift etc subject to condition that building is fit for occupation with availability of Electricity and water and legally satisfies all statutory norms and conditions for occupation***. The CE may direct the Contractor to resubmit details if the same are found incomplete to issue the final certificate and his decision to accept the details is final and binding on the Contractor.

Final Certificate shall be issued by the CE after the conditions are met with as per 22.4, 22.5, 22.6 and 26 and contractor's submission of **No Claim certificate cum receipt** as per the Proforma given in Appendix to Conditions of Contract.

23. SECURED ADVANCE AGAINST MATERIALS

23.1 The Contractor shall be entitled to be paid advance along with interim bill against materials which are not perishable and which are in the opinion of Corporation's Engineer, required for the works and have been brought on site for incorporation in the work but have not been so incorporated and are safeguarded against loss due to any cause whatsoever, (refer clause no-17). The amount of such advance against materials shall be arrived at on the following basis:

a) **75%** of the market value of materials required for the work and brought on site. ***The market value shall be derived from authorized GST invoice for purchase of material supported by proof of payment***

b) Such advance payment made against materials shall be recovered from or adjusted from the interim bills as and when the materials are utilized in the work.

Examples of certain perishable materials on which no advance shall be paid are **Cement,**Sand, Paint, Bitumen, Hard Boards/Soft Boards and other paper products, Petroleum Products, Coal Tar, Insulating Boards etc.

23.2 In case of dispute, the decision of the Chief Engineer on whether advance payment can be made against specific materials shall be final and binding.

24. UNFIXED MATERIALS AND EQUIPMENTS:

24.1 All tools, plants and materials brought to the site by the Contractor shall vest in the Employer and shall not be removed from the site of works except by permission of the Corporation's Engineer in writing. The Employer shall have a lien on these materials and plants.

25. REMOVAL OF IMPROPER WORK:

25.1 The Corporation's Engineer shall during the progress of the work have power to order in writing from time to time the removal from the work within such reasonable time or as may be specified in the order, of any materials, which in their opinion are not in accordance with the Specifications or instructions, the substitution of proper materials and the removal and proper re-execution of any work executed with materials or workmanship not in accordance with the Drawings and Specifications or Instructions and the Contractor shall forthwith carry out such an order at his own cost. In case of default on the part of the Contractor to carry out such an order, the CE shall have the power to employ other persons to carry out the same and all expenses consequent thereon or incidental thereto as certified by the Corporation's Engineer shall be borne by the Contractor and may be deducted from any amounts due or that may become due to the Contractor.

26. VIRTUAL COMPLETION:

26.1 The work shall be completed in accordance with the Contract and to the entire satisfaction of Chief Engineer. All unused materials, tools, plants, scaffoldings, temporary structures, hutments and things belonging to the Contractor shall be removed and the site of works cleared of rubbish and all waste materials by the contractor at his own expenses and delivered up tidy to the employer. After completion of the work, the contractor will serve a written notice to the CE to this effect. The Chief Engineer after satisfying himself shall thereupon approve the virtual completion. The Defect Liability Period shall commence from the date of such certification.

27. DEFECTS AFTER COMPLETION:

27.1 The defects, shrinkage, settlements or other faults, which may appear within "the Defects Liability Period, stated in the "Appendix to the Conditions of Contract" or if not stated then, **within 24 (Twenty four) months** after virtual completion of the work, arising on account of

materials or workmanship not in accordance with the Contract shall, upon the directions in writing of the Corporation's Engineer and within such reasonable time specified therein, be amended and made good by the Contractor at his own cost unless the CE shall decide that he ought to be paid for such amendment and for making good, and in case of default, the CE may employ and pay other persons to amend and make good such defects, shrinkage, settlement or other faults, and all damages, loss and expenses consequent thereon or incidental thereto shall be recovered from any monies due or that may become due to the Contractor. The CE may in lieu of such amending and making good by the Contractors, deduct from any money due or that may become due to the Contractor, a sum to be determined by the CE equivalent to the cost of amending such work. Should any defective work have been done or materials supplied by any Sub-Contractor employed on the work, who has been nominated or approved by the CE as provided in Clause No.16 the Contractor shall be liable to make good in the same manner as if such work or material had been done or supplied by the Contractor and been subjected to the provisions of this Clause and Clause No.2 hereof. The Contractor shall remain liable under the provision of this Clause notwithstanding the payment of any Certificate or the passing of any accounts.

28. PROVISIONAL SUMS, APPLICATION OF:

28.1 Deleted

29. OTHER PERSONS ENGAGED BY THE EMPLOYER:

29.1 CE reserves the right to execute any work not included in this Contract, which he may desire to have carried out, by other persons and the Contractor shall allow all reasonable facilities and the use of his scaffolding and plant for the execution of such work, but is not required to provide any special plant or materials for the execution of such work except by special arrangement with the Employer. Such work shall be carried out in such manner as not to impede the progress of the work included in the Contract and the Contractor shall not be responsible for any damage or delay which may happen to or be occasioned by such work.

30. SUSPENSION BY THE CONTRACTOR:

30.1 If the Contractor except on account of any legal restraint upon the Employer preventing the continuance of the work, shall suspend the work or in the opinion of the CE shall neglect or fail to proceed with due diligence in the performance of his part of the Contract or if he shall make default in respect of Clause No.2, the Employer shall have the power to give notice in writing to the Contractor requiring that the work be proceeded within a reasonable manner and with reasonable dispatch. Such Notice shall purport to be a notice under this clause. After such notice is given, the Contractor shall not be at liberty to remove from the site of the work or from any ground contiguous thereto any plant or materials belonging to him, which shall have been placed thereon for the work and the Employer shall have a lien upon all such plant and materials to subsist from the date of such notice being given until the notice shall have been complied with. If the Contractor shall fail for 7 (seven) days after such notice given to proceed with the work as therein prescribed, the CE may proceed as provided in Clause No.31.

31. DETERMINATION OF CONTRACT BY EMPLOYER:

31.1 If the Contractor (being an individual or a firm) commit any "Act of Insolvency" or shall be adjudged as Insolvent or shall make an assignment or composition of the greater part in number or amount of his creditors or shall enter into a deed of assignment with his creditors, or being an Incorporated Company shall have an order made against him or pass an effective resolution for winding up either compulsorily or subject to the supervision of the Court or Voluntarily or if the official Assignee of the Contractor shall repudiate the Contract or if the official Assignee or the Liquidator in any such winding up shall be liable within 7 (seven) days after notice to him

requiring him to do so, to show to the reasonable satisfaction of CE that he is able to carry out and fulfil the Contract and if required by the CE to give security therefore or if the Contractor (whether an Individual Firm or Incorporated Company) shall suffer execution to be issued or if the Contractor shall suffer any payment under this Contract to be attached by or on behalf of any of the creditors of the Contractors or if the contractor shall assign or sublet the Contract without the consent in writing of the CE first obtained or if the Contractor shall charge or encumber this Contract or any payment due or which may become due to the Contractor there under, or if the CE shall certify in writing that in his opinion the Contractor,

a. has abandoned the Contract, or

b. has failed to commence the work, or has without any lawful excuse under these conditions suspended the progress of the work for 7 (seven) days after receiving from the CE written notice to proceed, or

c. has failed to proceed with work with such due diligence and failed to make such due progress as would enable the work to be completed within the time agreed upon, or

d. has failed to complete the work within the stipulated date including authorised extensions or

e. has failed to remove the materials from the site or to pull down and replace the work within 7 (seven) days after receiving a written notice from the Corporation's Engineer that the said materials or work were condemned or rejected or

f. has neglected or failed persistently to observe and perform all or any of the acts, matters, or things, by this Contract to be observed and performed by the Contractor for 7 (seven) days after written notice shall have been given to the Contractor requiring the Contractor to observe or perform the same, or

g. has to the detriment of good workmanship or in defiance of the CE's instructions to the contrary sub-let any part of the Contract then and in any of the said causes, the CE notwithstanding any previous waiver, after giving 7 (seven) days notice in writing to the Contractors, determine the Contract, but without thereby affecting the powers of the CE or the obligations and liabilities of the Contractor, the whole of which shall continue to be in force as fully as if the contract has not been so determined and as if the work subsequently executed had been executed by or on behalf of the Contractor. And further, the Employer, his agents or servants, may enter upon and take possession of the work and all plant, tools, scaffolding, sheds, machinery, steam and other power, utensils and materials, lying upon the premises or the adjoining lands or road and use the same as his own property or may employ the same by means of his own servants and workmen in carrying on and completing the work or by employing any other Contractors or other person or persons to complete the work, and the Contractor shall not in any way interrupt or do any act, matter, or thing to prevent or hinder such other Contractor, other persons or person employed for completing and finishing or using the materials and plant for the work. When the work shall be completed or as soon thereafter as convenient, the CE shall give a notice in writing to the Contractor to remove his surplus materials and plant and should the Contractor fail to do so within a period of 14 (Fourteen) days after receipt thereof by him, the Employer may sell the same by public auction and shall give credit to the Contractor for the amount so realised. The CE shall thereafter ascertain and certify in writing under his hand what (if anything) shall be due or payable to or by the Employer for the value of the said plant and materials so taken possession of by the Employer and the expense or loss which the Employer shall have been put to in getting the work to be so completed, and the amount, if any, owing to the Contractor and the amount, which shall be so certified shall thereupon be paid by the Employer to the Contractor or by the Contractor to the Employer, as the case may be and the Certificate of the CE shall be final and conclusive between the parties.

32. TERMINATION OF CONTRACT BY CONTRACTOR:

32.1 If payment of the amount payable by the Employer under any Certificate of the EE shall be in arrears as unpaid for 60 (sixty) days after notice in writing requiring payment of the amount with interest of aforesaid shall have been given by the Contractor to the Employer, or if the work be stopped for six months under order of the CE or by any injunction or other order of any Court of Law, then and in any of the said cases, the Contractor shall be at liberty to determine the Contract by notice in writing to the Employer and he shall be entitled to recover from the Employer payment for all the work executed and for any loss, he may sustain upon any plant or material supplied or purchased or prepared for the purpose of the Contract.

32.2 In arriving at the amount of such payment, the net rates contained in the Contractor's original tender shall be followed or where the same may not apply, valuation shall be made in accordance with Clause No.15 hereof.

33. DETERMINATION OF CONTRACT DUE TO ABANDONMENT OR REDUCTION IN SCOPE OF WORK:

33.1 If at any time after the acceptance of the tender, the Employer shall for any reasons whatsoever not require the whole or any part of the works to be carried out, the CE shall give notice in writing to the Contractor who shall have no claim to any payment of compensation or otherwise whatsoever on account of any profit or advantage which he might have derived from the Execution of the whole of the works.

The Contractor shall be paid at contract rates for the full amount of work executed and in addition:

a. The cost at site of all surplus approved materials collected for incorporation in the work, which the Contractor does not wish to retain and which shall thereafter become the property of the Employer.

b. Where the Contractor desires to retain the surplus of approved materials (excepting materials supplied by the Employer or obtained in Employer's name, which shall, in any case, be returned to the Employer) the cost of handling and cartage charges for removal from the site to a reasonable distance not exceeding 25 kms.

c. If upon the determination of the Contract under this condition, the Contractor is of the opinion that he has suffered hardship by reason of the operation of these conditions, he may refer the circumstances with full details to the Chief Engineer, who on being satisfied that such hardship exists or has existed, shall make such allowance, if any as in his opinion is reasonable, and his decision shall be final, conclusive and binding.

34. DISPUTES TO BE FINALLY DETERMINED BY CHIEF ENGINEER:

34.1 The Instruction, Decision, Opinion, Direction, Certificate or Valuation of the CE with respect to all or any of the matters under Clause (2), (3), (5), (6), (9), (14), (15), (18), (23), (27), (30), (31) and (33) hereof (which matters are herein referred to as EXCEPTED MATTERS) shall be final and conclusive and binding on the parties hereto and shall be without appeal. Any other Decision, Opinion, Direction, Certificate or Valuation of the CE or any refusal of the CE to give any of the same shall be subject to the right of Arbitration and review as given under Clause No.36.

35. SECURITY DEPOSIT AND PERFORMANCE GUARANTEE AND EMD:

35.1 Amount towards Security deposit shall be calculated as per details given under Serial No.10 of "APPENDIX TO CONDITIONS OF CONTRACT" in the tender. Security Deposit can be either in Cash or in the form of Bank Guarantee.

In case of cash option, the EMD shall be retained as part of Security Deposit and balance Security Deposit shall be accumulated through retentions from Running Account Bills at 7.5% (maximum) of gross amount of bill. If the total amount of EMD is submitted in the form of Bank Guarantee and the contractor wants to avail the cash option i.e. the deduction of security deposit from the bills, then the contractor has to deposit a demand draft /pay order in the name of Life Insurance Corporation of India payable at Patna amounting to the total amount of EMD in lieu of Bank guarantee submitted towards EMD. Once this amount is deposited the contractor can avail cash option for security deposit and the bank guarantee submitted towards EMD shall be returned.

In case of Bank Guarantee option, the Contractor shall furnish one Bank Guarantee for full amount of Security deposit valid till end of defects liability period OR, two Bank Guarantees of like amounts each equal to half the Security deposit; one valid till virtual completion and the other till end of defects liability period.

35.2 Performance Guarantee under 10(b) of "Appendix to Conditions of Contract" shall be only in the form of Bank Guarantee valid up to scheduled date of completion.

35.3 The Bank Guarantee/s shall be from any Nationalised / Scheduled Bank preferably at place of work site or Zonal Headquarter of LIC within whose jurisdiction the work falls or where a Branch/Division of the Corporation exists.

35.4 Bank Guarantee/s (BGs) against Security Deposit (SD) and Performance Guarantee (PG) shall be executed as per the specimen pro-forma at Annexure B and C. Bank guarantee/s against Security Deposit and Performance guarantee shall be submitted within 21 (twenty one) days from the date of acceptance letter.

35.5 In case of failure by the contractor to furnish the Bank Guarantee against Performance Guarantee as per Cl.35.2 by the stipulated date or extended date if any, Employer shall without prejudice to any other right or remedy available in law, be at liberty to cancel the tender and forfeit the 50% Earnest Money absolutely.

35.6 50% of the Security Deposit (cash option) shall be refunded after obtaining the Occupancy Certificate from local Authority& provided that the employer has no claim for forfeiture of part or whole of the said deposit.

35.7 Balance 50% of Security deposit will be refunded to the contractor after the satisfactory completion of the defects liability period, subject to deductions for any appropriations thereof required to be made by the employer as per the conditions of contract.

35.8 If one Bank Guarantee in lieu of total Security Deposit is furnished, the same will be released only after the successful completion of Defects Liability period subject to any appropriations as aforesaid.

35.9 If two Bank Guarantees in lieu of Security deposit are furnished, the First Bank Guarantee will be released after obtaining the Occupancy Certificate from local Authorityand second shall be released after the satisfactory completion of Defects Liability Period subject to any appropriations as aforesaid.

35.10 Bank Guarantees towards Performance Guarantees (where applicable) shall be released after the virtual completion is issued.

35.11 Contractor shall keep the Security Deposit and Performance Guarantee, where applicable, replenished to its full value whenever any recovery or appropriation there from occurs. The employer reserves the right to do so from any money(s) due to the contractor laying with them.

35.12 The Contractor should note that no interest will be allowed on any part of the Security deposit.

35.13 No deductions will be effected from the bills when the total security deposit is paid in the form of Bank Guarantee(s) and the E.M.D shall be refunded after acceptance of Bank Guarantee(s).

35.14 In the event of failure by the contractor to submit Bank Guarantee(s) by the specified / extended date, recovery of Security deposit shall be effected from the R.A Bills. However, where the contractor fails to furnish Bank Guarantee against Performance Guarantee the matter shall be dealt with as per Cl. 35.5 above.

35.15 In all cases of Bank Guarantees, there shall be further provision of claim period of 6 months. If the contract period gets extended for any reason whatsoever, the contractor shall obtain the required extensions to the Bank Guarantee(s).

36. SETTLEMENT OF DISPUTES, ARBITRATION:

36.1 ***Any dispute and differences of any kind whatsoever arising out of or in connection with the contract or the carrying out of work (whether during the progress of the work or after its completion and whether before or after determination, abandonment or breach of contract) shall be referred to a Standing Committee consisting of one Retired High Court Judge and two members from Engineering fraternity retiring as Senior Engineer from Government/ Government Undertaking. The Committee will be constituted by the Chairman, LIC of India.***

36.2 The claims arising out of the Contract will be placed before the Committee once in a quarter and decision will be conveyed to both the contractually agreed parties.

36.3 Either of the parties being dissatisfied with the decision may approach to a three member Arbitral Tribunal, one each will be appointed by either party and both appointed arbitrators shall appoint third arbitrator who will act as presiding arbitrator.

36.4 Executive Dorector (Engg.) will appoint the Arbitrator on behalf of LIC of India. The arbitration shall be conducted in accordance with Arbitration and Conciliation Act 1996 as amended by the Arbitration and Re-Conciliation Act 2015 (3 of 2016) and any other amendment thereafter, if any.

36.5 The contractually agreed parties hereby also agree that the Arbitration under this clause shall be a condition precedent to any right of action in law of court under the Contract.

36.6 The references to arbitration by contractor on the matter of withholding by the Employer the certificate for interim payment can take place during the currency of the contract. However, on other kinds of disputes, unless both the parties agree in writing, reference of such disputes to arbitration shall not take place until after the completion or alleged completion of the work or termination or determination of contract.

36.7 It is a term of the contract that the person invoking Arbitration shall state the facts supporting his claim, the points at issue and the relief or remedy sought.

36.8 It is also a term of the contract that if the contractor does not make any demand for arbitration in respect of any claims within 120 days of receiving the intimation from the Corporation that the final bill is ready for payment, the claims if any received after 90 days period shall be absolutely barred from reference to the Arbitrator.

36.9 The Arbitration shall be conducted in accordance with the provisions of the Arbitration and Conciliation Act 1996 or any statutory modifications or Amendment to it from time to time.

36.10 In all cases Arbitration shall give separate award for each dispute or difference referred to him. The Arbitration shall decide each dispute in accordance with term of the contract and give a reasoned award. The venue of arbitration shall be in accordance with Arbitration Act. However, it may preferably be at L.I.C. of India, Zonal Centre or Place of Work Site.

36.11 The work under contract shall continue during the Arbitration proceedings and no payment due or payable to the contractor shall be withheld on account of such proceedings.

36.12 The Arbitration is deemed to have entered on the reference on the date he issues notice to both the parties calling them to submit their statement of claims and counter statement of claims.

36.13 Any fees payment/ reimbursements payable to the Arbitrator shall be shared equally by both the parties.

36.14 The Contractor hereby also agrees that Arbitration under this Clause shall be a condition precedent to any right of action in Law Courts under the Contract.

37. LUMP SUM ADVANCE (APPLICABLE TO CONTRACT COSTING Rs.25 LAKHS AND ABOVE)

37.1 Loan will be available if required by the Contractor, and may be given as under on submission of application by him subject to other conditions being fulfilled.

37.2 A lump sum amount not exceeding 10% in two instalments (5% + 5%) of the Contract accepted amount may be advanced against a Bank Guarantee and at the interest rate as specified in Appendix to the Conditions of Contract. The advance shall be utilised by the Contractor for the purpose of this Contract only and for no other purpose.

37.3 The Bank Guarantee (Proforma at Annexure 'C') shall be for the equivalent amount of loan 'plus' simple interest at specified rate plus 1% of loan amount to cover costs. The Bank Guarantee shall be from any Nationalised or Scheduled Bank preferably located at Zonal Head Quarters of LIC or place of work and shall be valid till the date of completion as specified in Appendix to Conditions of Contract. This shall be kept renewed from time to time to cover the balance amount and the likely period to complete recovery together with interest.

37.4 The amount of loan can be sanctioned to the Contractor on specific request as per terms of the contract and will be limited to 10% to be released in two instalments (5% + 5%) of the Contract accepted amount.

37.5 Recovery of the sums advanced by way of loan as above and of interest, thereon shall be made by deduction from the Contractor's running account bills in suitable percentages in relation to the progress of work after, 10% of the work is completed, subject to the condition that entire amount of loan with interest thereon shall be fully recovered by the time the work amounting to 80% of the Contract sum is completed. The interest on advance shall be calculated from the date of payment to the date of recovery, both days inclusive. It shall be ensured that at any point of time, Bank Guarantee is available for the amount of outstanding advance. The recovery of amount shall commence after 10% of work is completed and the entire amount together with interest shall be recovered by the time 80% of the work is completed. Provided that if at any time the Contractor fails to execute the Contract to the satisfaction of the Employer for any reason whatsoever, the Employer shall be entitled to recall forthwith the entire amount so advanced with interest, cost and legal expenses, etc. and/or recover the whole/balance amount as the case may be, from the bill if any, payable to the Contractor or by enforcing the Bank Guarantee.

37.6 Whenever extension of time is granted to the Contractors for the completion of the project and where the loan is not fully recovered, Contractor shall furnish fresh Bank Guarantee for extended period of Contract for the outstanding loan amount together with specified simple interest for the remaining period and 1% of outstanding loan amount towards costs.

37.7 Whenever the full amount of loan plus interest has been fully recovered, the Bank Guarantee shall be released.

37.8 If the situation so warrants a second loan will be available if required by the contractor subject to the following conditions :

a) At least 50% of the first loan stands recovered

b) The amount of the loan shall not exceed 5% of the balance amount of work.

c) The sum of amount outstanding plus amount of second loan shall not exceed 5% of the total value of work.

37.9 All other conditions applicable to lump-sum advance shall apply for the Second loan also.

GENERAL INSTRUCTIONS TO CONTRACTORS

NOTE: This is a time bound project and has to be completed within scheduled time. As such the Contractor will have to employ sufficient men, tools and plant and resources and submit a programme of planning of its resources before commencement of work.

1. DRAWINGS:

1.1 Drawings shall be kept open for inspection at places as mentioned in the letter to the contractor from the Chief Engineer. Drawings generally include the site plan, floor plans, elevations and sections of the proposed work.

2. INSPECTION OF SITE:

2.1 The Bidder shall visit and examine the site of work and satisfy himself as to the nature of the existing roads or other means of communication, the character of the soil and of the excavations, the correct dimensions of the work and facilities for obtaining materials and shall obtain generally his own information on all matters affecting the execution of the work. No extra charge made, in consequence of any misunderstanding or incorrect information on any of these points or on the grounds of insufficient description will be allowed. All expenses incurred by the Bidder in connection with obtaining information for submitting this tender including his visits to site and efforts in compiling the Tender shall be borne by the Bidder and no claims for reimbursement thereof shall be entertained.

3. WHOLE WORK TO BE COMPLETED IN THE SPECIFIED COMPLETION PERIOD:

3.1 The whole work is to be completed within the completion period stated in the Appendix to Conditions of Contract or the extended date of completion, if any. The Contractor will be required if necessary, to work overtime to complete the work by the stipulated date. No extra will be allowed on the Contract sum for such overtime work.

4. TIME AND PROGRESS CHART:

4.1 No Time and Progress Chart is attached to this Contract for guidance. The Contractor shall submit a time and progress chart (CPM/ PERT/ Quantified Bar Chart) fitted within the specified overall period of completion (as stated in Appendix to Conditions of Contract) **within 10 (Ten) days of the communication of letter of Acceptance** , to the Corporation's Engineer. In case the Contractor does not come forward for any change in the Time and Progress Chart as provided in the General Instructions to the Contractors, it shall be presumed that the Time and Progress Chart as per milestone specified is accepted in full in letter and spirit to maintain the pace of the progress of Work.

In addition to the above if the Contract Sum is Rs. 15 crore and above, the contractor has to submit monthly progress report of the work in a computerised form to the Corporation's Engineer. This progress report should contain the following:-

(a) Construction Schedule of the various components of the work through a bar chart for the next three months period.

(b) Progress Chart of various components of the work which are planned and achieved for the preceding 3 months and reasons for deviation if any should be mentioned.

(c) Details of the technical persons available at the site along with their designation.

(d) Targeted figure for financial achievement vis-à-vis planned and mentioning the broad details of all the Running Account Payment received.

(e) A statement showing the extra/ substituted/ deviated items submitted by the contractor and the items pending for sanction/ decision by the department.

(f) Quality assurance and quality control test conducted during the month with the results thereof.

(g) Details of hindrances if any.

4.2 Ancillary work should be so started that all such work is completed before the specified overall contractual period of completion.

4.3 The Contractor shall assume full responsibility for any delay in delivery of materials by Merchants or nominated Sub-Contractors not having completed the work in accordance with the Time and Progress Chart. Such excuses shall not form any criterion for extension of time, or any claims by the Contractor.

5. BENCHES:

5.1 The Contractor is to construct and maintain proper benches to indicate the inter-section of all main walls in order that the lines and levels may be accurately checked at all times. The Contractor shall provide suitable stones with flat tops and build the same in concrete for temporary or permanent benchmarks. All the pegs for setting out the work and fixing the necessary levels required for the execution thereof shall, if desired by the Corporation's Engineer likewise, be built in masonry at such places and in such a manner as the Corporation's Engineer may determine. Contractors' rates shall cover for these factors.

6. DRAWINGS ON SITE:

6.1 The Drawings maintained on the site are to be carefully mounted on boards of appropriate size and covered with a coat of approved transparent varnish or laminated at the cost of the Contractor. They are to be protected from the ravages of termites, ants, silver fish and other insects.

7. ORDER OF WORK:

7.1 The Chief Engineer reserves the right to fix the order in which the various items of work involved in this Contract is to be executed and Contractor shall comply with the same. There shall be no extra claims on account of this.

8. WORKMANSHIP:

8.1 The Work calls for a high standard of workmanship combined with speed.

9. REJECTED WORKMANSHIP OR MATERIALS:

9.1 Any workmanship, or materials not complying with the specific requirements or approved samples, or which have been damaged, contaminated or deteriorated, must be removed immediately from the site and replaced at the Contractor's expense as directed.

10. QUOTED RATES:

10.1 Contractor should note that unless otherwise stated the tender is strictly on ***Lump sum basis as per the scope of work and his attention is drawn to the fact that the quoted lump sum amount*** should be correct, workable and, self supporting.

11. WATCHING AND LIGHTING:

11.1 The Contractor from the time of being placed in possession of the site must allow for watching, lighting and protecting the work, the site and surrounding, properly by day and night on all days including Sundays or other holidays, at his own cost.

12. WATER:

12.1 The rates quoted by the Contractors shall include for providing all water required for the work including that required by special tradesmen and Sub- Contractors and pay all charges required by Local Municipal or other Authorities. Water must be clean, fresh, pure and free from earth, vegetable or organic matters, acid or alkaline substance in solution or suspension. The Contractors shall make their own arrangements for water supply. If supply from the Municipality or other local bodies be inadequate, the Contractor should provide tube well or wells or open well at his own cost. The Contractors must execute any temporary plumbing and pay all fees and charges. All health regulations in force shall be strictly observed by the Contractor and pay all necessary charges.

13. ELECTRICITY:

13.1 The Contractor shall arrange with the concerned Electricity Supply Authorities for a temporary meter and supply to the site and shall provide all temporary wiring, power and lighting points for the whole of the works and clear away when no longer required. He shall pay all charges for the same and for electricity consumed, including that consumed by Sub-Contractors. The Contractor should submit disconnection & no dues certificate from the supplying authority along with his final bill.

14. OFFICE FOR CORPORATION'S ENGINEER ON SITE:

14.1 The Contractor shall at his cost, provide a separate office (of suitable size) for the Corporation's Engineer/s on site with writing tables, chairs, electric lights and fans, Air Condition, drinking water arrangements, etc. as directed by the Executive Engineer and clear away at completion of work and make good all work disturbed and pay all charges. The Contractor shall also provide facilities for having the Corporation Engineer's office cleaned every day and kept in good and hygienic condition.

15. OFFICE ACCOMMODATION FOR CONTRACTOR'S STAFF :

15.1 The Contractor shall, at his cost, provide, fit-up and maintain in an approved position proper office accommodation for his representative and staff, which offices shall be open at all reasonable hours to receive instructions, notices or communications and clear away on completion and make good all work disturbed.

16. SECURITY AND PROTECTION:

16.1 The Contractor shall at his cost, provide any necessary temporary enclosures, gates, entrances, etc. for the protection of the work and materials and for altering and adapting same as may be required and removing at completion of the works and making good all works disturbed.

16.2 During inclement weather, the Contractor shall suspend concreting or plastering for such time as the Corporation's Engineer may direct and shall protect such work in course of execution from damage by approved measures.

16.3 Should the work be suspended by reason of rain, strike, lock-outs or any other cause, the Contractor shall at his cost take all precautions necessary for the protection of the work and shall make good any damage arising from any of these causes.

16.4 The Contractor shall at his expense cover-up and protect from injury from any cause, all new work and supply all temporary doors protection to windows, and any other requisite protection for

the whole work executed, whether by himself or special tradesmen of Sub-Contractors and any damage caused must be made good by the Contractor at his own expense.

16.5 All fences, trees, shrubs, grasses, lawn and other surfaces around the buildings or approaches thereto, which are required to be maintained are to be kept free from damage due to operations in connection with the work, at Contractor's expense.

16.6 The Contractor shall, at his expense, protect all projecting sills, jambs, copings, stone or concrete treads and mouldings and all concrete steps, wood work and joinery and the like from injury during the progress of the work.

16.7 The Contractor shall at his cost, protect joinery and make good all damages to the same from any cause whatsoever during the performance of the Contract and leave perfect to the satisfaction of the CE at completion. Before giving possession, the Contractor must see that all doors, windows and ventilation etc. work easily and shall make all necessary adjustments for such smooth working.

17. SANITATION:

17.1 The Contractor shall at his cost provide adequate latrine facilities and keep the same in a clean and hygienic condition to the satisfaction of the Public Health Authorities and shall cause such latrine and night soil to be cleared away whenever necessary and shall make good all works disturbed by these conveniences.

18. MINIMUM WAGES ACT:

18.1 The Contractor shall pay rates of wages and observe hours of work and conditions of employment to existing rules under Minimum Wages Act. Further, it shall be Contractor's responsibility to ensure that he pays his workmen wages, which are not lower than the minimum prescribed by the Union Government and State Government in which area this Contract, is being operated.

19. SHEDS FOR MATERIALS:

19.1 The Contractor shall at his cost provide and maintain proper approved sheds for the storage and protection of materials etc. and other work that may be executed on the site including the tools and materials of Sub-Contractors and remove on completion. Sheds for storage of Cement are to have floors raised from the ground.

20. TEMPORARY ROADS:

20.1 The Contractor shall, at his expense, provide such temporary roads on the site as may be necessary for the proper performance of the Contract and for his own convenience but not otherwise. Upon completion, such roads shall be broken up and levelled where so required by the Drawings at Contractor's expense unless the CE shall otherwise direct.

21. OBJECTS OF VALUE AND ANTIQUITY FOUND ON SITE:

21.1 All objects of value or antiquity found on the site shall remain the property of the Employer and such findings shall be immediately reported to the Chief Engineer.

22. WORKS AND SITE TO BE KEPT AND DELIVERED UP CLEAN:

22.1 All shavings, cuttings and other rubbish as it accumulates from time to time during the progress of the work and at completion, including that of Sub- Contractor and special tradesman to be cleared and carted away. All rejected materials shall be removed. Contractor's quoted rates shall allow for these factors.

23. USEFUL EXCAVATED MATERIALS:

23.1 Any sand, gravel, moorum or rock taken from excavation will remain the property of the Employer and in the event of it not being allowed to use in the work, the Employer reserves the right to dispose it off in any way he wishes or to direct the Contractor to cart it away as ordinary materials.

23.2 Should suitable sand or gravel or moorum or rock be found in the excavations and the Contractor be allowed to use the same in the work, in place of materials to be brought by him from outside he will be required to pay the Employer the full market value of the same.

24. SIGN BOARD AND HOARDINGS:

24.1 The Contractor shall not affix or place any placards or advertisement of any description or permit the same to be affixed or placed in or upon any hoarding, gantry, buildings or structure other than that approved by the Chief Engineer.

25. SCIENTIFIC AND MEASURING INSTRUMENTS:

25.1 Theodolite, levels, prismatic compass/chain, steel and metallic tapes and all other surveying instruments found necessary on the works, shall be provided by the Contractor at his expense for the due performance of this Contract as instructed by the Corporation's Engineer.

26. TOOLS FOR MASONS:

26.1 Every bricklayer or plasterer on the work shall be provided with suitable level, battens, trowels, wooden floats and breaking hammers for cutting bricks and templates, to enable him to carry out the work in a neat and workman like manner and each gang of brick layers or plasterers not exceeding six in number shall be provided with a suitable measuring rule, a plumb bob, a spirit level and a square in addition to the above mentioned, all to be to the approval of the Site Engineer.

27. CONTRACTOR'S MISTERIES AND SUPERVISORS:

27.1 The Contractor's Misteries and the Supervisors on the works shall carry with them a suitable measuring rule, a measuring tape, a spirit level, a plumb bob and a square and shall check the work of the bricklayer, plasterers, and carpenters and joiners to see that the work is being done according to the Drawings and Specifications. The Corporation's Engineer/Supervising Staff will use any and all measuring instruments or tools belonging to the Contractor as he chooses, while checking the work executed or being executed on the works.

28. NO OVERLOADING OF SLABS:

28.1 Floors of buildings under construction shall not be loaded by stacks of materials during construction without the prior approval of Corporation's Engineer. It is important that no load comes on the reinforced concrete floors until they are at least three weeks old and at no time must the load placed upon them exceed the load for which they are designed.

29. ALTERNATIVE ITEMS:

29.1 Deleated

30. ATTENDANCE ON SPECIALIZED AGENCIES:

30.1 Co-ordination: The Contractor shall be responsible for the co-ordination of all the work including that of Specialized agencies, for arranging runs of all services and working to the requirements and layout of the specialist trades, in all matters necessary for the complete execution of the work.

30.2 Rates quoted by the Contractor shall be inclusive of all attendance on Specialized agencies or other Contractors nominated by the Employer. Contractor must allow for provision of the use of his scaffolding to Specialized agencies and for its retention until such time all relevant works are completed.

30.3 The Contractor shall accept liability for and bear the cost of the supply of all necessary water, electricity, lighting, watching etc. for the Specialized agencies work.

30.4 The Contractor must allow in his rates for making good any holes and chases left by the Specialised agencies or other Contractors nominated by the Employer before the Builder's Work is completed and handed over.

30.5 The Contractors shall, at all times, give access to workmen employed by the local or other authorities or any men directly employed on the buildings and to provide such parties with proper, sufficient, and if required, special scaffolding, hoists and ladders and provide them with water and lighting, and leave or make any holes, grooves etc. in any work directed by the Chief Engineer, as may be required, to enable such workmen to lay or fix pipes, electric wiring, special fittings etc. Contractor's quoted rates shall allow for these factors.

31. OCCUPATION BY EMPLOYER:

31.1 The Employer reserves the right to occupy the works by sections as completed, as may be considered by the Chief Engineer both practicable and reasonable and without hindrance to the Contractor's progress.

32. TAXES, DUTIES, LEVIES AND DEDUCTION AT SOURCE:

32.1 The Contractors shall be responsible to pay all statutory levies/taxes imposed by the State and Central Government from time to time. It is deemed that the rates quoted by the contractor is inclusive of all applicable taxes except GST on works contract which shall be paid by LICI as applicable from time-to-time as per notification of Government of India.

32.2 Deduction at source of Income tax, all other statutory taxes as applicable and labourcess shall be made by LIC of India as per statutory provisions prevailing from time to time, from the running account/ final bill and remitted to the concerned taxation authorities / State Government on behalf of the contractor.

32.3 The contractor shall mention the following LIC of India GSTIN Number according to State of work site in their bill.

FOR BIHAR GSTIN NUMBER	**: 10AAACL0582H2Z0**
FOR JHARKHAND GSTIN NUMBER	**: 20AAACL0582H1Z0**
FOR ODISHA GSTIN NUMBER	**: 21AAACL0582H1ZY**

32.4 The vendor needs to display the invoice on the GST portal and remit the tax to the Govt. within specified period.

32.5 The measurement books along with the abstract are to be checked, corrected and accepted by the vendor and then only invoice with zero correction will be raised and uploaded by the vendor on GST portal.

32.6 The vendor should quote their rate considering all taxes/duties/levies/ labour welfare cess etc. which are not subsumed in GST but excluding GST on works contract as applicable which will

be paid extra at the rate prevailing at the time of billing. It is also advised to quote the rate after considering the input tax credit advantage and adjusting / deducting the same in the quoted rate/amount.

32.7 GST on works contract will be paid extra along with Bill payment as per applicable rate of GST at the time of billing.

SCOPE OF WORK

1.0 BRIEF ABOUT THE PROJECT:

Bhubaneswar Divisional Office of Life Insurance Corporation of India is having a parcel of leasehold (90 years from 7.5.1956) Land (Commercial) admeasuring 7994.79 Sqm. (86023.94 Sq. ft.) in prime location at Suryanagar, just opposite to the Governor's House. The plot is around 3.0 KM away from Railway Staton. around 2.4 KM away from Airport.

Earlier on the same plot our Bhubaneswar Branch Office–1 was housed in an old single storied building till 2010. The condition of the building was dilapidated & it was finally demolished after a new 3 storied building was constructed on the same plot to house LICI, Branch-1 & the Divisional Office temporarily. Recently the new Divisional Office building has been constructed at Pokhriput. Now divisional office is shifted to our newly constructed own Pokhariput Divisional Building shortly.

This vacant portion of the plot was earmarked for Investment Building only because of it's prime location, in view of the value of land as well as prospective rental income from building.

2.0 SCOPE OF WORK FOR THIS EPC CONTRACT

The Bidder is advised to visit the Site and ascertain condition before submission of the tender. The site is in the heart of city. There may be certain traffic restriction for heavy vehicles during certain period of day. There may also be noise and other restrictions as it is just opposite to the Raj Bhawan/ Governor's House. The proposed Construction work shall be done as per site conditions with least inconvenience to existing office, neighbors and general public. Contractor shall have to arrange material, labour, T&P and other resources keeping in mind the site conditions. Nothing extra shall be admissible on this ground. The scope of work shall include the features / requirements to be incorporated in the design as well as construction to mitigate such site condition to achieve the target levels as per site requirement and recommendations given in the Design Basis Report.

The bidders is provided with the concept plan of the proposed project for reference, our requirements, Technical specifications, Design Basis Reports and other details forming the part of bid documents. Based on these drawings and documents, the Bidders shall prepare their detailed designs inconformity with the local Bye- laws. The boundary wall for the plot with entrance gates is required to be provided. The designing and construction of Entrance Gates as per Master Plan are in the scope of work of contractor along with required dismantling of existing boundary wall and gates etc . and new construction is required.

The scope of work includes overall development of the plot. Besides these, all required MEP and other services, utilities, horticulture, landscaping, roads and pavements, parking. pathways, compound walls, watchman cabins, gates (Entry & Exit), external development, drainages, signage and all related utilities and as mentioned in the Design Basis Report and otherwise taking into consideration with respect to all statutory regulations as required for development are also included in the scope of work.

2.1 Briefly the Scope of Work includes the following :

I. Planning and Engineering

a. Getting the Submission Drawings prepared as per our requirement developing the Concept Drawings and showing all the details including the locations of UGR and Pump Room, Firefighting installations, Electrical Substation, STP, Rain Water Harvesting Pits, Landscaping, DG Sets, all servicing pits, borewell, Solar PV etc including the details of existing buildings as required.

b. Obtaining NOCs from all concerned statutory Authorities like Environment, Forest for cutting of trees if any, Airport Authority, Fire department, Ground Water Board, Police department and all other authorities as required for construction of the proposed Building and ancillary structures.

c. Getting the Plan sanctioned by Municipal Authorities after getting all NOCs required with necessary modifications of drawings as and when required with approval from LIC at each stage and submit to LICI the soft(AutoCAD and pdf) and hardcopy.

d. As per approved Architectural Drawings, Structural Drawings& Designs are to be prepared by the contractor based on soil test report. The structural design of the buildings and ancillary structures as required is to be done in Etab software of latest version conforming to latest BIS Code. The same should be got vetted through any Government Engineering College like IIT, NIT etc after taking approval from LICI.

e. Preparation of 'Good for Construction' detailed drawings for all Architectural, Structural,Electrical, Sanitary and Plumbing, Landscaping, Firefighting, all other services and features as mentioned in the DBR, latest concerned BIS codes and Manuals etc in consultation with LICI including modifications/ revisions as may be required and instructed from time to time.

f. Liasioning with all the authorities during the course of construction from time to time and Getting all necessary permissions/ certificates viz. Commencement of construction works, Plinth Level Certification, Electrical Inspection, Lift License, all service connections etc and Completion/ Occupation Certificate on completion of the work.

g. Preparation of As-Built drawings including all services, submission to all statutory authorities as per their requirements for getting the Completion/ Occupancy Certificate from the Statutory Authorities and submission of hardcopies as well as soft files (AutoCAD and .pdf format) to LICI.

h. The proposed building is aimed to get at least 3 Star/Silver rating from GRIHA/IGBC.

The Contractor has to arrange for appointment of Green Building Consultants from the approved list and take all actions starting from Registration with GRIHA/IGBC, incorporating all required specifications stipulated by them, documentation and submission to the Green Building authority from time to time and finally arrange for the rating Certificate.

III. CONSTRUCTION WORK INCLUDING SITE DEVELOPMENT:

Construction of foundation/ substructure & entire structure work of the building approved by LIC of India shall be executed including carrying out complete internal & external finishing work, flooring work in common areas, doors & windows, Security M.S. Grills and other MS structure for installation of outdoor units of Air-conditioners, Finishing work, waterproofing treatment of terrace & toilets, water storage tanks etc. unless otherwise specified in drawings and documents. During construction, the area should be barricaded/ covered and all safety measures to be followed. Temporary parking arrangement for vehicles is also to be made from time to time as required for smooth functioning of the existing offices. Also arrangement to be made for identifying and cutting the trees after taking necessary permissions from LICI and statutory authorities, if at all required.

Besides the scope of work as referred above, the construction of Building & Services with associated infrastructure shall include the following along with other utilities required for making the Buildings functional for occupation taking into consideration all statutory regulations:

i. Lifts – 2 nos 13 passenger lift, V3F Technology with Braille Call button.
ii. Internal Electrical wiring with all fittings & fixtures, DBs & Panels etc. by FRLS PVC insulated wire in FRLS PVC Conduit (HMS) with Modular type switches, Earthing, PFC Panel etc.
iii Wet Riser Fire Fighting and Sprinklers, Fire Detection & Fire Alarm System with Hybrid System (i.e. Intelligent Addressable Control Panel with conventional detectors and public address system for emergency evacuation) with required underground & overhead fire water tanks, firefighting pumps, equipment, panels, ring mains, fire & smoke detectors, fire alarm etc. complete including Construction of Pump room, as detailed in DBR.
iv, EPABX & Telephone Network System outlet wiring.
v. 1000 KVA Electrical Substations, Transformers, 50 KVA DG Sets, Street Lighting, HT panels, LT Panels, Capacitor Panels, Earthing etc. complete with necessary foundations and approaches etc. all internal and external LED fittings including cabling &connections as required.
vi. Overhead & Underground water storage tanks for domestic, fire, flushing, soft water with dual plumbing system
vii. Basic Security System with CCTV Cameras for common areas with 30 days video backup, Signages etc, Control Room with Monitors, Intercom system and EPBAX system
viii. 25KLD STP
ix. Lightning Arrestor
x. Pumps & Controllers

xi. 20kwp ongrid Solar PV including Net Metering
xii. Boom Barrier to control/ regulate authorized entry.
xiii. Borewell
xiv. External façade of the building for modern look like GRC Jalli/ Exterior grade HPL etc.
xv. Pressurised mechanical ventilation for Basement area
xvi. All LED fittings
xvii. Flood Light for Building front illumination
xviii. **Following all norms of GRIHA/IGBC for Green Building to get at least 3 Star/Silver Rating.**

The Site Development work includes

a. Construction of roads, pathways, parking lots, STP (under ground), water supply, sewerage, drainage works, Storm water drains, horticulture & landscaping including external lighting, Rain Water Harvesting etc. complete as per approved drawings and design.
b. Complete leveling/dressing including filling of earth, its supply, disposal of surplus earth/ debris/ malbaetc, if any is to be completed as directed by the Engineer-in-charge.Earth excavated from the site shall be used for earth filling at site itself.

c. External boundary wall with Two entry point to be provided. The contractor shall also be required to provide Main Gates. Security Control cabins etc.

d. Conservation of top soil as per Green Building norms.

2.2 Scope of Work also includes:

2.2.1 Planning and designing of:

a All electrical and mechanical services including related external services for works such as HT/ LT Electrical works, firefighting works, Lifts, Internal electrification, street lighting, LV works, STP etc., as per bye-laws and norms of the statutory and local bodies including making connections with the peripheral services after getting the services design approved from the local bodies /statutory bodies. The schematic drawings of external Services, fire fighting, sanitary &Plumbing , STP, Overhead water tank,UGR, Roads , pathways etc. are to be prepared. The Contractor is required to improve those drawings on the basis of Local Authority norms & requirements, BIS Codes / NBC-2016 . LICI's role shall be limited only to sign the application / drawings /documents for submission to the local bodies in the capacity of the owner for approval. However, statutory charges, if levied by the service provider towards cost of providing services shall only be reimbursed by LICI on production of relevant documents by the Contractor to the satisfaction of Engineer-in-charge or will be directly paid to the Authority on receiving original demand note.

b. *Planning & designing of waste water recycle system, rain water harvesting system including laying of pipelines and construction of related structures.*

c. *The concept drawings including Landscaping & Horticulture work, development plans showing Internal Roads, Pathways, Parking lots. Paved areas, Landscaping, Compound walls., Under Ground & Overhead tanks are uploaded with Bid Documents. These drawings are schematic one and the Contractor needs to prepare detailed working drawings based on Local Authority norms & requirements, BIS Codes / NBC-2016. As per norms of Statutory Authority if it is necessary to plant new trees within the LICI property. The Contractor to make detailed planning for plantation of trees / transplantation of etc. and execute the work as per norms as required.*

d. *Preparation of landscaping plan including planters and other details etc for the horticulture works and execution of same including providing unfiltered, construction of pump houses and installation of pumps therein etc. complete will be responsibility of Contractor. Construction of its boundary wall, (replacing the existing,including painting), water hydrants, the grassing, creepers and planting trees & cutting within campus etc. shall be completed as per the specification and drawing approved by the Engineer-in-charge subject to condition that these drawings confirm to the stipulations of local authorities.*

e. *Planning and designing of boundary walls. MS gates, providing MS railings, Wicked gates, Security Cabins, dustbins, sign boards, Numbering of floors / Flats etc all complete as per the drawing approved and direction of Engineer-in-charge.*

g. Planning and designing should include lighting interior & Exterior, steet/façade lighting all complete as per the drawing approved and direction of Engineer-in-charge

h. *Planning and designing of safe and efficient manner to allow for successful drainage to the rain water Harvesting catchments/ systems all complete as per the drawing approved and direction of Engineer-in-charge.*

k. Storm water drainage has to **account** for unhindered flow of water around the buildings such that rain water flow is at least 3m away from the building.

2.2.2 Construction of Building & Infrastructure:

Based on the Concept Drawings, Design Basis Report and other drawings, Technical Specifications and other documents given in the tender, Finishing / Flooring Schedule, approved makes of materials! equipment. Schedule of Doors/ Windows, fittings & fixtures. Schedule of Plumbing / Sanitary Fittings / Fixtures, Scale of amenities, the Construction of all buildings/ blocks, associated infrastructure &external development work & services shall be carried out and completed by the Contractor in a phased schedule as specified in the tender document. Following are each detail component's scope

2.2.3 TIME FRAME :

Time allowed for entire Planning, designing, and construction is 21 Months out of which first 6 months will be allowed for Planning, designing, getting NOC and sanctions from statutory authorities, and 15 months for construction with site development. Another 2 two months after completion of the building will be allowed for obtaining Occupancy Certificate and Green Building Rating.

The 'SCHEDULE OF MILESTONE FOR COMPLETION OF PROJECT' as per clause 19.1 of 'Conditions of Contract' has to be followed in this regard.

2.2.4 **Scope of the Construction work shall also include but not limited to the following:**

a. Getting the Plan sanctioned by Municipal Authorities after getting all NOCs required for submission of Plan for sanction with necessary modifications of drawings as and when required with approval from LIC at each stage

b. As per approved Architectural. Drawings, Structural Drawings& Designs are to be prepared by the contractor based on soil test report. Construction of foundation/ substructure & entire structure work of the buildings approved by LIC of India shall be executed including carrying out complete internal & external finishing work, flooring work, doors & windows, Security M.S. Grills to External Doors &Windows, external Finishing work, waterproofing treatment of terrace & toilets, Modular kitchen / pantry, overhead storage unit, wardrobe in all Bedroom of Flats, water storage tanks, Balconies etc. unless otherwise specified in drawings and documents.

c. Construction of roads, pathways, parking lots, STP (under ground), water supply, sewerage, drainage works, Storm water drains, horticulture & landscaping including external lighting, Rain Water Harvesting etc. complete as per approved drawings and design.

d. Complete leveling/dressing including filling of earth, its supply, disposal of surplus earth/ debris/ malba etc, if any is to be completed as directed by the Engineer-in-charge. Earth excavated from the site shall be used for earth filling at site itself.

e. External boundary wall with Two entry point to be provided. The contractor shall also be required to provide Main Gates. Security cabins etc.

Development of landscape area as per drawings, internal Roads of widths as shown in drawings and as per Bhubaneswar Development Authority and Other statutory authority norms, Open Parking Areas, Pathways.

3.1 DETAILED SCOPE OF WORK

3.1.1 Structural Design & Construction

Structural system of buildings is proposed as combination of columns and shear wall with conventional beam &slab system. Framing system and column placement shall be done in such a way that functionality of building is not hampered without any

compromise of structural arrangements. Structural system consists of RCC in Lift core area

I) **Design Work shall include :-**

a) The Contractor is required to carry out Detailed design/preparation of drawings based on DBR and also based on soil report;

b) Vetting of Structural Drawings / design from IIT or NIT.

c) Shop drawings and its approval from LICI .

d) Supply, fabrication, Construction. Installation and Commissioning.

e) Obtaining all interim and completion Approvals from Statutory Authority.

II) Further, details (in brief) are as under: -

a) The detailed Civil, Structural Design and preparation of Drawings for above mentioned buildings / spaces are within the Scope of the Contractor. For design of foundation, the Contractor is to use Soil report provided by LICI. However the Contractor may carry out the Soil Investigation afresh but the design has to be done based on the more stringent values.

b) The concept design (Architectural), Structural Design Philosophy of above buildings / spaces, structural framing is provided in tender documents based on which the contractor has to prepare detailed Civil, Structural drawings of eachand every aspect of the project required for construction of buildings in all respect. The contractors shall get the Structural Design & Drawings proof checked from the third party. a Govt. Agency like IIT / NIT. The fee payable for proof checking shall be borne by the Contractor .

c) The contractor shall not be absolved of their responsibility of structural stability and correctness of structural design. The contractor shall bear all the losses if arises out of the failure of any part of the project.

Based on the DBR & the architectural drawings, the Contractor shall submit the structural design and drawings based on the Design Philosophy given in the Technical Specification within the time as stipulated in Table of Milestone. Every Civil, Structural drawing /detail shall be prepared conforming to detailed Technical specification and relevant IS codes. All dimensions of various structural members / slabs / columns / elements shall be got approved from LICI.

d) The Civil/Structural Design & Drawings expressly (but not limited to) includes the following: -

i. Studying the Architectural Concept Design, Structural Design Philosophy, submitting proposed structural design framework of each building/floor/area and obtaining approval of LICI. Due care to be taken for integrating the structural drawing with the Architectural Drawings & with all MEP Services, Landscape features & Elevation features etc.

ii. Design on appropriate software like Etab and drawing on a software like Auto CAD including fabrication drawings, shop drawings, bar bending schedule

etc. of each and every component of buildings/spaces within Scope of work on suitable scale.

iii. Execution of complete work as per detail scope of work, Technical specification and drawings.

3.1.2 **Architectural& Civil finishing for all Works under Scope**

I) **The scope of work of the Contractor shall be as under** :-

a) Preparation of drawing & integration of all work into Building Informative model;
b) Shop drawings and its approval;
c) Supply. fabrication, Construction, Installation and Commissioning
d) The contractors shall integrate all aspects of the project into a 3D BIM model which will be shared & used for construction.

II) **Further, details (in brief) are as under :-**

The finishing work of all Stilt Floor, external areas outside building & all common areas within the buildings (like lift lobbies. staircases, ground floor lobbies, covered walkways, service lift lobbies &service areas etc.), all Office area separated by masonry walls, Refuge areas etc is included in the Scope of Works. The various parts of the project shall be finished / executed as per Schedule of Finishes provided in tender document.

3.1.2.2 Green Building Certification

It is aimed to get Green Building certification with minimum 3 star rating of GRIHA / Silver rating of IGBC for the proposed building. The project is to be built to the extent possible in compliant to scope in this contract, All electrical & mechanical fittings / fixture / appliances, to be provided for the work, should have minimum 3 star rating (of BEE) as available in market. All fittings and fixtures shall be provided which suits to the GRIHA/ IGBC rating. The contractor has to appoint Competent Green Building Consultant for the same and specified norms to be followed strictly. The building should have Green rating on completion. The payment to the Consultant has to be made by the Contractor, payment to the certifying agency will be done by LICI.

3.1.2.3. Time Schedule & Progress

The Contractor shall prepare phase wise (monthly) resource chart (materials, manpower and machinery) based on the project execution schedule and update the same on monthly basis.The Contractor shall also monitor the progress of work at site on a monthly basis, along with photographs & videos identifying delays, if any, with respect to overall construction schedule, identifying lapses/ deviations in the progress of work, assisting in devising remedial measures, preparing revised schedules and revised resource requirements etc., on a monthly basis, This report shall be submitted to Engineer-in-Charge. During the execution of the work, Contractor shall submit a detailed Monthly progress &programme report to the Engineer-in-charge by 5th of every month. The format of monthly progress &programme report shall be as approved by Engineer-in- Charge.

3.1.2.4 Submission of As built Drawing" on completion of project Preparation of as built drawing' to be given as soft copy at the end of project execution/ construction of the project showing **all s**ervices and vital points important for maintenance and operational point of view.

3.1.**3 Miscellaneous& Allied works**

The Scope of work of the Contractor shall also include as under: -

a) Detailed Designing/preparation of Shop drawings and its approval**(reference of DBR shall be taken),**
b) Supply, fabrication, Construction: Installation and Commissioning.
c) Obtaining Approval from concerned statutory authorities

(I) Plumbing & Sanitary

a) The Contractor to prepare plumbing and sanitary drawings as per NBC-2016, BIS Codes and CPHEEO Manual and prepare detailed fabrication /execution drawings & shop drawings, as required for execution and got approved from LICI before proceeding with the work.

b) The preparation ofSanitary/Plumbing fabrication & shop drawings expressly (but not limited to) includes the following: -

(i) Integration ofdetailed shop drawings with Civil/Structural details prepared by Contractor for the building and obtaining approval of LICI.
(ii) Preparation of fabrication & shop drawings on a software like AutoCAD etc.of each and every part of building having a sanitary/plumbing aspect within Scope of work on suitable scale.

c) The Execution of Plumbing/Sanitary work for buildings/spaces as per Scope of the work read with Technical Specifications and Drawings. TheSleeves, Cutout, Drainage arrangement, embedment, concealed piping, hot &cold water arrangement, overhead tanks, water recycling system etc. and connecting the service to the main line of Municipal Corporation are expressly included (but not limited to) in the scope of work.
d) The toilets in all floors of allblocks are to be completely fitted & finished including all plumbing & sanitary fixtures & fitting.
e) The toilets slabs will be sunken only by about 65 mm to accommodate waterproofing treatment and allow for drop and slope etc. All the traps are to be fixed below the soffit of slab. Core cutting is to be done as per requirements and piping shall be taken along ceiling to the ducts/ external vertical stacks with appropriate sealing.

(II) External Water Supply & Sewerage, Storm Water Drainage System, Drainage System, Rain Water Harvesting System

a) The External Water Supply & Sewerage. Storm Water Drainage System, Drainage System, Rain Water Harvesting System & schematic /Line drawings are to be scope of contractor. The detailed fabrication / execution drawings & shop drawings, as required at site are to be prepared by the Contractor and shall be got approved from LICI before execution of the work, External Water Supply & Sewerage Work shall be executed by the Contractor.

b) The preparation of External Water Supply & Sewerage, Storm Water Drainage System, Drainage System. Rain Water Harvesting including Recharge Wells Design fabrication & shop drawings expressly (but not limited to) includes the following

(I) Integration of detailed shop drawings with Civil/Structural details prepared by Contractor for each building and obtaining approval of LICI.

(ii) Preparation of fabrication & shop drawings on a software like AutoCAD etc.

c) The execution of work for above scope ofthe work read with Technical Specifications and Drawings and connecting the services from first manhole to the main line of the Municipal Corporation including approval from the Municipal Corporation (as applicable).

d) Design, installation, testing, commissioning and handing over of the above services with all services in running condition is included in Contractor's scope of work.

e) Supplying, installation, testing and commissioning of all internal & external Plumbing works as follows but not limited to the :

1. All water supply, drainage, rain water Internal Concealed/Open Piping with all accessories, fittings, fixtures etc.
2. All water Supply, drainage, storm water External Concealed / Buried /open Piping with all accessories, fittings, fixtures etc.
3. Gully trap, Inspection Chambres, manholes, Sewer trap Chambers with all accessories, fittings, fixtures etc.
4. STP Construction (under ground), connections and installation, commissioning of equipment /plant etc.
5. All sanitary /CP fittings and fixtures
6. Water Supply, Drainage Inlet/outlet Connections
7. Shifting diverting of existing Water Supply/drainage Lines
8. All Pumping System, Pump Panels, cabling etc.
9. Drainage/Storm Water line connection to Municipal drains
10. Liassoning with Respective Authorities
11. Obtaining required NOCs for the respective works
12. All Internal/External light fittings, fixtures
13. Solar PV System

The contractor shall furnish all labour, materials and equipment, transportation and incidental necessary for supply, installation, testing and commissioning of the complete Plumbing / Sanitary system as described in the Specifications and as shown on the drawings. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract.

Internal & external Sanitary Fixtures and Fittings, Internal and External Water Supply pipes & fittings, Internal and External Drainage, Approval from Local Authorities, Balancing, testing & commissioning, Test reports and completion drawings.

(III) Site Development & Landscape

a) Construction of Internal Roads, Pathways, Kerbs. open parking space etc. including connecting with the external road network as per Drawing and Technical Specification.
b) Hard and Soft Landscape in open land area including all horticulture operation, earth filling, grassing, tree plantation etc. as per Drawing and Technical Specification
c) Hard landscape to be done to achieve a high quality urban environment with permanent maintenance friendly features using granites in variety of anti-skid finishes.
d) Roads and pathways to have Concrete kerb stones.
g) Fire tender path to be maintained & marked around the building as per Fire norms.

(IV) SEWAGE TREATMENT PLANT (STP) (UNDER GROUND)

There will be a city sewer connection but all the sewerage generated will be fully treated within the project at the STP & waste water is recycled. The proposed Buildings will be divided in two segments and STP plants of 25 KLD capacity is to be provided as shown in the Layout Plan. The STP shall be of MBBR Technology. The scope of work of the contractor will include but not limited to following;

i) All Civil work like Excavation, RCC tanks, all required finishing, superstructure with Doors & Windows as per the schematic drawings and design and requirements of STP vendor.
ii) Procurement of STP plants of above mentioned capacity having MBBR Technology and its installation and its commissioning.
iii) All required Electrical Installations, Pumps and other equipments and piping etc..
iv) Operation and maintenance of STP plant till overall completion of the Project.

The parameters of treated water from STP shall achieve as per requirements of Environment Protection Rules, 1986 including any revision &ammendment and other requirements as per MOEF and any other Statutory Authority.

3.1.3 Scope of work related to Approvals / NOCs / Clearances from Statutory Authorities

A) Preparation of Drawings / Reports / Submissions:

i) The shared Concept drawing has been prepared based on the Survey carried out. However, the correctness of the Site Plan may be verified by the Contractor and if needed the Contractor may arrange for the fresh Survey of the plot at their own cost to establish the area of the plot, ground elevations with respect to mean sea level and levels as required for NOCs etc.

ii) **Master Layout Plan prepared by the Architect for submission to the Municipal / Development authority for approval shall be provided to the Contractor.**

iii). **Municipal Submission Drawings** of building proposals for the proposed Buildings including ancillary structures is to be prepared with modifications as required by the Contractor.

iv) Preparation of necessary drawings/proposals/reports, for obtaining remarks /NOC's from various departments including Bhubaneswar Municipal/ Development Authority and obtaining Commencement Certificate /Building Completion Certificate /Occupation Certificate.

v) There are trees in the plot. The contractor has to obtain the trees cutting permission and cut those trees. Compensatory plantation and /or transplantation as required shall be carried out by the contractor.

B) Submission of Drawings / reports /Proposals to various authorities.

i. Necessary permissions to commencement of work as a whole or at stages are required to be taken by the contractor.
ii. Contractor's responsibility also includes obtaining permissions for all type of service connections and Submission of Drawings for obtaining Building Completion / Occupation Certificates.

C) Other Services responsibilities:

i. The Contractor shall appoint Licensed Structural Engineer/ Civil Engineers/ Supervisors/Plumber/Electrical Engineer/Consultant for MOEF/Fire safety Consultant/ Garden / Landscaping Consultant and any other Consultant required for doing necessary compliance for Building completion and occupation certificate and the fees payable to all the Consultants/ Architects/Civil Engineers/Supervisions etc. shall be included in the quoted bid amount. No extra payment shall be made by LIC on account of above.
ii. In addition to the above Statutory or any other requirement for getting any approval for any item of work, the Contractor shall arrange the same on his own. However, any **statutory payments** and signing of affidavits will be done by the Corporation.
iii. Any other statutory requirement as per bye laws of local authority.
iv. Contractor shall arrange to discharge excess dewatering to Municipal drain during excavation with necessary permission of respective department.

The EPC Vendor will have either in house facility for planning , designing & engineering of the above project or will engage the following consultants for planning designing & engineering part of the above work with prior approval of LIC.

1) **Architectural Consultant** with valid Council of Architects Regisration No. and Minimum 10 years of experience in design & planning of similar work .
2) **Structural Consultant** with valid license and minimum 10 years experience in structural design of multistory buildings of similar architectural design.
3) **Façade Consultant** of suitable experience in similar works to design the Structural Glazing & external cladding work.
4) **MEPF Consultants** having suitable experience in designing of MEPF services of similar buildings .
5) **Landscape Consultant** having suitable experience in Landscape works of similar building .
6) **Green Building Consulatnt** for looking after the design aspect of the building for Green Building Rating (3 Star/ Silver rating from GRIHA/ IGBC). The consultant will facilitate and advise the EPC vendor throughout the concurrency of the project for obtaining desired green building rating either from GRIHA or IGBC.

3.1.5 : SCOPE OF WORK FOR ELECTRICAL INSTALLATIONS, H.T. WORK, LIFTS, FIRE FIGTHING, STREET LIGHT ETC

3.1.5.1 Planning, Designing, Supplying, Installation, Execution, Testing and Commissioning

All electrical and mechanical services including related internal / external services for works such as H.T. , LT Electrical works, D.G. Set, Fire Alarm & Fire Fighting works, Lifts, Internal Electrification, External & Landscapelighting , Earthing & lighting Protections, ELV works, solar pv system & Services in common areas etc.as per bye-laws and norms of the statutory and local bodiesincludingmaking connections with the peripheral services after getting the Servicesdesign approved from the local bodies /statutory bodies. LICI / Client's role shall be limited only to sign the application/ drawings /documents for submission to the local bodies in the capacity of the owner for approval. However, statutory charges, if levied by the service provider towards cost of providing services shall only be reimbursed by LICI/ Client on production of relevant documents by the Contractor to the satisfaction of Engineer-in-charge.

All designs shall be based on latest IS codes, NBC guidelines, ASRAE/ISHRAE specification, ECBC norms and other relevant applicable standards /norms/guidelines etc.

Based on the Master Plan, Concept Designs, Design Basis Report and other drawings, Technical Specifications and other documents given in the tender, approved Good for Construction Drawings /ShopDrawings, approved makes of materials equipment, associatedinfrastructure & external development work & services shall be carried outand completed by the Contractor in a phased schedule as specified in thetender document. Scope of work includes the construction of Machine Foundations for all heavy Equipment

A. The scope of work of EPC Contract shall be as under:-

- Detailed Designing / preparation of shop drawing on concept & DBR provided and obtaining LIC approval.
- Supply, fabrication, construction, installation and commissioning.
- Obtaining statutory approval of local authorities.
- Design & Schematic / Line drawings for internal Electrification as required. Any improvements recommended in drawing as per updated technology / product for benefit of project may be proposed by contractor at the time of execution to be approved by Engineer in charge. However detailed fabrications and shop drawing as required for execution at site are to be prepared by the contractor and got approved from LIC before proceeding with the works.
- The layout design (Scheme of Electrical arrangements of Electrical Works for Buildings / spaces and shop drawings of each and every aspect of the project, required for execution integrated with civil / structural / Architectural drawing for each building / spaces and obtaining approval of LIC
- Preparation of drawing etc of each and every part of building having an internal electrical aspect within scope of work on suitable scale.

B) Electrical Services e.g., DG, Panels, Distributions, Internal & external Electrical Works etc. (References of DBR shall be taken for detail design, fabrications & shop drawings)

The Electrical services scope of works under this EPC Contract includes the following:- (References of DBR shall be taken)

Otherwise

- Providing a complete end to end Electrical Supply System that will include Receiving HT 11 KV supply from ElectricalDistribution Company. Installation of Electrical Substation as per norms at location earmarked at Ground level of the project, HT panels, LT panels, individual metering system and creation of an Energy Center with Diesel Generator & ensuring complete distribution as per internal electrical scheme.
- Electric Power will be received from 11 KV grid through over head steel structure / underground cable which will be step down to 415V through 11 /0.433 KV Transformer, Preparation of layout/ Shop Drawings & SLD required for Transformer, HT Panels, DG Set, Bus Trunking etc. And approval of the same from LICI and Power Supply Company.
- Construction of Machine Foundations for all heavy Equipment
- Supplying and fixing of all equipments like Transformer, HT Panels, LT Panel, DG Set with AMF panel, Bus Trunking, cable trays, earthing, HT/LT power cable with terminations, safety equipments etc. As per technical specification & drawings and direction of LICI/ Power supply Contractor and as per Drawing and Technical Specification.
- Commissioning and handing over.
- Taking approval of installations from Electricity Supply Distribution Authority.
- The load should got sanctioned from Electricity Supply Distribution Authority, with provision to avail partial load as per our requirement and depending on our use.
- Supply, Installation & Commissioning of Oil Type Transformers & Substation including HT & LT work.
- MV switchgear and power distributions including wiring.
- Low voltage equipments.
- Power back up standby Generating system only for common area lighting and essential services like lifts, Pumps, STP etc. DG. Back up for the Fire Hydrant system it should be according to NBC-2016 or local CFO guidelines.
- General lighting / power layout for car parks and apartments.
- Emergency lightings for staircase, Stilt Parking & other necessary common areas for the same.
- lighting arrestor system
- Earthing , External lighting installation

- Complete internal lighting works along with fitting & fixtures.
- Complete internal electrical work including low voltage system for Telephone and intercom system, fittings & fixtures.
- All liaisioning works with local electricity Supply Company and obtaining the service connection will be in the scope of contractor.
- The earthing system will be in conformity with the IS:3043. All non current carrying metal parts forming part of the electrical system shall be connected to the grounding system. The requirement of Indian Electricity Rules and statutory requirement of local Electricity authority shall also be met fully.
- Voltage drop shall not be more than 3% from the output of the distribution transformers to the final distribution boards.
- FRLS PVC insulated stranded copper wires will be used for all sub mains and final circuit wiring in conduit. All life safety equipment cabling shall be Fire Survival Category.
- Heavy duty ISI marked FRLS PVC conduit will be used for wiring / extra low voltage wiring e.g Telephone cable and security co-axial cable etc wherever concealed in concrete. XLPE armoured cable / wire will be used for all external cabling including external / landscape lighting.
- The Lighting Protection System will be in conformity with the IS:2309.
- List of makes will be applicable for the all items.
- Wires/ Cable upto 10 Sq mm will be copper and more than above sqmm will be aluminium cable.
- All conduits will be ISI FRLS PVC heavy duty only.

B1) Diesel Generator: Detail Scope of work As under:-

In case of mains power failure, alternate supply available through DG (Minimum 50 KVA or above as the case may be) will feed all Common area Lighting, External Lighting, lifts (2 nos) & pumps, fire fighting arrangement, CCTV ,STP as per the requirement. Diesel Generator set with start-stop switches, AMF Panel, alternator, fuel tank, and exhaust system, acoustic &weather proof enclosure etc. Insulation of all equipments/ fittings etc. & their approvals from statutory authorities.

B2) Panels and Distribution Systems

- LT panels, DG set panels, Bus trunking, earthing, power cable, safety equipmentsetc as per technical specifications & drawing and directions of LIC / power supply agency and as per drawing and technical specifications.
- Commissioning and handing over
- Taking approval of installations from Electrical Supply Distribution and Inspection Authorities.
- Voltage Drop shall not be more than 3% from the output of the distribution transformer to the final distribution board.
- The Lighting Protection System will be in conformity with the IS:2309.
- Providing and laying / fixing cabling from the main receiving station, meter, electrical panel etc. as per technical specifications.
- Testing and commissioning of complete installation after service connection.
- There shall be independent panels for Main Incomers ,Fire Fighting, LIFT, ELV Systems, Domestic water Pumps, Common Distribution, Distribution from DG Supply, Emergency Lights, Tapping Arrangement with Suitable Ratings of MCCB at every wing and community hall etc.
- Construction of Service ducts for electrical supply etc. as per Drawing and Technical Specification.

B3) Internal Electrical Works: Detail Scope of work As under:-

The Execution of Internal Electrical work for buildings/spaces as per scope of work read with Technical Specifications and Drawings. The Following items are expressly included (but not limited to) in internal electrical executions:-

- Each floor/area slab/wall concealed electrical copper wiring /cabling/ conducting (PVC) network including fan boxes, plastic conduits, wires/ cables etc.
- Various type of LED lighting fixtures, ceiling fans, exhaust fans, etc.
- Switch boards, switches, plugs, fans, exhaust fans, regulators etc
- Distribution boards, circuit breakers, MCB,RCCB,MCCB,RCBO junction boxes, meters, electrical panels (LV/HV/MV) earthing etc.
- Approval from statutory bodies as required.

- All work to be carried out with prior approval of Local electricity distribution Company / statutory authorities & part commissioning approvals also to be obtained from the authorities and distribution agencies.
- All individual apartments to have metering with individual meters provided in the meter room at stilt level.
- FRLS PVC insulated ISI stranded copper wires will be used for all sub mains and final circuit wiring in ISI PVC FRLS Heavy duty conduit. All life safety equipment cabling shall be Fire Survival category.
- Heavy Duty ISI FRLS PVC conduit will be used for wiring/ extra low voltage wiring e.g. Telephone cable, data cable and security co-axial cable, etc. wherever concealed in concrete.
- All Lights &Fans will be supplied in each flat. Also geyser to be provided in toilet/bathrooms/kitchen as per DBR & exhaust fan in kitchen & toilet to be provided for each flat.

B4) Internal Lighting Works: Detail Scope of work as under

a) Light Fixture Design

- All the fixtures to be of best quality finish (In terms of product design, appearance, powder coating, internal reflectors, diffusers and overall finish) in order to give the interiors and car parking under podium a distinctive look and feel.
- All fixtures to have such fixing arrangements to the surfaces these have to connect, that orientations of fixtures remains architecturally aligned, fixtures are trim less or have less than 3mm trim. Connectors between lengths and to the mounting surfaces are quite robust and mostly click fixed.
- Fixtures wattages have not been defined. Only minimum lumen has been defined for each fixture. All fixtures have been rated for its lumen package (coming out of fixture) and system wattage. Lumen output from the fixtures has been defined to achieve the desired lux levels and the manufacturer will offer lowest wattage possible as per the best product technology available at the time of procurement to meet the lumen requirement.
- The earthing system will be in conformity with the IS: 3043. All non-current carrying metal parts forming part of the electrical system shall be connected to the grounding

system. The requirement of Indian Electricity Rules and statutory requirement of local Electricity authority shall also be met fully.

- All main light fixtures have been **considered with LED fixtures**.
- The electrical lighting systems shall be minimized by augmenting with natural lighting.
- On/ Off of light in the common area/Stilt area will be controlled through Group Lighting.
- Lighting lux is proposed to be variable as per the visibility needs of the spaces. And it should be fulfill the criteria of NBC, ECBC norms.
- Other efficient devices that are becoming available more and more in the markets shall be used.

b) Fans & Geyser:-

- **Ceiling Fans:** 1200 mm & 900 mm dia sweep ceiling fans as per requirements. All ceiling fans shall be should be BEE 5 Star rated. 1200 mm dia ceiling fans for bed rooms & living room and 900 mm ceiling fan for kitchen in each flat. Minimum air delivery and service value shall be as per the above specification. Not more than 2 fans on one switch board.
- **Exhaust Fans:** Light duty exhaust fan having 300 mm sweep, single phase, 1400 RPM with louvers in kitchen of each flat.
- **Geysers:** 15 Litres 5 star rated storage type geyser in two of the toilets as per DBR and

B5) Outdoor & Landscape Lighting:

The Scope of work shall be as under:

- Supply, fabrication, construction, installation and commissioning. All external & landscaped areas will be adequately lit with approved lighting fixtures so as to provide lighting to all pedestrian walkway, vehicular roads, entrances to complex, to buildings, to stilt etc to all fire exit. The landscape lighting will be done so as to create a pleasant environment in the evening for a safe & pedestrian friendly environment. Street light with LED light, landscape light, all signages as per technical specifications.
- The design of lighting and fixtures selection in these areas shall harmonize with the landscape.

- Ornamental and pole mounted light fixtures are to be appropriately scaled for each landscape situation. Alternates to pole lighting shall be considered to provide ambient and pathway lighting.
- Accent lighting must be located to avoid viewing bright sources from buildings and public areas.
- Pavement lights to be selected and spaced to provide even illumination, intersection, crossing, steps and ramps to be adequately illuminated for safety.
- Provide adequate lighting and fixture selection for all directional, location and safety signage.
- Armoured cable with earthing will be used for external landscape lighting power, Emergency Lighting / Escape lighting will be capable of:-
- Indicating clearly the escape routes.
- Providing adequate illumination along such routes to allow safe movement of persons towards and through the exits.

B6) Cable Tray / Conduits (As required)

Supply, fabrication, construction, installation and commissioning wherever required. These are suspended with cable tray systems used as trunk service distribution & mounting integrated tray. These will carry electrical supply, LV cables, CCTV wire etc in separate compartments & will be suspended as boxed / closed cable trays from the ceiling / beam above. Typically these may also carry wirings for light/ CCTV cameras if required.

C) Elevators : Detail Scope of work As under:-

- Providing, installation, testing and commissioning and handing over of elevators of required capacity as per Architectural Drawings & technical specifications. Detailed fabrications and shop drawings, as required for execution at site are to be prepared by the contractor and got approved from LIC before proceeding with the work.
- Obtaining approval from lift inspector/ electrical safety before and after commissioning.
- Passenger Elevators- Lifts shall be high quality, maintenance friendly finish & include all accessories. The panel shall be SS Braille buttons with LED display. The internal finishes & all features of all passenger / Stretcher shall be similar. The interiors shall be in Hair-lined stainless steel finish at all sides.

- The lifts are proposed on dual control basis and lifts will be **Machine room less** lifts with V3F drive.
- 2 Nos. of 13 passengers for the building has to be provided..
- Providing, installation, testing, commissioning and handing over of elevators of required capacity as per drawings and technical specification.

D) ELV System

D1) CCTV System : Detail Scope of work As under:-

Providing, Installation, testing and commissioning of IP based CCTV systems with NVR in the complex. The CCTV system shall monitor entrance lobbies, lift lobbies as specified, common areas, parking in stilts / ground floor, external periphery etc as specified. 30 **days** data shall be stored in the building.

D2) Conventional Fire Alarm : Detail Scope of work As under:-

- Detailed fabrication & shop drawings, as required for execution at site are to be prepared by the contractor and got approved from LIC before proceeding with the work.
- To provide fire alarm and detection system with associated communication and notification as per DBR & technical specification.
- The system shall be supplied installed, tested and got approved from the local / statutory authority and handed over to employer in an operational condition as per technical specification.
- Fire Alarm and Detection system will comprise of below mentioned components:-
  - i) Conventional fire detection system with addressable fire panel of latest technology.
  - ii) Manual call points for activation of Fire Alarm System manually. Hooters to be provided as per NBC-2016.

D3) EPABX / Intercom System

The scope of work shall be as under:-

- Supply, Installation, testing and commissioning of EPABX system compatible for analog, digital, IP phones complete in all respect as per technical specifications.
- Obtaining statutory & LIC approval of commissioning

- Providing and laying/fixing wire/cables from the EPABX to towers as per requirements and technical specification.
- Television Point & Telephone point outlet shall be provided at Drawing Room & one Bed Room at each flat, and at security Area etc.

E) SIGNAGE SYSTEMS

The scope of work for the contractor would be to design non-digital and digital signage system to achieve an effective way finding scheme both for internal roads and residential tower, as well as for all indoor common areas like Lift Lobbies, Letter box. Lift Exits, Fire Staircase, Service rooms, Fire Exit, Designating all utility Areas, Floors , Building Numbers & names etc. TRAFFIC SIGNAGES @ stilt floor.

a) Rumber Strips
b) Speed Retarder
c) Wall Guard
d) Parapet Flexible ABS Reflector
e) Column Guards
f) Sign Boards
g) Convex Mirrors

F) LIGHTING ARESTER SYSTEM

Air Terminal, 5.0 Mtr Mounting Mast, Down conductor, LSR, etc. and testing of the system complete in all respect. Lightning Protection complete with the Lightning Air Terminal - Configured as a Spheroid which is comprised of separate electrically isolated 4 rod surrounding an Earthened Central Finial. The upper section of the central final shall be rated to withstand 200KA. System should be properly earthed as per IS standards.

Lightning protection to building structure shall be provided by fixing of lightning conductor final with base connecting and installing horizontal conductor on roof top with suitable number of down conductor up to earth electrode via test point. The installation will be carried out as per BIS 2309 International Electrical Code of Practice..

G) Solar pv System : Detail Scope of work As under:-

- 20 KWp ON GRID mono crystalline silicon based pv module not less than 340wp, digital displaytype LCD for didplay, LCD/LED for status display including remote monitoring system inverter compliance with IEEE /IS 14286/IEC 61730 part –I and part -2 standard and code for solar generation plant with net metering arrangement will be provided in the terrace of the Car Parking Building. Necessary inverter, Solar panel, cabling, copper plate earthing , lighting arrestor etc. are the scope of the work.

Structure should withstand minimum wind velocity capacity of 200KM/hr. The drawing shall be got approved by Govt Engineering college before installation.

- The solar PV modules are designed to last 25 years or more. It is therefore essential that all system components and parts including mounting structure, cables, junction boxes, distribution boxes and other parts also have a life cycle of at least 25 years. Therefore all works shall be undertaken with the highest levels of quality and workmanship.
- Guaranteed annual generation should be 4.6KWH/KWp per day (1380KWH/KWp in a year considering 300sunshine days) during the first five years

H) Fire Fighting & Sprinkler System: Detail Scope of work is as under:-

- Design, Supply, Erection, Testing, Commissioning and handing over of complete fire protection system for both the buildings and premises in line with the stipulation of national Building Code 2016 and latest amendment if any & as per local Fire Authority bylaws.
- The work shall include providing and commissioning fire fighting pumps, delivery line, vertical risers, electrical panels, internal and external hydrants, sprinkler system in common area of the OQ bldg. and entire car parking Bldg, piping, hose cabinet, Air vessels and landing valves, portable fire extinguishers and any other firefighting measure complete as per requirement of National Building Code 2016 & as per local Fire Authority bylaws.
- The system shall be supplied installed, tested and got approved from the local / statutory authority and handed over to employer as per Drawing & technical Specifications.

Following are the Fire Fighting and Fire Protection System proposed as per NBC:-

- Fire Extinguisher System and Fire Hose Cabinet (FHC)
- Piping system confirming to IS: 1239- GI Heavy Class
- Wet riser system /Down Comer System
- Hydrant system
- Overhead Fire Water tank
- Sprinklers in stilt / ground level parking/Common Areas/ lobbies for Residential Building & car parking Bldg as per requirements of latest NBC & as per local Authority bylaws.
- The system must be comply with the NBC-2016 and local Fire Authorities guidelines.

- In addition to mandatory provision as per NBC and local fire bylaws, all other building where, wet riser/down comer/ sprinklers/ hydrant system etc are not mandatory, the following minimum fire safety provision to be made
  i. Wet Riser with booster pump at terrace.
  ii. Fire hydrant at landing of all floors.
  iii. Sprinkler systems in common areas at landing of all floors and parking
- Underground Fire water static storage has been provided in accordance to NBC 2016 requirement and as per IS:3844.
- Fire department connection shall be provided on the external wall at designated location for underground tank, fire brigade draw out connection shall be provided to draw out water during emergency of fire.
- The fire Fighting & sprinkler pumping system shall comprise of independent electrical pump and driven by the dedicated diesel engines and Jockeypumps, Terrace Pumps / Booster pumps etc as per NBC-2016 and local fire authorities. Job shall be inclusive of providing all cabling works, cable trays, earthing & other related items.
- It should be ensured that fire alarm call points and firefighting equipment provided along the escape routes can be readily located.
- Booster Pump at terrace.

I) PLANNING ,DESIGNING,SUPPLYING, INSTALLATION, EXECUTION, TESTING AND COMMISSIONING OF PUMPS & CONTROLLERS (Inter tank transfer & submersible)

a. Supply, installation, testing and commissioning of SS horizontal centrifugal /Submerssiblepump along with electrical prime mover of suitable capacity min 5 HP for transfer of water from underground tank to overhead tank as per design specification. The system should comprise of stand by Pump of equal capacity.

b. Supply, installation, testing and commissioning of multistage submersible pump for extraction of ground water as per design specification.

c. Supply and installation of necessary electrical cables and pump controllers for the above pumps.

d. Any other accessories required for successful operation of the above pumps to meet the desired purpose.

J) PREVENTIVE MAINTENANCE DURING DEFECT LIABILITY PERIOD

During defects Liability period of two years the Contractor is also responsible for carrying out of quarterly Preventive Maintenance in addition to attending break down calls and submission of Preventive Maintenance reports for the following works.:

I. LT Panels,

II. Lift Installations

III. Fire Fighting & Sprinkler Systems,

IV. Fire Alarm systems,.

V. CCTV Systems ,

VI. Solar PV System

VII. Sewage Treatment Plant

VIII. DG set installations

IX. EPABX / Intercom System

X. Lighting Protection System

XI. Water supply system.

XII. All internal & external electrical services.

No extra Charges will be paid for the above Preventive Maintenance works. The Quoted rates should include for the same.

J.1)Scope of Work for Operation & Maintenance

J.1.1 The scope of Operation & Maintenance (O&M) of various works of the investment building after completion of work to be executed by the EPC Contractor has been detailed in as under;

J.1.2 The Contractor shall operate and maintain the services like STP, Rain water harvesting System, Roads, etc till completion of defect liability period

.

J.1.3The contractor shall be responsible for maintenance of the project as per the scope of operation and maintenance specified in Technical specification to the entire satisfaction of the Engineering in charge till completion of defect liability period

.

The contractors shall remove promptly from the project all surplus construction machinery and materials, waste materials including (hazardous materials and waste water), Rubbish and other debris (including, without limitation, accident debris) and keep the project site/property in a clear, tidy and orderly conditions, and in conformity with the applicable laws, applicable permits and good industries practice.

NOTE: Please note that all specialized jobs like, Anti-termite treatment, Water-proofing Treatment, Rain Water Harvesting, UPVC Doors & Windows, Fire Fighting System, Lift, HT Substation, Solar PV System, Mechanical Ventilation etc. should be carried out through specialized agency by obtaining prior permission from Competent Authority.

ANNEXURE – 'A'

PROFORMA FOR

ARTICLES OF AGREEMENT

ARTICLES OF AGREEMENT made at..... this……..... day of……. ..... 20..... between THE LIFE INSURANCE CORPORATION OF INDIA, a body corporate constituted and established by the Life Insurance Corporation Act, 1956 (Act 31 of 1956) and having its Central Office at "Yogakshema", Jeevan Bima Marg, Mumbai and ITS Zonal Office at Jeevan Deep Building, Exihibtion Road, Patna -800001 hereinafter called the Employer (which expression shall include its successors and assignees wherever context or meaning shall so require or permit) of the one part and M/s ……..... (hereinafter called **"The Contractor"**) of the other part.

WHEREAS the Employer is desirous of constructing the……...

and has prepared ***Conceptual*** drawings ***Design Basis Report and Detailed Specification*** which have been signed by or on behalf of the parties hereto.

AND WHEREAS the Contractor has agreed to execute upon and subject to the conditions and instructions set forth herein (hereinafter referred to as **"the said Conditions")** the works shown upon the said drawings and /or described in the said Specifications therein set forth amounting to the contract sum of Rs…….. hereinafter referred to as **"the said contract Amount".**

NOW IT IS HEREBY AGREED AS FOLLOWS:

1. In consideration of the said Contract Amount to be paid at the times and in the manner set forth in the said conditions, the contractor shall upon and subject to the said Conditions execute and complete the works shown upon the said Drawings and described ***Design Basis Report and Detailed Specification***
2. The Employer shall pay the contractor the said Contract Amount or such other sum as shall become payable in the manner hereinafter specified in the said conditions.
3. The said Conditions and Appendices thereto shall be read and construed as forming part of this Agreement, and the parties hereto shall respectively abide by and submit themselves to the conditions and perform the Agreement in their part respectively in such conditions contained.
4. All disputes arising out of or in any way concerned with this Agreement shall be deemed to have arisen in **Patna** and only the Courts in **Patna** shall have jurisdiction to determine the same.
5. The contract comprises :-

i) Tender Documents Serial Pages……..

ii) Subsequent Correspondence Serial Pages……

ii) Architectural Drawings Serial Pages ……..

6. Only (……) alterations have been made in these documents and as evidence that these alterations were made before the execution of Contract Agreement, they have been initialled by the contractor and ……

…….. Engineer, ……..…….. Zone, Life Insurance Corporation of India …… The said officer is hereby authorised to sign and initial on the Employer's behalf, the documents forming part of this contract.

7. IN WITNESS WHEREOF THE Official Seal of the LIFE INSURANCE CORPORATION OF INDIA, _____ ZONE, was thereto affixed and signed on its behalf by the Chief Engineerand by _____ on behalf of the Contractor/s on the dates respectively mentioned against their signatures in the presence of the witnesses whose signatures are also appended.

In the presence of

CHIEF ENGINEER

Signature : .....
Name :.....
Address : .....

FOR AND ON BEHALF OF THE
LIFE INSURANCE CORPORATION
OF INDIA
Date :……

2. Signature : .....
Name : .....
Address : .....

In the presence of .....

1. Signature : .....
Name :.....
Address : .....

FOR AND ON BEHALF OF THE
CONTRACTOR
M/S ……..
Date :……

2. Signature : .....
Name : .....
Address : .....

ANNEXURE – 'B'

LIFE INSURANCE CORPORATION OF INDIA

(Refer Clause No. 35 of Conditions of Contract)

FORM OF BANK GUARANTEE IN LIEU OF SECURITY DEPOSIT

IN INDIVIDUAL CONTRACTS

To

THE LIFE INSURANCE CORPORATION OF INDIA

In consideration of the Life Insurance Corporation of India having its _____ Zonal Office at _____ in the State of _____ (hereinafter called **'the Corporation'** which expression shall unless repugnant to the subject or context include its successors and assignees) having agreed under terms and conditions of contract (vide its acceptance letter No._____ dated_____) made between _____*_____

(hereinafter called the said Contractor) and the Corporation in connection with _____ (hereinafter called **'the said contract'**) to accept a Deed of Guarantee and Indemnity as herein provided for Rs._____ from the _____**_____ in lieu of the Security Deposit to be made by the contractor and/or in lieu of the deduction to be made from the Contractor's bills, for the due fulfillment by the said contractor of the terms and conditions contained in the said contract, we the _____ (hereinafter referred to as **'the said Bank'**) and having our office at _____ do hereby undertake and agree to indemnify and keep indemnified the Corporation from time to time to the extent of Rs._____ (Rupees _____ only) against any loss or damage, costs, charges and expenses caused to or suffered by or that may be caused to or suffered by the Corporation by reason of any breach or breaches by the said contractor in respect of the said contract or of any of the terms and conditions contained in the said contract, or in respect of all its claims for money and / or material found due and recoverable from the said contractor and to unconditionally pay the amount claimed as such by the Corporation on demand and without demur to the extent aforesaid.

2. We, the said Bank further agree that the Corporation shall be the sole judge of and as to whether the said contractor has committed any breach or breaches of any of the terms and conditions of the said contract and the extent of loss, damage, costs, charges and expenses caused to or suffered by or that may be caused to or suffered by the Corporation from time to time on account thereof and the decision of the Corporation in this respect shall be final and binding on us.

3. The Corporation shall have the fullest liberty without affecting in any way the liability of the Bank under this Guarantee or Indemnity from time to time to vary any of the terms and conditions of the said contract or to extend time of performance by the said contractor, or to postpone for any time and from time to time any of the powers exercisable by it against the said contractor and either to

enforce or forbear from enforcing any of the terms and conditions governing the said Contract or securities available to the Corporation and the said Bank shall not be released from its liability under these presents by any exercise by the Corporation of the liberty with reference to the matters aforesaid or by reason of time being given to the said contractor or any other forbearance, act or omission on the part of the Corporation or any indulgence by the Corporation to the said contractor or of any other matter or thing whatsoever, which under the law-relating to sureties would but for this provision have the effect of so releasing the Bank from its liability.

4. It shall not be necessary for the Corporation to proceed against the contractor before proceeding against the Bank and the Guarantee and Indemnity herein contained shall be enforceable against the said Bank, notwithstanding any security which the corporation may have obtained or obtain from the contractor shall at the time when proceedings are taken against the Bank hereunder be outstanding or unrealized.

5. Notwithstanding anything contained in any of the foregoing clauses the liability of the Bank under this Guarantee shall not exceed Rs. _____ (Rupees _____ only). The guarantee shall remain in force till_____. If any extension of time be granted to the contractor, we undertake to extend the guarantee with the consent of the contractor. Unless a claim or demand under this guarantee is made or presented to the Bank within six months from the expiry date, all the rights of the Corporation under this Guarantee shall cease and the Bank shall be released and discharged from all liability hereunder.

6. We, the said bank lastly undertake not to revoke this guarantee and indemnity during its currency except with the previous consent of the Corporation in writing and agree that any change in the constitution of the said contractor or the said Bank shall not discharge our liability hereunder.

For and on behalf of the Bank

(Name and Designation)

The above Guarantee is accepted by the
LIFE INSURANCE CORPORATION OF INDIA.

For and on behalf of the LIC of India

(Name and Designation)
Dated:

Note No.1 ∗ : FILL IN AS APPLICABLE

A) For Proprietary concerns:-

Shri _____ son of _____ resident of _____ carrying on business under the name and style of _____ at _____ (hereinafter called **'the said contractor'** which expression shall unless the context requires otherwise include his heirs, executors, administrators and legal representative).

OR

B) For Partnership concerns:-

1. Shri _____
   son of _____
   resident of _____

2. Shri _____
   son of _____
   resident of _____

carrying on business in partnership under the name and style of _____ of _____ at _____ (hereinafter collectively called **'the contractor'** which expression shall unless the context requires otherwise include each of them and their respective heirs, executors, administrators and legal representatives)

OR

C) For companies :-

M/S / Shri _____ a company under the Companies Act 1956 and having its registered office at _____ in the state of _____ (hereinafter called **'the said contractor'** which expression shall unless the context requires otherwise include its successors and assignees).

Note No.2:

∗∗ Please fill in the name and address of Bank.

ANNEXURE – 'C'

LIFE INSURANCE CORPORATION OF INDIA

(Refer clause 37 of Conditions of Contract)

FORM OF BANK GUARANTEE TO SECURE A LUMP SUM ADVANCE

To

THE LIFE INSURANCE CORPORATION OF INDIA

In consideration of the Life Insurance Corporation of India having its_____ Zonal Office at_____ in the State of_____ (hereinafter called 'The Corporation' which expression shall unless repugnant to the subject or context include its successors and assignees) having agreed under the terms and conditions of contract vide its acceptance letter No. _____ dated _____ made between_____*_____

_____

_____

hereinafter called the said Contractor and the Corporation in connection with_____ (hereinafter called the said 'contract'), to make at the request of the contractor a lump sum advance of Rs._____ for utilizing it for the purpose of contract on his furnishing a guarantee acceptable to the Corporation, we the _____**_____ Bank (hereinafter referred to as 'the said Bank') a company under the companies Act, 1956 and having our registered office at _____ do hereby guarantee the due recovery by the Corporation of the said advance together with interest and costs thereon according to the terms and conditions of the said contract. If the said contractor fails to utilize the said advance for the purpose of the contract and/or the said advance together with interest thereon as aforesaid is not fully recovered by the Corporation, we the said Bank hereby unconditionally and irrevocably undertake to pay to the Corporation on demand and without demur to the extent of the sum of Rs._____.

1. We, the said Bank further agree that the Corporation shall be the sole judge of and as to whether the said contractor has not utilized the said advance or any part thereof for the purpose of the said contract and the extent of loss or damage caused to or suffered by The Corporation on account of the said advance together with interest and costs thereon not being recovered in full and the decision of the Corporation in this respect, shall be final and binding on us.

2. The Corporation shall have the fullest liberty without affecting in anyway the liability of the Bank under this Guarantee or Indemnity, from time to time to vary any of the terms and conditions of the said contract or the advance or to extend time of performance by the said contractor or to postpone for any time and from time to time any of the powers exercisable by it against the said contractor and either to enforce or forbear from enforcing any of the terms and conditions governing the said contract or the advance or securities available to the Corporation and the said Bank shall not be released from its liability under these presents by any exercise by the Corporation of the liberty with reference to the matters aforesaid or by reason of time being given to the said contractor or any other forbearance, act or omission on the part of the Corporation or any indulgence by the Corporation to the said contractor or of any other matter or thing whatsoever which under the law relating to sureties would but for this provision have the effect of so releasing the Bank form its such liability.

3. It shall not be necessary for the Corporation to proceed against the contractor before proceeding against the Bank and the Guarantee herein contained shall be enforceable against the Bank notwithstanding any security which the Corporation may have obtained or obtain from the contractor shall at the time when proceedings are taken against the Bank hereunder be outstanding or unrealized.

4. Notwithstanding anything to the contrary hereinbefore contained the Bank's liability hereunder shall not exceed Rs._____ (Rupees _____) in the aggregate. This Guarantee shall remain in force till the _____ day of the year 20…and the Bank's liability hereunder will cease to be operative unless any claim is lodged with the Bank within 6 (six) months thereafter.

5. We, the said Bank lastly undertake not to revoke this Guarantee during its currency except with the previous consent of the Corporation in writing and agree that any change in the constitution of the said contractor or the said Bank shall not discharge our liability hereunder.

For and on behalf of the Bank.

(Name and Designation)

The above Guarantee is accepted by the Life Insurance Corporation of India.

For and on behalf of the

LIFE INSURANCE CORPORATION OF INDIA

(Name and Designation)

Note No.1 ∗ **:** FILL IN AS APPLICABLE

A) For Proprietary concerns:-

Shri _____ son of _____ resident of _____ carrying on business under the name and style of_____ at _____ (hereinafter called 'the said contractor' which expression shall unless the context requires otherwise include his heirs, executors, administrators and legal representative).

OR

B) For Partnership concerns:-

1. Shri_____
   son of _____
   resident of _____

2. Shri _____
   son of _____
   resident of _____

carrying on business in partnership under the name and style of _____of _____ at _____(hereinafter collectively called 'the contractor' which expression shall unless the context requires otherwise include each of them and their respective heirs, executors, administrators and legal representatives)

OR

C) For companies:-

M/S / Shri _____ a company under the Companies Act 1956 and having its registered office at _____ in the state of _____ (hereinafter called 'the said contractor' which expression shall unless the context requires otherwise include its successors and assignees).

Note No.2 ** : Please fill in the name and address of Bank.

ANNEXURE – 'D'

LIFE INSURANCE CORPORATION OF INDIA

(Refer Clause No. 35 of Conditions of Contract)

FORM OF BANK GUARANTEE FOR PERFORMANCE GUARANTEE

IN INDIVIDUAL CONTRACTS

To

THE LIFE INSURANCE CORPORATION OF INDIA

In consideration of the Life Insurance Corporation of India having its _____ Zonal Office at _____ in the State of _____ (hereinafter called **'the Corporation'** which expression shall unless repugnant to the subject or context include its successors and assignees) having agreed under terms and conditions of contract (vide its acceptance letter No._____ dated_____) made between _____(hereinafter called the said Contractor) and the Corporation in connection with _____ (hereinafter called **'the said contract'**) to accept a Deed of Guarantee and Indemnity as herein provided for Rs._____ from the _____ for the due fulfillment by the said contractor of the terms and conditions contained in the said contract, we the _____ (hereinafter referred to as **'the said Bank'**) and having our office at _____ do hereby undertake and agree to indemnify and keep indemnified the Corporation from time to time to the extent of Rs._____ (Rupees _____only) against any loss or damage, costs, charges and expenses caused to or suffered by or that may be caused to or suffered by the Corporation by reason of any breach or breaches by the said contractor in respect of the said contract or of any of the terms and conditions contained in the said contract, or in respect of all its claims for money and / or material found due and recoverable from the said contractor and to unconditionally pay the amount claimed as such by the Corporation on demand and without demur to the extent aforesaid.

2. We, the said Bank further agree that the Corporation shall be the sole judge of and as to whether the said contractor has committed any breach or breaches of any of the terms and conditions of the said contract and the extent of loss, damage, costs, charges and expenses caused to or suffered by or that may be caused to or suffered by the Corporation from time to time on account thereof and the decision of the Corporation in this respect shall be final and binding on us.

3. The Corporation shall have the fullest liberty without affecting in any way the liability of the Bank under this Guarantee or Indemnity from time to time to vary any of the terms and conditions of the said contract or to extend time of performance by the said contractor, or to postpone for any time and from time to time any of the powers exercisable by it against the said contractor and either to enforce or forbear from enforcing any of the terms and conditions governing the said Contract or securities available to the Corporation and the said Bank shall not be released from its liability under these presents by any exercise by the Corporation of the liberty with reference to the matters aforesaid or by reason of time being given to the said contractor or any other forbearance, act or omission on the part of the Corporation or any indulgence by the Corporation to the said contractor or of any other

matter or thing whatsoever, which under the law-relating to sureties would but for this provision have the effect of so releasing the Bank from its liability.

4. It shall not be necessary for the Corporation to proceed against the contractor before proceeding against the Bank and the Guarantee and Indemnity herein contained shall be enforceable against the said Bank, notwithstanding any security which the corporation may have obtained or obtain from the contractor shall at the time when proceedings are taken against the Bank hereunder be outstanding or unrealized.

5. Notwithstanding anything contained in any of the foregoing clauses the liability of the Bank under this Guarantee shall not exceed Rs. _____ (Rupees _____ only). The guarantee shall remain in force till_____. If any extension of time be granted to the contractor, we undertake to extend the guarantee with the consent of the contractor. Unless a claim or demand under this guarantee is made or presented to the Bank within six months from the expiry date, all the rights of the Corporation under this Guarantee shall cease and the Bank shall be released and discharged from all liability hereunder.

6. We, the said bank lastly undertake not to revoke this guarantee and indemnity during its currency except with the previous consent of the Corporation in writing and agree that any change in the constitution of the said contractor or the said Bank shall not discharge our liability hereunder.

For and on behalf of the Bank

(Name and Designation)

The above Guarantee is accepted by the

LIFE INSURANCE CORPORATION OF INDIA.

For and on behalf of the LIC of India

(Name and Designation)

Dated:

Note No.1 ∗ : FILL IN AS APPLICABLE

A) For Proprietary concerns:-

Shri _____ son of _____ resident of _____ carrying on business under the name and style of _____ at _____ (hereinafter called **'the said contractor'** which expression shall unless the context requires otherwise include his heirs, executors, administrators and legal representative).

OR

B) For Partnership concerns:-

1. Shri _____
   son of _____
   resident of _____
2. Shri _____
   son of _____
   resident of _____

carrying on business in partnership under the name and style of _____ of _____ at _____ (hereinafter collectively called **'the contractor'** which expression shall unless the context requires otherwise include each of them and their respective heirs, executors, administrators and legal representatives)

OR

C) For companies :-

M/S / Shri _____ a company under the Companies Act 1956 and having its registered office at _____ in the state of _____ (hereinafter called **'the said contractor'** which expression shall unless the context requires otherwise include its successors and assignees).

Note No.2:

**** Please fill in the name and address of Bank**

LIFE INSURANCE CORPORATION OF INDIA

LETTER TO BIDDER FROM THE CHIEF ENGINEER

To,

……

……..

……

……

Dear Sir / Sirs,

SUB: **E-Tender on Design, Engineering, Procurement and Construction (EPC) basis for Proposed Construction of Investment Building (Basement+Ground+2 floors) at Suryanagar, Bhubaneswar, Odisha**

1) We hereby publish the TENDER on e-Tendering Portal (Website) through **http://www.tenderwizard.com/LIC** in **Electronic Mode** hereinafter referred as "**eTendering**" and consisting of following :

   (a) BID I : E.M.D. BID

   (b) BID II : PREQUALIFICATION BID

   (c) BID III : FINANCIAL BID

   Please note that copy of above e-Tender can be downloaded from above portal (website) and should be mandatorily submitted in **Online Electronic Mode** hereinafter referred as "**Online Offer**". The submission of Online offer duly Encrypted & Digitally Signed on above portal should be in prescribed Electronic Forms (Online) available on above portal for respective tender in Online Envelope(s) on or before **As per the Key Dates mentioned in the tender document and online portal for above tender.**

The bidders should submit required Tender document Fee and Earnest Money Deposit in a manner/mode as mentioned in e-Tender process (ref: Pre-Qualification BID details). Tender document fee of **Rs 5,000/- +@ 18% GST i.e. Rs.900.00 = Rs. 5,900.00** (Rupees five thousand nine hundred only) and **Earnest Money Deposit of Rs 33,52,500.00 (Rupees Thirty Three Lac Fifty Two Thousand Five Hundred) only** shall be submitted separately .

a) Tender document fee of **Rs 5,000/- +@ 18% GST i.e. Rs.900.00 = Rs. 5,900.00** (Rupees Five thousand Nine hundred only)in the form of Crossed Demand Draft/ Pay order/ Bankers Cheque of any Nationalized/ Scheduled Bank drawn in favour of **"Life Insurance Corporation of India"** payable at **"Patna"**

b) Earnest Money Deposit shall be submitted in the following form:-

Earnest Money Deposit of **Rs Rs 33,52,500.00 (Rupees Thirty Three Lac Fifty Two Thousand Five Hundred) only**

in the form of Demand Draft/Pay Order/Banker's Cheque/RTGS/NEFT in favour of "**Life Insurance Corporation of India**" payable at "**Patna**.

OR

II) Total amount i.e. **Rs 33,52,500.00 (Rupees Thirty Three Lac Fifty Two Thousand Five Hundred) only** in the form of Bank Guarantee (**as per enclosed proforma**) of any Nationalised/Scheduled Bank. The Bank guarantee shall be from any Nationalised /Scheduled Bank preferably at Patna or where a Branch/Division of LIC of India exists.

OR

III) Tender document Fee of **Rs 5,000/- +@ 18% GST i.e. Rs.900.00 = Rs. 5,900.00** (Rupees Five thousand Nine hundred only) (non-refundable) and Earnest Money Deposit of

Rs 33,52,500.00 (Rupees Thirty Three Lac Fifty Two Thousand Five Hundred) only

payment through NEFT mode directly to LIC Account.

Name of Bank :	**: AXIS BANK LTD.**
Branch	**: Main Branch, Patna**
Account No.	**: 142010200012704**
IFSC No.	**: UTIB0000142**
Account Type	**: Current**

**** NEFT/UTR No. and date receipt copies need not required to be submitted to our office ECZO, Engg Dept. Patna with sealed envelope before opening if BID-I&II.**

2) BIDs will be received at the office of Chief Engineer at above address **on or before As per the Key Dates** and the e-Tenders will be opened at **As per the Key Dates**in the presence of contractors or accredited representatives, who wish to attend the online Tender Opening process. The bidders can view the Tender Opening details through their respective Login IDs on the above mentioned e-Tender portal (Website). The Tenderer should ensure that their tender is received **Online Electronically** on or before the due date and time as specified in **"Key Dates"** in the Tender Document and above mentioned Portal (website). **Please note that above e-Tendering System is an automatically time locked system which will be locked immediately as soon as due date and time is over and will not accept any offer after that. So, the tenderers are strictly advised to do their process well before the due date and time to avoid any such instances.**

3) The Guidelines to Submit tenders on Electronic Tendering System (ETS) is part of **BID -I** of the Tender document. The tenderers are advised to carefully read the above document for understanding of e-Tendering System. The above Annexure will supersedes all the terms & conditions mentioned for submission of tender in document.

4) The Life Insurance Corporation of India does not bind itself to accept the lowest or any tender.

Yours faithfully,

CHIEF ENGINEER

LIFE INSURANCE CORPORATION OF INDIA

LETTER FROM BIDDER TO THE CHIEF ENGINEER

Date: ……..

To,
The Chief Engineer
LIC of India,
East Central Zonal Office,
Engineering Department (4th Floor),
Jeevan Deep Building,
Exhibition Road,
Patna-800001

SUB: **E-Tender on Design, Engineering, Procurement and Construction (EPC) basis for Proposed Construction of Investment Building (Basement+Ground+2 floors) at Suryanagar, Bhubaneswar, Odisha**

Dear Sir,

1) Having examined the Enrolment Form, Selection Criteria , Technical Specifications, Scope of work , Detailed Drawings, Specifications, Conditions of Contract etc. included in the tender document for the Lump sum EPC Contract relating to the above work, having visited/examined the site of the existing premises, having acquired the requisite information relating thereto as effecting the tender invited by you on behalf of the Life Insurance Corporation of India, I/We, the undersigned hereby offer to carry out the above mentioned work on Lump sum amount basis in strict accordance with the Contract Conditions and Specifications.

I/We, undertake to complete and deliver the whole of the works within a period as specified in Appendix to the Conditions of Contract from the date of issue of intimation from you that the tender has been accepted and upon receiving possession of the site. I/We shall be under the obligation to complete the entire work within the period of completion failing which to pay the sum as stated in the Appendix to the Conditions of Contract for every week that the works shall remain incomplete, damages as compensation subject to the conditions of contract relating to extension of time.

2) I/We enclose herewith my/our tender with an Earnest money remittance of **Rs 33,52,500.00 (Rupees Thirty Three Lac Fifty Two Thousand Five Hundred) only** in the appropriate format as specified in BID-I (Prequalifying Bid). I/We, hereby agree that part of this sum shall be forfeited by the Life Insurance Corporation of India in the event of my/our tender being accepted and I/We fail to execute Contract when called upon to do so.

3) In the event of the tender being accepted, I/We, agree to the retention of my/our EMD as a part of Security Deposit and the balance amount of Security Deposit to be recovered at 7.5% of Gross Value of work done from my / our Running Account Bills. If the total amount of EMD is submitted by me/us in the form of Bank Guarantee and I/We want to avail cash option i.e. deduction of security deposit in the from the bills, then I/We have to deposit a Demand draft/Pay order in the name of Life Insurance Corporation of India payable at Patna amounting to total amount EMD in lieu of Bank Guarantee submitted towards EMD. Once this amount is deposited then I/We can avail cash option for Security deposit and the Bank Guarantee submitted towards EMD shall be returned to me/us.

OR

I/We, agree to furnish a lump sum Bank Guarantee for total Security Deposit of **Rs: 20 Lakhs + 2.5% of accepted Tender Amount**or two Bank Guarantees each with 50% value from any Nationalized/Scheduled Bank at Patna as per specimen given in **Annexure "B"** to Conditions of Contract, within 21 (twenty-one) days of acceptance of tender. The Bank guarantee shall be from any Nationalised /Scheduled Bank preferably at Patna or where a Branch/Division of LIC of India exists.

5) I/We, agree to furnish a lump sum Performance Guarantee amounting to **3% of Accepted Tender Amount** in the form of Bank Guarantee from any Nationalized/Scheduled Bank at **Patna** as per specimen given in **Annexure "D"** to Conditions of Contract, within 21 (twenty-one) days of acceptance letter. The Bank guarantee shall be from any Nationalised /Scheduled Bank preferably at Patna or where a Branch/Division of LIC of India exists.

6) I/We, note that the Earnest Money Deposit of **Rs 33,52,500.00 (Rupees Thirty Three Lac Fifty Two Thousand Five Hundred) only** would be refunded to me/us.

a) On expiry of the validity of the tender or earlier at the discretion of Chief Engineer in case my/our tender is not accepted and

b) In case my/our tender is accepted, after I/We, furnish Bank Guarantee as mentioned above.

7) I/We, agree,

a) in case my/our tender is withdrawn before expiry of the validity period or before the issue of letter of acceptance, whichever is earlier, or makes any modifications in the terms and conditions of the tender which are not acceptable to the Department, in such case 25% of the EMD will be forfeited by the department.

b) in case my/our tender is accepted and the Performance Guarantee is not submitted within the prescribed period or approved extended period, 50% of the EMD will be forfeited automatically without any notice.

c) in case of forfeiture of Earnest money as prescribed above [6(a) and 6(b)],the tender shall not be allowed to participate in the retendering process of the work.

Yours faithfully,

(SIGNATURE OF THE CONTRACTOR)
Name and Seal
NAME OF THE PARTNER OF THE FIRM OR
NAME OF THE PERSON HAVING POWER OF
ATTORNEY TO SIGN THE CONTRACT
(CERTIFIED TRUE COPY OF THE POWER
OF ATTORNEY SHOULD BE ATTACHED

APPENDIX TO CONDITIONS OF CONTRACT

ESTIMATED COST :Rs. 3352.41 Lac

PERIOD FOR COMPLETION :24(Thirty One) Months

EARNEST MONEY DEPOSIT : Rs 33,52,500.00 (Rupees Thirty Three Lac Fifty Two Thousand Five Hundred) only

Sl. No.	Clause Nos.	Description	Remarks
1(a)	11	Minimum requirement of Technical staff	As provided in annexure I
1(b)	11	Recovery for Non Deployment of Engineer/s at the Site	As provided in annexure I
2	13	Date of commencement	Either 21(Twenty one) days from the date of acceptance letter issued to the contractor **OR** The day on which contractor is instructed to take possession of the site, whichever is **earlier.**
3	13 & 26	Completion Period	**21 Months** from the date of commencement (1) 6 months for Planning (Detailed Engineering etc.) works (2) 15 months for construction. **Additional 2 Months** is allowed for obtaining Completion / Occupancy Certificate from statutory authorities and Green Building Rating Certificate.
5	19.1	**Liquidated Damages for Delay**	0.5% of the contract sum per week, maximum of 10% of the contract sum .
6	21	Period of final measurement/ assessment	60 (Sixty) days
7	22	Interim certificate	As per the stages of payment mentioned elsewhere in the tender
8	22	Period of honouring interim certificate	20 (Twenty) days
9	22	Period of honouring final certificate	90 days from the date of submission of final measurements/assessment with details.
10	35	a) Security Deposit and b)Performance Guarantee	**a) Rs: 20 Lakhs + 2.5% of accepted Tender Amount** **b)** Performance Guarantee of value **3% of Accepted Tender Amount** in form of Bank Guarantee .
11	35	Recovery of Security Deposit	In case of Cash option, the Security Deposit shall be recovered from R.A. Bills at 7.5% of Gross amount of bill **till the sum along with sum already deposited as**

			EMD equals the total security deposit. If the total amount of EMD is submitted in the form of Bank Guarantee and the contractor wants to avail the cash option i.e. the deduction of security deposit from the bills, then the contractor has to deposit a demand draft /pay order in the name of Life Insurance Corporation of India payable at Patna amounting to the total amount of EMD in lieu of Bank guarantee submitted towards EMD. Once this amount is deposited the contractor can avail cash option for security deposit and the bank guarantee submitted towards EMD shall be returned.
11 a	35.10	Release of Performance guarantee :	Bank Guarantees towards Performance Guarantees shall be released after the virtual completion is issued.
12	37	Interest on Lump sum Advance	*10.00 %* p.a. Simple Rate of Interest.
13	17.5	Contractor's All Risk Policy inclusive of Third Party Liability	*The Contractor's All Risk Policy will be for the full Contract Value and Third Party liability will be 7.50% of the contract value*
14	17.6	Workmen's Compensation Policy	As per mutual agreement.
15	17.9	Recovery for non Extension of Insurance Policies (Workman's Compensation and Contractor's All Risk Policy inclusive of Third Party Liability)	*Date for submitting the renewed Insurance policy if any will be 15 working days before the last date of the existing policy , failing which LICI may insure/ renew insurance and apply penal cost on the Contractor* i.e. **Premium Charges + Rs. 10,000/- as Admin Charges + Rs: 25000/- as penalty plus GST.**
16	27	Defects Liability Period	**24 Months**
17	Annexure –R & T	Guarantee for Waterproofing and Anti-termite treatment	The guarantee of **ten years** shall be given for waterproofing treatment starting from the date of Virtual Completion of the work. The guarantee of **five years** shall be given for anti termite treatment starting from the date of Virtual Completion of the work
18	22.6	No Claim Certificate	To be given on Contractor's letter head

Note: **TAXES, DUTIES, LEVIES AND DEDUCTION AT SOURCE:**

- The Contractors Quoted rates shall be exclusive of GST on Works Contract. The GST on Works Contract shall be paid to the Contractor as per Notifications of Govt. Of India with applicable TDS.
- Penalty on account of non renewal of Insurance , Compensation in the form of Penalty if imposed will attract GST if any at applicable rates during contract period.
-

ANNEXURE I

CONTRACTOR'S SUPERVISION & MINIMUM REQUIREMENT OF TECHNICAL STAFF

Sr no.	Designation	Nos	Qualification	Experience	Amount for Recovery for non Employment.
1.	Engineer-in-Charge	1 No	BE/B. Tech (Civil)	Min. 3 years in all sorts of Construction Activities	Rs. 40000 per month.
2.	Civil Engineers	2 Nos	BE/B. Tech (Civil)	Min. 1 years in Building Construction work	Rs. 30000 per month
3.	Electrical Engineers	2 Nos	BE/B. Tech (Electrical)	Min. 1 years in Building Construction work	Rs. 30000 per month
4.	Site Supervisors	Adequate Nos	Diploma (Civil/Elect./Mech) Or ITI Trade certificate.	Min. 3 years experience for Diploma Holders and Min 5 years for ITI Trade Certificate.	Rs. 20000 per month.

Note :

1) All the Engineers shall be available at Site on the day when physical work is commenced at site but not later than one month from the date of commencement of work.

NO CLAIMS CERTIFICATE CUM RECEIPT

Received Rs._____ (Rupees_____) being the amount against my/our final bill dated _____ for_____ (Name of Work) in full and final settlement of bill.

Contractor

(Signature of Contractor on Revenue stamp)

Rubber stamp/seal of the contractor /company

CLARIFICATION ON EARNEST MONEY DEPOSIT

The authenticity of the Bank Guarantee submitted as EMD will be confirmed from the respective banks. In case the BG submitted by the contractor is not genuine the contractor will be barred from participating in the tender of the corporation for 3-5 years and the information will be shared with Govt. of India, Banks and other financial institutions, their previous/present employers etc.

REFUND OF EARNEST MONEY DEPOSIT

The EMD will be refunded to the unsuccessful bidders within 7 workings days (excluding gazette holidays, 2nd & 4th Saturday, Sundays and any other holiday declared in NI act) of opening of the price bid. The EMD for the successful bidder will be refunded after the authenticity of the BG for Security Deposit and Performance Guarantee is confirmed.

FOREITURE OF EARNEST MONEY DEPOSIT

1) If the lowest tender withdraws his tender before the expiry of validity period or before the issue of letter of acceptance whichever is earlier or makes any modification in the terms and conditions of tender which are not acceptable to department, then the department shall, without prejudice to any other right or remedy be at liberty to forfeit 25% of the earnest money and to refund the balance.

2) If the contractor fails to furnish the prescribed performance guarantee within the prescribed period or duly approved extended period, 50% earnest money will be absolutely forfeited automatically without any notice and the balance 50% will be refunded.

3) In case of forfeiture of earnest money as prescribed above, the tenderer shall not be allowed to participate in the tendering process of the work

APPENDIX TO GENERAL INSTRUCTIONS TO CONTRACTORS

SUB: E-Tender on Design, Engineering, Procurement and Construction (EPC) basis for Proposed Construction of Investment Building (Basement+Ground+2 floors) at Suryanagar, Bhubaneswar, Odisha

CLAUSE NO.14 :

In addition to facilities, provided by the contractor under clause 14.1 general conditions of contract, in Office for Corporation's Engineer on Site, the contractor shall also provide

(i) Two internet enabled computers with Auto CAD & MS Projects installed and printer of suitable configuration as approved and directed by Engineer In Charge .

(ii) Seating arrangement for 4 nos Officials of LIC of India and 1nos official of Project Management Consultant at site in Air-conditioned Office to be made

ANNEXURE – "R"

LIFE INSURANCE CORPORATION OF INDIA

FORM OF GUARANTEE FOR WATERPROOFING

(To be given by Waterproofing Contractor)

Name of the work : _____

Name of the Main contractor : _____

Name of Water Proofing Contractor

M/s. _____

_____

We M/s. _____

_____ hereby guarantee that the surfaces treated by us for waterproofing in the above work, for M/s. _____

the General builders Contractors for the above work, shall remain entirely watertight, Should, however, due to any unforeseen defect left out in the work carried out by us at the time of execution of the work, there be any leakage from any surface treated by us during the period of **ten years** from the date of virtual completion of work i.e. from _____ to _____ the same shall be rectified by us without any cost to the Life Insurance Corporation of India.

However, we shall not be responsible in any way if our work is tampered with or if the body of the structure is damaged due to sinking, cracking and/or by any other act of God.

The intimation received from LIC of India during Guarantee period shall be deemed to have been received from Main Builder's Contractor and inspection as well as necessary work shall be carried out and reported upon by us forthwith.

Signature of Waterproofing Contractor

Signature of the Main Builders' Contractor

ANNEXURE - "T

(PROFORMA OF GUARANTEE FOR ANTI-TERMITE TREATMENT)
(To be given on stamp paper of Rs. 10/-)

Name of the firm/Company & its address :-

To,

The L.I.C. of India,

Dear Sirs,

Sub:- Pest control – Pre construction anti termite treatment
Treatment – Guarantee regarding _____

We hereby certify that the foundation's and structure/s of the premises of the Life Insurance Corporation of India described in the schedule below, have been pre-treated by us against subterranean termite infestation in accordance with our procedure for pre-treatment set out in our letter/s No..... dated..... And in accordance with the terms and conditions under which the said works are carried out.

2. We hereby guarantee that the foundation/s structure/s of the said premises of the L.I.C. of India, shall be safe against subterranean or infestation for a period of 5 (FIVE) years from ..... To..... .

3. In the event of said structure/s and foundations of the premises of the L.I.C. of India being or becoming subject to subterranean termite attack or infestation at any time during the guaranteed period of 5 years, we agree to carry out as often as it becomes necessary, at our cost and expenses all and every treatment that may be necessary to render the said foundation/s and structure/s free from such subterranean termite attack or infestation.

3. The question whether the foundation/s and structure/s of the premises are or become subject to subterranean termite attack or infestation and whether any anti termiter is or has become necessary shall be decided by the L.I.C. of India and we agree that their decision in this regard shall be final and binding on us.

Yours faithfully,

Signature of specialized
Agency / firm with seal.

Signature of Bldg. Contractor who have done the Builder's work.

SPECIAL CONDITIONS OF CONTRACT

1.0 INTRODUCTION TO THE PROJECT:.

The present tender is for Proposed Construction of Investment Building (Basement+Ground+2 floors) at Suryanagar, Bhubaneswar, Odisha on Design, Engineering, Procurement and Construction (EPC) basis, as per the scope of work appended in the tender.

2. 0 The Special Conditions of Contract which include various deviations from "Conditions of Contract" and certain other Conditions particular to this Contract shall be read in conjunction with the "Conditions of Contract". Technical Specifications, Conditions particular to various works & specific scope of each work as specified together with Technical Specifications, Drawings etc.

3.0 The detailed Design Basis Report (DBR), Technical Specifications and layout plan Drawings are enclosed for location like Civil, Electrical, Plumbing. Fire. STP (under ground), External Development, Landscape, Street Lighting, Lifts etc. are attached to the tender documents, The same also includes specific scope of each work &conditions particular to the work. Drawings attached are indicative only. The lowest bidder (Contractor) is required to improve upon these drawings based on stipulation of NBC, Fire Authority, MOEF guidelines and any other Authority whose stipulations have bearing on the Project.

Being the EPC tender, bidder is advised to work out the detailing as per requirement given in tender documents and considering the same along with the relevant IS codes, NBC-2016, MOEF guidelines, CPHEEO Manual and latest technology etc.

The bidders, before quoting the tender are deemed to have studied the Design Basis Report, concept drawings, Technical specifications and scope of work. The contractor shall submit their detailed estimate along with rates along with vetted drawings, the details of which are mentioned elsewhere in the tender. No claim on account of any discrepancies, changes in nomenclature. variation. addition, alteration, modification, left over items etc. in Indicative items given in the tender, and submitted by the contractor, and as actually executed at site, shall be admissible. The contractor is required to execute all the works/items and quantities as per Scope of work, Design basis reports (DBR). Technical Specifications, Drawings etc. and to quote their amount/financial bid accordingly. In case of contravention of stipulation of this clause from any other clause/provision elsewhere in the tender document, then this clause shall have superseding effect to the extent of contravention and decision of Engineer-in-charge shall be final & binding on the contractor.

4.0 The Comprehensive 'Design Basis/Brief Report' shall be taken into consideration bythe bidders in their Design obligations. The Design Basis Reports are the minimum standards that the construction agency has to fully comply with, as per provisions of the contract.

5.0 The contractor is required to complete the project on Design &Build basis as specified in the Scope of Work, Technical Specification & Drawings covering the entire site area as given in Drawing submitted for Municipal approvaland contractor has to prepare the all internal/external services and the contractor's quoted Lump Sum tender amount is deemed to include everything from the award of work up to & including handing over of completed project, defect liability period.

However, the contractor is required to complete works for all services including further connections upto authority manhole/outlet point like Water Supply, Sewerage. Drainage, Electric Supply, Telephone Lines etc. After connection by external development agency the contractor shall have to arrange his own testing commissioning of complete project as necessary. All municipal & mandatory approvals required for occupation and completion of the project shall be obtained by the Contractor.

Soil Investigation has been carried out by LIC of India. Soil Report is uploaded along with Bid Document. The Successful Bidder has to take said soil report for consideration of structural design. However if the Contractor desires, then they can carry out fresh Soil Investigation at his own cost with permission from LIC and approval of the testing agency, but the structural design should be based on the more stringent values of the two tests.

a) All the design & drawings will become the property of LICI. The drawing cannot be issued to any other person, firm or authority or used by the contractor for any other project. No copies of any drawing or document shall be issued to anyone except LICI and authorized representative of LICI.

6.0 It shall be deemed that the contractor has satisfied himself as to the nature andlocation of the work. general and local conditions and particularly those pertaining to transport including restriction of movement of traffic/ vehicles etc.handling, availability and storage of materials. availability of labour, weather conditions at site and general ground/sub soil conditions and the contractor has to quote his rates accordingly and nothing extra shall be payable on any reason whatsoever.

7.0 LICIwill bear no responsibility for the lack of such knowledge and also the consequences thereof to the contractor. The information and site data shown in the drawings and mentioned in the tenderdocuments are furnished for general information and guidance only. In no case LICI shall be heldresponsible for the accuracy thereof or/and deductions, interpretations or conclusions drawn there from by the contractor and no claim shall be entertained whatsoever on this account, if the siteconditions/information is different or otherwise incorrect. It will be presumed that the contractor has satisfied himself for all possible contingencies, situations, bottlenecks and acts of coordination which may be required between the different agencies.

8.0 The contractor is required to submit all its submittals like Drawings, Documents,Reports, Schedules, invoice copies, etc. (whether original or revised) in 5 (Five) Hard & soft (CD/DVD/Pen Drive) copies. This clause applies to every submittal of contractor under this contract.

9.0 SITE INVESTIGATION

9.1 LIC of India has carried out the Soil Investigation at the above site. The report is uploaded with Bid Documents for necessary reference.

9.2 After award of work, the Contractor shall carryout detail survey for preparation of detail designs as per the scope of work and technical specification. The Contractor (Bidder) shall be deemed to have inspected and examined the Site, its surroundings, collected the data and all other information, and to have been satisfied before submitting the Tender as to all relevant matters, including (without limitation) :-

i. The form and nature of the Site.

ii. The climatic conditions.

iii. The extent and nature of the work and Goods necessary for the execution and completion of the Works and the remedying of any defects,

iv. The Laws, procedures and labour practices of the City, and

v. The Contractor's requirements for access, accommodation, facilities,personnel, power, transport, water and other services.

vi. Availability of required materials

9.3 The contractor shall however, ascertain the contour levels, location of proposed boundaries, any other site feature present at site for which he may get conducted fresh topographical survey done at his own cost. The contractor shall be held fully accountable for accuracy of levels/design, positions of buildings/ facilities etc. on account of details obtained from Topographical survey.

9.4 During the course of excavation, foundation of old building may be encountered which has also to be taken out and considered in the rate quoted.

9.5 If LIC is in a position to give electricity connection for construction purpose, the Contractor may avail of the same. Similarly the Contractor may be allowed to use water from any sources available with LIC. In that case electricity and water charges may be deducted @ 0.25% for each of electricity and water on the Value of work done.

10.0 COMPLIANCE WITH STATUTES, REGULATIONS AND LAWS

The Contractor shall familiarize themselves and conform in all aspects with:-

(a) The provisions, their legal interpretation in respect of any enactment and relevant judicial /administrative /quasi-judicial orders in India, particularly that of Patna as is and/or may become, applicable from time to time, related to or having impact on any aspect affecting the works

(b) The regulations or bye-laws of any local body and utilities.

(c) The Contractor shall be bound to give all notices required by statute, regulations or by-laws, as aforesaid and to pay all fees and bills payable in respect thereof. The Contractorwill arrange necessary clearances and approvals before the Work is taken up.

(d) Ignorance of Rules, Regulations and Bylaws shall not constitute a basis for any claim at any stage of work.

(e) The Contractor shall indemnify the LICI against all penalties and liabilities of every kind of breach of any such enactment, laws, regulations, bye-laws or rules.

11.0 PROGRAMME.

It is envisaged to complete the entire Development work as per the Scope of Work, Drawings, design Basis Reports, Technical Specifications as per details given hereunder:

A) Execution Works to be taken up:

Sl no	Nature of work	Particulars	Remarks
1	Tree Cutting	Obtaining Tree Cutting permission and cutting of trees coming in the Construction area including transplantation of trees and compensatory Plantations.	
2	Construction of New Buildings with all Services to make the Buildings Habitable.	Construction of proposed Investment Building i.e. (One Basement+Ground Floor+ 2 nos. upper floors)	Concept Drawings attached
3.	Services	STP Plant (under ground) shown in the layout plan, Sewarage Connection	Liaison with Electric Supply Authority if new Transformer is needed at this stage,
		RCC UGT and Municipal Water main & Water connections	
		Construction of proposed Road .	
		Electrical Service Connections	
4.	Approvals other works	(i) Obtaining Building Commencement Certificate/ Building Completion /Occupation Certificate and other approvals / permissions viz Lift Inspector, Electrical Inspector, Fire Deptt proceeding and required for Building Completion / Occupation Certificate.	
		(ii) Green Building Certification	
		(iii) Plantation of new trees as per Municipal requirements	
5.	Borewell	Both as per tender Scope of Work and also for use during construction purpose	Taking permission from the concerned Ground Water Board authority

12.0 Various Approvals from statutory Authority(s):

The Contractor is responsible for obtaining all necessary approvals from the Statutory Authorities, required for construction of the Buildings including obtaining Building Completion Certificates/ Building Occupation Certificates and Overall Layout Completion Certificate. The indicative of approvals required for completion of the work in totality is given as under;

12.01 Tree cutting permission from tree authority if requires.

12.02 Obtaining permission, Commencement Certificates for the Buildings, BuildingOccupation Certificate Certificate.

12.03 Co-ordination with Ground Water Board for borewell

12.04 Obtaining final remarks, compliance certificates from all the concerned departments / authorities necessary for obtaining Building Completion / Occupation Certificate.

12.05 Obtaining final Layout approval / Building Completion Certificates & Occupation Certificates of all the proposed Buildings.

12.06 Obtaining Green Building Certification for at least rating of 3 Star/ Silver from GRIHA/ IGBC.

13.0 REQUIREMENT OF WATER , POWER AND SPACE FOR CONSTRUCTION ACTIVITIES

The Contractor is required to obtain electrical power connection for construction purpose ,but with an objective to obtain permanent Electrical connection requirement for premises on completion. The Electrical load has to be calculated judiciously so that it becomes adequate to satisfy full fledged requirements for all the facilities provided in the project in addition to the lighting requirements with required LUX. Similarly the contractor shall make arrangements of water suitable for construction purposes as per the stipulation of IS codes. If any water source is available within the construction area and under the legal possession of LIC of India the contractor may use that source as an additional ,provided the contractor gets satisfied regarding quality of water required for construction purpose. Simultaneously action will be initiated to obtain permanent water connection from local authority , safe for drinking purpose.

The contractor has to make own arrangements to preserve the excavated earth from construction site and specific approval should be obtained from Corporation Engineer before the disposal of the same. **The topsoil should be preserved and brought back to the premises for use of filling of surrounding area around the building for landscaping purpose.** Similarly earth required for backfilling shall be augmented from the excavated earth so preserved provided it is found suitable by Corporation Engineer. The soil having high liquid limit shall not be used for back filling. The surplus Earth after carrying out backfilling and landscaping work shall be disposed off by the contractor in authorized dumping yard as identified by Local Authority, taking all permission from local authority.

The contractor shall make standby arrangements for water and electricity to ensure uninterrupted supply, with permission from the concerned authorities.

14.0 PERMANENT POWER , WATER, SEWAGE CONNECTION and SOLID WASTE COLLECTION SYSTEM

In addition to obtaining permanent water and power connection for the building the contractor is required to obtain sewage connection by following the rules and regulations of appropriate authorities.

15.0 DOCUMENTS TO BE SUBMITTED BY THE CONTRACTOR AFTER AWARD OF WORK

The Contractor is required to submit the following within Six months time period from date of award of work.

i. The necessary soil report is uploaded with Bid Documents for reference of Contractors. The Structural design has to be carried out as per Soil investigation report attached to Bid Documents. However the Contractor can get the Soil investigation done afresh, but the most stringent value of the reports has to be taken for structural design.

ii. Detailed structural design and working drawings duly vetted by Government Engineering Colleges like IIT Bhubaneswar, NIT Bhubaneswar or any other as approved.

iii. The Contractor has to prepare the Architectural drawings and submit it for Municipal Approval after obtaining all required NOCs. Contractor has to prepare the, details shop drawings of Doors, Window, , Toilets, Electrical Installations, Fire Fighting, Sanitary & Plumbing, External services, Landscape & Horticulture etc. The Contractor need to verify these drawings with relevant BIS Codes / NBC-2016 , Design Basis report, Technical Specifications and submit to LICI Good For Construction Drawings/ Shop Drawings for manufacture/ Fabrications drawings to LICI for approval. The Contractor to get vetted the Structural & MEP, Façade, HVAC, Fire Fighting ,HT substation ,LT installation, drawing vetted by Government engineering Colleges like IIT , NIT or reputed Govt Engineering College at Bhubaneswar.

iv. Working drawings for works as mentioned above:

The drawing shall be detailed , self explanatory with proper legends and good enough to calculate the quantities of items to be executed for construction and successful completion of the project

v. Detailed price schedule of quantities supported by self explanatory estimate is to be prepared based on working drawings vetted by Government engineering Colleges like IIT Bhubaneswar, NIT Bhubaneswar etc.

If called upon by the employer , the contractor , is required to submit further calculations and clarification to make the Estimate clear and comprehensive . The rate of items shall be taken from the latest published CPWD DSR with appropriate cost index wherever applicable. For those items where CPWD DSR rates are not available the contractor is required to submit rate analysis based on market rates for material and labour.The item description of various works shall be in terms CPWD DSR latest edition. For items not covered in CPWD DSR latest edition, the contractors shall provide standard item description as prevalent in the industry. Since it is an EPC contract, "**the amount quoted**"by the contractor shall remain firm in the currency of the contract to complete the project in all respect and make the systems installed functional and make good any defects during defect liability period of two years. No claim on account of any discrepancies, change in nomenclature, variation, addition, alteration, modification and left over items in priced schedule of quantities submitted by the contractor shall be entertained. The priced schedule of quantities based on all the vetted working drawings submitted by the contractor shall have following purpose as far as this contract is concerned ;

a. To ascertain approximately items of works involved in this work and its sequence of execution

b. To ascertain and derive the rate of any devalued work(refer Clause no 15 of conditions of contract)

c. Stages of payment have been stipulated in the tender. It has been envisaged, if required to modify and revise the based on the stages of payment priced schedule of quantities submitted by the contractor. However this shall be carried out based on mutual agreement.

d. LIC of India shall make interim payment to the contractor as certified by the LIC's Engineer-In- Charge as specified and valued in accordance with the proportion of the total contract price assigned to each item and its stages in schedule of payment. The entire scope of work is divided into major cost centers. Each major cost center contains group of activities /items of work. The basis of part payment on pro rata basis will also be allowed and shall be worked out on the percentage of work done of total scope of work of activity/item for respective cost centre in consultation with Corporation Engineer. Documentary evidence in this regard shall also be enclosed along with performa invoice.

The weightage of major cost center with respect to accepted contract amount as given in payment schedule shall be verified based on detailed price schedule of quantities submitted by the contractor and the weightage assigned to major cost centre with respect to accepted contract amount shall be reviewed and modified with mutual agreement.

16.0 ADJUSTMENT IN PRICES OF MATERIALS AND LABOUR :

16.1 ADJUSTMENT OF MATERIALS

For the purpose of adjustment in price of materials the component shall be 60% of the value of work done up to a given stage. This shall be worked out as per the following formula

$$V_m = \{ 60/100 (R_n - R_{n-1}) - B_p - M_{n-1} + M_n \} \times (W - W_0) / W_0$$

Where,

V_m= Variation in price for materials i.e. increase or decrease in the amount in rupees to be paid or recovered.

R_n = Total value of work done (excluding advance on materials at site upto the period under reckoning) on the basis of weightages assigned for various activities / items as given in Payment Schedule with respect to accepted contract amount. The deviated items worked out fully on the basis of rates prevailing at the time of last date of receipt of tender to be included.

R_{n-1}= Total value of work done (excluding advance on materials at site) considered in the bill prior to the period under reckoning. The deviated items and such other items shall be considered as per Rn above.

M_n = Advance being allowed in the bill under consideration against materials at site

M_{n-1} = Advance allowed in the bill prior to the period under scrutiny against materials at site

B_p = Sum of Amounts calculated by multiplying the Executed Quantities of all items whose Basic Price have been mentioned in tender with the respective Basic Prices.

W_0 = All India Wholesale Price Index for all commodities (Base = 100; Year 2004-05) as prevailing on the last day for submission of tender (including extended date, if any).

W = Average All India Wholesale Price Index for all commodities (Base = 100; year 2004-2005) as published in the RBI Bulletin for the period of the bill under consideration viz. from the date

of previous bill (date of commencement in case of first bill) to date of current bill (date of virtual completion in case of final bill or any earlier cut off date as fixed).

16.2 ADJUSTMENT OF LABOUR :

The contractor shall pay wages to the skilled and unskilled labour not less than the rates prescribed under the minimum wages act. Variation in prices of labour shall be worked out by applying the following formula and necessary payment/ recovery made :

$$V_L = 25/100 \times (R_n - R_{n-1}) \times (I - I_0) / I_0$$

V_L =Variation in price for labour i.e. increase or decrease in the amount in rupees to be paid or recovered.

I =Average All India Consumer Price Index for Industrial Workers (base 100 year - 2001) declared by Labour Bureau, Govt. of India, as published in Reserve Bank of India Bulletin during the period under reckoning.

Average All India consumer Price Index for Industrial workers for the period of the bill under consideration viz. from date of previous bill (date of commencement in case of first bill) to date of current bill (date of virtual completion in case of final bill or any earlier cut off date as fixed)

I_0=All India Consumer Price Index for Industrial Workers (base 100 year- 2001) ruling on the last date of submission of tender (including extended date, if any)

R_n=As defined under 16.1 above

R_{n-1}=As defined under 16.1 above

16.3 If the last date for submission of tender / date of bill is between 1st to 15th of a particular month the relevant economic index (W, W_0, I, I_0) for the previous month is to be considered. However, if the last date of submission of tender/ date of bill is between 16thand end of month, the relevant economic index for the month shall be reckoned while calculating the material/labour price adjustment.

16.4 The total amount payable to the Contractor towards adjustment of prices of materials and adjustment of variation in wages of labour worked out as per Clause no 16.1 & 16.2 shall be restricted to 10 % of accepted contract amount. Further the total amount payable towards price adjustments at any point of time before settlement of Final Bill shall be restricted to 10% of the amount of work executed and valued as per details provided in Stages of Payment.

NOTE :

1) The adjustment in prices of Materials and Labour shall be considered / effected only when the Contractor submits authentic data for prevailing indices along with the RA/Final Bill. The Employer reserves the right to set aside certain amount from the Bill if the Contractor does not submit the authentic data of prevailing indices along with the bill.

2) For adjustment in prices of materials &labour the indices (WPI/CPI) published by RBI as mentioned above which are available as on the date of submission of final bill (final / provisional indices) will only be considered for settlement of final bill. No further review will be done, even if there are variations in indices (WPI/CPI) after the final bill is settled.

3) In case during the period of contract, the base years for publishing Economic Indices are changed as per statute, then the revised indices will be considered as per the published data available at the time of setting the bill/s.

4) The Following stipulations are applicable for both adjustment of material and labour:

a. When there is authorized extension after scheduled period of completion as specified in contract (Not stage wise completion) i.e. no imposition of compensation for delay in the form of penalty, price adjustment towards material &labour may be paid for the extended period with prevailing index during the extended period.

b. If the extension is granted with imposition of compensation for delay in the form of penalty, no adjustment towards material &labour shall be paid but recovery due to fall in index shall be effected

17.0 DEFINITION OF EXTRA ITEM

During the currency of contract, the Employer may ask the contractor to carry out certain works which is beyond the scope of work, Design basis report and detailed specification, it is contractually binding on part of the contractor to execute those extra works . However the contractor shall be paid for those extra items at rate as stipulated in Latest CPWD DSR with applicable cost index. For the additional works if rates are not available in DSR, it shall Be decided based on actual with 15% towards overheads & profit. The original material purchase invoice / bills should be submitted for arriving at the actual cost.

18.0 TESTING OF MATERIALS

1. During the progress of work contractor shall maintain Field Laboratory with all necessary equipment required for day to day field test like grading of sand , Cube testing , Silt content , thickness of materials and gauge of other materials etc including all equipmentsrequired for Day to day electrical works in a satisfactory manner till the completion of work. All other regular tests including requisite materials as per Table A below shall be carried out as directed at approved laboratory.

2. During the progress of work, tests as prescribed below for various materials of construction shall be conducted as per the frequency noted in the table below. **Contractor's attention is also drawn to Clause 9 of Conditions of Contract**

3. No re-imbursement of testing Charges of any of the test shall be done to the Contractor. The Contractor to bear the cost of all the samples and testing charges including the cost involved in depositing the samples at approved Testing Laboratory, approved/ accredited by NABL.

Following charts to be followed for the frequency of tests:

Table -A

Material	Test	Field/ Laboratory test	Test procedure	Frequency of testing
Water	i) pH Value (ii) Limits of Acidity (iii) Limits of Alkality (iv) Percentage of solids (a) Chlorides (b) Suspended matter (c) Sulphates (d) Inorganic solids (e) Organic solids	Lab	IS 3025	Water from each source shall be got tested before the commencement of work and thereafter once in every three months till the completion of the work. Water from municipal source need be tested only once in six months. Number of Tests for each source shall be 3
Cement	a) Physical requirement (i) Fineness (ii) Soundness (iii) Setting time (Initial & Final) (iv) Compressive strength (v) Consistency of standard cement paste	lab	IS 4031 (part I to VI)	Every 50 tonnes or part thereof. Each brand of cement brought to site shall be tested as per this frequency.
Sand	Organic impurities.	Field	As per Relevant IS code	Every 20 cum or part thereof or more frequently as decided by Engineer-in-Charge.
	Silt Content	Field	As per Relevant IS code	Every 20 cum or part thereof or more frequently as decided by Engineer-in-Charge.
	Particle size distribution a, b, c, d & e	Field or Laboratory as decided by the Engineer-	As per Relevant IS code	40 cum or part thereof

		Incharge		
	Bulking of Sand	Field	As per Relevant IS code	Every 20 cum or part thereof or more frequently as decided by Engineer-in-Charge.
~~Fly ash~~	~~Total chloride in percent by mass, max.~~	~~Lab~~	~~IS 12423~~	~~Every 10 cum or part thereof or more~~
	~~Loss of ignition in percent by mass, max.~~	~~Lab~~	~~IS 1727~~	~~Frequency as decided by Engineer-in-charge~~
	~~Fineness, specific surface in m2/kg~~	~~Lab /field~~	~~Blaine's permeability method~~	~~Frequency as decided by Engineer-in-charge~~
	~~Compressive strength at 28 days in N/mm2, Min.~~	~~Lab~~		~~Only in cases when fly ash is used as pozzolana in cement~~
Stone aggregate	(a) Percentage of soft or deleterious material	Field or Laboratory Test as required	IS 2386	For all quantities
	Particle size	Field/ Lab	IS 2386	For every 45 cum or part thereof for RCC Work only. For rest of items as decided by Engineer-in-charge
	a) Estimation of organic impurities	Field/ Lab	IS 2386	For every 40 cum or part thereof
	(b) Surface moisture	Field/ Lab	IS 2386	For every 40 cum or part thereof
	(c) Determination of 10% fine value	Field/ Lab	IS 2386	For every 40 cum or part thereof
	(d) Specific gravity	Field/ Lab	IS 2386	For every 40 cum or part thereof
	(e) Bulk density	Field/ Lab	IS 2386	For every 40 cum or part thereof

	(f) Aggregate crusing strength	Field/ Lab	IS 2386	For every 40 cum or part thereof
	Aggregate impact value	Field/ Lab	IS 2386	For every 40 cum or part thereof
Concrete	Slump test	Field	As per Relevant IS code	15 cum or part thereof
Reinforced cement concrete (Nominal Mix)	Slump test	Field/ Lab	As per Relevant IS code	(i) every 5 cum or part thereof in case of column (ii) Every 20 cum or part thereof for slabs, beams and connected columns (iii) Every 20 cum or part thereof for other R.C.C. work for all other small items and where R.C.C. done in a day is less than 5 cum test may be carried out as required by Engineer-in-Charge
	Cube Test	Lab	As per Relevant IS code	(i) every 5 cum or part thereof in case of column (ii) Every 20 cum or part thereof for slabs, beams and connected columns (iii) Every 20 cum or part thereof for other R.C.C. work for all other small items and where R.C.C. done in a day is less than 5 cum test may be carried out as required by Engineer-in-Charge
Reinforced Cement Concrete (Design Mix)	Coarse Aggregates		As per Relevant IS code	50 cum or part thereof & also on each change of source
	Fine Aggregates		As per Relevant IS code	50 cum or part thereof & also on each change of source
	Cement		As per	50 cum or part thereof & also

			Relevant IS code	on each change of source
	Slump test	Field	As per Relevant IS code	50 cum for R.C.C. work including in all other small location. R.C.C. done in a day is less than 50 cum test may be carried out as required by Engineer-in-Charge
	Cube Test	Field/ Lab	As per Relevant IS code	50 cum for R.C.C. work including in all other small location. R.C.C. done in a day is less than 50 cum test may be carried out as required by Engineer-in-Charge
Reinforced Cement Concrete (Ready Mix)	Coarse Aggregates		As per Relevant IS code	50 cum or part thereof & also on each change of source
	Fine Aggregates		As per Relevant IS code	50 cum or part thereof & also on each change of source
	Cement		As per Relevant IS code	50 cum or part thereof & also on each change of source
	Slump test	Field	As per Relevant IS code	50 cum for R.C.C. work including in all other small location. R.C.C. done in a day is less than 50 cum test may be carried out as required by Engineer-in-Charge
	Cube Test	Field/ Lab	As per Relevant IS code	50 cum for R.C.C. work including in all other small location. R.C.C. done in a day is less than 50 cum test may be carried out as required by Engineer-in-Charge

Reinforcement steel	a)Tensile strength b) Ultimate tensile stress c) Yield stress % Elongation	Field/ Lab	As per Relevant IS code	One test per category for every consignment used in work.
Stone / Granite/	Moisture absorption	Lab	IS 1124	100 sqm of part thereof
	Specific gravity	Lab	IS 1122	100 sqm of part thereof
marble	Moisture absorption	Lab	IS 1124	100 sqm of part thereof
	Specific gravity	Lab	IS 1122	100 sqm of part thereof
	Hardness test	Lab	MHO's scale	100 sqm of part thereof
Timber	Moisture content	Field (by moisture meter) laboratory test as required by Engineer-in- Charge	As per Relevant IS code	Every one cum or part thereof.
Flush door	End immersion Test knife test Adhesion Test	Laboratory	IS 2202	One in hundred and every part there of
Steel	(a) Tensile strength (b) Bend test	Laboratory	IS 1599	Every 20 tonne or part thereof.
Steel tubular pipes	a) Tensile Test (b) Bend Test (c) Flattening	Laboratory	IS 1608 IS 2329 IS 2328	Every 8 tonne or part thereof
Ceramic Tiles / Vitrified Tiles	Water absorption Crazing Test	Laboratory	As per Relevant IS code	One test for every 10,000 nos. or part thereof.

Any other test required for other materials to be conducted as directed.

A. Construction phase

a. Facility of labourers during construction

i. Provision of drinking water, waste water disposal and solid waste management should be ensured for labour camps. Water usage during construction should be optimized to avoid any wastage

ii. Proper sanitation facilities should be provided for construction workers to endure environmental sanitation. Sewage generated from the areas occupied by the construction labourers have to directed into the existing sewage drain of the area. In case of non availability of the sewer system, an on site treatment system has to be provided.

iii. Health and safety of the workers should be ensured during construction. Personnel protective equipment like helmets, earmuffs earplugs etc should be provided to the workers. For vibration control damped tools must be used and the number of hours that a worker uses must be limited.

b. Steps to avoid disturbance during construction

i. All the topsoil excavated during construction activities should be stored for use in horticulture/landscape development within the project site. Adequate erosion and sediment control measures to be adopted before ensuring construction activities

ii. Prior permission should be obtained from competent authority for demolition of the existing structure, if any.

iii. Disposal of muck including excavated material and demolition debris during construction phase should not create any adverse effects on the neighboring communities and disposed of taking the necessary precautions for general safety and health aspects

iv. Diesel generators sets during construction phase should have acoustic enclosures and should conform to E(P) rules prescribed for air and noise emission standards

v. Vehicles/equipment deployed during construction should be in good condition and should conform to applicable air and noise emission standards and should be operated only during non peak hours

vi. Ambient noise levels should conform to residential standards both during day and night. Only limited necessary construction should be done during nighttime. Fortnightly monitoring of ambient air quality (SPM, SO2 and NOX) and equivalent noise levels should be ensured during construction phase.

vii. Construction spoils including bentonite, bituminous material and other hazardous material including oil from construction equipment must not be allowed to contaminate watercourses and the dumpsites for such material must be secured so that they should not leach into ground water. If necessary, oil trap should be installed where there is deployment of heavy machineries

viii. Regular supervision of the above and other measures should be in place all through the construction phase so as to avoid disturbance to the surroundings.

ix. The contractor must ensure that no driven piles shall be proposed for this project.

x. 15 m screen and adequate sprinkler arrangement shall be provided .Care should be taken to keep all material storages covered and contained so that they are not exposed to wind.

xi. Loading and unloading operations should not be carried out in open areas

xii. Use of ready-mix concrete is recommended in this project.

xiii. Adequate mitigation measures should be adopted to control dust emission, noise and vibrations from construction activities. Vehicles and construction machineries should be properly maintained. Vehicle should conform to PUC norms.

xiv. Locally available material with less transportation cost should be used preferably But the material should meet standard of materials mentioned in the tender.

xv. Promotion of use of cleaner fuel quality improvement should be done. Excessive energy consumption and fuel usage should be avoided.

xvi. Accumulation /stagnation of water should be avoided to ensure vector control.

c. **Selection of material for better energy efficiency**

i. Use of energy efficient construction materials should be ensured to achieve the desired thermal comfort.

ii. Design layout should ensure adequate solar access and ventilation.

iii. Construction technologies that require less material and possess high strength should be adopted.Material with low embodied energy and high strength should be used preferably.

iv. Use of alternate building materials and alternate construction techniques should be considered apart from conventional materials and methods. Use of hollow unit masonry should be considered.

v. Use of energy efficient lighting systems should be promoted. Solar energy should be used for power savings, Solar PVmodule will be provided in the roof of the building.

vi. Proper insulation of roof should be provided to achieve desired thermal comfort. Use of light coloured , reflective roofs having an SRI of 50% or more should be incorporated.

vii. Use of high reflective pavements to keep parking lots, pavements and inside roads cool should be incorporated.

viii. Guidelines to the occupants should include usage efficiently measures such as energy efficient lighting and water efficient system

ix. Reduce hard paving onsite and/or provide shade on hard paved surfaces to minimize heat island effect and imperviousness of the site

d. **Plantation proposal**

i. No trees can be felled without prior permission from the Tree Cutting Authority.

ii. The Contractor should plant at least the minimum of trees as NOC of Tree authority. The landscape planning should include plantation of native species. The species with heavy foliage broad leaves and wide canopy cover are desirable. Water intensive and /or invasive species should not be used for landscaping

e. **Water supply**

Water requirement during construction phase shall be met from municipal supply. Arsenic free water supply should be ensured. Ground water should not be abstracted without prior permission of the Statutory Authority as per norms of State Govt/ Local Authority if any.

f. **Sewage treatment plant**

Waste water shall be treated in STP.

g. **Storm water management & Mitigation of heat island effect**

i. Adequate storm water drainage network to be designed for the project without disturbing the surrounding settlements. Storm water management plan should be implemented so as to prevent sudden discharge of excessive volumes of storm water to receive waters thrust by reducing the shock load on the drainage system and impact on receiving water body

h. Rainwater harvesting scheme

i. The Contractor must follow the rainwater harvesting guidelines of Local Authorities.

ii. The contractor must collect rainwater from rooftop catchments and reuse for various purposes after necessary cleaning. Water bodies should be created and used for storing rainwater. Adequate retention time and storage provisions should be provided for harvesting rainwater .

iii. Adequate water storage for firefighting should be provided as per norms.

i. Municipal solid waste management

Adequate provisions shall be made for storage of solid waste and adequate means of access shall be provided. Provision for Onsite MSW storage facility for minimum 2 days shall be provided.

j. Transport management

i. Both internal and external traffic planning and management should be adequate to ensure uninterrupted traffic movement in the area during construction as well as operation phase

ii. The design of service road and the entry and exit from the project area should conform to the norms and standard of Competent Authority for traffic management. Bell mouth type arrangement should be made at the entry &exit . Proper traffic management plan should be adopted in consultation with traffic authorities.

k. Others:

i. All mandatory approval and permissions are required from Director of Explosives, Fire department etc should be obtained.

ii. Efficient management of indoor air quality must be ensured for health and safety of the users

iii. Adequate measures to be adopted for water conservation , during construction and operation stage.

iv. Provisions should be kept for the integration of solar water heating system

v. Adequate access/ movement to fire tenders should be provided

vi. Facility with automatic alarm should be provided at basement car parking if any.
vii. Durability of structure and protective methods in contact with the land fill should be considered
viii. On site verification for methane should be done before initial stages of construction

B. Operation phase

a. Water supply

i. Water requirement during construction phase shall be met from municipal supply. Arsenic free water supply should be ensured. Ground water should not be abstracted without prior permission of the competent authority.

ii. Use of water conforming to ISO standards should be installed at the inlet point of water uptake to monitor the daily water consumption . Use of water efficient devices/fixtures and appliances should be promoted. Installation of dual flushing system should be considered to conserve water

b. Sewage treatment plant

i. Waste water shall be treated in STP. Treated waste water shall be fully reused for landscaping, car washing etc. The Contractor should ensure Zero discharge of treated sewage.

c. Emission from diesel Generator set:

i. Noise barriers will be provided at appropriate locations so as to ensure that the noise levels do not exceed the prescribed standards. Diesel generator sets should be provided with integral acoustic enclosure at the manufacturing stage itself as per CPCB norms

ii. Stack heights and emissions from DG sets should conform to the norms of Central Pollution control board. The certification of space design for DG sets should be done by competent Authority

d. Ensure Energy Efficiency

i. Use of energy efficient construction material to achieve the desired thermal comfort should be incorporated. The desired level of R and U factors must be achieved. U factors for the top roof should not exceed 0.4 watt/sqm/degree Centigrade with appropriate modification of specification and building technologies . The provision of NBC latest revision should be strictly followed.

ii. Use of energy efficient electrical systems should be promoted. High efficiency should be used

iii. Energy efficient motors and properly rated transformers should be installed. Manufacturer's certificate to this effect shall be obtained and kept on record. Backup power supply shall be based on cleaner fuel.

iv. The power cabling shall be adequately sized as to maintain the distribution losses not to exceed 1% of the total power usage. Record of transmission losses shall be maintained. The Contractor shall install permanent electrical metering to record demand (kVA), energy(kWh) and total power factor

v. Solar energy should be used at least for water heating

e. Others

i. The implementation of Environment management plan should be carried out, as proposed. Regular monitoring should be carried out during construction and operation phases.

ii. The contractor should provide guidelines to the users to ensure conservation of energy and water. In house Environmental awareness campaigns should be carried out at regular intervals to ensure environmental protection

iii. Fire fighting systems should be designed in compliance with the MCGM and NBC norms. Preventive measures should be adopted for risk & disaster management as per the provisions of the national building Code latest revision

iv. Environmental management Information system shall be maintained properly.

v. The contractor should restrict the use of glazed surface as per national building code , latest revision.

C. General Conditions

i. All the labourers to be engaged for construction works should be screened for health and adequately treated before issue of work permits . The labour Act of Cental/ State Govt. has to be followed for engaging labours at site.

ii. All other statutory clearances such as the approvals for storage of diesel from Chief controller of explosives, civil aviation dept. (if required etc) shall be obtained by Contractor from the Competent Authorities.

21.0 COMPLETION AND TAKING OVER CERTIFICATE:

i) Work shall not be taken over by Engineer/LICI unless complete work orsection(s) as applicable are completed in all respect and all defects pointed out by Engineer are attended by the contractor to the satisfaction of Engineer and site is cleared of all materials, plants and machinery not required aftercompletion of work, all rubbish, labour huts & all other temporary structures constructed by contractor for his use are removed from construction site.

ii) The Works shall be taken over by the Employer/LICI when they have been completed in accordance with the Contract, have passed the Tests on Completion,including Integrated Testing and Commissioning where ever applicable as per the contract, and a Taking Over Certificate shall be issued. If the Works are divided into Sections. the Contractor shall be entitled to apply for a Taking over Certificate for each Section. The Engineer will:-

(a) Issue the Taking Over Certificate to the Contractor, stating the date onwhich the Works or Section were completed, including the Tests on Completion and Integrated Testing and Commissioning where ever applicable as per the contract: or

(b) Reject the application, giving his reasons and specifying the workrequired to be done by the Contractor to enable the Taking over Certificate to be issued. The Contractor shall then complete such work before issuing a further notice under this Sub-Clause.

iii) As-Built Drawings and Documents

Prior to issue of any taking over certificate, the Contractor shall furnish to the Engineer a complete set of as-built Drawings, in 5 (Five) hard copies and in micro film form or in such other medium as may be acceptable to the Engineer, reflecting the Project as actually designed, engineered and constructed, including an as-built survey illustrating the layout of the Project and setback lines, if any, of the buildings and structures forming part ofProject Facilities. The work shall not be considered to be completed for the purpose of taking over until such documents have been submitted to the Engineer.

iv) The terms 'Completion Certificate', 'Certificate of Completion' and 'TakingOver Certificate' shall be treated as synonymous, however, to the exclusion of term 'Taking Over Certificate' used for individual sections/works/Installations as part of the contract.

22.0 Confidentiality

Both Parties shall treat the details of the Contract as private and confidential, except to the extent necessary to carry out obligations under it or to comply with applicable Laws, The Contractor shall not publish, permit to be published, or disclose any particulars of the Works in any trade or technical paper or elsewhere without the previous agreement of LICI.

23.0 Compliance of Laws

The contractor shall keep himself fully informed of all acts and laws of the Central and state govt. (i.e, Govt. of Odisha) all local bye laws, ordinances, rules and regulations and all orders and decree of bodies or, tribunals having any jurisdiction or authority which in any manner affect those engaged or employed on the work or which in anyway affect the conduct of the works. Contractor shall at all times. observe and comply with all such laws, ordinances. rules, regulations. orders and decrees, and shall give all notices and pay out of his own money any fees or charges to which he may be liable. He shall protect and indemnify LICI and its officers and employees against any claim or liability arising out of violations of any such law, ordinances. legislations, order or decree, whether by himself or by his employees &authorized representatives.

24.0 DISCLAIMER

The Contractor acknowledges that prior to the execution of this Agreement, the Contractor has, after a complete and careful examination, made an independent evaluation of the Request for Qualification, Request for Proposals, Scope of the Project, Specifications and Standards of design. construction and maintenance. Site, local conditions, physical qualities of ground, subsoil and geology, traffic volume & restrictions. suitability and availability of access routes to the Site and all information provided by the Employer or obtained procured or gathered otherwise, and has determined to its satisfaction the accuracy or otherwise thereof and the nature and extent of

difficulties, risks and hazards as are likely to arise or may be faced by it in the course of performance of its obligations hereunder. The Contractor confirms that it shall have no claim whatsoever against the LICI in regard the accuracy,adequacy. correctness, reliability and/or completeness of any assessment, assumptions, statement or information provided by it.

i) The Contractor acknowledges and hereby accepts the risk of inadequacy, mistake or error in or relating to any of the matters set forth elsewhere in the tender document and hereby acknowledges and agrees that the LICI shall not be liable for the same in any manner whatsoever to the Contractor, or any person claiming through or under any of them.
ii) The Parties agree that any mistake or error in or relating to any of the matters set forth elsewhere in tender document shall not vitiate this Agreement, or render it voidable.
iii) In the event that either Party becomes aware of any mistake or error relating to any of the matters set forth elsewhere in tender document, that Party shall immediately notify the other Party, specifying the mistake or error.
iv) Except as otherwise provided in this Agreement, all risks relating to the Project shall be borne by the Contractor; and the LICI shall not be liable in any manner for such risks or the consequences thereof.

25.0 SAFETY MEASURES

i) During the progress of work contractor shall ensure the following:

a. To ensure safe and hazard free working environment.

b. To achieve confidence by ensuring following safety performance for:

- Scaffolding (fixed and mobile) including ladders & platforms
- Electro-mechanical activities and controls
- Temporary power supply and tools
- Storage condition
- Fire prevention
- Waste/pollution control
- Monitoring and control of working on height
- Focusing in the most would-be hazard of high-rise construction: falling, slip, fire, electrical flashing of tower crane, hoist, lift, elevator, scaffolding etc.

ii) Contractor should strictly abiding and complying with local code and governmental regulations and stipulations.

iii) There should be NO COMPROMISE on safety .

iv) Contractor should Ensure workers work in compliance with protective devices, measures and procedures required by the act and regulations

v) Also, ensure that workers should use or wear all protective device or clothing required for safety.

vi) All employees (worker, site charges and others) will wear the Personnel Protection Equipment i.e. Hard hat, safety boots, gloves, hearing protection, respirator, eye protective safety glasses etc.

vii) Provisions of BIS SP 70: Handbook on Construction Safety Practices will be complied by the contractor.

26.0 SPECIALIZED WORK

For Water proofing, Anti-termite, Electrical Work, HT substation ,Lift, ELV, Façade, DG set, Fire fighting, Solar power plant, Solar Water Heating Systemetc, the approval of agencies is to be obtained from Chief Engineer before execution of the same. Also electrical works to be carried out through Class A licensed electrical Contractor of the same state where work is to be executed.

The warrantee/guarantee cards for the fixtures / fittings / equipments / machines etc provided by Manufacturers is to be submitted to LICI in original.

27.0 GST REGISTRATION

The Contractor should have valid GST registration.

28.0 Reduction in scope of work due to non approvals from Statutory Authority.

Architectural Drawings are prepared based on Bye-laws and considering the permitted Top level as per Bye-laws. It is presumed that the Statutory Authority will approve the drawings with Commercial Building (Basement + Ground + 2 Upper Floors) without any curtailment of proposed height(s)/ Floor(s) of the Building(s).

In case if the Statutory Authority does not permit to construct as per the Architectural Drawings, the scope of work shall be suitably modified. In such cases the Accepted Contract Amount shall be modified and it will be decided as per the detailed self explanatory estimates submitted by the Contractor .(Refer Clause no 16 (v) of “Special Conditions”

29.0Mobilizations of Labour, Materials, Equipments and Machinery etc:

The Contractor to make mobilization of Labour, Materials, Equipments and Machinery etc considering the above. No compensation of any kind shall be payable to the Contractor for idle of Labour, Materials, Equipments and Machinery etc.

30.0 Inspection of work by CTE/CVC/Auditors

Since the Project comes under the preview of CTE /CVC/Auditors, the inspection may be carried out by the team of CTE/CVC/Auditors. The Contractor has to provide all necessary support to facilitate the inspection and submit required documents and reports. The CTE may also ask testing of certain materials / works carried out, contractor has to arrange for the same. Any Observations conveyed by CTE/CVC/Auditors as regards quality of the materials/work executed, workmanship, deviation from Technical Specifications, Drawings and DBR etc shall be deemed to be the observations of LIC of India. The Compliances of the observations and any decisions given by the CTE /CVC/Auditors shall be binding on the Contractor. LICI may withheld some amount / or keep pending settlement of Final Bill of the Contractor if inspection of the work is carried out by the CTE /CVC/Auditors and the inspection report is pending or compliance of observations not done by the Contractor.

FOR ELECTRICAL WORK (SPECIAL CONDITIONS)

1. Electricity Load Sanction: The contractor shall submit required drawings and application and shall obtain Electrical load sanction from local Electricity Authority for which all official fees shall be paid/reimbursed by LIC of India.

2. All electrical works shall be carried out by the licensed electrical contractor having valid electrical license and as per IE rules, Regulations and Provisions of Government of India are applicable in this tender. Electrical installation should be get inspected by the electrical inspector before energisation as per statutory requirement of the state electricity boards rule.

3. Solar PV to be installed strictly as per DBR with net metering and necessary co-ordination with the local electric supply authority.

4. **TEST AFTER INSTALLATION OF LIFT :**

After the completion of the lift work and before the same put into operation, the test as follows shall be carried out by the Contractor :-

i. To determine Insulation Resistance between various wiring and the Earth.
ii. To determine Earth Continuity of Electrical Installation.
iii. To determine that the Motor Brake, Door Locking Devices etc.
iv. To determine that the Motor attains the rated speed at the rated load.
v. To determine that the speed gear stops the lift car while carrying the rated load.
vi. Two tests shall be carried out – one with contract load and the other with empty car with ropes attached and all electrical apparatus attached.
vii. Dead Load test shall be carried out by subjecting the equipment to the maximum dead load for half an hours. The equipment to the capable of retaining this load for the specific period with out signs of permanent distortion.

The entire test shall be carried out to the satisfaction of the Employer as well as the requirement of the statutory bodies, local bodies , Local Electric Supply authority, Lift Inspector if required & Fire prevention office in the state of odisha . All arrangements/Permission including test instruments shall be arranged by the Contractor and necessary clearance /test certificate should be obtained from the concerned authorities/ LIFT INSPECTOR and should be submitted .

Requisite inspection charges as required by the inspection authorities are to be deposited with the state treasury. This amount shall only be reimbursed on submission of the copy of the documents deposited in treasury challans.

5. **Contractor has to obtain NOC from the Fire Deptt/ Statutory body for no objection before the work and also after completion of the work relating to fire Fighting work .**

6. **For Electrical Sub- Stn work , the work should be carried out through license electrical contractor having valid HT license.**

31.0 DAY TO DAY SUPERVISION, QUALITY CHECK, MEASUREMENT OF WORKS AND MONITORING OF PROGRESS BY PROJECT MANAGEMENT CONSULTANT (PMC)

LIC of India may appoint Project Management Consultant (Hereinafter called PMC) for the said work. The representative of the appointed PMC shall be present at site on regular basis for supervision of works, quality check, measurement of works, project monitoring etc. and the Contractor shall work in tandem with the PMC for smooth and timely progress of work. Contractually the PMC shall be deemed to act on behalf of LIC of India.

Wherever in this tender it is written 'Employer's representative', it should be read as 'Employer's Representative / PMC'.

LIST OF PRINCIPAL MAKES / AGENCIES / BRANDS OF VARIOUS MATERIALS

1. Materials used in the work should be from the following list of principal makes/ brands. All brands appearing under each specific head shall be treated as being on “at par”. In case of non-availability of these makes/brands, Chief Engineer shall allow materials licensed by BIS bearing "ISI" monogram at par with principal makes.
2. For all other manufactured materials for which principal makes are not mentioned the materials allowed to be used in the work shall have BIS certification and samples for which are to be got approved prior to use of the same in the work.

3. For some materials BIS certification may not be available. In such cases the samples shall have to be got approved before using in the work.

S.No.	Material	Approved Make/ Brand
	FAÇADE WORK	
1	Aluminium	Jindal / Bhoruka / Global Aluminium
2	Reflective Glass	SaintGobain / Asahi / Guardian / Pilkington
3	Clear Float Glass	SaintGobain / Guardian
4	Glass Processing	SaintGobain / GlassTech / FG / Fuso / Asahi / GSC / SYP / CSG / Mahavir Glass
5	PVB Lamination	Dupont Kurarray / Solutia
6	SGP Lamination	Dupont Kurarray / Solutia
7	Weather Sealant	Sika / DowCorning / Tremco
8	Structural Sealant	Sika / DowCorning / Momentive / Tremco
9	ACP (Solid / Metallic)	Alucobond plus / Alcopanelfr / Alubondfr
10	ACP (Solid / Metallic) - Non FR	Alucobond / Alpolic / Alcopanel / Alubond / Aludecor / Alstrong
11	Solid Aluminium Sheet	Novelis / Euramax
12	Anchor Fastners	Hilti / Fischer / Mungo / Powers
13	EPDM & Silicon Gasket	Amee Rubber / Osaka / Eltech
14	Powder Coating	Jotun / Akzonoble
15	Powder & PVDF Processer	SP Coating / MJ Coaters / Aura International / Global / Bhoruka
16	Spacer Tape (Open PU Cell)	Norton / Tremco / BOW

S.No.	Material	Approved Make/ Brand
17	Spandrel Insulation	UP Twiga / Equivalent
18	Rock wool (Fire Stop insulation)	Rockwool India / Roxul Rockwool
19	Smoke Seal Intumuscent	Hilti / Sika
20	Fire stop & smoke seal assembly	Side Rise , Hilti
21	Acrelyic sealant	Hilti, STI
22	Smoke Seal Sealant	Hilti / Dow corning / Sika
23	Backer Rod	Supreme Industries
24	Spider	Dorma / Lisus / Sadev / Kinlong
25	Patch Fitting	Dorma / Geze / Kinlong
26	Revolving Doors	Dorma / Geze / Boonedam
27	SS Clambs (Stone cladding)	Hilti / Halfen
28	Mild steel	Jindal / Sail / Tata/ RINL
29	Stainless Steel	Salem Steel / Sail / Jindal / Tata
30	Anodizing Processors / chemicals	(Global / Bhoruka / Ajit India
31	Fire Exit Door Panic Device	Von Duprin / Dorma
32	Fire Rated Door	Glass wall system / Vijay Systems Engineers / Shakti Hormann
33	SS Friction Hinges	Giesse / Cotswold / Securistyle
34	Multipoint Locking sets	Giesse / Lavaal / Alualpha / Savio
35	Cremone Handle	Giesse / Lavaal / Alualpha / Savio
36	Rollers for Slidings windows / doors	Giesse / Laval / Sotralu / Roto / Savio
37	Flush lock for Slidings	Giesse / Laval / Sotralu / Roto / Savio
38	Wool Pile with PVC Film	Schlegel / Equivalent
39	Casement Window Hinges	Giesse / Alualpha /Laval / Savio
40	Doors Hinges	Giesse / Alualpha /Laval / Savio

S.No.	Material	Approved Make/ Brand
41	Cast in Channel	Hilti / Jordal / Halfen
42	Terracota tiles / Buggets	
43	High Density Pressure Laminate	Fundermax / Century / Royal touch / Trespa
44	High Density Pressure Laminate (wood veneer)	Prodima / Sparklex
45	Aluminium Expanded Mesh	Italmesh / Arcmesh / Equivalent
46	Seamless Glass Railing	Façade One / Viva / Q rail
47	Fire Rated Glass	Saint GobainVitrotec / Schott glass / Pilkington /
48	P U Paint	Jotun / Akzonobel / Berger
49	Elastomeric Paint	Berger / Asian
50	Texture Paint	SKK / Equivalent
51	Doors Hinges	Giesse / Alualpha /Laval / Savio
52	Automatic Sliding Door	Dorma / Geze / Kaba
53	Automatic operable vents	Geze / Alualpha
54	Aluminium cladding system / Swiss cladd / Corrugated sheet cladding	Façade One / Equvalent
55	Alusleek Entrance Fin system	Façade One / Equvalent
56	Automatic vents	SE Control / Geze / Alualpha

STRUCTURAL & CIVIL		
S.No.	**Material**	**Approved Make/ Brand**
1	White Cement	Birla Cement
		J.K. White
		Travancore Cements Ltd
2	Reinforcement Steel (TMT-Fe 500)	SAIL
		Tata Steel
		RINL
3	Structural Steel / M.S. Tube	TATA
		Jindal Steel & Power Ltd
		JSW Steel Ltd
		RashtriyaIspat Nigam Ltd
		SAIL
4	Plasticizer, Super Plasticizer, Admixtures, Other construction chemicals	Asian Laboratories
		CICO
		Ultracon
		Fosroc
		Sika
		Kunal Conchem
		Pidilite
		BASF
		ECMAS
5	Waterproofing Compound (Crystalline)	Fosroc
		Sika
		Pidilite
		Choksey
		Roff
6	Waterproofing Self Adhesive (HDPE) Membrane	Asian Paints Ltd
		Ardex Endura
		Fosroc
		Pidilite
7	EPDM Waterproofing Membrane	Polygomma / Pidilite / STP

S.No.	Material	Approved Make/ Brand
8	PU Elastomeric Membrane (spray applied) for Deck waterproofing	BASF
		Fosroc
		Pidilite
		Sika
9	Glasswool Insulation	UP Twiga
		Owens corning
		Gupta glass wool
10	Rock Wool Insulation	Lloyds
		Roxul Rockwool
		Rockwool India
11	Swellable Bar	
12	Polycarbonate Sheet	Tuflite
		Gallina
		Coxwell
13	Decking Steel Sheet	TATA Steel
		Lloyds
		JSW
14	Shuttering Ply	Archid
		Kitply
		Century
		Merino
15	Rebarring Chemical	Trutek
		3M India
		Birla
16	Fire Sealant	Sika
		3M India
		Wacker
17	Parallel Threaded Couplers (Compliant to IS 16172:2014)	Dextra
		Halfen Moment
		G-Tech

S.No.	Material	Approved Make/ Brand
18	Extruded Polysterene Board	STP
		Supreme
		Shalimar
		Owens Corning
19	AAC Block	Aerocon
		Finecrete
		Builtech
		Magicrete
		Instablock
		JK
20	AAC Mortar	Ferrouscrete
		Ultratech
		JK
21	Moisture Resistant Board	Saint Gobain
		Greenlam
		USG Boral
		Duro
		Merino
22	Veneered Particle Board	Merino
		Kitply
		Duro
		Archid
		Greenlam
23	Laminated Particle Board / Laminates	Merino
		Novapan
		Greenlam
		Duro
		Archid
		Swastik
		Century
		Kitlam

S.No.	Material	Approved Make/ Brand
24	Flush door / Laminated Flush doors	Century
		Duro
		Green
		Archid
		Merino
		Anchor
		Swastik
		Kutty
25	Hardware for Fire Check Door	Kich
		AssaAbloy
		Godrej
26	Plywood	Merino
		Archid
		Greenlam
		Duro
		Anchor
		Swastik
		Century
	Veneer	Decowood veneer
		Euro Veneers
		Durion veneer
		Green Lam veneer
	Lamination	Green Lam
		Merino
		Sunmica/Formica
		Century
		Durian
		Sundek
		Anchor
		Decolam
27	Expansion Joint – Modular	Sanfield
		Vexcolt
		Hercules
		Devin
		Z-Tech
28	Polyster Powder Coating Paints	Nerolac
		Berger
		Akzonobel

S.No.	Material	Approved Make/ Brand
29	Silicon based water repellent / Weather Sealant	Dow Corning
		STP
		Pidilite
		Wacker
30	Poly-Sulphide Sealant	Fosroc
		Laticrete
		Pidilite
		Wacker
		Sika
		Dow Corning
31	Wall Putty	Birla Wall Care
		Snowcem
		JK White
		Berger
		Asian Paints
32	Curing Compound	Fosroc
		STP
		Sika
		Pidilite
		Cico
		BASF
33	Oil Bound Washable Distemper	Asian Paints
		Nerolac
		Akzonobel Dulux
		Berger
		Jenson & Nicholson
34	Acrylic Distemper	Berger
		Asian
		Dulux

S.No.	Material	Approved Make/ Brand
35	Premium Acrylic Emulsion paints	Dulux
		Berger
		Nerolac
		Asian Paints
		Jenson & Nicholson
36	Cement Primer	BP White (Berger)
		Nerolac
		Decoprime WT Asian
		Akzonobel (Dulux)
37	Cement Paint	Snowcem Plus
		Asian
		Berger(Durocem Extra)
		Ultratech
		Nerolac (Nerocem with
		Titanium)
38	Steel / Wood Primer	Akzonobel (Dulux)
		Berger
		Nerolac
		Jenson & Nicholson
		Asian Paints
39	Textured Exterior Paint	Akzonobel (Dulux)
		Asian (Apex Ultima)
		Spectrum
		Nerolac Kansai (Excel)
		Berger
40	Synthetic Enamel Paint	Akzonobel (Dulux)
		Berger
		Asian (Apcolite)
		Kansai Nerolac
		Jenson & Nicholson

S.No.	Material	Approved Make/ Brand
41	Epoxy Paint	Kansai Nerolac
		Asian
		Akzonobel(Dulux)
		FOSROC
42	Epoxy Flooring	Flowcrete
		BASF
		FOSROC
43	Fire Paint	Asian
		Jotun
		Akzonobel
44	Heat Resistant Tiles	Swastik
		THERMATEK
		Dalal Tiles Induatries
45	Gypsum Plaster	Ferrous Crete
		KK
		Elite (90)
		Ultratech
46	Pre-Cast GRC Jali	Unistone
		Dalal Tiles Industries
		Ecovision
47	Stainless Steel	Salem Steel
		Jindal Alloys
		SAIL
48	Welding Electrodes	Advani
		L & T
		Modi
49	Stainless Steel Hardware	Godrej
		KICH
		OZONE

FALSE CEILING		
S.No.	**Material**	**Approved Make/ Brand**
50	False Ceiling – Gypsum	Saint Gobain
		Armstrong
		India Gypsum
		Dexune
		Daikin
		USG Boral
51	False Ceiling – Metal	Saint Gobain
		USG Boral
		Hunter Douglas
		Dexune
		Armstrong
52	Gyp Board	Saint Gobain
		USG Boral
		Vans Gypsum
53	Open Cell Ceiling	Armstrong
		Hunter Douglas
		New Age False
		Ceiling Pvt Ltd
		Dexune
54	False Ceiling Grid System	Gyproc
		USG Boral
		Armstrong
		Dexune
		RK
55	Baffle Ceiling	Armstrong
		New Age False Ceiling Pvt Ltd
		Hunter Douglas
56	Acoustical Tile False Ceiling	Armstrong
		USG Boral
		Himalaya Acoustic

FLOORINGS		
S.No.	**Material**	**Approved Make/ Brand**
57	Mosaic / Chequered Tiles	NITCO
		Dalal Tiles Industries
		Unistone
58	Ceramic Tiles / Glazed Tiles	Kajaria
		Asian (AGL)
		Somany
		H&R Johnson
		EURO
		NITCO
		Vermora
59	Vitrified Tiles (Antiskid / Matt / Glazed)	Somany
		Asian (AGL)
		Kajaria
		H&R Johnson
		RAK
		EURO
		NITCO
		Vermora
60	PVC Flooring	Wonder floor
		Marvel
		Flora
		Armstong
		Premier Polyfilm
61	Cement Concrete Tiles (designer Tiles)	Unistone
		Ultra
		Eurocon
62	Paver Block &Kerb stone	NITCO
		Dalal Tiles Industries
		Industries
		Ultra

S.No.	Material	Approved Make/ Brand
63	Tile / Stone Adhesive / Tile / Epoxy Grout	Pidilite
		Fosroc
		Ferrous Crete
		BASF
		MYK Laticrete
64	Dash / Anchoring Fasteners	Trutek
		Boun
		Axel Industries
		Fasteners India
		Bosch
65	Floor Hardener	Ironite
		Fosroc
		Sika
66	Composite Marble /Granite / Engineered Stone	Asian(AGL)
		Johnson
		Kalinga
67	Water Based Melamine Polish	Asian Paint
		Berger
		Pidilite
		Akzonobel Dulux
68	Fire Retardant Paint	Asian Paint
		Berger Paint
		Shalimar
69	Calcium Silicate False ceiling	Everest
		NCL
		Aerolite
70	Calcium Silicate Ceiling Tile/ Board	Gyproc
		Aerolite
		Hilux

S.No.	Material	Approved Make/ Brand
71	Building Signage	Hindustan
		Signage
		Galaxy Signage
		PR Graphics
		Signsutra
		Motivatte Solution
	HARDWARE	
73	Nuts / Bolts & Screws	GKW
		Atul
		Boun
74	Door/Window Fittings	Godrej
		Hardwyn
		Everite
		Dorset
75	Door Closer	Everite
		Hardwyn
		Godrej
		Hettich
		Dorma
76	Die Cast Patch Fittings	Hettich
		Ozone
		AssaAbloy
77	Fire Rated Doors	Iclean
		Navair
		Shakti

S.No.	Material	Approved Make/ Brand
78	Floor Springs	Dorset
		Hettich
		Everite
		Hardwyn
		Dorma
79	SS Tower bolt	Lockwood
		(AssAbloy)
		Everite
		Godrej
		Dorset
80	SS Butt hinges with ball bearing grade SS 304	Lockwood
		(AssAbloy)
		Godrej
		Hettich
	PLUMBING & SANITARY	
81	Sanitary Fittings & Accessories	Jaquar
		Duravit
		Kohler
		TOTO
		Kerovit
82	CP Brass Fittings	Jaquar
		Hindware
		Kohler
		Parryware
83	G.I. / M.S. Pipe	Tata
		Jindal (Hissar)
		Surya Prakash

S.No.	Material	Approved Make/ Brand
84	G.I. Fittings	Unik
		R-Brand
		KS
		Surya
		Zoloto
85	SS Pipes	Jindal
		Tata
		Viega
86	HDPE Pipes	Reliance
		Vertex
		Vectus
		Jain Irrigation
		West Well
		Oriplast
		Supreme
87	DI Pipes	Electrosteel
		Jindal
		Tata Ductura
88	DI Fittings	Kartar
		Electrosteel
		Kalinga
89	CI Fittings	Neel
		Kartar
		Electrosteel
90	Float Valve	IVC
		KSB
		Leader
		Zoloto

S.No.	Material	Approved Make/ Brand
91	UPVC Pipe and Fittings	Astral
		Prince
		Vectus
		Supreme
		AKG
		PKS Export
		Finolex
		Surya Roshni
92	PVC Pipe & Fittings	AKG
		Surya (Prakash)
		Supreme
		Vectus
		Finolex
93	CPVC Pipes & Fittings	AKG
		Finolex
		SFMC
		Astral
		Surya Prakash
		Supreme
		Vectus
94	Centrifugally Cast (Spun) Iron Pipes & fittings	NECO
		SKF
		Electrosteel
95	Centrifugally Cast (Spun) Iron (Class LA) pipes	NECO
		Electro Steel
		TATA
96	Centrifugally Cast (Spun) Ductile Iron Pipes & Fittings	Electro Steel
		Jindal (Hissar)
		Kalinga

S.No.	Material	Approved Make/ Brand
97	C.I. Manhole covers, Frames & GI Gratings	NECO
		SKF
		RIF
		Jain Spun Pipe Co.
		BIC
98	SFRC Manhole covers & gratings	KK
		OCR
		Pargati
99	Gun Metal Valves, Globes	Kartar
		Sant
		Castle
		Zoloto
100	Floor Traps	Jayana
		Chilly
		Nirali
102	Water Meter	Capstan
		Zoloto
		Leader
103	Brass Stop & Bib Cock	Zoloto
		Leader
		Sant
		Astral
		L&K
104	Non Return Valve (Check valve) ½" to 1¼"	Zoloto
		Kartar
		Sant
		Leader
105	Brass Ferrules	Dhawan Sanitary Udyog
		Kalsi
		Annapurna

S.No.	Material	Approved Make/ Brand
106	Polythylene water storage tank	Sintex
		Vectus
		Polycon
		SPL
107	Insulation for hot water pipes	Lloyd
		Armaflex
		Careflex
108	Insulation for external /exposed hot water pipe	Lloyd
		Armaflex
		Careflex
109	Pipe protection for external water supply pipes	Pypkote
		Armaflex
		Makpolykote
110	Stainless Steel Sink	Neelkanth
		Cera
		Nirali
		Anupam
		Jayna
		Franke Fabre
111	Stoneware Pipes	Perfect
		Hind
		RK
112	Gully Traps	Perfect
		Hind
		RK
112	RCC Pipes (NP-2)	Lakshmi
		Pragati Concrete
		Sood&Sood
		Jain & Co.
114	Ball Valves / wafer type valves	Zoloto
		Leader , AIP

S.No.	Material	Approved Make/ Brand
115	Air Release Valves	Sant
		Leader
		Zoloto
116	Pipecoat	IWL Ltd
		Pypkote
		STP
117	CI Double Flanged Sluice Valve	Kirloskar
		Kejriwal
		IVC
		Sondhi
118	Adhesives	Duratuff
		Pidilite
		McCoy Soudal

APPROVED MAKE OF MATERIALS LIST FOR ELECTRICAL WORKS - INTERNAL ELECTRICALS & HT CABLES

PVC RIGID CONDUITS & ACCESSORIES ISI (FRLS)	PRECISION/ BEC/ AKG/ POLYPACK/ SG
PVC CASING CAPING (FRLS)	PRECISION/ BEC/ AKG / DIAMOND
MS CONDUITS	AKG / BEC / NIC / SUPREME
LT / HT CABLES (FRLS)	POLYCAB / FINOLEX / AVOCAB/ GLOSTER / CCI / RR KABEL/ DELTON
WIRES (FRLS)	FINOLEX / RR KABEL/ HAVELLS / V. GUARD
MAIN DISTRIBUTION BOARDS	ABB/ LEGRAND /L&T/ SCHNEIDER / SIEMENS
MINIATURE CIRCUIT BREAKER	ABB/LEGRAND/L&T/ SCHNEIDER / SIEMENS

ELMCB / RCCB	ABB/LEGRAND/L&T/ SCHNEIDER / SIEMENS
INDUSTRIAL SOCKET & TOP POLYCARBONATE	CROMPTON/ LEGRAND / L & T
DOMESTIC FITTINGS (COLOUR OF COVER PLATES SHALL BE SELECTED BY LICI)	
MODULAR SWITCHES & SOCKETS ACCESSORIES & REGULATORS	ANCHOR/ SSK/ LEADER/ CRABTREE/ MK/ LEGRAND / ABB
ADHESIVE TAPE	BHOR (STEEL GRIP) OR APPROVED EQUIVALENT
HOLDERS / CEILING ROSES	ANCHOR/ SSK/ LEADER/ CRABTREE/ MK
TELEPHONE (RJ 11) / T.V. SOCKETS (CO-AXIAL)	M. K. INDIA MAKE (WRAPAROUND) / LEGRAND / ABB / D-LINK/ MOLEX/ HONEYWELL
TELEPHONE WIRES / CABLE	DELTON / FINOLEX / RR KABEL/ HAVELLS
T.V. CO-AXIAL CABLE	FINOLEX / DELTON/ NATIONAL
TELEPHONE TAG BLOCK	KRONE TAGS WITH STANDARD BOX WITH LOCKING ARRANGEMENT
CABLE LUGS	DOWELL / LOTUS / JAINSON / COMET
CABLE GLAND SINGLE / DOUBLE COMPRESSION	HMI / COMET / CENTRAL HARDWARE IND / DOWELLS/ SIEMENS
LUMINARIES	PHILIPS / CROMPTON/ WIPRO/GE/K-LITE/HAVELS
LIGHTING FIXTURES (FLAME PROOF)	PHILIPS / CROMPTON/ WIPRO/GE/K-LITE/HAVELS
CEILING FANS / WALL FANS / AIR- CIRCULATOR FAN / EXHAUST FAN	CROMPTON / BAJAJ / ORIENT/ ALMONARD/ USHA
SWITCH FUSE UNIT/SWITCH GEAR	L&T / SCHNEIDER / SIEMENS / ABB MAKE/ ENGLISH ELECTRIC

HRC FUSES/ FUSE CARRIER & LINKS	L&T / SCHNEIDER / SIEMENS / ABB MAKE./ ENGLISH ELECTRIC
CHANGE OVER SWITCH	L&T/ SIEMENS / HPL
CONTACTORS / POWER CONTACTORS FOR CAPACITOR DUTY	L&T / SCHNEIDER / SIEMENS (EPCOS)/ ABB/ TELEMECANIQUE
APFC RELAY	EPCOS / NEPTUNE/ L&T / SCHNEIDER/ CONZERV
CAPACITOR BANK	EPCOS / NEPTUNE/ L&T / SCHNEIDER/ CROMPTON
MCCB / ACB	L&T / SCHNEIDER / SIEMENS / LEGRAND / ABB
AMMETER / VOLTMETER	AE / HPL /MECO/L & T / AMP/ ENERCON / CONZERV/NEPTUNE/ SCHINEIDER/ RISHABH
SELECTOR SWITCHES	L & T/ SALZER / KAYCEE / SIEMENS/ C&S/CONZERV/ RISHABH
INDICATOR LAMPS (LED TYPE	SIEMENS / TEKNIC / PRECIFINE/ PHILIPS / ESSEN / L&T/ C&S/ ELMEX/ BHARTI /CONZERV/ RISHABH
CONNECTOR STRIPS	ELMEX / WAGO / CONNECT WELL/ PHOENEX
LOAD MANAGER ENERGY MANAGEMENT SYSTEM	ENERCON / L&T / HPL / CONZERV / ELMEASURE
KWH METER	ENERCON / L&T / SECURE/ HPL / CONZERV / ELMEASURE
RELAYS (PROTECTION)	ALSTOM / AREVA / SIEMENS/ L&T
PUSH BUTTON STATION	L&T/ C&S/ ALAN/ EAPL/ TEKNIC
HT CABLE TERMINATION	RAYCHEM / MAHINDRA / 3M
CABLE TRAY	ASSOCIATED INDUSTRIES / GLOBE / INDIANA / SUNRISE / HASTI / MM ENGG
RISING MAINS	ENGLISH ELECTRIC/ L&T/ SIEMENS/ GEC / SCHNEIDER

TRUNKING SYSTEM	LEGRAND/ MK ELECTRIC / PRECISION/ MODI
RUBBER MATS	JYOTI/ X-VOLTS
BUS BAR ALUMINIUM	JINDAL/ INDALCO/ CENTURY
BUS DUCT (AIR INSULATED TYPE)	SYSTEM & POWER CONTROL/ JACKSON / HAVELLS
CURRENT TRANSFORMERS	AUTOMATIC ELECTRIC / KAPPA/ L&T/ ELMEX/ BHARTI
TIMERS	L&T/ SIEMENS/ MINILEC
MONOBLOCK SUBMERSIBLE PUMP	KIRLOSKAR/ CROMPTON/ CRI / ABB/ SIEMENS/ KSB/ GRUNDFOS/ WILO /XYLUM
MOTOR STARTER	SIEMENS/ L&T/ CROMPTON/ ABB/ SCHNEIDER
LIGHTENING ARRESTORS	PACTIL/ HECO/ ATLAS / GK. ELECTRICALS
UPS	VERTIV (EMERSON) / NUMERIC/ APC/ SCHNEIDER/ DELTA /ABB
BATTERY	EXIDE / AMRON / HBL KNIFE/ ROCKET
TRANSFORMER	CROMPTON GREAVES / AREVA / KIRLOSKAR / BHEL/ VOLT AMP/OEI/OTPL/ALPHA
11/ 33KV VACUUM CIRCUIT BREAKER/ RMU PANEL	ABB / SIEMENS / SCHNEIDER /CGL
PROTECTION RELAYS (NUMERIC TYPE)	ABB / ESSUN RAYROLLE (ER) / SIEMENS / ALSTOM/ CGL
HT CT/PT	PRAGATI / ECS / KAPPA / JYOTI
AMMETER / VOLTMETER / KWH METER / MULTI FUNCTION METER	CONZERV / SECURE METERS / AE / RISHAB/ MECO/ SCHNEIDER
P.V.C. TERMINALS	ELMEX / WAGO / CONNECTWELL

SYNTHETIC INSULATING MATS	CPRI CERTIFIED FOR REQUIRED VOLTAGE LEVEL.
HT INSULATORS	PACTIL / ATLAS/ JYOTI
DG SET	CUMMINS/ PERKINS/ CATTER PILLAR/ KIRLOSKAR/ GREAVES COTTON
ALTERNATOR	STANFORD/ JYOTI/ CROMPTON GREAVES/ KOEL GREEN/ LEROY SAMAR
LT PANELS	CPRI APPROVED PANEL BUILDERS ONLY
GEYSERS	RACOLD / CROMPTON / BAJAJ

LIST OF APPROVED MAKES FOR HVAC

CHILLER	TRANE/ CARRIER/ YORK/ DAIKIN/ DUNHAM BUSH
COOLING TOWER	ADVANCE/ BELL/ MIHIR/ PAHARPUR/ MARLEY/ EVAPCO
PRESSURIZED EXPANSION TANK AND AIR SEPARATOR	ANERGY/ ARMSTRONG/ GRUNDFOSS/ ITT/ EMERALD
PLATE TYPE HEAT EXCHANGER	ALFA LAVAL / SONDEX / ACCU-THERM
CHILLED WATER PUMPS WITH VFD/DP SENSORS & TRANSMITTERS	ARMSTRONG / GRUNDFOSS / WILO / XYLEM / LUBI
AIR HANDLING UNITS	CITIZEN / ZECO / EDGETECH / SYSTEM AIR/ ETHOS
CENTRIFUGAL PLUG TYPE FANS FOR AHU	PUNKER / NICOTRA / KRUGER
INLINE FANS/TUBE AXIAL FAN/ WALL MOUNTED EXHAUST FANS	KRUGER / SYSTEMAIR / NICOTRA/AIRFLOW/ PROFOUND
CENTRIFUGAL EXHAUST FAN	NICOTRA/KRUGER/SYSTEMAIR/AIRFLOW/ PROFOUND

ELECTRIC MOTORS	SIEMENS/ CROMPTON /ABB/ L&T
MOTOR STARTERS, POWER SWITCHES/ACB	SIEMENS/ABB/SCHNEIDER/ L&T/ CROMPTON
MS/GI PIPE	TATA/ZENITH/JINDAL/ PRAKASH/ APOLLO
BUTTERFLY VALVE	KITZ/ AUDCO/ BELIMO/ INTERVALVE/ ECONOSTO/ ANERGY/ NICO/ ADVANCE,/DANFOSS/ HONEYWELL/LEADER,
BALL VALVE	KITZ/AUDCO/BELIMO/ ADVANCE/CIMBERIO/DANFOSS/ANERGY
NON-RETURN VALVE(WAFER TYPE)	SANT/INTERVALVE/ADVANCE
CONTROL VALVES	SIEMENS/DANFOSS/HONEYWELL/JOHNSON/ BELIMO
C.I. 'POT' STRAINER	TRISHUL/EMERALD/ LEADER
'Y' TYPE STRAINER	TRISHUL/EMERALD/DANFOSS/HONEYWELL
GLOBE VALVE	AUDCO/VIRGO/ DANFOSS/HONEYWELL
AUTOMATIC AIR PURGING VALVE	SANT/ITAP/ANERGY/FLEMCO
PRESSURE GAUGES	H GURU/ASHCROFT/ WAREE/FIEBIG
WATER PRESSURE GAUGE (GLYCERINE FILLED)	H GURU/ASHCROFT/WAREE / FIEBIG
SOLENOID VALVES	AVCON/ROTEX
FLARE NUTS / CU. FITTINGS	CASTEL / KIM / MANDEV
MOTORIZED VALVE	KITZ/BELIMO / HONEYWELL/ SIEMENS
MAGNAHELIC GAUGES	DWYER / ALM
TEMPERATURE GAUGES	H GURU/ASHCROFT/WAREE / FIEBIG
AIR FILTERS (OTHER THAN HEPA)	DYNA/AIRTEC/FREIDUNBURG
HEPA FILTERS	DYNA/CAMFIL/THERMADYNE/ FREIDUNBURG

ALUMINIUM GRILLES/ DIFFUSERS	AIRPRODUCTS /DYNACRAFT/CARYAIRE/COSMOS
FIRE DAMPER/DUCT DAMPER	GEORGE RAO/BELIMO/JOVENTA
G.I. SHEETS	SAIL/ JINDAL/ TATA
MS STRUCTURALS	SAIL/ JINDAL/ TATA
HEAT RECOVERY UNIT (HRU)	CITIZEN / ZECO
VRV/ VRF UNITS	CARRIER / MITSUBISHI / HITACHI / VOLTAS / DAIKIN/ BLUESTAR
CUSHY MOUNTS/ VIBRATION ISOLATOR a. SPRING TYPE b. RUBBERISED	DUNLOP / AEROFLEX / POLYBOND
INSULATION a. FIBERGLASS/ RESIN BONDED GLASS WOLL b. EXPANDED POLYSTYRENE	BEARDSEL/ ARMASELL/ LLOYD/ OWENS CORNING

LIST OF APPROVED MAKES FOR FIRE FIGHTING WORKS

M. S PIPE	TATA/JINDAL/ HISSAR/PRAKASH/SURYA/SAIL
G. I PIPES	TATA/JINDAL/ HISSAR/PRAKASH/SURYA/SAIL
FORGED FITTINGS	SS/ VS/ TRUE FORGE
BALL VALVE / GATE VALVE (GUNMETAL)	SANT/ LEADER/ ZOLOTO
BUTTERFLY VALVE	ZOLOTO/ KIRLOSKAR/ LEADER/ AUDCO /L&T VALVES
MOTORIZED BUTTERFLY VALVE	ADVANCE/ AUDCO/L&T VALVES/ ZOLOTO
BALANCING VALVE	ADVANCE/ VTM-UTAM/ L&T
NON RETURN VALVE	ADVANCE/ VTM-UTAM/ L&T

Y-STRAINER	EMERALD/ AUDCO/ L&T VALVES/ KIRLOSKAR ZOLOTO
POT STRAINER	RAPIDCOOL/ EMERALD/ SANT/ AUDCO/ L&T VALVES ZOLOTO
THERMOMETER	EMERALD/ ANERGY/ HONEYWELL
HOT WATER GENERATOR	SANT /EMERALD/RAPIDCOOL
AIR PRESSURE VALVE	ANERGY / CASTLE / LEADER
C.I. DOUBLE FLANGED SLUICE VALVES	KIRLOSKAR/ZOLOTO /SANT / IVC/ SONDHI / KEJRIWAL
C.I. DOUBLE FLANGED NON-RETURN VALVES	KIRLOSKAR/ZOLOTO/LEADER/IVC
DUAL PLATE / WAFER TYPE NON-RETURN VALVES	KIRLOSKAR/ZOLOTO/LEADER/IVC
FOOT VALVE WITH STRAINER	KIRLOSKAR/LEADER/ZOLOTO
Y-TYPE / POT / SUCTION STRAINER	KIRLOSKAR/LEADER/ZOLOTO/ADVANCE
FIRST AID HOSE REEL DRUM	SUPEREX/NEWAGE/SAFEX/SAFE FIRE/SAFEGUARD
THERMO PLASTIC HOSE REELS FOR DRUMS	SUPEREX/NEWAGE/SAFEX/SAFE FIRE/SAFEGUARD
FIRE EXTINGUISHERS (WATER TYPE PORTABLE, CO_2 PORTABLE AND TROLLEY MOUNTED, DRY POWDER, PORTABLE FOAM TYPE CHEMICAL PORTABLE & PORTABLE ABC-POWDER TYPE)	ZENITH/MINIMAX/SAFEX/CEASEFIRE/NEWAGE/SAFE FIRE/SUPEREX/OMEX/EXFLAME
R.R.L. HOSE & C.P. HOSE	SUPEREX/NEWAGE/SAFE FIRE/SAFEGUARD/CRC
BRANCH PIPE, NOZZLE, COUPLING ETC.	SUPEREX/NEWAGE/EVERSAFE/MINIMAX/LIFEGUARD/SAFEGUARD/ SAFE FIRE/CRC
LANDING VALVES	SUPEREX/NEWAGE/EVERSAFE/SAFE/ FIRE/KIRLOSKAR/MINIMAX

FIRE BRIGADE CONNECTIONS	SUPEREX/NEWAGE/EVERSAFE/MINIMAX/SAFE FIRE
FIRE FIGHTING EQUIPMENT NOT COVERED ELSEWHERE	SUPEREX /NEWAGE /EVERSAFE
HOSE BOX	SUPEREX /NEWAGE/EVERSAFE
FLOW SWITCHES	HONEYWELL/SWITZER/MCDONNELL & MILLER
PRE-FABRICATED STRUCTURAL SUPPORTS AND CLAMPS	CHILLY/ HITECH/ EASYFLEX
PRESSURE GAUGE	EMERALD/FIEBIG/H.GURU/WIKA
ANTIVIBRATION PADS & SUCTION & DELIVERY FLEXIBLE PIPE CONNECTORS	EASYFLEX /RESISTOFLEX/DUNLOP/SAIL/TATA STEEL LTD/RINL
FLEXIBLE DUCT CONNECTOR	KANWLL INDUSTRIAL CORPORATION/ RESISTOFLEX / EASYFLEX
STAINLESS STEEL BRACH PIPE	SAFEX /PADMINI /GETECH
FIREMAN AXE / INSTALLATION CONTROL VALVE	SAFEX /PADMINI /GETECH
2-WAY / 4-WAY FBC	SAFEX /NEWAGE /GETECH
RUBBER BELLOW	KANWAL INDUSTRIAL CORPORATION / RESISTOFLEX /AIP VALVES/ EASYFLEX
ANTI VIBRATION PAD	EASYFLEX/RESISTOFLEX/EMERALD
MOTORS FOR FIRE PUMPS	SIEMENS/KIRLOSKAR/CROMPTON/ABB
FIRE PUMPS	KIRLOSKAR/SCHNEIDER/GRUNDFOSS/SIEMENS/ABB
CONTROL PANEL OF TERRACE PUMPS	ADVANCE PANEL & SWITCHGEAR /ADLEC TRICOLITE ELECT INDUSTRY /SPC /ELECTROTECH
TIMER, OVERLOAD RELAYS	L&T/SIEMENS/SCHNEIDER
ANNUNCIATION PANELS	PCD/AGNI/TRICOLITE/ADLEC/TYCO
SINGLE PHASE PREVENTOR	MINILAC/L&T/SIEMENS

ANTI VIBRATION MOUNTING	KANWAL INDUSTRIAL CORPORATION /RESISTOFLEX/EASYFLEX
STARTER	L&T/SIEMENS/CROMPTON/SCHNEIDER/ABB
CURRENT TRANSFORMER (CAST RESIN)	AE/L& T/KAPPA

LIST OF APPROVED MAKES FOR ELV SYSTEM

CONTROL PANELS, VOICE EVACUATION SYSTEM, DEVICES, MODULES, SENSORS(ADDRESSABLE)	HONEYWELL /NOTIFIER /SIEMENS (FIRE FINDER SERIES)/ COOPER'S/ BOSCH /UL JOHNSON CONTROL/IFC
TWIN TWISTED SHIELDED / UN-SHIELDED CABLE	FINOLEX/ NATIONAL/ R.R. KABLE/ GLOSTER/ HAVELL'S/ HONEYWELL
AMPLIFIER	BOSCH/HONEYWELL/,PHILIPS
MICROPHONE/ SPEAKERS	BOSCH/ HONEYWELL/PHILIPS
LENSES	HONEYWELL/ SONY/ BOSCH/ PELCO/SIEMENS
CAMERAS	HONEYWELL/ SONY/ BOSCH/ PELCO/SIEMENS
DVR /NVR	HONEYWELL/ SONY/ BOSCH/ PELCO/SIEMENS
MONITOR	SONY/ SAMSUNG / LG/ DELL/ HP
LCD KEY BOARD	TVS ELECTRONICS/ WIPRO/ ACER/ DELL/ HP
WORK STATION	HP/ DELL/ IBM
ACESS CONTROL SYSTEM	HONEYWELL/ MATRIX/ HID
PUBLIC ADDRESS SYSTEM	HONEYWELL/ ATIES/ BOSCH/PRISARIO.
IP EPABX SYSTEM	MATRIX, PANASONIC, AVAYA/ HONEYWELL
ACCESS CONTROL SYSTEM	HONEYWELL/MATRIX/HID

EM LOCK	ALGATECH, DORMA, BELL/ HONEYWELL
EMERGENCY EXIT SWITCH	RAVAL, HONEYWELL, SYSTEM SENSOR
NETWORK SWITHES & ACCESSORIES	CISCO, HP , AVAYA/ HONEYWELL
CAT 6 CABLE / PATCH CORD	TYCO, MOLEX, LEGRAND, D-LINK/ HONEYWELL
RJ45 / RJ –CONNECTORS/ IO BOX / PATCH PANEL	LEGRAND, D-LINK/ HONEYWELL
DATA NETWORK RACK	APW , VALRACK , RITTAL, HCL , A-LINK, DIGITRON / HONEYWELL
BOOM BARIER	GANDHI AUTOMATION, SHIVANANDA AUTOMATION, GODREJ/ HONEYWELL

LIST OF APPROVED MAKES FOR LIFTS

LIFTS	KONE/ MITSUBISHI / OTIS / SCHIENDLER/ THYSSENKRUPP / JHONSON
ESCALATORS	KONE/ MITSUBISHI / OTIS / SCHIENDLER/ THYSSENKRUPP / JHONSON

LIST OF APPROVED MAKES FOR SOLAR POWER SYSTEM

SPV MODULES: MEEETING IEC SPECIFICATIONS 61215/61730 (MNRE APPROVED)	TATA POWER/ BHEL/ ALPEX/ MOSER BEAR/ CEL
POWER CONDITIONING UNIT WITH DATA LOGGER FACILITY MEETING NEC, UL,CEC CERTIFICATION / SPECIFICATION, IEC	DELTA / SCHNEIDER / EMERSON / ABB

NOTE: ANY OTHER ITEM NOT MENTIONED ABOVE, APPROVAL ARE TO BE TAKEN FROM THE ENGINEER- IN- CHARGE / CONSULANT PRIOR TO EXECUTION.

THE VENDOR SHALL QUOTE RATES FOR THE VARIOUS ITEMS AFTER ASCERTAINING THE AVAILABILITY, DELIVERY SCHEDULE ETC. OF THE SAME.

Design Basis Report - Architectural

OBJECTIVE AND BASIS OF THE REPORT

This report outlines the concept approach for Planning, Design, Structure, Services, Logistics, etc. and includes:

- Site Composition and Planning
- Commercial Building Design and Construction
- Structural Design and Construction Technology
- Building Materials & Finishes
- Mechanical, Electrical, Plumbing Systems
- Fire Safety & Security
- Landscape Design and Horticulture Detailing
- Site Management and Logistics
- Project Costing and Tendering Details
- Implementing of the latest innovative, environment friendly, green and energy conservative design features for the project.

KEY OBJECTIVES OF THE DESIGN

Following shall be the key objectives of the design of the building:-

1. To achieve maximum FAR within the height restrictions, the building is conceptualized to achieve FAR of 1.22 as against permissible limit of 2.00.

2. To make the building of modern-look with unique Architectural feature using ultra modern finishes, like ACP / HP Laminate / structural glazing on the façade to attract prospective tenants and to enhance brand value of L.I.C.

3. To provide organised parking in basement to meet the requirements of local By-laws.

4. To provide four staircases and two lifts along with four sets of Ladies and Gents toilets on each floor.

5. To make the building environmental friendly by using maximum natural light and also with use of LED lights.

6. To have safe secure and user friendly facility for physically challenged persons and elderly persons.

7. To adopt safe, effective and efficient use of construction techniques.

8. To make building environment-friendly and maximize energy saving in order to minimize the operational costs.

9. To provide Rain Water Harvesting System for roof top and open ground rain water to recharge underground water reserve.

10. To provide sewerage treatment plant of adequate capacity in order to recycle the waste water

11. To install a bore well in the building premises to make availability of water in case of scaracity of municipal water.

13. Salient features of Design:

- Water proofing of Roof and its insulation is to prevent heat gain into building,
- Low - flow faucets and plumbing/ sanitary fixtures to reduce water consumption.
- Rain water harvesting system will feed the underground water table.¬
- Sewerage Treatment Plant (STP) .
- Dual water supply pipes.
- Sewerage and waste water recycling after treating in landscape and horticulture areas.
- To reduce electric consumption, LED lights/ fixtures in common areas & compound.
- Fire Detection System with addressable fire detectors and micro processor based fire alarm panel. Hooters for early warning of the people for evacuation Public address system to facilitate faster and effective evacuation
- External and internal hydrants , dedicated water tank for fire and automatic sprinkler systems Ventilated stairways for smoke-free evacuation
- Security monitoring at every stratergic access point
- automatic rescue device in Elevators
- Equipped with CCTV cameras in common areas

PLANNING CONSIDERATIONS

Plot area as per possession : 7994.79 Sqm.

Existing Office Building G+2 : 2761.755 Sqm.

As per the Concept Plan developed, the proposed Commercial building (B+G+2) :

All figures in Sqm.	**Proposed Built-up / Construction Area**	**FSI / FAR Area**	**Rentable Area**
Basement Floor	2882.37	83.42	

(Parking)			
Ground Floor	2215.45	2215.45	1772.36
1st Floor	2271.53	2271.53	1817.22
2nd Floor	2271.53	2271.53	1817.22
Mumty	117.06	117.06	
Total	**9757.94**	**6958.99**	**5406.80**
	i.e. 104995.43 Sft	**i.e. 74878.73 Sft.**	**i.e. 58177.16 Sft Say 58000 Sft**

Calculation for Ground Coverage requirement as per bylaws :

Permissible Coverage = 40% of Plot Area = 3197.916 Sqm.

Coverage of Existing Building = 806.907 Sqm.

Balance Available Coverage = 2391.009 Sqm.

Proposed Coverage = 2271.53 Sqm.

Total Coverage Achieved = 3078.44 Sqm (38.51%)

Calculation for FAR requirement as per bylaws :

Maximum FAR allowed = 2

Total BUA Allowed = 15989.580 Sqm.

Balance BUA allowed = 15989.580 – 2761.755 = 13227.82 Sqm.

Proposed BUA = 6958.99 Sqm.

FAR Achieved = (2761.755 + 6958.99) / 7994.79 = 1.22.

Permissible Height as per Height restriction of Local Authority : 10.00 Mtr.

Exact FSI/FAR Area shall be as per approved Municipal Approval, which is to be obtained by the EPC Contractor by preparing plans as per local bye laws. In view of Height Restriction, Full FAR/FSI could not be achieved.

Calculation for Parking requirement as per bylaws :

Total Combined BUA = 6958.99 + 2761.755 = 9720.75 Sqm.

Requirement = 40% of FAR Area = 40% of 90% of BUA = 3499.47 Sqm.

Provided : In Existing Building 207.20 Sqm + Basement in proposed building 2882.37 Sqm

& Open Parking 503.85 Sqm, Total = 3593.42 Sqm.

The design proposal focuses on making the building function in a cohesive manner in terms of built - unbuilt space relations, infrastructure, services, visual aesthetics as well as practical use.

The FLOOR PLAN given is indicative and to be checked for the above-mentioned area for which we have received the Approval from our Central Office. The drawings are also to be checked whether it is satisfying the controlling Bylaws and any change required has to be brought to the notice of LIC and necessary changes are to be carried out and finalized with approval of LIC authority. It is to be aimed to provide optimum utilization of space keeping the bylaws provisions.

EXTERIOR 3D VIEW OF THE PROPOSED BUILDING

As given in Page 1 of this Bid-III.

SCHEDULE OF FINISHES

<table>
<tr><th>Sr no</th><th>Item</th><th>Specifications / Finishes</th></tr>
<tr><td>I</td><td>STRUCTURE</td><td></td></tr>
<tr><td>1</td><td>Type of Structure</td><td>RCC Framed Structure</td></tr>
<tr><td>2</td><td>Expected SBC</td><td>Refer the attached Soil Investigation Report of M/s Ray Infratech Foundation Engineering Consultant dated 24.01.2022
<table>
<tr><td>Isolated Column Footing of Sizes</td><td>Depth Below EGL (M)</td><td>Recommended Safe Load Carrying Capacity (Tonne / Sqm)</td></tr>
<tr><td>1.5M x 1.5M and 2.0M x 2.0M</td><td>2.0</td><td>20.0</td></tr>
<tr><td>- do -</td><td>2.5</td><td>25.0</td></tr>
<tr><td>- do -</td><td>3.0</td><td>30.0</td></tr>
<tr><td colspan="3">However the size, depth and type of foundation shall be as per structural design which is within the scope of the Contractor</td></tr>
</table></td></tr>
<tr><td>3</td><td>Seismic Zone</td><td>Zone III (To be considered in Foundation / Structural design as per IS 1893-2002)</td></tr>
<tr><td>4</td><td>Special Feature of External Facade</td><td>Combination of Structural Glazing, GRC (Glass Reinforced Concrete Mess), HPL (High Pressure Laminate) Sheet, ALCO (Aluminium Composite) Panelling on front and two sides of Building.</td></tr>
<tr><td>II</td><td>COMPONENTS</td><td></td></tr>
<tr><td>1</td><td>Concrete</td><td>Ready Mix Concrete (100% use of PPC Cement as per GRIHA Norms)</td></tr>
<tr><td>(a)</td><td>Foundation</td><td>As per approved Structural design & drawings based on Soil Investigation Report. Grade of RCC should be of minimum M25 grade.</td></tr>
<tr><td>(b)</td><td>Plinth and Superstructure</td><td>As per approved Structural design & drawings based on Soil Investigation Report. Grade of RCC should be of minimum M25 grade.</td></tr>
</table>

(c)	**For Non-structural Members**	Volumetric Mix 1:1.5:3 with PPC Cement as per GRIHA Norms
2	**Masonry Walls**	
(a)	**Foundation**	Brick work with Fly Ash Bricks (non-modular) of class designation 7.5 in below plinth if required
(b)	**Internal Walls**	Autoclaved Aerated Cement blocks masonry with 150mm thick AAC Blocks in super structure above plinth level with RCC Band with 2 nos 8mm dia TMT bars at every 3rd course with approved block laying polymer modified adhesive mortar (To comply GRIHA norms)
(c)	**External Walls**	Autoclaved Aerated Cement blocks masonry with 250mm thick AAC Blocks in super structure above plinth level with RCC Band with 2 nos 8mm dia TMT bars at every 3rd course with approved block laying polymer modified adhesive mortar (To comply GRIHA norms)
3	**Steel**	TMT Steel FE500D minimum grade for RCC work or as per structural design in view of Seismic Zone - III
4	**Staircase Railing**	SS Railing of SS 304 grade with 12mm thick coloured toughened glass, as per design and drawings including necessary SS fittings etc. Design/ Drawing to be submitted by the Contractor for approval before execution.
5	**Doors**	
(a)	**Entrance Door at Ground Floor Only**	Automatic Sensor based Sliding toughened clear glass door with patched fittings and locking arrangement
(b)	**Internal Door**	All other internal lobby door will be made of 12mm thick toughened glass with patched fittings, floor spring and locking arrangements. SS Collapsible Shutter for additional security with locking arrangements to be provided.
(c)	**Toilet/ Balcony Door**	Flush Door, Single Shutter, with thickness 30mm with minimum 1.00mm thick approved make lamination on both sides with approved shade, design etc. with Granite frame with double stone to make rebate and with edge moulding with a granite strip at bottom to prevent water coming out and as approved as per design and drawing. Hardware fittings will be as per Schedule of Hardware Fittings as mentioned elsewhere in this Tender.

(d)	**Generator Room, Machine Room, Plumber/Machine Room & Mumpty**	MS Frame and Grill Door Shutters with Synthetic Enamel Paint. Contractor to prepare and submit Design/Drawing and take approval before execution.
6	**Hardware Fittings**	
(a)	**Main Door (Fully Glazed) & Internal Doors**	Heavy Duty Fittings such as SS Handles, Heavy Duty Floor Springs, Locks, Pivot etc. Please refer Schedule of Hardware Fittings for details
(b)	**Toilet / Balcony Doors**	Stainless Steel Mat Finish Fittings. Please refer Schedule of Hardware Fittings for details
7	**Windows / Ventilators**	
(a)	**Windows Frames & Shutters**	Colour Anodized Aluminium Windows with sliding shutters and louvered ventilator with 5mm thick heat resistant reflective glass. 20 micron anodized aluminium section. All Windows shall be fixed on all-round subframe of 18mm thick Granite Stone od approved shade and design including shampering, moulding etc complete.
(b)	**Louvered Ventilators**	uPVC Louvered Ventilator with size 600 x 600/ 600 x 900 mm / as per drawing. Fixed window / ventilator made of (small series) frame including 6mm clear glass and 4mm thick louver frosted glass with Exhaust Fan as per design, colour, pattern, make etc. In addition to above, SS Mosquito net panel to be provided from inside / outside as per design with uPVC frame of required section, all hinges, locking arrangement etc. complete including preparation of design and drawing etc. complete.
8	**Flooring**	
(a)	**Basement Parking including Driveway and Ramp**	Vacuum Dry Evaporated Concrete (VDF) with broom finish, with M25 design concrete having average 150mm thickness
(b)	**Open Parking Area (Public Use)**	Combination of 60mm thick factory made PU moulded chamfered edged cement concrete paver blocks of M35 grade over 50mm thick layer of fine sand laid over a base of 100mm thick M15 grade concrete of nominal mix. Sub-base shall be of rubble soling and grass pavers.

(c)	**Investment Area**	IPS flooring 40mm thick with light weight / foam concrete. Double Charged Vitrified Tiles 600mm x 600mm has to be provided afterwards as per requirement of the tenants, which is not included in this scope. However, if instructed, the Contractor has to lay the same with extra payment as per DSR rate.
(d)	**Entrance Lobby, Staicase, Landing / Treads / Risers & Cladding at all floors**	**(i)Entrance / Passage/ Common Corridors / Lift Lobby -** Honed /flamed finish Granite of suitable size of 16mm thick as per approved shape, size, pattern etc. Basic Price of Granite shall be Rs 2000.00 per Sqm.
		(ii)**Staircase** - Honed /flamed finish Granite in single piece of 16mm thick on trade, mid-landing, floor landing and skirting shall be in trapezoidal form with its vertical height at nosing of the step shall be 900mm. Nosing of steps shall be double nosing with half moulding by providing additional strip of 75mm wide stone underneath of step for full staircase as per approved shape, size, pattern. Basic Price of Granite shall be Rs 2000.00 per Sqm.
		(iii)**Lift Lobby Cladding** - Honed /flamed finish Granite of suitable size of 16mm thick as per approved shape, size, pattern etc. upto height of False Ceiling. Basic Price of Granite shall be Rs 2000.00 per Sqm.
(e)	**Toilet Flooring & Walls**	For all Toilets- Anti-skid Ceramic tiles for flooring of size not less than 300 x 300or more laid on Cm(1:4) bed and dado upto 2.40 Mtr / ceiling height with approved designed Ceramic tiles of size 300x600 mm fixed on backing of CM(1:3). Basic Rate for Floor Tiles: Rs 430 per Sqm. & Wall Tiles : Rs 538 per Sqm
9	**Granite at other places**	
(a)	**Granite Top of Wash Basin Counter**	Honed /flamed finish Granite of suitable size of 16mm thick as per approved shape, size, pattern etc. Basic Price of Granite shall be Rs 2000.00 per Sqm.
(b)	**Windows**	All windows shall be fixed on all round subframe (wall width) of 16mm thick granite stone of approved shade and design including chamfering, moulding etc complete. Window sill shall be in 2 pieces, one full width of bottom & half at top in the inside portion to stop seepage og rain water and windows/ ventilators shall be provided on the outer sill stone. Basic Price of Granite shall be Rs 2000.00 per Sqm.

10	**Plastering**	
(a)	**Internal Polymer Modified Plaster (As per GRIHA Norms)**	Polymer modified self curing plaster for 6mm thick in ceiling, 12mm thick internal wall of approved make with fiber mesh fixing to all RCC and Brick / Block work joints and 1.5mm thick cement based putty on top of plastered surface.
	External Polymer Modified Plaster (As per GRIHA Norms)	Polymer modified self curing plaster Brick / Block masonry & RCC surfaces shall be minimum 18mm thick provided in two coats with Plaster in under-coat 12mm thick & for upper coat 6mm of approved make with fiber mesh fixing to all RCC and Brick/Block work joints. Integral water-proofing compound shall be added to polymer modified materials as per manufacturer's recommendations. All external painting work shall be carried out with all necessary surface preparation with minimum 1.5mm thick cement based putty of approved make.
11	**Painting**	
(a)	**Internal Painting as per GRIHA Norms**	Distempering with 1st quality acrylic distemper (ready mixed) having VOC content less than 50 gms/litre, od approved manufacturer, of required shade and colour complete, as per manufacturers' specification. Two or more coats on new work : Stilt, Podium Floor Ceiling including walls, beams, columns, lift walls(inside), cable duct, staircase & lift lobby area etc. All painting work shall be carried out with all necessary surface preparation, min 1.5mm thick cement putty of approved make, min 1 coat of primer and min. 2 top coat of paint upto the satisfaction of Engineer-in-charge.
(b)	**Entrance Lobby, Staircase Area**	Wall with plastic emulsion & ceiling with OBD with cement based putty above classing HPL/ Glazing at 2.10 mtr at entrance lobby and above Granite cladding of 900mm in staircase area.
(c)	**Enamel Paint**	Synthetic Enamel Paint for Grills, collapsible shutters, with one coat of anti-corrosive primer & minimum 3 coats of synthetic Enamel Paint.
(d)	**External Wall**	**1.** External Paint- Applying Exterior Grade Premium Acrylic Smooth exterior paint with Silicon additives of required shade: with approved thickness, Shade , pattern & make etc. All painting work shall be carried out as per

		manufacturer's specifications with all necessary surface preparation, min 1 coat of exterior primer applied @ 2.20 kg/10 sq m, and min 3 top coats @ 1.43 ltr/10 sqm of paint up to the satisfaction of Engineer Incharge.
12	**Waterproofing**	
(a)	**Water-proofing at Terrace**	Cement based integrated water proofing treatment in Cement mortar 1:4, 110mm average, through specialized agency with 10 years guarantee, but with Crazy Ceramic Tile flooring on top as per GRIHA Norms. All precautionary measures to be taken to avoid damage of water-proofing work during work of MEP pipes, AC unit, solar plant etc., otherwise the water-proofing work has to be redone without any extra cost.
(b)	**Basement Water proofing (Vertical & Horizontal surface)**	Box type water-proofing with Kota Stone from external side (bottom and sides) and Crystalline waterproof painting from inside (wall only) after pressure grouting with cement slurry mixed with suitable admixture.
(c)	**Toilet Waterproofing**	To be done as per CPWD specification, Item No. 22.3, page 1169 and 1170, including 25mm thick PCC1:1.5:3 with water proofing compound. No sunken portion to be provided in toilet, only depression to be made to accommodate water-proofing treatment, 25mm thick PCC, so as finished floor of toilet shall be 25mm down from external flooring with provision for required slope towards trap.
13	**Plumbing & Sanitary Fittings**	
(a)	**Soil/Waste Water Pipes**	UPVC Heavy Duty of suitable dia (Pressure Capacity 6 Kg/Sq. cm)
(b)	**Rain Water Pipes**	UPVC Medium Duty of suitable dia (Pressure Capacity 4 Kg/Sq. cm)
14	**Sanitary Fittings**	
(a)	**Water Supply Pipes**	CPVC, Heavy Duty and suitable diameter pipes
(b)	**Plumbing Fittings**	CP Brass Bib taps, Pillar Taps, Sink taps and Stop Cock. Flushing Cistern : The Flushing Cistern shall be 3/6 dual

		flushing type. Bib Cock and Pillar Cock : The flow rate of pillar tap must be less than or equal to 6 litres/minute (at 3 Bar pressure). Urinal Flushing : The Flush rate of Urinal flushing must be less than or equal to 1.5 litres per flush (at 3 Bar pressure) or as per GRIHA ratings.
(c)	**Sanitary Wares**	White Vitreous China wares
(d)	**Counter Wash Basin**	Counter Wash Basin of Oval shape of White glazed vitreous china of size 550mm x 400mm with 15mm dia CP Brass Pillar Tap (Pillar tap shall be push button type)
15	**Sewarage Treatment Plant**	25 KLD readymade Aerobic STP for treating the sewerage water (underground) PVC package type with MBBR technology STP.
16	**Water Tank**	
(a)	**UG Water Tank**	M-30 grade Cement Concrete for Reinforced Cement Concrete work for Domestic and Fire Tank of capacity 1.25 lakh litre (For Domestic 25000 litre & for Fire 100000 Litre)
(b)	**Over-head Tank**	M-25 Grade RCC Tank of capacity 35000 Litre (Domestic 25000 Lit + Fire 10000 Litre). Separate 5000 Litre Water Tank to be constructed for Flushing Purpose which is to be filled with STP treated water only.
17	**Rain Water Harvesting**	Pit of size 2.0 m x 2.0 m x 1.5m with 250mm thick brickwall and 150mm dia naked bore of depth 30m. Filling of pit with gravel, brick and all other required arrangement.
18	**Landscaping**	Necessary Green Belt with grass mixing with trees and decorative bushes as per landscape plan.
19	**Persons with differently abled and elderly person**	The proposed building shall have provisions of Barrier free for persons with disability (Divyangajan) and Harmonized guidelines and space standard for Barriers free built environment for persons with disability and elderly person.
20	**Fabrication**	Window / Balcony Grills : Mild Steel Grill work for windows and ventilators as per design and drawing including necessary welding and approved design and pattern and colour etc.

21	**Anti-termite Treatment**	Lindane/ Chlorophyriphos 20% EC applied in stages as per IS specifications.
22	**False Ceiling at Entrance Lobby**	Gypsum Board decorative false Ceiling with Cornice on appropriate framework.
23	**False Ceiling in Toilet**	12.5 mm thick square edged PVC laminated Gypsum Tile of size 595mm x 595mm, made of Gypsum Plasterboard, manufactured from natural Gypsum as per IS 2095 Part I and laminated with white 0.16mm thick fire retardant PVC Film on the face side and 12 micron metalized polyster on the back side with all edges sealed with the face side PVC film which goes around and wraps the edges and is bonded to the edges and the backside metalized polyster film so as to make the tile a completely sealed unit.
	Note :1. Above are the broad guidelines of Technical Specification, however detailed specification is described in the DBR of respective trades **2.The technical specification is based on the GRIHA Norms considering minimum 3 Star rating from GRIHA / Silver rating from IGBC. Appointment of Green Building Consultants shall be done by the Contractor. Building shall have green rating on completion.**	

SCHEDULE OF SANITARY & PLUMBING FITTINGS

Minimum Basic Rates, Makes & Models for Sanitary / Plumbing Fittings:

Jaquar - Clarion Series or equivalent make low- flow fittings. MRP given below may vary at the time of installation **of above items . Nothing extra shall be on account of any variation in prices.**

Sr No.	Item	Min. Basic Rate (excld. GST)	Remarks / Model
1 a	Wall Mounted Water Closet	Parryware – Cardiff C0264, Closet (520 x 350 x 375mm) with E8122 Soft Close Seat Cover MRP Rs 9340.00 Or Equivalent make	

1 b	Concealed Flushing Cistern	Parryware – E8120 LINEA Plus with Chrome Plated Push Plate MRP Rs 5599.00 OR Equivalent make	
2	Under Counter Oval Shape Vitreous Chine Wash Basin	Parryware – Niagara C0494 (550 X 445 X 190mm), White MRP 2330.00 Or equivalent Make	
3	Urinal With EFS – Ac Power	Parryware – E-Whiz C0584 AC with Power Source – White (360 x 345 x 620mm height) with Sensor MRP 18370.00 Or equivalent make	
4	Pillar Cock – Long Neck, Pressmatic Type	Jaquar Pillar Cock Auto Closing System	

5 a	Angular Stopcock For Urinal	Jaquar PRS-CHR-077 Clarion Series with Flange, MRP Rs 950.00 Or Equivalent make	
5 b	Angular Stopcock for Wash Basin, Cistern, Water Purifier etc.	Jaquar CQT-CHR-23059 Clarion Series with Flange, MRP Rs 950.00 Or Equivalent make	
6	Short Body Bibcock	Jaquar CQT-CHR-23047 Clarion series - with flange MRP ₹ 1,250.00 Or equivalent make	
7	Two-Way Bib Cock for WC	Jaquar CQT-CHR-23041 Clarion series with flange MRP ₹ 1,375.00 Or equivalent make	
8	Health Faucet	Jaquar ALD-CHR-577 Allied MRP ₹ 1,675.00 Or Equivalent make	

9	Toilet Paper Holder	Jaquar AHS-CHR-1553 Hotelier MRP ₹ 1,700.00 Or Equivalent make	
10	Soap Dispenser	Jaquar ACN- CHR-1137N Continental MRP ₹ 3,700.00 Or Equivalent Make	
11	Non Touch Automatic Drier	Dolphy Automatic Jet Hand Dryer D-JETHANDDRYER MRP Rs. 13000/- Or equivalent make	
12	Rob Hook	JAQUAR AQN-CHR-7791 Queen's MRP ₹ 825.00 Or equivalent make	
13	Sink Cock	Jaquar CQT-CHR- 23347 Clarion series ₹ 1,425.00 Or equivalent make	

14	Towel Ring	Jaquar AQN-CHR- 7721 Queen's MRP ₹ 1,200.00 Or Equivalent make	
15	Towel Rail	Jaquar AQN-CHR-7711 Queen's ₹ 1,700.00 Or equivalent make	
16	Grab Bar	January AHS-CHR-1507 Hotelier ₹ 1,450.00 Or equivalent make	

Note : The Rentable Areas in each floor is divided into four parts, each part having one Gents Toilet and one Ladies Toilet. Each Gents Toilet should have minimum 2/3 Wash Basin and 3 Urinals and WC as shown in Concept Plan. Each Ladies Toilet should have 2/3 Wash Basins, WC as shown in Concept Plan. Each set of basins should have common granite platform with continuous mirror with Towel Ring. Each WC should have one EPWC with Cistern, Bib tap, Health Faucet, Toilet Paper Holder and Rob Hook. Two Separate 20mm water supply pipe connection to be left for Water Purifier and Pantry with valves at positions approved by LIC including concealed drainage for waste water, in each of tenants portion. Provision of Janitor Room/Corner should be there.

SCHEDULE OF HARDWARE FITTINGS

Sl	Door	Type	No	Hardware Fittings per Door
1	Main Entrance Door at	Automatic Sliding	1	All Stainless Steel Heavy Duty

	Ground Floor,	Toughened 12mm th Clear Glass Double Leaf Door, 2000 wide x 2400 height		Patched Fittings, Lock, SS Pipe Handle Set - 450mm long
2	Entrance Lobby Doors	12mm thick Toughened Glass Door, 1500 wide x 2100 height	13	All Stainless Steel Heavy Duty Patched Fittings, Lock, SS Pipe Handle Set - 450mm long, Floor Spring and Pivot, Stainless Steel Heavy Duty Hinges
3	Mumty Room Door, Pump Room Door, Control Room Door, Lift Machine Room Door, Electrical Room Door etc	MS Frame with MS Sheet Door with Stiffner : 1000 x 1800 with 300mm sill for Mumty Door and 1000 x 2100 for Other Doors, Painted with Synthetic Enamel Paint	7	MS Hinges with Steel Pin, Stainless Steel Aldrop, Tower Bolt etc.
4	Toilet Entrance Door, Guard Room Door, Fire Escape Staircase Door	16 -18mm thick double Granite Strip Door Frame with 30mm thick Solid Core Flush Door, 1000 mm wide, imm th Laminated on both sides with edge polished	20	Stainless Steel Heavy Duty Hinges-4 nos, Mortice Lock with Handle-1 no., 300mm SS Tower Bolt – 1 No.
5	WC Door, Duct Door	16 -18mm thick double Granite Strip Door Frame with 30mm thick Solid Core Flush Door, 800 mm wide, imm th Laminated on both sides with elge polished	60	Stainless Steel Heavy Duty Hinges-4 nos, 200mm SS Handle – 2 nos, 150mm Baby Latch – 2 nos, Rob Hook-1.

LANDSCAPE WORK (HARDSCAPE & SOFTSCAPE WORK)

LANDSCAPING & PLANTATION WORKS

While undertaking this work, the contractor shall develop the Parks, Lawns, Gardens, Basket Ball Courts, Jogging Track, etc. and other activities mentioned below and as shown in the tender drawings.

The Contractor shall submit the detailed working drawings to LICI along with the Layout, Material and the execution plan for approval before commencing the work. The contractor shall prepare the detailed Construction drawings based on the tender drawings. The structural/other services design required for landscaping/horticulture features shall be done by the Contractor.

Contractor shall also undertake any modifications arising out of co-ordination/ Interference of various services/ facilities during execution and also as per IOD conditions and Environmental Clearance. In case of any discrepancies between Specification due to DBR, Scope of Work, Technical Specification, LICI Specification, IS Codes etc. Stringent of all will be applicable.

Major activities to be undertaken for above scope are indicated below; however contractor shall undertake all other activities as necessary for successful completion of the project. Any other work not covered in here and required to be carried out to meet functional requirement shall be carried out as per manufacturer recommendation and Standard Industry practice. Nothing extra whatsoever shall be paid on this account.

HARDSCAPE CIVIL & FINISHES WORKS

Site Leveling, Landform and finished levels: Site Leveling for its finished levels as proposed in the Grading and drainage plan shall be done by Contractor including excavation and filling with good earth as required. All external proposed finished levels, retaining walls and slopes shall be incorporated by Contractor including necessary excavation, backfilling with excavated earth/borrow earth, compacting, finishing etc. the grading in tender drawing is indicative and can be modified as per approval from engineer in charge.

Drainage: Design and Construction of Drainage system to effectively drain the site and collect the storm water, in harvesting pits or retention ponds.

This shall be done in coordination with plumbing drawings and other external services.

Driveway and car parking: Construction of Driveway network and Car Parking, these needs to be executed with finishes for efficient connections to the building and parking areas. Top finish of driveway and parking shall be as per finishes specified in this DBR including base. Contractor to ensure that all the structural elements required for driveway and car parking are structurally safe.

Pathway and Paved Plazas.: All pathways connections to be executed as per finishes specified in this DBR elsewhere with care taken for the levels and as per paving pattern intent. Structural elements and Sub base layers for all paved surfaces should be structurally viable.

Gate and Boundary wall: It should be done as per tender drawings. Details should be

structurally viable. Gate shop drawings to be prepared as per tender drawing. Shop drawings shall be submitted to the engineer in charge for approval.

Landscape Elements: Special garden structural features such as and not limited to pergolas, gazebos, benches, sculptures etc. shall be provided as per drawings. Details shall be structurally viable and lighting provisions should be made. Shop drawings shall be submitted to the engineer in charge for approval.

Irrigation: Proper Irrigation system shall be provided and installed as per tender drawings locations. Vendor Shop drawing shall be submitted to the engineer in charge for

approval. Irrigation system shall specify location of all irrigation units in accordance with the planting scheme. Contractor shall design the whole irrigation system based on DBR considering the requirement of water as per landscape, plantation and other horticulture work. Contractor shall provide robust irrigation system which can sustain in all weathers.

External lighting: Light fixtures to be installed at site as per tender drawings and approved vendor shop drawings and technical specifications. Minimum 10% of street lighting should be solar lighting.

Signage: External Signage for site entrance, way finding, space markers for all building entrances. Fixtures to be executed at site as per approved vendor shop drawings and technical specifications. To be coordinated with and not limited to structural consultant and electrical consultant for any lighting intent associated.

Service Coordination: Coordination of all external services for their proposed locations by respective service consultants. The main aim is to reduce visual impact of the services in the landscape and merge or hide them within landscape.

SOFTSCAPE- HORTICULTURE WORKS

Planting to be executed as per LIC as per direction of Engineer in charge for the plant species to be planted. Contractor shall prepare shop drawings for the variations proposed for approval to engineer in charge.

Plantation shall be done only after services have been laid and base civil work of the adjoining areas is done. Proper measures to safe-guard the planting shall be taken by Contractor.

Maintenance of the horticulture works shall be carried out by Contractor as specified. Planting intent is in different zones to achieve varying character of planting throughout the site.

TECHNICAL SPECIFICATION FOR LANDSCAPE DEVELOPMENT HORTICULTURE WORKS:

SITE PREPARATION

Preparation of mounds of various size and shape by available excavated / supplied earth in layers, breaking clods, watering of each layer, dressing etc.

Preparation of beds for hedging and shrubbery by excavating 60 cm deep and trenching the excavated base to a further depth of 30 cm, refilling the excavated earth after breaking clods and mixing with sludge or manure in the ratio of 8:1 (8 parts of stacked volume of earth after reduction by 20% : one part of stacked volume of sludge or manure after reduction by 8%), flooding with water, filling with earth if necessary, watering and finally fine dressing, levelling etc. including stacking and disposal of materials declared unserviceable and surplus earth by spreading and levelling as per direction of engineer in charge.

Digging holes in ordinary soil and refilling the same with the excavated earth mixed with manure or sludge in the ratio of 2:1 by volume (2 parts of stacked volume of earth after reduction by 20% : 1 part of stacked volume of manure after reduction by 8%) flooding with water, dressing including removal of rubbish and surplus earth, if any, with all leads and lifts.

(a) Holes 1.2 m dia and 1.2 m deep

(b) Holes .90 cm dia, and .90 cm deep

Rough dressing the trenched ground including breaking clods. Uprooting weeds from the trenched area after 10 to 15 days of its flooding with water Including disposal of uprooted vegetation. Fine dressing of the ground.

Spreading of sludge, dump manure and/or good earth in required thickness as per direction of engineer-in-charge

Mixing earth and sludge or manure in the required proportion specified or directed by the Engineer-in-charge

Filling mixture of earth and sludge or manure in the desired proportion in trenches, flooding with water and levelling

GRASSES

Providing & laying Selection no. 1 grass turf with earth 50mm to 60mm thickness on existing ground prepared with proper level and ramming with required tools wooden and then rolling the surface with light roller make the surface smoothen and light watering the same, as per direction of Engineer in charge.

Supplying & Stacking of Selection No.1 Grass at site fresh & free from weeds having proper roots in green including loading, unloading, carriage and all taxes paid etc. and as per direction of Engineer in charge.

TECHNICAL SPECIFICATIONS FOR LANDSCAPE DEVELOPMENT GENERAL

Scope:

Contractor to furnish all materials, labour and related terms necessary to complete the work indicated on drawing and specified here in.

MATERIALS:

Plant materials:

•Plant materials shall be well formed and shaped true to type, and free from disease, insects and defects such as knots, windburn, injuries, abrasion or disfigurement.

•All plant materials shall be healthy, sound, and vigorous, free from plant disease, insect pests or their eggs, and shall have healthy, well-developed root systems.

•All plants shall be hardy under climatic conditions similar to those in the locality of the project. Plants supplied shall conform to the names listed on both the plan and the plant list. No plant material will be accepted if branches are damaged or broken. All material must be protected from the sun and weather until planted.

•All plants shall conform to the requirements specified in the plant list, except that plants larger than specified may be used if approved, but use of such plants shall not increase the contract price. If the use of the larger plant is approved, the spread of roots or ball of earth shall be increased in proportion to the size of the plant. Deliver plants with legible identification labels.

Topsoil:

Good earth PH range 6.5 to 7.5 Topsoil or good earth shall be a friable loam, typical of cultivated top soil of the locality containing at least 2% of decayed organic matter (humus). It shall be taken from a well-drained arable site. It shall be free of subsoil, stones, earth clods, sticks, roots or other objectionable extraneous matter or debris. It shall contain no toxic material. No top soil shall be delivered in a muddy condition.

Fertilizer:

Dry farm yard manure shall be used. It shall be free from extraneous matter, harmful bacteria insects or chemicals.

Root System:

The root system shall be conducive to successful transplantation. Where necessary, the root- ball shall be preserved by support with hessian or other suitable material. On soils where retention of a good ball is not possible, the roots should be suitably protected in some other way which should not cause any damage to roots.

Condition:

Trees and shrubs shall be substantially free from pests and diseases, and shall be materially undamaged. Torn or lacerated roots shall be pruned before dispatch. No roots

shall be subjected to adverse conditions, such as prolonged exposure to drying winds or subjection to water-logging, between lifting and delivery.

Supply and substitution:

Upon submission of evidence that certain materials including plant materials are not available at time of contract, the contractor shall be permitted to substitute other material and plants, with species of equitable amount. All substitutions shall be of the nearest equivalent species and variety to the original specified and shall be subject to the approval of the department.

Packaging:

Packaging shall be adequate for the protection of the plants and such as to avoid heating or drying out.

Marking:

Each specimen of tree and shrub, or each bundle, shall be legibly labelled with its name.

TREES, ORNAMENTAL PLANTS & PALMS PLANTING:

Trees should be supplied with adequate protection as approved. After delivery, it planting is not to be carried out immediately, balled plants should be placed cheek to cheek and the ball covered with sand to prevent drying out. Bare-rooted plants can be heeled in by placing the roots in a prepared trench and covering them with earth which should be watered into avoid air pockets round the roots.

Digging of Pits:

Tree pits shall be dug a minimum of three weeks prior to backfilling. The pits shall be 1.2 m in diameter and 1.2 m deep. It shall be replaced with soil mixture as specified further herein. While digging the pits, the top soil up to a depth of 30 cm may be kept aside, if found good (depending upon site conditions) and mixed with the rest of the soil. If the soil is bad below, it shall be replaced with the soil mixture as specified further herein. The bottom of the pit shall be forked to break up the sub-soil.

Backfilling:

If the excavated soil is normal; it shall be mixed with manure. River sand shall be added to the soil if it is heavy. However, if the soil is bad, the pit shall be refilled with imported good garden soil mixed with manure 2:1 by volume(2 parts of stacked volume of earth after reduction 20%: 1 part of stacked volume of manure after reduction by 8%) The soil backfilled has to be watered through and gently pressed down a day previous to planting to make sure that it may not further settle down after planting. The rest 100mm shall be filled with manure. The soil shall be pressed down firmly by treading it down, leaving a shallow depression all around for watering.

Planting:

No tree pits shall be dug until final tree positions have been pegged out for approval. Care shall be taken that the plant sapling when planted is not buried deeper than in the nursery, or in the pot. Planting should not be carried out in water logged soil.

Plant trees at the original soil depth; the soil marks on the stem is an indication of this and it should be maintained on the finished level, allowing for setting of the soil after planting. All plastic and other imperishable containers should be removed before planting. Any broken or damaged roots should be cut back to sound growth.

The bottom of the planting pit should be covered with 50 mm to 75mm of soil. Bare roots should be spread evenly in the planting pit; and small mound in the center of the pits on which the roots are placed will aid an even spread. Soil should be placed around the roots, gently shaking the tree to allow the soil particles to sift into the root system to ensure close contact with all roots and to prevent air pockets. Backfill soil should be firmed as filling proceeds, layer by layer, care being taken to avoid to avoid damaging the roots, as follows:

Chlorpyrifos emulsifiable concentrate 20% with 1% concentration shall be applied on walls of pit, and initially pit shall be filled to 200 mm depth with earth mixed Chlorpyrifos emulsifiable concentrate 20% with 1% concentration. The balance earth shall be filled in a mixture of 1:2 (part manure to 2 part earth). Chlorpyrifos emulsifiable concentrate 20% with 1% concentration shall be applied every 15 days.

Staking:

Newly planted trees must be held firmly although not rigidly by staking to prevent a pocket forming around the stem and newly formed fibrous roots being broken by mechanical pulling as the tree rocks.

Methods:

The main methods of staking shall be:

(A) A single vertical stake, 900mm longer than the clear stem of the tree, driven 600mm to 900mm into the soil.

(B) Two stakes as above driven firmly on either side of the tree with a cross-bar to which the stem is attached. Suitable for bare-rooted or balled material.

(C) A single stake driven in at an angle at 450 and leaning towards the prevailing wind, the stem just below the lowest branch being attached to the stake. Suitable for small bare-rooted or balled material.

(D) For plant material 3m to 4.50 m high with a single stem a three-wire adjustable guy system may be used in exposed situations. The end of stake should be pointed and the lower l m to 1.20 m should be coated with a non-injurious wood preservative allowing at least 150 mm above ground level.

Tying:

Each tree should be firmly secured to the stake so as to prevent excessive movement. Abrasion must be avoided by using a buffer, rubber or hessian, between the tree and stake. The tree should be secured at a point just below its lowest branch, and also just above ground level; normally two ties should be used for tree. These be adjusted or replaced to allow for growth.

Watering:The contractor should allow for the adequate watering in of all newly

planted trees and shrubs immediately after planting and he shall during the following growing seasons, keep the plant material well-watered.

Fertilizing:

Fertilizing shall be carried out by application in rotation of the following fertilizers, every 15 days from the beginning of the monsoon till the end of winter:

Sludge of organic well-rotted dry farmyard manure or vermi-compost or approved organic manure as per directions of landscape architect:

SHRUBS, GROUND COVERS, CREEPERS PLANTING IN PLANTERS AND BEDS

All areas to be planted with shrubs shall be excavated, trenched to a depth of 600 mm, refilling it with finely mixed good black garden soil and excavated earth (after breaking the clods and mixing with sludge in the ratio 8:1 (8 parts of stacked volume of earth after reduction by 20%: 1 part of stacked volume of sludge after reduction by 8%). Backfill soil should be firmed as filling proceeds, layer by layer, care being taken to avoid damaging the roots, as follows:

Chlorpyrifos emulsifiable concentrate 20% with 1% concentration shall be applied on walls of pit. The balance earth shall be filled in a mixture of 1:2 (part manure to 2 part earth). Chlorpyrifos emulsifiable concentrate 20% with 1% concentration shall be applied every 15 days.

Tall shrubs may need staking, which shall be provided if approved by the Landscape Architect depending upon the conditions of individual plant specimen.

For planting shrubs and ground cover shrubs in planters, good earth shall be mixed with sludge in the proportion as above and filled in planters.

Positions of shrubs to be planted should be marked out in accordance with the planting plan. When shrubs are set out, precautions should be taken to prevent roots drying.

Planting holes 45 cm dia and 45 cm deep should be excavated for longer shrubs.

Polythene and other non-perishable containers should be removed and any badly damaged roots carefully pruned. The shrubs should then be set in holes so that the soil level, after settlement, will be at the original soil mark on the stem of the shrub. The hole should be backfilled to half pots depth and firmed by treading. The remainder of the soil can then be returned and again firmed by treading.

Landscape Management

The Contractor shall maintain all planted areas within the landscape contract boundaries for two year after the area is handed over in whole or in phases.

Maintenance shall include replacement of dead plants, watering, and weeding, cultivating, control of Insects, fungus and other diseases by mean off spraying with an approved insecticide or fungicide, pruning, and other horticulture operations necessary for the proper growth of the plants and for keeping the landscape contract area neat in appearance.

MAINTENANCE WORKS DESCRIPTION AND FREQUENCY:

Landscape site. Cleaning/Housekeeping regularly/ as and when required. All rubbish e.g. waste paper; plastic etc. shall be removed off.

Semi-mature and mature ornamental trees shall be provided as per schedule and drawings to be prepared and got approved..

Landscaped sites Irrigation/Watering As per physical condition. Watering of all plants has to be done

Pest control as and when required.

Anti-termite treatment as per requirement At least once during DLP even problem does not occur.

Trimming/pruning /Training As per site requirement

Turfs Mowing As per schedule will be done by mechanized tools.

Mortality Replacement:

Replace the plants mortalities in case of natural plant death and due to Negligence.

Safety, Health and Environment:

Pruning and repairs:

Upon completion of planting work under the contract all trees should be pruned and all injuries repaired where necessary. The amount of pruning shall be limited to the minimum necessary to remove dead or injured twigs and branches and to compensate for the loss of roots

Tree guards:

Where tree guards are necessary, care should be taken to ensure that they are provided as per site conditions.

1 1.9.4 Nursery Stock:

Planting should be carried out as soon as possible after reaching site. Where planting must be delayed out of necessity, care should be taken to protect the plants from pilfering or damage from people or animals. Plants with bare roots should be heeled-in as soon as received or otherwise protected from drying out, and others set closely together and protected from the wind. If planting is to be delayed for more than a week, packaged plants should be unpacked, the bundles opened up and each ground of plants heeled in separately and clearly labelled. If for any reason the surface of the roots becomes dry the roots should be thoroughly soaked before planting.

The plants, trees, shrubs, grass etc to be provided as per tender drawings attached. The design intent of planting shall be as under and the species of plants to be used in various zones of plantation are given below shall be used in combination to prepare a detailed planting plan. The detailed Planting plan shall be approved by Engineer –In- Charge. The decision of engineer in charge shall be final and binding on the Agency.

Tree Plantation Plan:-

Contractor needs to plan and deploy special agencies to carry out tree plantation as per Environmental Clearance requirement Tentative list of new trees to be planted on site is shown below.

Sr. No.	Nameoftheplant	Common Name	Quantity	Characteristics & ecological importance
1	Cassia fistula	Bahava	4	Small deciduous tree. Excellent bright flowering tree for arid regions.
2	Plumeria alba	Champa	2	Ornamental flowering tree
3	Polyalthia longifolia	Ashoka	20	Large evergreen tree, Effective in decreasing noise pollution.
4	Mangifera indica	Mango	2	Large evergreen and fruit bearing tree
5	Terminalia arjuna	Arjun tree	1	Large deciduous tree, occasional in wild habitat and drought tolerant
6	Psidium guajava	Guava	2	Small deciduous tree, common in gardens, fruit bearing tree.

STRUCTURE - DESIGN BASIS REPORT

1.0 INTRODUCTION

This document specifies the various design considerations and assumptions for the Structural Engineering Design of the proposed Investment Building at Suryanagar, Bhubaneswar, Odisha. The proposed commercial building consists of Basement +3 stories.

2.0 SCOPE OF DESIGN BASIS REPORT:-

Design Basis Report is aimed at consolidating basis of the work that Structural Designer is going to carry out in delivering structural framework of the building which will be compatible with architectural theme, satisfy functional needs, adhering to building norms and Indian Standards provisions and which will be safe, stable, strongand yet optimally economical.

3.0 DESIGN CRITERIA:

- The Structural design of the proposed project is based on Indian Standard Codes and is analyzed for Dead, Live, Wind and Seismic load conditions taking into relevant load combinations recommended by codes
- The structure proposed is RCC Beam/Slab construction with Columns and RCC Walls suitably placed
- The core wall around lifts are of concrete
- The vertical loads including the Dead load and super imposed loads are transferred to the soil through columns, core walls and foundations.The contractor has to carry out the design of foundation as per soil report enclosed.
- The lateral loads due to wind and seismic forces are dissipated to soil through the proposed RC walls/columns
- The type of foundation proposed has to be designed as per the soil investigation report. As per recommendations in the Soil Test Report, Pile Foundation is preferred and considered in the estimate.
- The Buildings are RC frame with open storeys, stipulation of clause nos 7.10.1,7.10.2,7.10.3 & 7.10.4 and sl I under table -6 of IS 1893-2016 are to be complied

4.0 STRUCTURAL SYSTEM

- The structure is a RCC frame structure with Columns, Beams, Regular slab and RC Structural Wall system. The building will be designed for the appropriate thermal and shrinkage stresses as the length of the some of the buildings exceeds 45m.
- The Columns/RC Walls are provided of sufficient size to control deflection under seismic/wind loads. Ductile detailing shall be done as per codal provisions.
- The structural configuration shall be selected to suit the best in the Functional and Architectural requirements.

5.0 DESIGN LOADS:

The building to be analyzed for the following basic load cases:-

1. Dead Load
2. Live Load
3. Seismic Load
4. Wind Load

The Brief Description of each load case is as follows:

5.1 Dead Load:

Dead load shall include weight of all structural and architectural components. All Dead Loads shall be considered as per IS: 875-1987 (Part 1).

Unit Weight of Materials:

Sr. No.	Materials	Unit Weight (kN/m^3)
1	Concrete	25
2	Steel	78.5
3	Water	10
4	Soil	18

5.2 Live loads:

The Imposed Loads are to be considered as per IS: 875 (Part 2) as follows:

Sr. No.	Description	Loads Used UDL(kN/m^2)
1	Office/ Community Hall	4.0
2	Bed, Dinning & Drawing room	2.0
3	Corridors, passages, staircase, and Restaurant/Cafe Area	3.0
Sr. No.	**Description**	**Loads Used UDL(kN/m^2)**
4	Toilet and bathrooms	2.0
5	Balconies	3.0
6	Assembly Place	5.0
7	Terrace	1.5
8	Parking Slab	2.5
9	Driveways & Ramps	2.5
10	Staircase, Lobby and Balconies	4.0
11	Electric Room	5.0

5.3 Earthquake loads:

Earthquake loads:

Bhubaneswar falls under Seismic Zone III as per IS: 1893 (Part 1) - 2016 and has the following factors are to be considered for designs:

Seismic Zone = III

Zone factor (Z) = 0.16

Importance factor (I) =1.2

Response reduction factor(R) = shall be as per IS: 1893(Part-1)-2016 taking into account the structural system adopted.

Soil Type = III (Soft Soil) (Please check with the latest soil investigation Report)

Damping Factor = 5%

Modal Combination = CQC (Complete Quadratic Combination)

Directional combination = SRSS (Square Root of the Sum of Square)

T = 0.09*h/ √d

Design Seismic Base Shear Vb = Ah * W

5.4 Wind loads:

Wind pressure shall be calculated in accordance with IS: 875 (Part 3) - 2015. Bhubaneswar is having basic wind speed of 50 m/s with a factor of 1.15 .This structure to be designed as per Gust factor method as per IS 875-2015. Design life of structure is 50 years. The modification factors considered are as follows:

k1, Probability Factor (50 years life)	1.00
k2, Height and Size Factor (Terrain Category 3, Building Class C)	As per IS 875(Part3) for existing terrain and Building Class
k3, Topography Factor	1.00
k4, Importance Factor for Cyclonic Region	To be considered as per IS as the building is within 60 Km from east coast line

6.0 LOAD COMBINATIONS

The result from the computer analysis in the form of member forces and reactions are to be used for design of the structural members. The various loads should be combined in accordance with the stipulations in the relevant design codes. Following load combinations of the member forces to be considered for arriving at the design forces:

Primary Load Cases:

1. Dead Load (D. L.)
2. Live Load (L. L.)
3. Eqx (X- dir. earthquake)
4. Eqy (Y- dir. earthquake)
5. Wx (X- dir. Wind)

6. Wy (Y- dir. Wind)

Basic Load Combinations:

1	1.5(D. L. + L. L.)	14	1.2(D. L. + L. L.+ Wx)
2	1.2(D. L. + L. L.+ Eqx)	15	1.2(D. L. + L. L.+ Wy)
3	1.2(D. L. + L. L.+ Eqy)	16	1.2(D. L. + L. L.- Wx)
4	1.2(D. L. + L. L.- Eqx)	17	1.2(D. L. + L. L.- Wy)
5	1.2(D. L. + L. L.- Eqy)	18	1.5(D. L. + Wx)
6	1.5(D. L. + Eqx)	19	1.5(D. L. + Wy)
7	1.5(D. L. + Eqy)	20	1.5(D. L. – Wx)
8	1.5(D. L. - Eqx)	21	1.5(D. L. – Wy)
9	1.5(D. L. - Eqy)	22	(0.9D. L. + 1.5Wx)
10	(0.9D. L. + 1.5Eqx)	23	(0.9D. L. + 1.5Wy)
11	(0.9D. L. + 1.5Eqy)	24	(0.9D. L. - 1.5Wx)
12	(0.9D. L. - 1.5Eqx)	25	(0.9D. L. – 1.5Wy)
13	(0.9D. L. – 1.5Eqy)		

In addition to above, load combinations due to dynamic analysis need to be included. For non orthogonal columns, additional 30% earthquake load of other direction shall be taken. Accidental eccentricity of 5% is to be considered as per clause 7.8 of IS: 1893-2016.

Moreover, cracked RC section properties have to be modified separately for factored and un-factored loads as per the clause 7.2 (Table-6) of IS 16700-2017:

Sl No	Structural Element	Unfactored Load	Factored Load
i.	Slabs	0.35Ig	0.25Ig
ii.	Beams	0.7Ig	0.35Ig
iii.	Columns	0.9 Ig	0.7 Ig
iv.	Walls	0.9 Ig	0.7 Ig

Where, Ig is the gross moment of inertia of the section.

7.0 GEOTECHNICAL DETAILS

The Soil Investigation Report is available and uploaded with this Tender. As per recommendation in the Report,suitable foundation to be designed. However the Contractor can carry out their soil investigation, however the design is to be made based on the more stringent values.

8.0 ANALYSIS METHOD

The buildings are planned as a combination of R.C.C. shear wall/ columns beams and slabs forming framed structure. After preliminary sizing of various structural members, a computer model of the structural frame of Building will be generated for carrying out computer analysis for the effects of vertical and lateral loads that are likely to be imposed on the structure.

The building structure is to be analyzed using latest version of ETABS. Above mentioned Analysis/Design software has been thoroughly tested, validated and recognized internationally by several organizations and is well suited for the analysis of building system. Geometrical dimensions, member properties and member-node connectivity, including eccentricities will be modeled in the analysis problem. Variation in material grades, if present, will also be considered. The permissible values of the load factors and stresses will be utilized within the purview of the Indian standards.

The computer analysis will evaluate individual internal forces, reactions at foundation level and deflection pattern of the entire structure and in the individual members. This data will then be used to verify adequacy of the member sizes adopted and after further iteration to arrive at the most optimized design of the structural members. Some re-runs of the analysis programs might be required for arriving at the optimum 3-Dimensional structural frame that satisfy the strength and stability criteria in all respects.

Beams and columns in the structure will be modeled as line members. The shear walls will be modeled as “shell” elements. All slabs shall be modeled as “membrane” element. Rigid Diaphragm is given to reduce degrees of freedom and make problem size smaller. The Structure is analyzed for all possible load combinations i.e. gravity loads, wind earthquake, earth pressure, temperature, etc. acting on it throughout its life span.

8.1 Gravity Load Analysis

Vertical forces are primarily carried by the columns. Live load, superimposed dead load are applied on slabs as pressures.

8.2 Wind Analysis

The building structure shall be designed for the applicable external wind pressure and the same has been considered in Design basis report of Façade. The structure is to be designed as per Gust factor method as per IS 875-2015.

8.3 Seismic Analysis

The building is analyzed by Equivalent static method (ESM) and Response spectrum method (RSM). The spectra considered for the building is as per IS 1893 (part1):2016. The base shears due to response spectrum (RSM) in each direction are compared with the respective direction base shear due to equivalent static method (ESM). If the base shear due to ESM if found to be more than the base shear due to RSM then the equivalent scale factor is applied in RSM and the analysis to be redone.

9.0 DESIGN METHODOLOGY

All structural concrete elements shall be designed according to the Limit state Method as specified in IS: 456-2000. Appropriate loads and its combinations, as per relevant clauses in IS codes, for the most unfavorable effects are chosen for design. Detailing of concrete structures to be done as per IS 13920 – 2016.

10.0 MATERIALS AND CONSTRUCTION

The cement used for RCC work in the sub structure & super structure will be OPC/ PSC in Ready Mix Concrete of grade min. M25. All RCC works will be mechanically vibrated to produce dense, sound and durable concrete as per specifications. The water used in all stages of construction shall strictly conform to IS: 456-2000. If any other cement is used it will be taken care of in mix design of concrete. RMC / Batch Mixing of concrete to be done for structure with mechanical vibration to produce dense, sound and durable concrete. . Excavation for open foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil at founding level during excavation, the same shall be removed and compensated by PCC of Grade M15. The foundation pits Shall be maintained dry during the complete construction period by means of suitable dewatering systems.

10.1 Lean Concrete

Lean Concrete of minimum 100mm thickness of lean concrete M15 grade using 20mm down size graded crushed stone aggregate shall be provided under all RCC foundations. Mud mat shall be extended 100mm on all sides beyond the edges of footings. Concrete Mix of M10 to be used for leveling concrete or as plum concrete only.

10.3 Reinforcement

All reinforcement bars will be HYSD bars of Fe500D grade as per IS 1786.

Structural Steel shall conform to IS: 2062 as applicable, and Structural Steel Tubes shall be Grade Yst 240 as per IS: 1161-1998.

The Young's Modulus of Elasticity shall be considered as follows:

For Structural Steel, Es = 200000 Mpa

For Concrete, Ec = 5000 √fckMpa (IS 456:2000)

Where fck = 28-day characteristic compressive strength of concrete in Mpa.

High Tensile Steel (Fy)=1860N/mm2

11.0 COVER TO REINFORCEMENT:

Concrete cover requirements is governed by criteria outlined in the IS: 456-2000. The values shown below are appropriate for 2 hours of Fire resistance. The following classification also applies in the design of structural elements:

Exposure	Classification	Minimum Grade of Concrete
Members in contact with the ground	Very Severe	M35
Members in interior environments	Mild	M20
Members in above ground exterior environment	Moderate	M25

Clear cover to the main reinforcement shall be as follows.

1. Slab (roof & floor), Waist slab of staircases whichever is more — 15mm
2. Beams (Roof & floor) & Lintels — 25mm

Secondary Beams

3. Columns/Shear Walls/Pedestals (Main R/F) 40mm
4. Foundation slab, base slab & footings in contact with soil 50mm
5. Retaining Walls 50mm

12.0 DEFLECTION CRITERIA

Type of Deformation	Limit
Deflection of all members due to all loads (including temp, creep, shrinkage)	≤ span /250
Deflection of all members due to all loads (including temp, creep, shrinkage) of RCC members after erection of partition, application of finishes.	≤ span /350 or 20mm
Seismic Load (Inter Story drift)	< 0.004 x story height
Wind Load (for overall structure)	< H/500

Where, H - total height of the structure.

Care has to be taken to ensure that for all the structural elements, the deflection values are well within the above limits.

13.0 CRACKING LIMITS:

Limiting values of crack width as per clause 35.3 of IS:456-2000 to be followed in the design. In general for slabs and beams, the crack width is limited to 0.3mm. For basement retaining wall and water retaining structures, foundations and other underground structures in contact with sub-stratum/backfill crack width is limited to 0.2mm.

14.0 DESIGN STANDARDS

In the analysis, design and detailing of the building, the latest editions of following Indian Standards will be referred:

Sl. No	Code	Description
1	IS: 875(Part 1)-1987	Code of Practice for Design Loads (Other than Earthquake) for Buildings and structures – Dead Loads
2	IS: 875(Part 2)-1987	Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures – Imposed Loads
3	IS: 875(Part 3)-2015	Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures – Wind Loads

4	IS: 875(Part 5)-1987	Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures – Special Loads and Combinations
5	IS: 1893-2016 Part-1	Criteria for Earthquake Resistant Design of structures
6	IS: 4326 - 1993	Earthquake Resistance Design and Construction of Building - Code of Practice
7	IS: 13920 -2016	Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic forces
8	IS: 456-2000	Code of Practice for Plain and Reinforced Concrete
9	SP-34	Hand book on Concrete Reinforcement and Detailing
10	IS: 1786-2000	High Strength Deformed Steel Bars and Wires for Concrete reinforcement - Specification
11	SP- 16	Design aids for Reinforced Concrete to IS 456-1976
12	IS:800 - 2007	Code of practice for general construction in steel
13	IS1904	Indian Standard Code of Practice for design & construction foundations in Soil: General Requirements
14	IS 3370:2009	Code of practice for concrete structure for the storage of liquids
15	IS 2911	Code of Practice for design & Construction of pile foundation

DESIGN BASIS REPORT - PLUMBING, SANITARY & DRAINAGE WORK

1. GENERAL :

Reliable and Satisfactory supply of good potable water and an appropriate disposal arrangement of generated effluent are of prime importance in building designed for commercial purpose. Keeping this crucial aspect in view, the provisions of various requirements are made and discussed in the report.

2.0 DETAILED SCOPE OF WORK:

This report proposed to cover the technical details pertaining to the following heads in Plumbing & Sanitary Engineering services:

a.Water Supply System (External)

- Connection of external Municipal/statutory water supply line / proposed sources up to water tank
- Water Storage Tank
- Distribution system of external & internal water supply. Distribution of water of adequate pressure to each and every taps/faucets/outlets.
- Distribution system of recycled water from STP line to Horticulture & Landscaping & Flushing Tanks

b.Sewerage Line System

- Collection and navigating the same through pipe line/ drainage system
- Connection to external Sewerage system
- Sewage Treatment Plant (MBBR Technology)
- Reuse of Treated Water from STP for flushing, irrigation

c. Rain Water Drainage System and Rain Water Harvesting

- Rain water collection
- Disposal of surplus water to external water drainage system
- Storage of water in Rain Water Harvesting Tanks
- Use of water for Flushing / Gardening.

d. Internal Plumbing Works

- Plumbing
- Internal Water Supply System
- Soil and waste water pipes
- Rain water pipes
- Sanitary & Plumbing Fittings
- Disposal to Manhole

3.0 BUILT UP AREA & CONFIGURATION OF THE BUILDING:

- Plot Area : 7994.79 Sqm = 86023.94 Sft
- Basement BUA : 2882.37 Sqm = 31014.30 Sft.
- Gr. Floor BUA : 2271.53 Sqm = 24441.66 Sft.
- 1st Floor BUA : 2271.53 Sqm = 24441.66 Sft.
- 2nd Floor BUA : 2271.53 Sqm = 24441.66 Sft.
- Mumty BUA : 117.06 Sqm = 1259.57 Sft.
- Type of Building : Commercial
- Height of Building : 10m.

4.0 PLUMBING

A.WATER SUPPLY REQUIREMENT :

- The water demand for domestic & flushing requirements shall be as per the latest NBC code. The exact capacity of fire tank shall be as per NBC and local fire deptt. norms as fire NOC shall be issued by the local fire dept.
- The size of the connection will mainly governed by the supply hours and the• pressure at which the water will be delivered. Normally the local Municipality would fix the size of connection, once the demand is registered with them.
- The source of water supply would be municipal water and municipal drainage is• available in the locality and hence it is proposed to connect the building sewer lines to the municipal drainage system1.
- As per the National Building Code 2016, the occupancy load of the building is considered as 100 Sft per person. The total built up area of the building is 74868 Sft excluding basement; Deducting 25% the Carpet Area is 56151 Sft. So No. of persons expected is 561.Hence the water requirement is calculated for 550 persons considering diversity factor. The daily consumption would be 45 liters per person and the total requirement of water would be 24750 ltrs, Say 25000 Ltrs . This calculation is indicative; the actual size of the tank to be provided for domestic purpose shall be given by the PHE Consultant of the EPC Contractor as a part of building design.

- On tentative basis, It is proposed to construct underground sump for 25000 ltrs. And overhead storage unit for 25000 litres .However actual size of the tank shall be worked out by PHE Consultant of the EPC vendor, subject to the above minimum capacity.

- The capacity of Underground fire storage tank would be 100,000 litres or as per the requirement of NBC and Local Fire Dept. Norms. The Fire tank at terrace shall be for 25000 litres. It is proposed to collect the rain water from terrace and open areas and leave in discharge wells for rain water harvesting including collection of rain water in a tank for re-use as per local authority requirements.

- On account of limited open space availability it is proposed to provide underground STP• for recycling of waste water for the purpose of gardening and flushing as per requirement of Green Building Concept. The excess treated water may be discharged in Municipal drain.

IV) WATER DISTRIBUTION

The water will be supplied to the overhead tanks from the UG Tank through pumps and distributed through gravity for all the floors. Hydro- pneumatic pumps at terrace floor shall be provided as per design for pressurization.

To supply water to floors and landscaped areas a network of Heavy duty Pipe line varying in dia from 100 mm to 15 mm would be provided as per the requirement of water at various locations. Separate lines shall be provided to supply domestic water and flushing water to the floors.

Flushing water from OH flushing tank would be supplied only to flushing system i.e. Flushing cisterns of WCs and flush system of urinals. For taps on washbasins, Domestic supply only will be provided.

For lawns and gardens , a net work of pipes would be provided varying in dia from 40 mm to 15mm Pipe line. Supply for lawns & gardens shall be taken from both flushing tank & domestic tank through separate lines.

Required size of Pressure reducing valves shall be provided at suitable locations on the vertical down take pipes & horizontal lines wherever required to achieve the required working pressures.

Treated water from Sewer Treatment Plant (STP) tank shall be supplied for Landscape & Horticulture through garden hydrants/pipes and also to be supplied to Flushing tanks. However separate lines shall also be provided for supplying domestic water to lawns & gardens to irrigate the same in the case when adequate flushing water shall be not be available from STP for irrigation purpose.

To prevent any breakdown in the system all mechanical equipments expected to have normally backup in case emergency/or break down.

If necessary the EPC contractor may install hydro-pneumatic water supply system for efficient water supply system.

Pumping Machinery - The pumps would be provided with vermin proof panels, capacitors, main and auxiliary switches, starters, phase sequence indicator or pilot lamps meters Volt and Ampere meters. All the accessories will be installed in floor mounted / wall mounted panel board. Copper cables of required sizes with crimping lug connections are to be considered.

V) PLUMBING SYSTEMS

a) CPVC pipes for concealed internal work

b) C class GI pipes/ UPVC Pipes for external & exposed works

c)**Fittings and Fixtures**

- Sanitary fixtures shall be white /pastel colors/special colors vitreous china• and of high end quality and make & as per approval of LIC.
- C.P. fittings shall be as per requirement and of premium quality range and taps• & cocks with controlled flow of water & confirming to GRIHA/ IGBC norms.
- For most of the sanitary and plumbing fixtures, catalogue no, makes and basic• prices are provided in civil, architectural and structural DBR, and in E- tender document. The fixtures provided shall not be of lesser model & basic price than the specified in the tender. Due to oversight if model & basic cost is not specified for any fixtures, it is deemed that the quality/range of the fixtures shall match with the other fixtures provided in a particular toilet.

VI) DRAINAGE WORKS

As recommended in code of practice for soil and waste pipes above ground (I.S: 5329 - 1964) shall be of two pipe system, in which separate vertical stacks as per the following is provided:

i. Soil Pipes shall carry the wastes from WC‟s & Urinals directly to manhole outside the building.

ii.Waste Pipes shall carry the wastes from Wash Basins, Sinks, Floor rains, etc. to Gully Traps outside the building and in turn connect to l manholes.

iii.Vent Pipe - Dedicated vent of required size shall be provided separately for each stack as recommended.
iv.

iv.UPVC rainwater pipes to be provided to dispose water to Rain Water Harvesting System through a network of drains/ pipes and chambers.

To ensure that the plumbing system is unhindered, all toilets/wet areas shall be designed with the following structural provisions:

S No.	Details	Requirements
a)	Wet Areas/ toilets slab to be sunk	Wet areas to be made sunk by around 50-60mm and waterproofing of the same to be carried out as per specification given in civil DBR. Pipe lines of Wash Basins, Sinks & Floor Drains and soil pipes of WC should be taken down though core cutting in the toilet slab and collected below the slab. The ceiling of the toilet will be covered by marine grade Gyp Board false ceiling. Core Cutting for traps and WC soil pipes shall be provided and marked accordingly

Utilization of Shafts

S. No.	Shafts	Size / Detail
a)	Plumbing shafts for Toilets	(i)In the shaft pipes to be placed in such a way so that all vertical pipes are exposed and approachable and accessible within the shaft. (ii) Hence a service platform to be provided. (iii) Doors need to be provided for every shaft, at approachable level, for repair & maintenance and cleaning.
b)	Rainwater Pipes	Rainwater pipes with required size from terrace and other places to be placed preferably in plumbing shafts with efficient overview and responsible detail designing and preparing working drawing
c)	Other Shafts	Other shafts may be utilized as per site requirement and final planning and detailing.

Material for Soil, Waste & Rainwater Pipes .

- Un-plasticized Rigid PVC Rain Water down take pipe 6Kg/Sq.cm (IS:13592) with fittings.
- Heavy Duty SWR Pipes

Drainage Disposal :

- The design of external drainage would be as per guide lines given in CPHEEO (Central Public Health and Environmental Engineering Organization) and internal drainage arrangements would be done as per guide lines given in the manual published by Bureau of Indian Standards.

- The rate of generated effluent is considered as 90% quantity of total water consumed. Separate Ground water infiltration is not considered because: Most of the lines up to sump would run below building and would be provided with concrete encasing. Quality of work is expected to be good and satisfying the testing requirements when tested hydraulically. The slopes in the gravity lines would be 1 in 80 to 1 in 100 normally.
- The layout of the building should be such that major quantum of the effluent would be collected in collection chambers at the ground level from where it will be discharged into the sewage treatment plant at a single point.
- Bye pass line from STP Plant to nearest Municipal Sewer to enable to pump the sewage to Municipal Sewer with pumping arrangement during the breakdown period of STP operation. The pipeline to be designed to resist the pressure.

Design Parameter for Sewerage System

The design parameters for the drainage system should be as per NBC latest version and other BIS codal provisions

The indicative data required to design the network are pipe lengths, nodal demands, ground level of the nodes, other design constraints such as peak factor, minimum and maximum allowable velocities, manning coefficients, outfall nodal demand, ground elevation, number of nodes, links etc.

a) Depth of Flow (up to 250 mm dia pipe) - Max. 50% full at peak

b) Velocity

Minimum velocity at peak - 0.60 m/sec

Maximum velocity at peak - 3.00 m/sec

c) Peak Factor - 3 times the average flow

d) Interception factor - 0.80

e) Manning Constant - 0.011 (for RCC PIPES)

f) Design Equation - Manning Equation.

g) Size of Manholes

For depth of manholes up to 0.90 m - 600 x 600 mm

For depth of manholes 0.90 to 1.65 m - 0.90 m. dia

For depth of manhole 1.65 to 2.25 m - 1.20 m. dia

For depth of manhole 2.25 & above - 1.50 m. dia

h) Man Hole Interval - As per site requirement Max. 30 M

i) Material of pipe - SW Pipe or RCC NP2/NP3

j) Min. diameter adopted for sewer pipe - 200/ 250 mm Dia.

Appurtenances & Material Specifications for the Sewerage System

a) Pipes

i. PVC Pipes of dia 150mm to 250mm Eco drain (SN-8) pipe as per IS:16098.

ii. S.W. Pipes of dia 150mm and 350mm Grade „A" as per IS:651 depending on site conditions with laying, jointing and bedding as per IS:4127-1983.

iii. R.C.C. Pipes Class NP2/NP3 of dia 200mm and above as per IS:458, for normal slopes and general site conditions(Road crossing etc).

b) Manholes

The manholes shall be constructed of brick masonry as per standard specifications of National Building Code / CPWD according to requirement and having details as follows:-

i. Type „A"-- Rectangular of size 900x800 mm up to 900mm depth.

ii. Type „B" -- Rectangular of size 1200x900 mm from 900mm & upto 2.45m depth.

iii. Type „C" -- Circular Manhole of Size 910mm dia for depth upto 1.67m.

iv. Circular Manhole of Size 1220mm dia for depth above 1.67m and upto 2.30m.

v. Circular Manhole of Size 1520mm dia for depth above 2.30m.

c) Manhole Covers

RCC manholes Cover with frame of HD-20 designation

SEWAGE TREATMENT PLAN:

It is proposed to install a Sewage Treatment Plant 35 KLD or as per building parameter as per latest Norms of Central pollution control Board (CPCB) in order to conserve water, the treated sewage water is to be re-used for Flushing and irrigation. The sewage is generally generated from the toilets and pantry. The sewage flow conditions will be varying throughout the day with the flow peaking in the morning & evening hrs. It is proposed to treat the sewage in Moving Bed Bioreactor (MBBR) attached growth process, not only to reduce the level of pollution in the wastewater to the limits specified by the Pollution Control Board and can also make it suitable for use in Flushing and Horticulture after further tertiary treatment by providing filtration plant .

STPs based on Moving Bed Bioreactor (MBBR) attached growth using PVC fill media & fine bubble non-clog type membrane diffusers. The plant is partly covered from the top & manholes can be provided to access the inside of the tank.

Indicative Treated Water Parameter or as per CPCB - MBBR Technology:

Sr. No.	Parameters	Units	Inlet	Outlet
1	pH		6 to 8	6 to 8
2	BOD	Mg/l	300 - 400	<5
3	COD	Mg/l	600 - 750	<10
4	TSS	Mg/l	450 - 550	<30
5	Oil & Greese	Mg/l	15-70	Nil
6	Coliform	MPN/100Ml		230

STORM WATER DRAINAGE:

a) **Introduction**

The storm water drainage will be provided as per guide lines given in CPHEECO unless otherwise any specific requirements are given. The storm water disposal arrangements would be in two parts as below

i) Rain Water Pipes of requisite dia. and numbers are proposed for draining rainwater from terraces of various buildings.

ii) The rain water received from roofs and from open plots will be collected in RCC NP2/NP3 class pipes or PVC Agri Pipe of 10 Kg/cm2 lines of various diameters. The rainwater will be collected in catch pits which will be disposed in natural course through pipe line connected to these catch pits.

b) **Design Criteria**

The rain water intensity of 150 mm/hr is to be considered for designing the system. The runoff factor is considered as unity because at above rate of intensity the water table will be at ground level and there will be hardly any percolation because of paved area The pipes would be considered as running in half full conditions for design purposes. System Design

The rain water pipe coming down from roof will terminate in a rain water receiving chamber. The chamber then will be connected to Collection System. The rain water receiving chamber will be having RCC heavy type grating at top so that water in surrounding area will also have access in disposal system which will be connected to percolation pits at intervals, so that max water is percolated and ground table is raised.

The catch pits would be of brick masonry chambers (CPWD specification) of varying depths. The system will carry surface runoff as well the rain water from roofs of all buildings proposed as new construction.

Also there will be a trench drain from the periphery of the arena to take the surface water to the recharge pits or rain water storage tank the trench will be stone finished because of the level difference which can destroy the PCC also there will be 12 tanks at various intervals to reduce the velocity of the water & also act as a Rain water harvesting Tanks.

c**) Rain Water Harvesting**

The Governments in all states have provided guide lines for Rain Water Harvesting. A suitable scheme would be introduced and coupled with the Collection System. The scheme will be such that it will be very easy for operation. Very low cost maintenance would be involved. Use of electric power, mechanically operated equipments etc would be totally avoided. The scheme implemented would be with minimum capital cost and minimal recurring expenditure.

Rain water harvesting tank of adequate capacity as per requirement of statutory authority /MOEF shall be constructed of appropriate material. The overflow from RWHT shall be connected to municipal storm water drain.

APPROVALS, CLEARANCES & DISCLAIMER

As per the latest govt. notifications clearances from local pollution control board authorities and Ministry of Forests and Environment to be obtained for project

Necessary processing for obtaining permissions /NOC for STP, exhaust systems and other environmental related matter, for boring of tube well, or any other permission required from Local /Statutory authority and ultimately obtaining NOC/ permission/connection from local/ statutory authority is the responsibility of the EPC contractor.

Necessary processing for obtaining permissions /NOC from Fire Fighting authority and ultimately obtaining NOC/ permission/connection from local/ statutory authority is the responsibility of the EPC contractor.

Necessary processing for obtaining permissions for obtaining water supply / sewerage /drainage/electric connections from Local /Statutory authority and ultimately obtaining NOC/ permission/connection from local/ statutory authority is the responsibility of the EPC contractor.

However, statutory fees shall be paid by LIC

Data produced in this report shall not be altered without due consent Discrepancy observed in this Report / Document /Calculations shall be immediately brought to the notice.

LIST OF REFERENCES

a. National Building Code 2016 (Govt. of India)
b. Hand book of Water Supply and Drainage, Bureau of Indian standards. SP-35 (S&T).
c. Manual of water supply & Treatment, Central Public Health and Environmental Engineering Organization.
d. Sewerage and Sewage Treatment (Ministry of Urban Development, New Delhi), (Govt. of India)
e. Schedule of specifications of C.P.W.D. (Govt. of India) with all latest amendments issued from time to time
f. Hand book for Public Health Engineering by Indian Water Works Association.
g. Manual on Ground water &Tubewells by Central Board of Irrigation & Power, Govt. of India.
h. Ministry of Environment & Forest Guidelines
i. Water supply and sewerage by Steel
j. Code of practice for provision and maintenance of water supplies for fire fighting IS: 9668:1990
k. Other relevant ISI codes
l. Code of basic requirement for water supply, drainage and sanitation
m. IS:1172:1983by Bureau of Indian Standards
n. Latest relevant NFPA Codes, USA, in particular NFPA-13, 14,20 & 22 (NFPA)
o. Universal Plumbing Co.
p. Latest Green Building Norms
q. **CONSOLIDATED LIST OF BIS STANDARDS APPLICABLE**

S. No.	I.S. Code	Description / Title
1.	I.S : 3989	Centrifugally cast (spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories (2nd rev.) (Amendment 2)
2.	IS:1536	Specification for centrifugally cast (spun) iron pressure pipes for water, gas and sewage.
3.	I.S: 1538 (Part-I to XXIII)	Specification for cast iron fittings for pressure for water, gas and sewage.
4.	I.S:3714	Code of practices for laying C.I pipes
5.	I.S:782	Specification for caulking lead

6.	I.S:1239 (Part-II)	Specification for mild steel tubes, tubular and other wrought steel filling.
7.	I.S:1879	Specification for malleable cast iron pipe fittings.
8.	I.S:4984	High-density polythene pipe for potable water supplies, sewage and Industrial effluents.
9.	I.S:783	Width and depth of trench for R.C.C pipes.
10.	I.S:4127	Width and depth of trench for S.W pipes.
11.	I.S: 780	Specification for sluice valve for water works purposes.
12.	I.S:651	Specification for salt glazed stoneware pipe and fittings
13.	I.S:7558	Code of practice for domestic hot water installation.
14.	I.S: 1742	Code of practice for building drainage
15.	I.S: 2064	Code of practice for selection, installation and maintenance of Sanitary appliances.
16.	I.S:2065	Code of practices for water supply in building
17.	I.S: 2183 (Part-I)	Code of practice for Plumbing in multistoried
18.	I.S:1239	Specifications for mild steel tubes tubulars and other wrought steel fittings. (Fifth Revision)
19.	I.S:778	Specifications for copper alloy gate, globe and check valves for water works purposes.
20.	I.S:5312 (Part-I)	Specifications for swing check type reflux (Non return) valve
21.	I.S:908	Specifications for fire hydrant (2nd Revision)
22.	I.S:5290	Specifications for landing valve
23.	I.S:901	Specifications for coupling double male and female instantaneous pattern for fire fighting (3rd revision)
24.	I.S:884	Specifications for first aid hose reel for fire fighting (1st Revision)
25.	I.S:903	Specifications for fire hose delivery couplings branch pipe, nozzles and nozzles spanner (3rd revisions)
26.	I.S:933	Specifications for portable chemical from fire Extinguisher
27.	I.S:2171	Specifications for portable fire extinguishers, dry powder. (3rd revision)
28.	I.S:2190	Code of practice for selection, installation and maintenance of portable first aid fireextinguishers.
29.	I.S:2878	Specifications for fire extinguisher carbon dioxide type. (2nd revision)
30.	I.S:9972	Specification for sprinkler
31.	I.S:3844	Code of practice for installation and maintenance of internal fire hydrants and hose reels on promises.
32.	I.S : 3114	Code of Practice for laying of C.I. pipes (2nd Rev.)
33.	I.S. : 456	Code of practice for plain and reinforced concrete (3rd Rev.) (Amendment 2)

34.	I.S. : 12820	Code of practice for dimensional requirements of rubber gaskets for mechanical joints and push on joints for use with cast iron pipes and fittings for
35.	I.S. : 1172	Code of basic requirements for water supply, drainage & sanitation (4th Rev.)
36.	I.S. : 1200 (Part-16)	Code of practice for methods or measurements of building and Civil Engineering works: Part 16 Laying of water and sewer lines including
37.	I.S. : 1200 (Part-19)	Code of practice for methods or measurements of building and Civil Engineering works: Part 19 Water supply, plumbing and drains (3rd Rev.)
38.	I.S : 13095	Butterfly valves for general purposes
39.	I.S : 458	Precast Concrete pipes (with or without reinforcement) (3rd rev.) (Amendment 2)
40.	I.S : 1726	C.I. Manhole covers & frames (3rd rev.)
41.	I.S : 1916	Steel cylinder pipe with concrete lining and coating (1st rev.).
42.	I.S : 12592(part1)	Pre-cast concrete manhole covers and frames: Part 1 Covers (Amendment 3)
43.	I.S : 12592(part2)	Pre-cast concrete manhole covers and frames: Part 2 Frames
44.	I.S : 6392	Steel pipe flanges (Amendment 1)
45.	I.S : 6418	C.I and malleable C.I. flanges for general engineering purposes.
46.	I.S : 4985	Unplasticized PVC pipes for potable water supplies (2nd Rev) (Amendment 2)
47.	I.S : 7181	Horizontally cast double flanged pipes for water ,gas and sewage.(1st Rev.) (Amendment 1)
48.	**I.S : 210**	Grey iron casting. (4th Rev.)
49.	**BS EN 1057**	Copper pipes
50.	BS EN 1254	Copper Fittings

DESIGN BASIS REPORT : ELECTRICAL & OTHER INSTALLATIONS

GENERAL

The Electrical System shall be designed in accordance with the following listed applicable codes, standards, design guidelines and authorities having jurisdiction:

- National Building Code-2016
- Applicable sections of NFPA
- IES: Illuminating Engineering Society
- IEEE: Institute of Electrical and Electronic Engineers
- NEMA: National Electrical Manufacturers Association
- UL: Underwriters Laboratories
- Energy Conservation Building Code.
- National Electrical code.
- CPWD General Specifications for Electrical Works Part I Internal.
- CPWD General Specifications for Electrical Works Part IV Sub Station.
- BIS: Bureau of Indian Standards
- BEE : Bureau of Energy Efficiency
- Regulation lay down by the local & State Govt. Authorities.
- Regulation lay down by the Electrical Inspectorate, Govt. Of India

B. ELECTRICAL SERVICES

1. Source of Power
2. LT Distribution Including Cables
3. Emergency power supply
4. Illumination Levels
5. System of Wiring / Cabling
6. Switching Arrangement
7. Internal light fixture & Fan
8. MV switchgear & Power Panels
9. Distribution board
10. MV cables
11. Estimated power requirements
12. Earthling
13. Lighting arrestor
14. External Lighting
15. APFC Panel
16. Lift
17. Various Electrical Motors & Pumps
18. ELV service- Telephone / intercom , Data wiring system
19. Addressable Fire Alarm System with public announcement system
20. Design based report on Air Conditioning system
21. Smoke Management system at Basement
22. Fire Suppression System

23. Signage
24. CCTV

DESIGN CRITERIA:

The design basis report covers all the basic guidelines to be followed for electrification of this project. However it may not cover all aspects of the system design which must be taken into consideration during finalization of the tender .

The following factors are to be taken into account while designing the electrical system for this building;

- Safety of life and property.
- Reliability of power supply to the extent possible.
- Automatic protection of all electrical appliances through selective protection system.
- Simplicity of operation.
- Ease of maintenance.
- Flexibility of system .
- Iinitial Cost.

1. SOURCE OF POWER: Electrical Supply

Based on prevailing electricity rules , 415/230 V supply will be made available through Individual metering system by the agency for the investment building. The agency shall approach the electric supply authority (**TPCODL,BHUBANESWAR)**for providing the Point of Supply to the building for the proposed electrical load. As per their advise and requirements, providing the necessary infrastructure i.e. ***Pole mounted /plinth mounted substation and associated works thereof is in the scope of this work.*** However, if the supply company provides the infrastructure on the deposit Basis then the deposit amount shall be reimbursed to the agency. Any statutory payment made for obtaining electrical service connection shall be reimbursed on production of ORIGINAL receipt.

1.1: **HT power network**: Power from the HT metering unit of the local body (TPCODL) will be transferred to the 11 KV/33 KV HT distribution panel after providing suitable capcity RMU/VCB if require by means of 11 KV underground HT XLPE cable.

1.2:**Step Down subsbtation**:- Power received from 11/33 KV will be stepped down to 415/433 Volts by using 1000 KVA (ONAM) copper wound step down distribution transformer .

2. : **LT distribution**: From the Point of Supply of Electric Supply Company, LT feeder with outgoing Aluminium Conductor armoured XLPE cable of required rating shall be laid upto will be feed to the Main LT panel which is located in the Electrical Room of the ground Floor of the building.

Power from the Main L.T. Panel to sub-panel/floor panel,Distribution boards shall be distributed through adequate size of cables, wires, controlled through adequate size of switchgears, MCCB's etc.**All sub floor panel in each floor must have suitable capacity and sufficient capacity MCCB for feeding electric power to the individual rentable area along with suitable cable tray arrangement to each rentable area for both air conditioning and lighting load as per the requirement.**

Separate Panel shall be provided in the Electrical Room for the Emergency load. The supply to this panel shall be feed from DG set. Aluminium Conductor armoured XLPE cable shall be provided for incoming/outgoing connections from/to DG set .

Metering arrangement:-The building is designed to have 4 office area in each floor. Hence, separate elelctric feeder panel along with LT metering arrangement can be planned and discussed with the supply agency for the individual required load. If the supply company agreed to the above proposal,then individual LT meter for individual area can be provided with necessary aggrement with the supply of authority at the time of use of the space.

3. Emergency backup Power supply (DG Set)

During normal power condition, all electrical loads will be on Mains power available through feeder. In case of mains power failure, alternate supply available through DG (50 KVA) will feed all Common area Lighting, External Lighting, Lift & water & fire pumps, UPS (i.e. computer points)as per the requirement. The power supply for lighting and air conditioning of individual area through DG set has to be decided and separate metering arrangement may be made for supply of DG power.

4. Illumination Levels: The lighting will be as per the specifications laid down for commercial along with the recent developments in illumination.The general lighting of various areas will be planned to provide the following illumination levels as per IS: 3646.

Si No	Area	Type Of Lighting Source & fixtures	Illumination Level (Lux)
1	Office Area (T**he lighting layout along with fixing of fixtures is in the scope of Tenant)**	Recess/surface mounting type LED fittings having color rendering index of not less than 80 and lighting system life of 50,000 burning hours and very low system loss. The fixture will be recessed mounted in false ceiling.	(1) Basement 350-400 (2) Passage 200

2	Pump/ Similar rooms	Surface mounting type LED tube light fitting	200
3	Parking area in basement	LED Spherical/Square/Rectangular Surface mounting type	150
4	Corridors and utility areas like toilets, lift lobbies, staircases & Substation	Combination of LED tube lights, Box fittings, Cove including sinage Lighting. Illuminated Fire Exit sign at entrances to fire escape staircases.	200

4.All **internal lighting fixtures** should be LED type having, CRI >80, THD <10%, Driver should be BIS certified. In Common Areas, Corridors, Staircase etc , most of the points shall be group controlled (not requiring separate switch) such that alternate points are connected in one group.

A complete lighting system will be designed based on the needs of different areas. Lighting shall be provided in all the areas of the building. The type and quality of fittings and their luminous intensity shall relate to the space being illuminated and will take into account and effect to architectural space concept and colour scheme.

The internal lighting should have ultra modern LED fittings (2x2 fittings)along with down lighter,LED strip lighting ,4 ft LED tube light , ceiling fan 1200 mm,wall mounting fan of 400 mm with metallic body with metallic blade, in basement, lobby, strircase, pump room, electric room and all common area.

5. System of Wiring:

The system of wiring will be with PVC insulated ISI FRLS 1.1 KV grade copper conductor stranded wire in ISI Marked Heavy Duty FRLS PVC concealed /surface conduits.

Minimum size of copper conductor will be as follows:

01	Light/fan/exhaust fan/call bell/twin control light point	3x1.5 sqmm PVC FRLS wire
02	Power point in lighting circuit	2x2.5+ 1x1.5 SQMM PVC FRLS wire
03	Power point for industrial use (AC/Geyser)	2x 4+ 1x2.5 sqmm PVC FRLS wire

Colour code will be maintained for the entire wiring installation i.e. Red, Yellow, Blue for three phases, black for neutral and Green for earthing.

Providing MODULAR switches, socket type stepped electronic celing fan regulator, modular sockets all on modular swtich plate to be fixed on MS concealed box OR PVC surface box.

POWER PLUG POINT / AC point / geyser point shall be with 5-pin socket outlets, 16 Amps switch + universal socket outlet. Wiring for power point/AC/geyser shall be with 2x4+ 1x2.5 sq.mm wires.

Independent plug point/ raw power point on table shall be with 6 Amp- 5-pin socket outlets with 6 Amps switch .Wiring for independent plug/raw power point shall be with 2x2.5+ 1x1.5 sq.mm wires.

All internal electrical works shall be carried out with ISI marked PVC insulated FRLS 1.1 KV grade copper conductor stranded wire in ISI Marked Heavy Duty FRLS PVC conduit and accessories. All switches, sockets, AC Starter (Modular type), Tele Phone socket, / Data sockets, stepped type electronic fan regulators, bell push , Ceiling rose, Holders and accessories along with matching mounting boxes shall be of modular type.

Provision by laying pipes for incoming telephone cables from outside of the each building is also covered in the scope of work.

Staircase lighting shall be group controlled.

The connection between incoming switch / isolator and bus bar shall be made suitable size of thimble and cable.

Conduits for fire alarm system, telephone, Data networking, are to be provided for ease of drawing wires and maintenance as per the direction of the Engineer-in-Charge .For accommodating various size of cable incoming to the building, G.I. pipe/DWC pipe of suitable size shall be provided.

Suitable number 5A/15A 5 pin socket outlets with switch shall also be provided at appropriate locations, keeping in mind of requirements like supply point in lift shaft, security cabin, Electrical panel room, pump room etc.

The **Minimum points** in building are as under:-

Si No	Type of point	Basement	Ground Floor	1st floor	2nd floor
1	Power Point (A.C / Eqipment point	10	20	20	20
2	Light/wall fan/ c.fan point	80	96	96	96
3	5A plug point	5	20	20	20
4	Exhaust fan point	8	8	8	8

6. Switching Arrangement:

Switching arrangement at various locations has been planned keeping in view the ease with which isolation can be achieved and also the level of fault protection desired at the particular current rating. In Main LT panel, switching on incoming circuits will consist of MCCB (not less than 250A) to be provided. Sub-distribution boards will incorporate MCCB/ MCBs as per requirements. Final distribution board will incorporate Miniature Circuit Breaker (double pole/single pole) backed by Residual Current Circuit Breaker with over current protection.

7. INTERNAL LIGHT FIXTURES , FAN

Following LED type Light Fixtures are proposed:-

All internal lighting fixtures should be LED type having CRI >80, THD <10%, Driver should be BIS certified. The system efficacy of Luminaries shall be minimum 120 lm/W, suitable for working temp -10 to +45 deg. C, humidity 10% to 90% having IP rating 20, and complete luminaire shall have guaranteed life of 50,000 burning Hrs or 6 years whichever is earlier. Driver should be of constant current with input voltage 220-240 V, power factor > 0.9 and efficiency of ≥ 85 %, THD ≤ 10%, Surge protection (L-N) 1KV, Surge protection (E-L/N) 2 KV. Driver shall have open load and short circuit protection confirming to EN 61547. Recess fittings shall have diffuser so designed to light False ceiling as well. In case Luminaries (except down lighter) is to be recessed with the false ceiling grid / required to be suspended , the same to be suspended to the true ceiling by providing Anchor fasteners of 8 mm diameter and suspended by GI wires so as the load of the luminaries is not transferred to the false ceiling grid.

Each light fixture / luminaries shall be provided with an earthing terminal suitable for connection to the earthing conductor. All metal or metal enclosed parts of the housing shall be bonded to the earthing terminal so as to ensure satisfactory earth continuity throughout the fixture.

All exit signages, lights in staircases, exit path and in critical areas shall be on essential supply. In, Corridors, parking etc , points may be group controlled (not requiring separate switch) however not more than four light points is to be grouped together while in staircase two way switches to be used for controlling light point.

Ceiling Fans: 1200 mm dia sweep ceiling fans in basement/lobby/electrical panel etc area shall be provided . All ceiling fans shall be should be BEE 5 Star rated.Minimum air delivery and service value shall be as per the BIS specification. Not more than 2 fans on one switch board.

Exhaust Fans: Heavy duty exhaust fan (metal) having 300 mm sweep, single phase, 1400 RPM with louvers in the Toilets.

8. MV SWITCHGEAR & POWER PANELS

Compartmentalized type powder coated Power & Lighting Cubical panels, Distribution boards as per Specification & vendor GA Drawing. There shall be separate panels/feeder for Normal and emergency Lighting, Power, LIFT, Pumps, and D.G. supply.

All electrical panels shall have coppper bus bar and 20% spare capacity in terms of outgoing breakers and cable sizes shall be kept.

In Building, Electrical Duct will be provided for the fixing of cable or wire in Heavy duty PVC pipe from meter room to floor distribution box (DBs).

Type of power: There shall be Critical (DG set supply), Non-critical (Normal supply). All Lighting, fans, UPS (computer points),fire alarm panel & Pump a will be on DG set supply. The other loads including power point outlets/AC point shall be on Normal Supply.

Building Panels: In building main panel Incomer, outgoing, bus bar, indicating instruments etc shall be designed as per connected load and shall be got approved from Engineer-in- charge.

9. DISTRIBUTION BOARDS

TPN PPI Double Door Distribution Board, VTPN & Flexi Distribution Boards, SPN Distribution Board, MCB/MCCB Enclosures, with required quantity & capacities of MCCBs, MCBS, RCCBS, RCBOS, Change Over switches, etc. for light, power, AC Emergency supply Distributions.

10. MEDIUM VOLTAGE CABLES, CABLE CONNECTIONS & TERMINATIONS

All Horizontal runs of Cables shall be laid on surface of wall/beam/column/ceiling. The underground cable shall be laid in trench as per the BIS specifications. The single/double run 8 SWG G.I. earth continuity conductor shall be provided with cable.

Aluminum / Copper XLPE insulated medium voltage (1100V grade) ISI cables for incoming supply to all the panels , distribution Boards, Equipments & appliances Adequate size single /Double compression type brass cable glands and tinned copper / AL. neck type lugs including cutting / stripping of cable insulation, fixing of cable glands, crimping the lugs.

11. ANTICIPATED /TENTATIVE POWER REQUIREMENTS:

Although tentative load is calculated but EPC contractor has to re-evaluate the load calculation again.

Sr. No.	Type of load	Load in KW	Diversity factor	Maximum Demand(KW)
1.	Lighting/fan Load/independent plug point considering 2W/sqft for rentable area i.e. 58000sqft	116	0.8	92.80
2.	Lighting Load for common area LS	10	0.8	8.0
3.	AC Load/Power Point	485	0.8	388.00
4.	Landscape lighting	20	0.5	10.00
5.	Elevator-2 nos	15	1	15.0
6.	STP	10	0.8	8.00
7	Pump(Centrifugal & submersible)	5	0.8	4.00
8	External Lighting	5	0.8	4.00
9	Equipment load 2W/sqft for rentable area i.e. 58000sqft	116	0.8	92.80
10	Fire Pump	45	1	45.00
11	Ventilation fan	45	0.8	36.00
Total		872		703.60
				703.60KW

Total KVA Considering 0.95 Power factor = 740.60 KVA
Considering efficiency of Transformer (0.9) = 822.90 kVA
Hence, We may consider 1000 KVA distribution step down transformer

12. Earthing:

Dedicated earthing with 600 mm x 600 mm x 3.15 mm Copper Plate electrodes for I.T. Equipment (i.e. UPS and DG) and 600mm x 600mm x 6 mm G.I. plate earthing for other installation shall be provided . The work will be carried out strictly as per BIS/IEC. Earth conductor, earth bus, protective conductor etc for building shall be as per provision laid down in IS specifications .Earthling system should be designed

such as to maintain earth resistance as specified IS/ IE specifications/ rule. Earth resistance shall be checked / tested in harsh climatic conditions.

a) Code of practice for Earthing IS: 3043

b) Code of practice for the protection of Building and an allied structure against lightning IS: 2309.

c) Indian Electricity Rules 1956 with latest amendments.

d) National Electricity Safety code IEEE publication.

13. Lightening Arrestor:

Lightening Arrestor: Air Terminal, 5.0 Mtr Mounting Mast, Down conductor of suitable size GI strip 20x3mm, 25x3mm, testing point, LSR, etc. and testing of the system complete in all respect. Lightning Protection complete with the Lightning Air Terminal - Configured as a Spheroid which is comprised of separate electrically isolated 4 rod surrounding an Earthened Central Finial. The upper section of the central final shall be rated to withstand 200KA. System should be properly earthed as per IS standards.

Lightning protection to building structure shall be provided by fixing of lightning conductor final with base connecting and installing horizontal conductor on roof top with suitable number of down conductor up to earth electrode via test point. The installation will be carried out as per BIS 2309 International Electrical Code of Practice.

14. External Lighting:

Passages, paths/street/Gate and building lighting will be carried out to meet the requirements of building using LED type lighting luminaries etc. with underground cables and with auto & manual switching system for operation.

Lighting for outdoor areas e.g. Perimeter, Building illumination is also being considered by energy efficient LED and shall be controlled with contactor and timer for automatic on/off and to achieve economy and energy saving. Manual operation option should also be there. External lights are to be connected through underground cables. Recessed metal halide lights shall be provided in the ground floor. Few floodlights shall be provided to highlight some portions of the buildings. Gate light shall be also provided.

Street light poles along with 3 way weather proof junction box suitable for upto 3 Cx 2.5 sq.mm. cable, Cable entry & exit conduit, wiring from junction box to the light fixture with 3C x1.5 sq. mm.PVC ZHFR insulated copper wire, SP MCB for ON/OFF control inside the junction box 2.5 m long, 8 SWG G.I. wire coil type earthing for each pole.

For lighting of the security patrolling boundary roads and other roads and pathways, streetlight poles will be used with suitable rating LED Fixtures. The power supply (single phase supply) to street lights will be taken to from common area DB.

Street-lighting shall be operated with timers located in the distribution pillars and shall be operated as follows:

6 PM to 10 PM	-	100% Lights ON
10 PM to 6AM	-	50% Lights ON

Street light has to be provided as below:		
1	External Periphery	LED Street light fitting on 4.5 mtr 50 mm Dia G.I. Pipe lamp post. (not less than 45 W LED Light) LED street light fittings with 25 mm Dia G.I. pipe bracket on external wall of Building (not less than 18 W LED Light)
2	Gate pillars	Suitable decorative lights (not less than 18 W LED Light)

The light fittings are to be of CROMPTON/PHILIPS/WIPRO/GE/K-LIE/HAVELLS MAKE

15.1 APFC PANEL

1 No. APFC panel (around 350 KVAR +_ 5% with staging capacitors which included 50KVAR, 25KVAR, 20KVAR, 15KVAR,10 KVAR,5KVAR,3 KVAR, 2 KVAR, 1 KVAR) shall be provided & it will be connected with LT panel. Panel shall have approximately 10% capacity of fixed capacitors (always on) and 90% capacity of automatically connected Capacitors.

i)Capacity : Designed capacity to maintain overall P.F. of the system between 0.98 to 1.00
ii)Type of capacitor: Dielectric self healing type shunt capacitor 14% D-tuned harmonic filter with current limiting device discharge register.

i) Incomer : Microprocessor controlled MCCB of designed capacity
ii) Bus bar : Copper of suitable rating
iii) Contactors : Capacitor duty contactor of suitable rating
iv) Other accessories and metering instruments like power factor digital meter, 3 CT type APFC relay, 24 V DC Shunt trip coil, and Three Phase Under voltage relay.

. **15.2** :**DIESEL GENERATOR SET :** The DG set shall be provided by LICI /Tenant (own /rented). However the necessary cabling from/to DG set to/from main panel shall be carried out by the contractor***.For common amenities,a DG set (50 KVA) preferably of 3 phase,415 volt,50 hz silent weather proof to be provided along***

with AMF panel with battery and battery charger ,anti vibration pad and RCC frame as required,asdirected and as approved.

16. LIFTS

Contractor to provide lift (Automatic & Machine room less) as per lift shafts shown in the building plans approved by Municipal authority having the following specification.

Handling Capacity (HC)

The lift car (stainless-steel hairline car) should be designed to carry minimum 13 passengers according to available shaft sizes of two numbers ,v3F technology and brallie cvall button.

Travel

Approximately 14 meters.

Landings

Basement+Ground + 2 floor

SPEED

1.0 MPS

Machine: Machine room less V3D drive, Gearless machine

Maintenance and Reliability

The lift systems as described should be reliable and easily maintainable.

Lifts shall be complete with PVC flooring and toe guard of adequate height.

The car shall be with false ceiling, 4 no. LED fittings, 1 no. fan, stainless steel hand rail on one sides.

Digital floor position indicator, in the car and at all landings, Travel direction indicator, in the car and at all landings.

Gongs / Car chime & visual indication through directional arrows on all landings for pre arrival of the car at all floors.

Overload warning Audio & Visual indicator, inside the car (lift should not start on overload).

Battery operated alarm bell and emergency light duly fed by a suitable inverter SMF batteries for 30 minutes back up.

Car operating panel luminous buttons in car and intercom (3ways at car, lobby, controller).

Luminous hall buttons at all landings. Landing call registered indicator at all floors.

Voice annunciation system. This will announce the position of the car landing.

Protection against over-voltage, under-voltage, reverse pahse and single phasing should be provided

Control : Simplex full collective selective , AC VVVF – Microprocessor-Based Controller .

Automatic rescue device(ARD).for rescuing the passenger inside the car to the nearest floor on power outage/breakdown. Audio visual indication in the Car regarding lift is in ARD mode and the passenger(s) shall be taken to nearest floor.

Ventilation opening in the Car Body Required fans. The fan should be auto switch off when there is no passenger inside the lift car

Operating panel inside Car Automatic cum manual flush mounted luminous brail button suitable for barrier free environment for physically challenged persons.

Fireman's Switch required for all lifts at ground floor.

Landing doors in lift enclosures shall have a fire resistance of not less than one hour.

Telecommunication system in lift for communication between the passengers in the lift & fire control room (press & speak type) with rechargeable maintenance free battery backup.

Inside the lift shaft there shall be arrangement of one light point at each floor level and one light point at over head, one light point in lift pit. All light points shall be in group controlled and wired with 1.5 sq mm FRLS copper conductor cable. 15 amp power plug and 5 amp power plug shall be provided at alternate floor. Wiring of these power plugs shall be done with 4 sq mm FRLS copper wires. LED Bulk head fittings of suitable rating to provide minimum lux of 100 shall be connected with In each building power supply to DBs meant for Lift shall be provided at suitable location as approved by Engineer-in-charge using suitable size XLPE insulated armored cable. Supply of cable shall be in the scope of work.

17.VARIOUS ELECTRICAL MOTORS & PUMP SET : Providing suitable rated single phase submerssible pump for pumping water from underground tank to overhead tank. The Pump control panel shall consist of Starter, Overload Relay, Undervoltage relat and dry run proection relay.

Providing suitable rated single/three phase (not less than monoblock pump inside underground tank for pumping water from UGT to overhead tank. The Pump control panel shall consist of Starter, Overload Relay, Undervoltage relat and dry run protection relay.

The water level controller unit shall be provided for all the pump sets for AUTO operation.

18.-DESIGN BASIS REPORT ON ELV SERVICES

1.0 INTRODUCTION:

The Design Philosophy is to ensure fulfillment of all functional requirements in accordance with Design Guidelines, Relevant Standards and Codes- NBC 2016, IS 2189, NFPA 72 as well as local By laws.

ELV System is proposed on Shell & Core concept. Scope includes ELV Design for building including for common areas.

2.0 EXTRA LOW VOLTAGE SYSTEMS (ELV SYSTEMS)

Extra low voltage systems proposed for are~~,~~ Telephone , Fire Alarm System, to have security and comforts and shall be planned as per the interior layout.

SYSTEM DETAILS	LOCATIONS	BRIEF DETAILS
Telephone	Office Building -For Office work Stations, etc.	Incoming Cable at ground floor of Building, MDF Boxes floor wise/ wing wise, Telephone Point wiring with Tel. outlet.
Fire Alarm system along with public address system	i) Office Building – Entire Building.	**Adressable type Fire Alarm Systems(hybrid model) with conventional detectors along with public address system for emergency evacuation ., MCP, Hooters, cabling works , Isolators, Fire Panels etc for various floors will be designed based on the layout attached.**

3.0 TELEPHONE / INTERCOM SYSTEM

The following standards form the basis of proposed scheme:

ANSI/TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard – March 2001.

ANSI/EIA/TIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces –February, 1998.

ANSI/EIA/TIA-606 Administration Standard for the Telecommunications Infrastructure ofCommercial Buildings – February 1993.

ANSI/TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications – August, 1994.

Provision of space in ELV duct shall be done as per requirements.

Telephone/Intercom : Separate raceway provision at entry point may be made for connection of telephone wires /cables of required sizes with tag box.

19. Addrseable FIRE ALARM SYSTEM and PUBLIC ANNUCIATION SYSTEM

1) Fire detection & alarm systems shall be designed for addressable type fire alarm panel, ,Optical smoke detectors, Heat detectors, Manual call points, Input & Output modules. Electronic hooters, Response indicators, Strobe, Floor indicator panels and Repeater fire alarm panels.

Each floor will have manual call points at all strategic points such as staircase landing, emergency exits etc.

Detectors shall be provided for office area , common area, staircase and parking area.

Fire alarm control panel is sized, based on the requirement of devices - Manual call point & Hooters & detectors .

All connections will be with 2core x 1.5 sq.mm, ZHFR unarmored Copper cable including PVC MMS FRLS rigid conduits conducting.

Fire Detection and alarm system shall be provided in accordance with the prevalent Fire codes and National Building Code of India 2016. Addressable fire detection and alarm system shall be provided.

Break-glass stations (manual fire alarm stations) shall be located on the occupied side of the door to each exit stair and at intermediate locations at every floor as required (Maximum distance between pull stations shall not exceed 60 m). Where available, double action break-glass stations shall be provided.
The tentative points in building are as under:-

Si No	FACP Type	MCP Points	Hooter Points	Smoke Detector	Heat Detector
1	Addressable	In Stilt & In lobby at every floor	In Stilt parking & In lobby at every floor	In office area, lobby at every floor and Stilt parking & In	In pantry , panel rooms as directed.

2) PUBLIC ANNUCIATION SYSTEM:- A PA system integrated with Fire alarm which will provide spot announication system which help in incident of fire detection and help in faster evacuation along with all ancillaries to be panned for the entire

building and same may be provided with detailed floor drawing. The same has to be approved by the Fire authority of odisha.

20. DESIGN BASIS REPORT ON AIR CONDITIONING SYSTEM (VRF system)

Each office area will be having their own AC system will be installed by the tenant concerned for various floors. However , we have considered the AC load considering VRF type air conditioning system through combination of Cassette and high wall Split AC (minimum 3 BEE star rated with Nominal Cooling Capacity of 3516 watt per ton with ±5% tolerance and with ecofriendly refrigerant gas).

21.SMOKE MANAGEMENT SYSTEM AT BASEMENT:-

21.1:-The ventilation system for car and bike parking area would consist of forced air inlet and forced air exhaust through mechanical fans for the basement.The basement shall be separately ventilated and so there will be separate shaft to serve the exhaust air and fresh air for basementseparately.Mechanical ventilation gfans capacity shall be minimum 30 air changes per hour (ACPH) in case of fire and distress call.

21.2:-For normal exhaust system at basement should be 12 air changes per hour.This system will ensure proper quality of air and generally provide aclean and pollution free atmosphere for basement.

21.3:-The mechanical ventilation fans should start automatically through the fire protection system of the bulding and it shall be integrated with main fire alarm system of the building along with Public announication system which will operate automatically during fire or distress call .These ventilation fans should have an arrangement to start manually as and when required.

21.4:-The DG set to be provided for the building should take care the fire fighting load and it should operate automatically when main power supply will be cutoff during fire or distress call.

21.5:-The Lift lobbies,lift well corridors should have separate air pressurization system having smoke extraction ventilation fansof required capacity.A pressure difference (positive) for lift wells and lobby shall be maintained of 50 Pa and 30 Pa respectively .Exhaust ducts shall be provided at the ceiling level.This will help these area free of toxic gases and smoke during fire for safe escape route.

21.6:- A pressure difference (positive) for staircase shall be maintained at 40 Pa during emergency operation.For this mechanical fans have to be provided.Grills shall be provided on each landing level of the staircase and it will connect through metallic duct . the ducts shall be passed through designated masonary shafts.

21.7:-All the service shafts serving two or more floors in the core of the building shall be sealed.

21.8:-All the shafts coming from the basement for exhaust system shall be terminated at ground floor level to the atmosphere.

21.9:-Smoke extraction fans shall have class (H) insulation and a fire rating of 2 hours.

***22: FIRE* SUPRESSION SYSTEM**:-A comprehensive fire suppression system as per the approved layout,considering the local by laws of fire authority of Odisha and NBC may please be designed. The same design must be approved by the fire authority of odisha and pre NOC must be taken from authority and the entire design of fire suppression system should consider all the points mentioned in the NOC and the same after installation again will be inspected by fire inspector of Odisha so as to get the Fire NOC. The considered design should have the provision of the following

22.1:-The fire suppression system consist of electric driven pump,disel pump ,terrace pump,jockey pump and required integrated fire apnnel must be designed taking into consideration of floor area must bedesigned.

22.2:- Required capacity of fire tank at basement and top of roof should be designed as per the fire norms.

22.3:-Based upon the size of the main fire pump,required piping consisting of main header and branch lines to be laid with suiable support and insulation so as to maintain the required minimum pressure of 3.5 KG/cm2 at all the time. If the pressure drops,the required terrace and jockey pump should start automatically to maintain the pressure during fire or distress call.

22.4:-Two or three way fire brigade connection shall be connected to each down comer and to be positioned at street levels so as the inlet accessible from the outside of the building by fire brigade during any emerhgency.

22.5:-In each floor level,fire hose and fire nozzle ina separate enclosure as per the provision must be provided and same must be considered during design.

22.6:-Sprinler at all floors along with necessary layout circuit must be prepared considering the applicable fire norms.

22.7:-The drainage system shall be provided with all types of valves like Butter fly valve,Ball valve,Non return valve,pressure gaue etc.

22.8:-After completion of the system in all respect,a final acceptance test will be given by the agency in confirmation with acceptance of the owner along with handing over of the syetm . All maintenance and operation manuals ,certificates and documents must be handed over to the owner.

23:- **SIGNAGE** :- A self illuminating EXIT and various display signage system must be prepared with required size and to be fixed in the marked location in and around the building as per the fire norms for safe passage in case of fire and distress call.

24. CCTV:4.0 MP IP IR DOME/ BULLET CAMERA along with necessary wiring,Minimum 16 Chanel NVR, Monitor, Modem Rack, 1KVA ON-LINE UPS of

6Hrs Back Up shall be provided in Lift Lobby , stair Case, Basement and Building External service.

25. **AIR CONDITIONING**:-Iron structure to be provided in a suitable place in the investment building for outdoor of the AC machines to be installed by the tenant.Suitable capacity MCCB in each rentable area along with distribution board for lighting and air conditioning to be provided . The necessary wiring for air conditioning , lighting load etc will be carried out by the prospective tenant .

26.Sensor Based CAR Parking System :

Sensor based car parking system with controller, display etc. as required will be provided by the contractor in the Car parking Bldg.

27. **COMPREHENSIVE ANNUAL MAINTENANCE CONTRACT**:-A detailed comprehensive annual maintenance contract of the following system should be worked out and an contract will be placed for a fixed period with due aggrement with the owner.

27.1 :- Fire Suppression /Fire Alarm / Fire Fifghting,

27.2 :- Automatic lift.

27.3 :- Substation

27.4 :- CCTV

27.5 :- Solar Power

27.6 :- Sensor Based CAR Parking System

27.7 :- Electrical Installation system

28. All type ancilary job which includes internal electrical work, fire alarm and suppression system,automatic lift shall be carried out through experienced respective agency who are having has valid expertise, license as required by the authority concerned .

TECHNICAL SPECIFICATIONS

SECTION I GENERAL REQUIREMENTS

GENERAL

1.1 Information

This section sets out the general requirements for carrying out the Architectural and Finishes works for the project and shall be read in conjunction with all relevant work sections and other documents.

The Specification shall be read in conjunction with the other documents, which together shall form the contract specifications. Notwithstanding the subdivision of the specification under different headings, every part of it shall be deemed supplementary to and complementary to the other part.

All materials and workmanship shall be in accordance with the latest relevant Indian Codes and standards. Except that where the said standards are in conflict with the specifications, the standards take precedence.

The standard specification set out the basic quality of material and workmanship required from the contractor. Any statements pertaining to the sequence and the procedures for the construction of the works herein specified shall be regarded only as a guide to the contractor.

It shall be contractual duty and responsibility of the contractor to have his own done in-depth studies by his consultants for proper details, procedure, mode of execution, use of relevant type, form and size of machineries for the works, form and extent of temporary works requirement and providing the works as specified in or necessarily to be inferred from the documents and drawings forming this contract.

The Contractor shall perform the contract works in proper manner and with due competency for the satisfactory completion of the same.

1.2 Codes, Regulations, Standards and Technical References

A. Regulations

The whole of the Works and materials are to be in accordance with the Building Control Regulations, other regulations as set out by the authorities having jurisdiction over the works, and the relevant bylaws unless otherwise stated. Ensure that the requirements in the Specification are strictly adhered to when carrying out the Works, unless otherwise directed.

B. Standards and Codes of Practices

Unless otherwise agreed by the Employer's Representative, ensure all of the Works comply with the relevant requirements of the Standards and Codes referenced in the body of the Specification. Alternative Standards and Codes may be proposed for approval by the Employer's Representative, provided it can be demonstrated that the alternative Standards and Codes comply with the requirements of the standards specified. All Standards and Codes quoted are the current version, unless specific year references are noted.

C. Technical Reference

Where specified, be guided by the principles and methods as set out in the technical reference when carrying out the works. Alternative methods and principles may be proposed in lieu of the referenced document, subject to acceptance by the Employer's Representative, if it can be demonstrated that the specified quality or performance of the works can be achieved.

1.3 Work Preambles

A. Ambiguity

Before commencing any works, obtain clarification or instructions in relation to any discrepancy or ambiguity, which is discovered within and between the Specification Work sections, and one or other contract documents issued by the various parties.

B. Approved Sub-contractors

All sub-contractors for the works are subject to the acceptance of the Employer's Representative. At the time of tender and before the commencement of work, submit the list of subcontractors intended to be engaged for the works. Submit with the list, details such as the relevant track records of the firms, the qualification of the personnel and details of equipment to be engaged for the works.

C. Licences, Permits and Liaison with the Authorities

Be responsible to initiate the application for all necessary licences, permits, etc and to carry out all necessary liaison with the Government Departments and Statutory Boards, etc whenever necessary, for the satisfactory completion of the Works. Be responsible for ensuring that these licences and permits are obtained in good time

D. Safety Regulations and Temporary Works

Strictly observe all necessary safety requirements and legislation to fully comply with the provisions of the Workplace Safety and Health Regulations and/or any other requirements from the authorities having jurisdiction over the works.

E. Safeguarding Properties Adjacent to Site

Propose and adopt site procedures and methods of working such as to limit to a minimum any disturbance and vibration to the buildings around the Site. Identify and implement protective measures necessary to safeguard the adjacent properties prior to carrying out the works.

Indemnify the Employer in accordance with contract conditions against all claims for loss and/or damage to the adjoining properties by reason of the carrying out of the works or by reason of insufficiency of precautionary measures.

F. Site Supervision

Provide personnel with adequate and relevant experience to Employer's Representative's acceptance, to supervise the Work. Submit the CV of the supervisor(s) to the Employer's Representative where directed.

G. Coordination of Works

Ensure that all units, components or assemblies whether from one or different sources, are available in time for incorporation into the Works.

H. Maintenance Manual

Develop and submit for Employer's Representative's acceptance, a strategy in the form of a maintenance manual and logbook, to ensure that elements that are likely to deteriorate significantly can be replaced or rectified.

PART 2 PERFORMANCE REQUIREMENTS

2.1General Requirement

Engage methods and resources that will ensure the works achieve the specified quality within the agreed programme and cost.

2.2Environment

Ensure the carrying out of the works will not cause un-acceptable pollution, noise, erosion and vibrations to the environment as stipulated by the tender and other relevant authorities.

PART 3 MATERIALS

3.1 MATERIALS GENERALLY

Products are to be new unless otherwise specified. All materials are to be supplied clean, undamaged and in good condition ready to be used for the Works. For products with a limited shelf life, ensure no parts or whole are expired. Where a choice of manufacturer or source is allowed for any particular product, supply the whole quantity required as the same type and from the same manufacture and/or source unless otherwise approved. Produce written evidence of sources of supply when requested. Ensure that the whole quantity of each product supplied is of consistent kind, size, quality and overall appearance.

Ancillary products and accessories are to be of a type recommended by the main product manufacturer, unless otherwise specified.

Unless otherwise described, all materials shall be new and in accordance with the latest Indian Standards and the Contractor shall produce all necessary Certificates to substantiate this fact if so required by the Employer's Representative. Unless otherwise described, the description of each item of measured works shall include for supplying and delivering of all materials, unloading, sorting, selecting, storing, carriage and cartage, cutting and all waste on materials, hoisting, all labour setting, fitting and fixing in position, covering up and protecting finished work, clearing away all debris and waste, return of packing, carriage paid, use of plant and equipment, supervision, establishment and overhead charges, profit and all other labour and materials necessary for the due and proper execution of each item.

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Use of environmentally friendly products and materials that are certified by approved local certification body and are applicable to non-structural and architectural related building components should be adopted where appropriate or required by this Specification.

3.2 ORDERING OF MATERIALS

Unless otherwise directed, do not place orders for materials before the sources and samples of the materials have been approved and the results of any preliminary tests required by the Specification have been accepted.

3.3 CERTIFICATES FOR MATERIALS

All materials and products are to be manufactured and tested in accordance with the appropriate Standard or as specified. All materials and products delivered to the site are to bear the manufacturer's name, brand name or any other data required to verify compliance with the specified requirements. Where appropriate, provide certificates from the supplier or test agencies verifying such compliance. Include, whenever applicable, the location in the Works or the delivery or batch which the certificate represents.

Where certificates of manufacture or tests are not available for materials proposed for use in the Works, carry out independent testing to determine compliance with the specified requirements where directed by the Employer's Representative.

Where applicable or whenever requested by the Employer's Representative, the Contractor shall submit test certificates of materials to be used in the Works certifying that the materials in question comply in all respects with the Specification. The Contractor shall obtain the said certificates either from the materials manufacturers or from an approved testing laboratory. All costs incurred in obtaining the certificates shall be borne by the Contractor.

3.4 Storage of Materials

Store all materials in a manner, which is not detrimental to their use in the Works and in accordance with any specified requirements.

Ensure that the storage facilities and the loadings resulting from the storage will not adversely affect the construction, the building and other buildings/amenities nearby. Engage specialist advise if appropriate.

Do not permit the storage of materials, components or equipment on new or partially completed work without prior approval.

3.5 Rejected Materials

Immediately remove from the site, all materials which are unidentified or do not meet the requirement of the specification.

PART 4 WORKMANSHIP

4.1 WORKMANSHIP GENERALLY

Ensure that all works are carried out:

i. In accordance with the specified methods and procedures where applicable;
ii. In accordance with good building practice;
iii. In accordance with the manufacturers' instructions where applicable
iv. By suitably qualified and experienced personnel.

4.2 SETTING OUT AND LEVELS

The Contractor shall appoint a licensed land surveyor to check and to confirm the existing levels, location of the existing drains and sewer inverts, existing underground services, alignment and levels of existing roads, etc. before commencing any work. The Contractor shall be deemed to have taken into account the time and cost to carry out the said works in this tender.

4.3 DELIVERY, STORAGE AND HANDLING

Deliver materials and products to the site with labels showing brand name, product name and manufacturers batch number.

Store materials in accordance with the manufacturer's recommendations. Use in order of delivery and before expiration of the shelf life date.

4.4 PROTECTION OF PRODUCTS AND COMPONENTS

Take measures to prevent over-stressing, distortion and other damage to the products. Keep products and components clean and free from contamination. Prevent staining, chipping, scratching or other disfigurement, particularly of products exposed to view in the finished work.

Keep dry to prevent premature setting, moisture movement and similar defects. Where appropriate store off the ground and allow free air movement between stored products

Prevent excessively high or low temperatures and rapid changes of temperature in the products.

Protect adequately from rain, damp, sun and other elements as appropriate. Ensure that products are at a suitable temperature and moisture content at time of use.

Ensure that sheds and covers are of ample size, in good weatherproof condition and well secured.

Keep different types and grades of products separately and adequately identified.

Keep products in their original wrappings, packings or containers until immediately before they are used. Wherever possible, retain protective wrappings after fixing until shortly before handing over to the owners.

Ensure that protective measures are fully compatible with and not prejudicial to the products and materials.

No measurements will be done since it is EPC contract.

SECTION II MASONRY WORK

AAC Block walls (thickness as required / shown on drawings) shall be used at all places for this project except for locations where block / brick wall is necessary. The AAC Block wall shall be constructed as per the IS Specifications with Block laying adhesive and RCC bands at horizontal levels 1000 mm c/c and vertically at every 3000 mm c/c and / or at ends/ opening sides & top.

A. BRICK WORK

1. INDIAN STANDARDS

Indian Standards to be followed are:

All relevant standards as specified elsewhere in this volume are applicable.

i. IS 226 Specification for Structural steel standard quality
ii. IS 1077 Specification for common burnt clay building bricks
iii. IS 2116 Specification for sand for masonry mortars
iv. IS 2212 Code of practice for brickwork
v. IS 2250 Code of practice for preparation and use of masonry mortars.
vi. IS 8112 Specification for 43 grade OPC
vii. IS 12269 Specification for 53 grade OPC
viii. SP 27 Handbook of method of measurement for building works.

Brick work shall be adequately stiffened in the horizontal & vertical directions with concrete bands based on the specific situation of the wall, i.e., external, internal, height, length, thickness, type, lateral supports, mortar mix etc., based on Masonry Design codes & National Building code Part VI Section 4 by the Contractor.

2. MATERIALS

2.1 Bricks

2.1.1.1 Table Moulded Bricks : Bricks shall be sound, hard, well-burnt, uniform in size, shape and colour, homogeneous in texture, giving a metallic ringing sound, free

from flaws, cracks, holes, lumps or grit and arises should be square, straight and sharply defined. They shall not break when struck against each other and dropped flat from a height of 1 m to the ground. They shall conform to designation 7.5 or higher of Table-1 of IS 1077 giving classes of common burnt clay bricks.

2.1.2 Bricks shall have to be approved prior to procurement. Bricks shall be obtained from an approved source and shall be of uniform colour, size, and shape. Bricks shall have smooth rectangular faces with sharp straight right angle edges. Maximum absorption shall not be more than 15% of its dry weight on immersion in water for 24 hours. Minimum crushing strength shall be 35 kg/sq cm if not specified in the drawings.

2.1.3 Bricks of approved quality and quantity shall have to be procured by the contractor at the desired time. No delay or extra cost due to non-availability shall be accepted. The contractor is obliged to carry out the work as specified. It shall be the responsibility of the contractor to procure sufficient quantities of bricks and stack them at site or elsewhere to avoid delays.

2.1.4 AAC Blocks: These Blocks shall be machine moulded and prepared in plant byappropriate propositions as manufacturer's specification. The AAC Blocks shall confirm toIS Standards. Visually the blocks shall be sound, uniform size, free from visible cracks,warpage and organic matters. The Blocks shall be solid with / without frogs and shall beconfirming to IS specification.

2.2 Mortars

2.2.1 Mortars for masonry shall be prepared in accordance with IS 2250 code of practice for preparation and use of masonry mortars.

2.2.2 Cement

Cement used shall be ordinary Portland cement conforming to IS and shall be of grade 53 or 43.PSC(Portland Slag Cement) and PPC (Portland Pozzolona Cement) may be used in non structural works.

2.2.3 Water

Water used for masonry shall be clean and free from injurious amounts of deleterious materials.

2.2.4 Fine aggregate (sand)

2.2.4.1.1 Natural sand deposited by stream or glacial agencies as a result of disintegration of rock is the best form of fine aggregate. The fine aggregate shall conform to following standards.

i. For plain and reinforced concrete IS 383 Specification for coarse and fine aggregates from natural sources for concrete.

ii. Mortar and grout IS 2116 Specification for sand for masonry mortars.

2.2.4.1.2 Sea sand should not be used unless approved by the Employer Representative. If approved, the required treatment shall be done as per the instructions of the LIC of India

2.2.4.2 Sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain any appreciable amount of clay. Sand shall not contain harmful impurities such as iron, pyrites, coal particles, lignite, mica shale or similar laminated material, alkali, and organic impurities in such form or quantities as to affect the strength or durability of concrete or mortar. Also it should not contain any material liable to attack the steel reinforcement.

2.2.4.2.1 When tested as per IS 2386 Part I and Part II, fine aggregate shall not exceed permissible quantities of deleterious materials as given in table 1 of IS 383.

2.2.4.2.2 Fine aggregate shall be thoroughly washed at site with clean fresh water such that the percentage of all deleterious material is within the permissible limits laid down.

2.3 Metal reinforcement

Metal reinforcement used in brick masonry shall conform to the following Indian Standard Specifications.

- IS 226 Specification for steel standard quality
- IS 412 Specification for Expanded metal steel sheets for general purpose
- IS 432 Specification for Mild steel and medium tensile steel bars
- IS 1566 Specification for Steel fabric or hard drawn steel wire

3. MORTAR

3.1 Mortar shall be prepared by mixing fine graded aggregate with cement in the proportion specified for respective items of work as shown in the drawings. Mortar mixes shall generally be 1:6 for 230mm width & above, & 1:4 for 150mm width. Mixing of mortar shall be done by mechanical mixers only. Hand mixing may be permitted in specified cases on the written permission of the LIC OF INDIA

3.2 Mortars shall be specified by proportion. Volumetric mixing shall be based on dry volumes of each ingredient. For convenience, measurement shall correspond to volume of one cement bag i.e. 0.035 cu m. Boxes shall be of size 40 X 35 X 25 cm. These shall be marked as mortar mixing boxes by red paint and shall be used throughout the contract. Hand mixing or mechanical mixing proportions shall be done with the use of these boxes.

3.3 Cement mortar shall be prepared by mixing cement and sand in specified proportions. Proportioning shall be carried out as detailed above. Sand shall be added suitably to allow for bulkage if required. Bulkage shall be determined as specified in IS 2386 Part III. Cement and sand added to mixer shall be thoroughly mixed and water shall be added to it gradually. After addition of water the mixer shall run for a minimum of 3 minutes. The mortar mixed shall be consumed within 30 minutes of its mixing.

4. WORKMANSHIP

4.1 Bricks used for masonry in cement mortar shall be soaked by immersing in water or by hosing of water (so as to prevent bubbling.) at least one hour prior to start of actual laying.

4.2 Bricks shall be laid in English bond unless otherwise specified. Half or cut bricks shall be used only for the purpose of bond and at no other place.

4.3 Work shall be true to horizontal lines and perfect plumb. Vertical joints shall be truly vertical and those in alternate courses shall be in the same vertical line. Joints of each course shall be within the limit of 6 mm to 10 mm depending upon the size of bricks. Total height of 9 cm brick with 5 courses and 5 mortar joints shall be 50 cm. In no case shall joint thickness of horizontal and vertical be more than stated above. Joints should be filled to full depth and checked each time. Prior to start of work it must be noted and checked that bricks on top are full-size bricks (flat or brick on edge). To achieve this, precautions should be taken from the start of the first layer. Thickness of joints shall be so adjusted so as to have full bricks on top. Also it must be noted and checked that all horizontal joints on, every floor are at the same level, so as to allow proper bonding at junctions. Required datum levels must be established throughout the floor and only then should work start.

It is equally important to take into account levels of windowsills, lintels, etc. While finalizing courses and joint thickness. In normal practice architects do take care of these while finalising levels, but it is difficult to expect the ideal situation at all places. In such situations, the decision of the LIC OF INDIA shall be taken such as providing brick on edge, concrete sills, etc.

In addition, for convenience and speed, gauge boards of exact width shall be fixed at the edges of masonry to correct line and plumb. These boards shall be marked with course levels to achieve exact height of each course and full bricks at the top.

4.4 One or half brick thick wall shall have minimum one face in true plumb.

4.5 It is imperative to raise the brick work uniformly over complete Work joined together. If this is not possible, raked brickwork shall be done at 45 degrees to the vertical. Toothing shall not be accepted.

4.6 All iron fixtures, pipe outlets, hold-fasts for doors and windows shall be fixed when the brick work is in progress. It must be embedded in cement mortar or concrete as specified or as directed by the LIC OF INDIA Required treatment to fixtures shall be carried out prior to embedding.

4.7 To achieve better results and proper working, the following tools should be available with masons working at site:

- Spirit level
- Wooden/Aluminium straight edge 3 m long
- metre steel tape
- Right angle 1/2 metre long

- Line and pin strings
- Plumb
- Storey rods

4.8 Joint thicknesses shall be provided as discussed above. Joints shall be filled to full depth before second course is laid. Frogs shall be upward at all times. Joints shall be raked back to a minimum 10 to 15 mm while the mortar is green. Surface of brick work shall be cleaned with coir string, wire brushes, etc. to keep the surface free for the next operation. All dropped and spoiled mortar, brickbats, etc. shall be cleared from the floor before work is closed for the day.

4.9 Protection and curing

Green work shall be protected from rains by suitable covering. Masonry in cement mortar shall be kept constantly moist on all the faces for a minimum period of ten days. The top of masonry shall be left flooded with water at close of the day.

4.10 Scaffolding

Scaffolding independent of brickwork i.e., double scaffolding shall be provided. It should be tied to brick work or structure at suitable intervals in both directions. Two rows of planks shall be provided all around. Planks shall be at least 50 mm thick and well-tied to scaffolding. Railing to the outside face shall be provided. While erecting scaffolding, the following points must be noted and closely followed:

i. Minimum number of holes in the horizontal direction. Holes shall be formed by omitting header brick.

ii. No holes in pillars under 1 metre in width.

iii. No holes near the skew backs of arches.

iv. Scaffolding must be sound and strong and easy to maintain.

v. Holes left must be closed while finishing the plaster.

5. WORKS DEEMED INCLUDED

5.1 The works shall include for all the materials and labour as described in their respective items of work and for all the operations as detailed in the respective specifications for the various items of work. Brick on edge courses, cut brick corners, splays, reveals, cavity walls, shall be included in BRICK WORK.

5.2 The following operations shall be included in the work -:

a. Raking out joints for plastering or for pointing done as a separate process or for finishing joints flush as work proceeds;

b. Preparing tops and sides of existing walls and the like for raising;

c. Rough cutting and waste for forming gables, cores of arches, splays at caves and the likes and all rough cutting in the body of brick- work, unless otherwise stated;

d. Plumbing to angles and battered surfaces;
e. Forming reveals to jambs where fair cutting on exposed faces is not involved;
f. Leaving holes for pipes, etc.;
g. Building-in holdfasts, air bricks, fixing bricks, etc.;
h. Building-in ends of beams, joists, slabs, lintels, sills, trusses, etc.;
i. Forming openings and flues for which no deduction is made;
j. Bedding wall plates, lintels, sills, roof tiles, corrugated sheets, etc., in or on walls, if not covered in their respective trade.
k. Leaving chases of section not exceeding 50 cm in girth.

SECTION III PLASTERING AND POINTING

The primary requirement of plasterwork shall be to provide absolutely water right enclosure, dense, smooth and hard and devoid of any cracks on the interior and/or exterior. The contractor shall do all that is necessary to ensure that this objective is achieved. All plastering shall be finished to true plane, without any imperfections and shall be square with adjoining work and form proper foundation for finishing materials such as paint etc., Masonry and concrete surfaces which call for applications of plaster shall be clean, free from efflorescence damp and sufficiently rough and keyed to ensure proper bond, subject to the approval of the Engineers / Architects. Wherever directed by the Engineer / Architect, all joints between concrete frames and masonry in filling shall be expressed by a groove cut in the plaster. The said groove shall coincide with the joints beneath as directed. Where grooves are not called for, the joints between concrete members and masonry in filling shall be covered by Plaster mesh strips 200 mm wide on either sides or as called for on drawings/documents, which shall be in position before plastering

1. INDIAN STANDARDS

1.1 Indian Standards to be followed are:

All relevant standards as specified elsewhere in this volume are applicable.

i. IS 383 Specification for coarse and fine aggregates for natural sources for concrete.
ii. IS 412 Specifications for expanded metal steel sheets for general purposes
iii. IS 1542 Specifications for sand for plaster
iv. IS 1661 Code of practice for application of cement and cement-lime plaster finishes
v. IS 2402 Code of practice for external rendered finishes
vi. IS 2645 Specifications for integral cement water proofing compound

2. MATERIALS

2.1 Cement

2.1.1 Cement used shall be ordinary Portland cement conforming to IS and shall be of grade 53 or 43.PSC(Portland Slag Cement) and PPC (Portland Pozzolona Cement) may be used in non structural works

2.2 Water

2.2.1 Water used for mixing and curing shall be clean, reasonably clear and free from objectionable quantities of silt, oils, alkalis, acids, salts so as not to weaken mortar.

2.2.2 Water tested shall be in accordance with IS 3025. Maximum permissible limits ofdeleterious materials in water as given in IS 456 are reproduced for ready reference in table 6 of Annexure.

2.3 Coloured cement may be either ready-mixed material or may be obtained by mixing pigments and cement at site. The pigments to be mixed with cement shall conform to Appendix "A" of IS 2114 code of practice for laying in-situ Terrazzo Floor Finish.

2.4 Sand shall conform to IS 1542 specification for sand for plaster. For white or coloured renderings, only quartz or silica sand shall be used. For textured finishes produced by treatment of freshly applied final or finishing coat with a tool coarser, particles used shall be screened through 3.35 mm IS sieve or 2.36 mm IS sieve. For torn texture a slightly larger portion of material coarser than 4.75 mm IS sieve shall be use

2.5 Aggregate shall conform to IS 383.

2.6 Marble dust obtained from crushing of hard marble stone shall not contain morethan 8% of silt determined by field test. Fineness modulus shall be greater than 1.0.

2.7 Integral water proofing compound shall conform to IS 2645 (specification for integralwater proofing compound).

2.8 Fibrous materials

Certain natural fibres, such as flax, sisal, manila, jute hemp, and coconut fibres may be used for incorporation in the mortar. They shall be clean, dry and free from oil.

2.9 Expanded metal

Expanded metal used as background for rendering shall comply with requirements of IS 412.

2.10 Plaster Mesh

Plaster mesh of shall be used over junctions of concrete and masonry or two dissimilar materials about 200 mm wide fixed with GI wire nails etc. as directed by the LIC of India.

3. MORTARS

3.1.1 General

3.2 Cement mortar

3.2.1 Cement mortar shall be prepared by mixing cement and sand in specified proportions. Proportioning shall be carried out as detailed above. Sand shall be added suitably to allow for bulkage if required. Bulkage shall be determined as specified in IS 2386 Part III. Cement and sand added to mixer shall be thoroughly mixed and water shall be added to it gradually. After addition of water the mixer shall run for a minimum of 3 minutes. The mortar mixed shall be consumed within 30 minutes of its mixing.

3.2.2 If ready mix mortar is used the mortar is to be prepared as per the manufacturers specifications .

4. WORKMANSHIP

4.1 Preparation of mortar mix

4.1.1 The material used in preparation of plastering mixes shall be measured by volume using gauge-boxes or by weight.

4.1.2 When cement is measured by weight, 1440 kg of material shall be taken equivalent to n one cubic meter.

4.2 Mixing

4.2.1 Mixing shall be done mechanically. Each mortar batch shall be used within half an hour. Hand mixing if permitted as special case shall be carried out on a clean, watertight platform. The mixing operation shall be continued with addition of necessary quantity of water until a uniform appearance and consistency of mortar is obtained.

4.2.2 Cement and sand shall be mixed dry in required proportion to obtain a uniform colour and water shall then be added to get the required consistency for the plaster.

4.3 Method of plastering:

4.3.1 Surfaces to be plastered must be clean and free from dust, loose material, oil, grease, mortar droppings, sticking of foreign matter, traces of algae, etc. It is very important to ensure that there should not be any chance of the plaster getting de-bonded due to presence of materials harmful for bonding.

4.3.2 Raking out of joints is expected to be carried out along with masonry but it should be checked thoroughly so as to receive good key.

4.3.3 Walls should be sufficiently damp prior to plastering. Water from plastering mortar must not be absorbed by masonry under any condition.

4.3.4 Any unavoidable projections in masonry and concrete surfaces shall be chiseled back. Care shall be taken that surrounding surfaces are not damaged and reinforcement is not exposed.

4.3.5 Thickness of one coat should not be more than 15mm and less than 8 mm for single coat finished plaster.

4.3.6 In case of multi coat plaster, sufficient time shall be allowed for the undercoat to harden (cured, dried and shrunk properly) before subsequent coats are applied.

4.3.7 Undercoats shall be scratched or roughened before they are fully hardened to form a mechanical key.

4.3.8 The method of application is also important and hence it is recommended that themix be thrown on the surface rather than stuck with trowel. This increases the adhesion.

4.3.9 Scaffolding should be rigid, allowing free and safe movement on the platform and it should be at sufficient distance or height from the working areas. Scaffolding with railing gives more confidence to workers and improves the quality of work.

4.3.10 Actual plastering shall be undertaken only on the approval of the LIC OF INDIA Plasterwork should only follow the steps mentioned below:

a. Surface must be thoroughly cleaned.

b. Plaster area must be provided with level dabs or spots allowing working and checking with 2-3 m straight edge. Depth of plaster must not be less than 8 mm at any point.

c. Required concealing services must be completed and tested.

d. No further cutting of masonry must be required.

e. Repairs carried out to masonry or concealing work must be cured and dry.

f. Surface must be sufficiently damp.

g. Plaster dabs are checked for plumb and level by the LIC OF INDIA or his representative.

h. Joints, concealing and repairing areas must be covered with 20 gauge GI chicken mesh as per the LIC OF INDIA's instruction.

4.3.11 Corners, external or internal, shall be finished along with final coat. It is advisable to have rounded corners.

4.3.12 Plaster shall be cured for 14 days by wet curing except in near finish plaster. During this period plaster shall be protected from exposure to extremes of temperature and weather.

4.3.13 Plaster shall be leveled and lined by aluminium hollow section, 2-3 m long. (This will give even and levelled surface). There shall not be more than 2 mm difference in level when checked with 3 m straight edge. It is important that enough pressing and beating is done to achieve compact filling of joints and that the area is fully compacted.

4.3.14 Finishing of plaster may be carried out with wooden float (randhas) or trowelled smooth with sheet metal trowels as specified. Care shall be taken to avoid excessive trowelling and overworking of the wooden float.

4.3.15 All corners, internal or external, shall be truly vertical or horizontal. These shall be finished with a proper template to achieve best workmanship for rounding and chamfering as specified or directed.

4.3.16 Plaster shall be cut to correct horizontal or vertical line at the end of the day or if work requires to be suspended for any reason

It is advisable to limit the area of plaster to 15 sq m to avoid cracks due to thermal movements of dissimilar material in contact, it is advisable to provide joints treated with groove or any other detail as suggested by the Architect. These joints if not specified shall be treated with 200 mm wide reinforcing Plaster mesh (approved by the LIC OF INDIA) fixed over joints by GI nails and the area plastered.

5. TYPE OF PLASTER

5.1 Rough cement sand plaster

Single coat cement-sand plaster with cement-sand mix in proportion of 1:6 shall be carried out over the entire area as detailed above. The plaster shall be finished just with wooden float to give a rough surface as backing for tiling work. Thickness may be from 10 to 20mm as specified in the drawings.

5.2 Stone Crete Plaster

Decorative, long lasting, maintenance-free outside facade shall be obtained. Undercoat as detailed in clauses above of this section shall be prepared and applied. Finishing coat 12 mm thick shall be applied over the keyed undercoat. Mix shall be in ratio of 1:1:2 proportion (i.e. 1 white cement or grey cement, 1 marble powder and 2 marble chips). Finished coat shall be firmly applied and worked over to get a fine, smooth surface. Top grade masons shall only be employed. The surface should be perfectly true in line and level. There shall be no difference in level when checked with a 3 m long straight edge. Finished surface shall be cured for 2 days thoroughly with water. Then neat and pleasing designs as approved or directed by the Architect shall be chiselled out and further curing shall be done.

5.3 External Water proof Plaster

20mm two coat cement and sand mortar in proportion of 1:4 shall be applied to external surfaces. The first or the scratch coat shall be approximately 14mm thick and shall be carried out continuously without break to the full lengths of walls or natural breaking points, such as doors, windows and the like. The scratch coat shall be applied to prepared surfaces with heavy pressure to produce a true and even surface and then lightly roughened by cross scratch lines to provide a bond for the finishing coat. The scratch coat shall be cured for at least 7 (seven) days and then allowed to dry. The second coat shall be 6 mm thick and shall not be applied until at least 10 (ten) days after the application of the scratch coat. Before the application of the second coat the scratch coat shall be uniformly dampened. This coat shall be applied from top to bottom in one operation and

without joints and the finish shall be straight, true and even. Only approved white sand shall be used for the second coat and for finishing work. Sand for finish shall be of even coarse size and shall be dashed on the surface and sponged. Water proofing compound shall be added as per manufacturers specifications in the plaster mix. Where 32mm thick plaster or render is specified for the purpose of providing beading, bands and the like work shall be carried out in either two or three coats as directed by the LIC of India or his representative. For pebble face finished plaster or render pebbles of approved size and quality shall be dashed against the final surface to obtain a uniform pattern to the satisfaction of the LIC of India or his representative.

5.4 External Plaster or Render

18mm two coat cement and sand mortar in proportion of 1:4 shall be applied to external surfaces as specified. The first coat shall be 12mm thick and the second coat 6mm thick. The first layer shall be dashed against prepared surfaces with a trowel to obtain an even surface. The second layer shall then be applied and finished leaving a trowel finished even and uniform surface.

5.5 Rough Cast Plaster

The specification for sand faced plaster shall also apply to rough cast plaster, subject to the following:

Base coat

The first coat of plaster shall be of cement mortar 1:4 mixed and applied according to the relevant provisions of IS 1661. The finished thickness shall be 12mm for brick masonry and concrete surfaces and 15mm for stone masonry. The plaster shall be laid by throwing the mortar by using a strong whipping action and pressing to form a good bond. The surface shall be roughened.

Second coat

The second coat shall be the roughcast mixture consisting of aggregate, which may vary in size from 5mm to 8mm and may consist of specially graded mixture mixed with fine sand and cement. The proportion of cement to sand to aggregate shall be 1:1:3. It shall be flung upon the first coat with large trowels to form an over protective coat. The second coat must be applied while the first coat is still soft and plastic. The work shall generally conform to requirements IS 1661. The thickness of the coat shall be about 12mm

5.6 Grit Finish Plaster

Select aggregates, 12mm below, granite chips.

Remove all dirt, foreign material and stone dust.

Clean the aggregates with water thoroughly.

Mix the aggregates in proportion of one cement to two parts of aggregate thoroughly to a well and consistent paste.

Apply on a rough plastered surface prepared to receive the grit plaster.

Water the plastered surface to an extent such that the grit plaster can be applied.

After initial setting of grit plaster use a wet sponge to clean the surface.

Use hose water to clean the grit surface effectively so that the grit particles are seen neat and clean and the surface is cleaned of any of the cemented particles.

5.7 Metal Lath Plaster

Work to include backing and reinforcement to plaster.

Fix metal lath over areas which have to be covered with plaster.

Fix metal lath over surface where two different materials meet which have to be covered with plaster.

Lathing material shall be expanded galvanized mesh weighing not less than 1.8 kg/sq.m.

Tying wire shall be black annealed steel 18 G wire.

Provide reinforcement as shown in drawings and tied to the main structural member.

Fix metal lath from the centre outwards so that it is taut.

Extend lathing to a minimum of 150 mm on to adjacent concrete or masonry surface which are to be plastered.

Provide temporary support at one end of the lath and plaster work, and plaster with cement mortar 1:3, one part of cement and three parts of sand.

Finish the lath and plaster work with smooth/sand faced plastering as per instructions by architect.

5.8 Waterproof Finishes

Where specified or directed by the LIC of India or his representative the Contractor shall incorporate approved waterproofing admixtures obtained from reputed manufacturers into the mortar for plasterwork and render. Quantities to be used and the method of incorporation shall be strictly in accordance with the manufacturer's instructions subject to the satisfaction of the LIC of India or his representative. Admixtures shall not contain calcium chloride unless specifically approved by the LIC of India or his representative and shall conform to IS 2645.

6. WORKS DEEMED INCLUDED

6.1 Description of item in the drawings, unless otherwise stated, includes, wherever necessary, conveyance and delivery, handling, unloading, storing, fabrication, hoisting, all labour for finishing to required shape and size, setting, fitting and fixing in position, straight cutting and waste, return of packings and other incidental charges.

6.2 Levels and heights shall be as indicated in the drawings.

6.3 Preparation of surface shall be as approved by the LIC of India

6.4 Trimming off the projections on masonry shall be included in the price.

6.5 Scaffolding and working platform shall be included in the price.

6.6 Materials as detailed and as required to complete item as specified shall be included in the price.

6.7 Curing of pointing shall be included in the price.

6.8 Cleaning of adjacent areas, windows, doorframes, etc. including masonry surface in exposed masonry work.

SECTION IV FLOOR FINISHES

1.1 Scope

This Specification describes the general requirements for flooring finishes and rendering on projects.

Contractor shall be responsible for cleanup& Housekeeping & shall take every precaution necessary to ensure the protection of the completed works till hand over to Owners representative.

1.2 Applicable Codes

i. IS 269 Specification for ordinary and Low Heat Portland Cement
ii. IS 383 Specifications for Coarse and Fine Aggregates
iii. IS 777 Specifications for Glazed Earthenware Tiles
iv. IS 1237 Specification for Cement Concrete Flooring Tiles
v. IS 1443 Code of Practice for Laying and Finishing of Cement Concrete Flooring Tiles
vi. IS 2571 Code of Practice for Laying In-situ Cement Concrete Flooring
vii. IS 457 Specifications for Ceramic Unglazed Vitreous Acid-Resisting Tiles

1.3 General Materials

Cement shall be ordinary Portland cement/PSC conforming to IS 269 for all purposes. Lime shall conform to IS 712.Other than Structural work , PSC(Portland Slag Cement) and PPC (Portland Pozzolona Cement) may be used.

Sand shall conform to IS 1542. For white and/or coloured render only quartz or silica sand shall be used.

For textured finishes and final or finishing coats sand used shall be screened through 3.35mm and 22.36mm IS sieves respectively. For torn texture a slightly larger proportion of sand screened through a 4.75mm IS sieve shall be used.

Water used for mixing and curing shall be clean, clear and free from silt, oil, alkalis, acids,salts and the like.

Coloured cement shall be either ready mixed material or may be obtained by mixing pigments and cement on Site. Pigments mixed with cement shall conform to IS 2114.

Integral waterproofing compound shall conform to IS 2645.

1.4 Glazed, Ceramic & Vitrified Tile Work

The type, quality, size, thickness and colour of tiles for flooring, skirting and dados shall be of the best quality as described and approved by the Employers Representative or his representative. The Contractor shall provide the Employers Representative or his representative with samples for approval and only approved tiles, skirting and dados shall be brought on to the Site.

Before laying tiles sub-surfaces shall be thoroughly cleaned and washed of all loose materials, dirt, laitance and the like and then well wetted without forming water pools on the surface.

Tiles shall be laid on cement mortar bedding 20mm thick in the proportions of one part of cement, four parts sand.

Tiles shall be laid on mortar beds one after another, each tile being gently tapped with a wooden mallet until properly bedded and level with adjoining tiles. Joints shall be perfectly straight and uniform in thickness. Tiles shall be laid perfectly level unless otherwise specified or directed by the Employers Representative or his representative. After laying joints of tiles shall be finished with white cement or cement of approved colour as described.

Floor tiles laid adjoining walls shall project at least 12mm under plaster or render, skirting or dados. Half tiles and cut pieces shall be avoided as far as possible. After laying flooring shall be allowed to cure undisturbed for 7 (seven) days. Design traffic shall not be allowed on the floor for at least 14 (fourteen) days after laying tiles. Following curing each and every tile shall be lightly tapped with a small wooden mallet. Should this give a hollow sound such tiles, together with any cracked or broken tiles, shall be removed and replaced with new tiles to proper lines and levels.

The work shall include admixtures & grouts such as Laticrete / Bal Endura (Cementitious Polymer Grout) & LATICRETE 290 (Adhesive) or equivalent from Bal Endura all as manufacturers specifications & drawings.

Corner Beadings

External round/ convex and internal concave PVC corner beads to match the colour of the tiles. PVC Inner Corner Tile Beading and External Round edge Tile Beading of nominal thickness 1.2mm of Colours matching the tile colours& depths of, 9.5 and 10.5mm made out of PVCU and PVC co-extrusion equivalent to BS 5750 as protector for tiles inner corners and external edges, for all vertical and horizontal edges. The size shall be minimum length 2.5mts. Joints are not permitted. Tile Spacers 3mm spacers made of PVC as per manufacturers specifications with size of 30 x 30 x 3mm. where directed 2mm spacer may be provided instead of 3mm spacers.

For skirting and dado vertical surfaces shall be thoroughly cleaned and wetted and evenly and uniformly covered with a 12mm thick coat of cement mortar (1:4).
Backs of tiles for skirting and dados shall be covered with a thin layer of neat cement paste and tiles gently tapped against the wall with a wooden mallet. Work shall be done from the bottom of the surface proceeding upwards. Joints shall be as close as possible and the work shall be truly vertical and flush. Corners and junctions shall be finished true. At the tops of dado work glazed tile borders, if specified, shall be provided.

The work for flooring, skirting and dado work shall be inclusive of forming angles, corner pieces and approved borders.

1.5 Shahabad, Tandur, and Kota Stone Flooring, Dado, Coping & Skirting

Stones as described shall be of approved quality, free of defects hard, sound, durable and uniform thickness and approved by the Employers Representative or his representative. Edges shall be chisel dressed and the top surface shall be machine polished with joints running true and parallel from side to side. The Contractor shall provide the Employers Representative or his representative with samples for approval and only approved stones shall be brought on to the Site.

The slabs shall be machine polished, Flamed or honed as mentioned in the drawings at the factory prior to being brought to the Site. All edges shall be machine cut to have the slabs to required correct sizes and the edges shall be ground smooth and even to full depth. A straight edge laid along the side of the slab shall be in full contact with it. All angles and edges of the

slabs shall be true and square and free from chipping. Bull nosing, grooves & chamfering of edges for staircases & skirting, etc., shall be as indicated in the detailed drawings.

Before laying slabs sub-surfaces shall be thoroughly cleaned and washed of all loose materials, dirt, laitance and the like and then well wetted without forming water pools on the surface.

Thoroughly wetted stones shall be laid on cement mortar bedding not less than 20mm and not more than 25mm thick in the proportions of one part of cement and six parts sand.

Mortar shall be evenly spread over sub surfaces and covered with a bed of cement at the rate of 5kg per square metre over areas that can be covered with stones within half an hour.

Stones shall be laid on cement beds one after another, each stone being gently tapped with a wooden mallet until properly bedded and level with adjoining stones. Joints shall be perfectly straight and uniform in thickness. Stones shall be laid perfectly level unless otherwise specified or directed by the Employers Representative or his representative. After laying joints of stones shall be struck smooth.

Floor stones laid adjoining walls shall project at least 12mm under plaster or render, skirting or dados. Cut pieces shall be avoided as far as possible. After laying flooring shall be covered with a layer of damp sand and allowed to cure undisturbed for 7 (seven) days. Design traffic shall not be allowed on the floor for at least 14 (fourteen) days after laying stones. Following curing each and every stone shall be lightly tapped with a small wooden mallet. Should this give a hollow sound such stones, together with any cracked or broken stones, shall be removed and replaced with new stones to proper lines and levels. To ensure that such replaced stones match those laid earlier laid the Contractor shall order sufficient extra stones to meet this requirement.

The work shall include admixtures & grouts such as 511 IMPREGNATOR (Sealer) & LATICRETE 111 & 4237 all as manufacturers specifications & drawings.

For skirting and dado vertical surfaces shall be thoroughly cleaned and wetted and evenly and uniformly covered with approximately a 20mm thick coat of cement mortar (1:4).

Backs of stones for skirting and dados shall be covered with a thin layer of neat cement paste and tiles gently tapped against walls with a wooden mallet. Work shall be done from the bottom of the surface proceeding upwards. Joints shall be as close as possible and the work shall be truly vertical and flush. The work for flooring, skirting and dado work shall be inclusive of forming angles and corner pieces

Pre-polished counters for wash basins

The Slabs shall be fixed on RCC slab/ MS framework true to line and level all as per detail drawing including Skirting, Fascia band & verticals wherever required, and making openings in the slab counter for seating washbasins etc. and pillar cock, including edge polishing and rounding of edges as approved. Shop drawings for seating arrangement shall be prepared by the vendor & approved by the Architect.

1.6 Marble and Granite Flooring, Dado, Coping & Skirting

The type, quality and thickness of marble and granite slabs for flooring, skirting and dados shall be of the best quality as described and approved by the Employers Representative or his representative and shall be hard, dense, uniform, homogenous in texture, have even crystallising grains and be free from cracks and other defects. The Contractor shall provide the Employers Representative or his representative with samples for approval and only approved slabs shall be brought on to the Site. The slabs shall be machine polished, Flamed

or honed as mentioned in the drawings at the factory prior to being brought to the Site .All edges shall be machine cut to have the slabs to required correct sizes and the edges shall be ground smooth and even to full depth. A straight edge laid along the side of the slab shall be in full contact with it. All angles and edges of the slabs shall be true and square and free from chipping. Bull nosing, grooves & chamfering of edges for staircases & skirting, etc., shall be as indicated in the detailed drawings.

Flaming on polished granite to achieve the required undulated flame finish shall be done using the thermal torch. The ignited torch shall be held at 45 degrees to the granite slab plane with required temperature using combination of Oxygen and LPG gasses in presence of continuous water jet for immediate cooling. The pressure of the gasses required, depends on the level, intensity and pattern of flaming as approved by the Architect.

Honed Finish of granite shall be prepared where necessary to have a smooth surface without reflection. Pathways and walkways shall be provided with Honed granites.

Granite Slabs for Lift flooring shall have suitable Epoxy underlays & adhesives as per the detailed drawings & manufacturers specifications.

Rough Dressing

The stone surface to be chisel dressed to one plane by removing all bushings so that the maximum depression is not more than 6mm.

One Line Dressing

This is done after the rough dressing is completed by point chiselling so that the variations are not more than 4mm. Work includes rough dressing also.

Two Line Dressing

This is done after one-line dressing is done by chiselling so that variations are not more than 2.5mm. Work includes rough and one line dressing also.

Three Line Dressing
This is done after two lines dressing is over by chiselling so that the variations are not more than 1.5mm. Work includes rough, one line & two lines dressing also.

Before laying sub-surfaces shall be thoroughly cleaned and washed of all loose materials, dirt, laitance and the like and then well wetted without forming water pools on the surface.

Slabs shall be laid in cement slurry over a cement mortar bed approximately 18mm thick (one part of cement, and six parts sand) evenly spread over sub-surfaces.

Slabs shall be gently tapped with a wooden mallet until properly bedded and level with adjoining slabs. Joints not exceeding 1mm wide shall be perfectly straight and uniform in thickness. Slabs shall be laid perfectly level unless otherwise specified or directed by the Employers Representative or his representative. After laying joints shall be finished with white cement.

The work shall include admixtures & grouts such as 511 IMPREGNATOR (Sealer) & LATICRETE 111 & 4237 all as manufacturers specifications & drawings.

Slabs laid adjoining walls shall project at least 12mm under plaster or render, skirting or dados.

After laying flooring shall be allowed to cure undisturbed for 10 (ten) days. Design traffic shall not be allowed on the floor for at least 14 (fourteen) days after laying slabs. Following curing slabs shall be lightly tapped with a small wooden mallet. Should this give a hollow sound such slabs, together with any cracked or broken slabs, shall be removed and replaced with new slabs to proper lines and levels.

The above procedure shall be followed again after slabs are polished. To ensure that such replaced slabs match those laid earlier the Contractor shall order sufficient extra slabs to meet this requirement.

After joints have developed sufficient strength floors shall be machine polished to the desired finish to the satisfaction of the Employers Representative or his representative. Sufficient quantities of water shall always be used during polishing to prevent scratching. For skirting and dado vertical surfaces shall be thoroughly cleaned and wetted and evenly and uniformly covered with approximately a 12mm thick coat of cement mortar (1:4). Backs of cut slabs for skirting and dados shall be covered with a thin layer of neat cement paste and tiles gently tapped against the wall with a wooden mallet. Joints shall be as close as possible and the work shall be truly vertical and flush. At the top of dado work borders, if specified, shall be provided.

Once work has set skirting and dados shall be hand polished with Carborundum stone to produce a high glossy finish. Corners and junctions shall be finished true.

The work for flooring, skirting and dado work shall be inclusive of forming angles, corner pieces and approved borders.

Urinal Partitions

The Urinal Partitions shall be 25mm thick. double side polished Granite slabs of size (450 +365) x 1050mm between Urinals. Top, side and all visible surfaces shall be polished & rounded off and fixed In CM 1:4 to walls with necessary MS clip sections as per detail drawings& approved by Architects.

Pre-polished Marble counters for washbasins

The Slabs shall be fixed on MS framework/ RCC slab true to line and level all as per detail drawing including

Skirting, Fascia band & verticals wherever required, and making openings in the Granite counter for seating washbasins etc. and pillar cock, including edge polishing and rounding of edges as approved. Shop drawings for seating arrangement shall be prepared by the vendor & approved by the Architect.

1.7 Integral Cement Finish on Concrete Floors

Where integral cement finish is specified to concrete floors surfaces of concrete shall be screed to proper levels and tamped with tamper with conical projections to ensure that aggregate is forced below the surface.

Surfaces shall be finished with a wooden float and a trowel applying sufficient pressure to provide a smooth finish. Treatment shall be continued until the concrete reaches its initial set. No cement or cement mortar finish is to be used on finished surfaces. Where specified, floor hardeners, approved by the Employers Representative or his representative, shall be supplied and incorporated into surface finishes in accordance with the manufacturer's recommendations.

1.8 IPS Flooring

General

The flooring shall be of specified thickness and shall consist of 1:2:4 concrete base/ M15 concrete as specified in the finishing schedule and 12mm thick wearing coat. The granolithic flooring shall be laid in alternate panels. The size of panels shall be as decided by the Employers Representatives.

Laying of 1:2:4/ M15 Concrete Base

The 1:2:4/ M15 concrete base shall be of graded course aggregate of 20mm and down size, 10mm course sand & cement. The ingredients shall be thoroughly mixed with sufficient water to obtain the required plasticity.The floor shall be completed with 1:1 cement sand mortar 12mm thick and cement slurry 2.2kg/sqm including Glass divider strips 45/50x4mm thick set in the flooring including necessary levelling, setting, etc.

The free water on the surface of the base shall be removed and a coat of cement slurry of the consistency of thick cream shall be brushed on the surface.

The prepared 1:2:4/ M15 concrete shall be laid immediately after mixing on the fresh grouted base. The concrete shall be spread e evenly and levelled carefully. Low places shall be filled, humps removed and the whole surface again leveled. The layer shall be compacted by ramming and toweled and allowed to set.

Mixing and Laying Of Wearing Coat

One part of cement in dry state shall be mixed with 1.5 parts by volume of well graded/crushed granite chips of 6mm maximum size. The ingredients shall be then mixed with sufficient water as for ordinary concrete. The wearing coat shall be laid 12mm thick over 1:2:4 cement concrete base immediately after it has set compacted and levelled with a steel trowel. Just sufficient trowelling shall be made to give a level surface. The surface should not be over trowelled, as excessive trowelling will bring the cement to the surface, which shall be strictly avoided. When the initial set takes place further compaction by steel trowelling shall be done and final brushing shall be made before the topping becomes too hard.

Floor hardeners

Where specified in the drawings, floor hardeners, approved by the Employers Representative or his representative, shall be supplied and incorporated into surface finishes in accordance with the manufacturer's recommendations.

Curing

As soon as the surface is hard enough, it shall be covered with sacking or sand and kept continuously wet for a period of at-least one week.

1.9 Screed Flooring

General

The flooring shall be of specified thickness and shall consist of 1:2:4 concrete base as specified and 12mm thick wearing coat. The screed flooring shall be laid in alternate panels. The size of panels shall be as decided by the Employers Representatives.

Laying of 1:2:4 Concrete Base

The 1:2:4 concrete base shall be of graded course aggregate of 20mm and down size, 10mm course sand & cement. The ingredients shall be thoroughly mixed with sufficient water to obtain the required plasticity.

The free water on the surface of the base shall be removed and a coat of cement slurry of the consistency of thick cream shall be brushed on the surface.

The prepared 1:2:4 concrete shall be laid immediately after mixing on the fresh grouted base. The concrete shall be spread evenly and levelled carefully. Low places shall be filled, humps removed and the whole surface again levelled. The layer shall be compacted by ramming and trowelled and allowed to set.

MS Mesh at joints

MS mesh shall be laid at all panel joints with mesh of size 40mmx80mm-10 SWG

Mixing and Laying Of Wearing Coat

One part of cement in dry state shall be mixed with 1.5 parts by volume of well graded/crushed granite chips of 6mm maximum size. The ingredients shall be then mixed with sufficient water as for ordinary concrete. The wearing coat shall be laid 12mm thick over 1:2:4 cement concrete base immediately after it has set compacted and levelled with a steel trowel. Just sufficient trowelling shall be made to give a level surface. The surface should not be over trowelled, as excessive trowelling will bring the cement to the surface, which shall be strictly avoided. When the initial set takes place further compaction by steel trowelling shall be done and final brushing shall be made before the topping becomes too hard.

Floor hardeners

Where specified in the drawings, floor hardeners, approved by the Employers Representative or his representative, shall be supplied and incorporated into surface finishes in accordance with the manufacturer's recommendations.

Curing

As soon as the surface is hard enough, it shall be covered with sacking or sand and kept continuously wet for a period of at-least one week.

1.10 Vacuum Dewatered Concreting & Flooring

1.10.1 Preparation

The surface to receive flooring shall be clean, free from dirt and free from foreign material.
Any undulations or mortar remaining on the floor shall be trimmed.
Base course shall be trimmed.
The base shall be cleaned and watered before laying the floor.
Work includes at all depths and heights.
The finished surface shall be kept wet for a maximum period of one week.

1.10.2 Concreting (General)

Concreting shall have a concrete base of M20 of specified thickness.
Flooring shall have hardtop on the concrete base.
Flooring shall be laid in strips, the size of which is mentioned on the drawings.

1.10.3 Materials

Cement – Cement used shall be ordinary Portland cement conforming to IS and shall be of grade 53 or 43.PSC(Portland Slag Cement) and PPC (Portland Pozzolona Cement) may be used in non structural works
Sand - River sand
Aggregate - Max.size 10 to 20mm
Water - Potable
Nito hardener (Optional) - @ 3kg/sqm
Poly Sulphide sealant - At all control joints of size 10mmx6mm at every 200 sqm area

1.10.4 Execution

Mix cement, sand and aggregates in proportion 1:1.5:3 thoroughly with water to get an appropriate consistency.

Prepared concrete shall be laid immediately after mixing.

The base shall be free from water and other foreign materials, dust and dirt.

A coat of cement slurry of the consistency of thick cream shall be brushed on the surface of the base course.

The concrete shall then be spread over this base evenly and levelled carefully.

Low areas shall be filled with concrete and humps removed. De-vaccumisation shall be done for removing the voids.

The whole concrete surface shall be levelled, compacted by ramming and trowelling.

Prepared surface shall be allowed to set.

Hardener screed:

Hard top to be prepared as per the specifications with Nito hardener and one part of dry cement.

The heard top shall be provided over concrete base immediately after it is set, compacted and levelled with a steel trowel.

The surface shall be trowelled to bring the hardener coat to a levelled surface.

Excessive trowelling shall be avoided.

After the initial set, further compaction shall be done by steel trowelling.

Final brushing where required (to achieve desired surface finish) shall be made before the floor top becomes too hard.

1.10.5 Curing

1.10.5.1 Curing shall commence as soon as the surface is hard enough to receive the water. The surface shall be covered with sacks or sand and shall be kept continuously wet for a period of at least one week.

1.11 Wooden Laminate floor

Wooden Laminate flooring shall be of PERGO or approved equivalent make comprising of a substrate of High density fibre board over a backing resin film, underlay boards & foam, all topped by a decorative laminate film of approved pattern & design topped by an transparent overlay as an anti abrasive protector all as per manufacturers specifications. The rate shall include for necessary Skirting boards, beadings, finishing profiles etc., complete all as per directions of Architect/Engineer in charge.

1.12 Engineered Wooden Floor

Engineered wood flooring shall be of TRY SQUARE make and Kayu Kuku wood species of Length of 300mm ~ 1500mm, with 121mm wide slats and 12.5mm thick. A layer of 2mm roofing felt/ PU foam shall be laid on bare levelled slab. 6mm thick marine ply wood shall be laid out on the roofing felt / PU foam including providing 12mm space along the walls. Slats shall be laid on top of ply wood with locking by Tongue and groove on all four sides. Slats shall be laid with maximum 1mm micro bevel 'V Groove' along all the joints. Pre finished Slats shall be coated with Aluminium Oxide with ceramic coating as per manufacturers specifications & Architects instructions

1.13 Solid wood floor

Providing and laying Exterior grade Solid wood flooring of TRYSQUARE make wood species IPE Species from Brazil of Length of 900mm ~ 1800mm as per approved drawings, with

120mm wide slats and 21mm thick. Slats shall be locked by nailed from the top on a hardwood runner base as per manufacturers specifications & Architects instructions. Slats shall be laid with minimum gap of 3 to 4mm. Slats shall be oiled at the site.

1.14 Wooden Cladding

Providing and fixing panelling on wall. Framing shall consist of Aluminium Section 50 mm x40 mm (Wall Thickness 2 mm) @ 2'0" C/C. Both ways horizontally and vertically on the wall. This framing would be covered by ¼" thk. Ply & Road wood veneer finished with melamine polished. Wooden moulding, lipping etc. as directed by Architect shall be provided wherever required

1.15 Dholpur Stone Cladding

a. Stone shall be all hard, sound durable and tough, free from cracks, decay and weathering and defects like cavities, cracks, flaws, sand holes, veins, patches of soft or loose materials uniform shade.
b. The stone shall be cut into slabs of required thickness along the flames parallel to the natural bed of stones.
c. The stone shall be wetted before laying. They shall then be fixed with mortar in position without the use of chips, or underpinning of any sort.
d. Where so desired, the adjoining stones shall be secured to each other by means of stainless steel pins 40mm long and 6mm diameter or as specified in the item of schedule.
e. The stones shall be secured to the backing by means of stainless steel angle or cramps of design/size given in the drawing or as per site condition.

   Stainless steel cramps can also be of 25x6mm flat 30cm or 16.5cm long required according to thickness of wall or as per site conditions unless specified otherwise they may be provided as directed by the Engineer-in-Charge. The cramps shall be spaced not more than 60 cms apart or as shown on the drawing and fixed with approved fasteners in RCC or with concrete blocks in brick work.
f. Cramps may be attached to its sides or top and bottom and or sides top and bottom. The minimum number of cramps required for fixing to the wall shall be as per requirements of design to carry the loads.
g. When cramps are used to hold the unit in position only, the facings shall be provided with a continuous support in which the stones rest at the ground level and other storey levels, the support being in the form of projection from or recesses into the concrete floor slab, or a beam between the columns or stainless steel angle attached to the floor slab or beams.
h. The pins, cramps and dowels shall be laid in non shrink grout and their samples got approved by the Engineer-in-Charge.
i. Stainless steel angle cramps/bracket shall be held in position with the help of expansion hold fasteners (Wedge expansion type) approved make.

1.16 ALUMINIUM COMPOSITE PANEL METAL CLADDING

Scope of Work

The contractor shall design, supply, fabricate, deliver and install and guarantee all construction necessary to provide a complete aluminium composite panel cladding, complete with all necessary anchors, hardware and fittings to provide a total installation, fully in conformity with the requirements and intent of the drawing and specification as per item description. The scope of work shall be read in conjunction with those in the specification of curtain walling.

Design Concept

a. The proposed cladding shall be based on a water-tight system.
b. A 20mm wide joint shall be provided between cladding elements to cater for individual panel installation and shall be sealed off with extruded EPDM gasket or silicon sealant.

Aluminium Composite Panel Cladding

Providing, designing, cutting, bending and fixing 4mm thick aluminium composite cladding of approved make on external façade of size as shown with Water tight system either curved or straight in plan. Skin material 0.5mm thick aluminium sheet (3005 H6) core material natural polyethylene, aluminium cladding panel to be of approved colour/shade fixed with extruded aluminium basic frame, angle cleats, weather sealants, rivets, GI brackets all as approved, using suitable chemical/anchor bolts on structural steel work including necessary accessories complete in all respects. Where level difference is shown dummy structural steel backup frame shall be provided. Protective Film: The finished surface shall be protected with 80 microns self adhesive Peel Off film with two layers of white and black tested to withstand at least 6 months exposure to local weather condition, without loosing the original peel off characteristic or causing stains or other damages.

Technical Data

A. Composition: Skin material 0.5mm thick aluminium sheet (3005 H6) core material natural polyethylene.
B. Dimensions: Panel thickness: 4mm

   Panel size: Width 1000/1250/1500mm, Length between 1500 and 5000mm

   Tolerance

   Width + 2.0mm ,

   Length + 4.0mm

   Thickness + 0.02mm
C. Principal Properties: Panel weight: 5.5 kg/sqm

   Thermal expansion: 1mm/M/60 deg.C.
D. Acoustic Properties: Average airborne sound transmission loss 26 db.
E. Mechanical Properties: Tensile Strength RM> 160 MPa.

   0.2% Proof stress RP> 130 MPa.

Modulus of Elasticity E 70,000 Mpa.

Elongation A-50 – 5-7%

F. Aluminium Extrusions: Extrusions shall be of aluminium alloy 6063 T conforming to BS 1470 – 1475: 1972 in mill finish.

1.17 ALUMINIUM INSULATED WALL PANEL

Scope of Work

The contractor shall design, supply, fabricate, deliver and install and guarantee all construction necessary to provide a complete aluminium insulated wall Panelling, complete with all necessary anchors, hardware and fittings to provide a total installation, fully in conformity with the requirements and intent of the drawing and specification as per item description.

The scope of work shall be read in conjunction with those in the specification of curtain system and interior fit outs.

Design Concept

a. The wall system shall be based on a water-tight system.
b. Seamless joint shall be provided between elements with clip lock system and shall be sealed off with extruded EPDM gasket or silicon sealant.

SECTION V RAILINGS

1. MS Railing, Grill, Canopy Steel Ladder (General)

These shall be made from MS sections consisting of M.S. Pipes, flats, square / round bars, channels, Tees, angles, plates, etc. as per the detailed drawings. The work includes fixing with screws or necessary anchor bolts and flats to fix the railing rigid in position. The members shall be welded together and all the welded joints shall be filed to make smooth joints. The work includes Synthetic enamel/ powder coating/ Autocoat paint to all steel members as per manufacturers specifications after phosphating and appropriate primer coat, etc. complete. of required shade as per the finishing schedule& drawings.

2 GI Pipe Railing

Providing GI pipe railing as per detailed drawings above flooring with `A' class GI pipes as per design including all specials, bends, elbows, Tees and with holdfasts or clamps. If the pipe railing is to be fixed in ground or brick work it shall be with 300 x 300 x 450mm (1:2:4 PCC) and if it is to be fixed in RCC work with necessary anchor bolts and plates to fix the railing rigidly in position.

3 MS Staircase Railing

Providing MS Staircase Railing with Top hand rail of 50mm dia Hollow MS pipe of 16 gauge to be welded as railing to the verticals made of 40mm dia MS tubes with 25mm dia MS Rod Mid Rails 3 Nos. welded to 40mm dia MS Tube Vertical Pipe. Verticals should be fixed to the concrete slabs with 200mm x 150mm, 10 gauge MS plate anchored with 4 Nos. of 10mm dia

75mm long Expansion bolts. All exposed MS sections to be painted with 2 coats of Synthetic

Enamel paint over a coat of primer, etc., complete. all as per Architectural drawings and instructions. Horizontal bars of 10mm dia MS rod of nos. as called for in the drawings to be fixed to the verticals.

4 MS Staircase Hand Rail

Providing Staircase hand rail of 65mm dia hollow MS pipe of 16 gauge, fixed to 12mm dia MS rod bent to profile and welded to insert plates of 200mm x 125mm size and 6mm thick, anchored in the wall with 4 nos. of 10mm dia, 75mm long expansion bolts, etc., complete, as per architectural drawings. Rate to include painting all MS sections with 2 coats of Synthetic Enamel over a coat of primer.

5 MS Handrail with Wooden Handle

Providing Staircase hand rail of 65mm dia Wooden anchored in the wall with 4 nos. of 10mm dia, 75mm long expansion bolts, etc., complete, as per architectural drawings. Rate to include painting all MS sections with 2 coats of Synthetic Enamel over a coat of primer.

6 Stainless Steel Handrail with Glass

The hand rail shall be 900mm high & made from 38mm diameter Brush finished stainless steel in position of D-line make with intermediate vertical balusters in stainless steel flats of size 52 x 12mm thick as recommended by the manufacturer adhering to the detail drawings. The 10mm thick edge polished toughened glass shall be rigidly held in position with vertical balusters with necessary interim and end adjustable brackets as per the manufacturer's specifications. The balusters shall be rigidly held in granite floor with necessary anchor fasteners, sleeves and finally covered with brush finished stainless steel coupling as per the detail drawings. The fixing of anchor fasteners shall carried in close co-ordination with Civil Contractor and should be completed before finishing the Granite flooring as instructed by the Architects. The 75% of glass shall be fixed with 3M film for frosted/ etched effect to the pattern as indicated in the detail drawings. The Contractor to submit the shop drawing of the same including the fabrication details, calculations and stability report. The work to start only on written approval of the same by the Architects.

7 Stainless Steel Handrail without Glass

Fabricating, Supplying and Fixing in position SS Staircase Handrail with Top hand rail of 50 mm dia Hollow SS pipe of to be welded as railing connected to the verticals through 8mm connecter plate with 2mm SS flat base plate below the hand rail. The Verticals shall be made of frame work of 2 Nos. 50X6 mm SS flat with 8mm spacer plate and rounded edges finish placed at 1000mm c/c as balusters as per the detail architectural drawing. Mid rails shall be 3 Nos 20mm dia SS rods connecting the verticals. Balusters should be fixed to the concrete slabs with 150mm x 100mm, 6mm SS plate anchored with 4 Nos. of 10mm dia 75mm long Expansion bolts as per the detail drawings. All SS sections will be finish as per Architects / Site in charge instructions. All sections to be of grade 304.The Contractor to submit the shop drawing of the same including the fabrication details, calculations and stability report. The work to start only on written approval of the same by the Architects.

8 Stainless Steel Ramp Handrail

Fabricating, Supplying and Fixing in position SS Ramp Handrail with Top hand rail of 50mm dia Hollow SS pipe of to be welded as railing connected to the verticals through 30mm wide SS flat. The Verticals shall be made of frame work of 2 Nos. 50X6 mm SS flat and rounded edges finish placed at 1300mm c/c as balusters as per the detail architectural drawing. Mid rails shall be 2 Nos 30mm X 30mm SS flat connecting the verticals. Balusters should be fixed to the concrete slabs with 150mm x 100mm, 6mm SS plate anchored with 4 Nos. of 10mm dia 75mm long Expansion bolts as per the detail drawings. All SS sections will be finish as per Architects / Site in charge instructions. All sections to be of grade 304. The Contractor to submit the shop drawing of the same including the fabrication details, calculations and stability report.The work to start only on written approval of the same by the Architects.

9 Stainless Steel Wheel chair Access Railing

Fabricating, Supplying and Fixing in position Wheel chair Access Railing with Top hand rail of 50mm dia Hollow SS pipe of 16 gauge to be welded as railing to the verticals made of 2 no's 50 x 6mm SS flat section placed back to back 1200mm c/c is connected with railing by 30mm wide SS flat sections as per the detail Architectural drawing and 100mm dia SS pipes 3 no's placed equally as mid rails as per the detail architectural drawing. The verticals fixed to the concrete slabs with 100mm x 150mm, 6mm MS plate anchored with 4 Nos. of 10mm dia 75mm long Expansion bolts as per the detail drawings. All SS & MS sections will be finished as per Architects / Site in charge instructions. All SS sections will be finish as per Architects / Site in charge instructions. All sections to be of grade 304. The Contractor to submit the shop drawing of the same including the fabrication details, calculations and stability report. The work to start only on written approval of the same by the Architects.

10 Glazier's Work

All glass for Railings etc. shall be as specified in the drawings and free from air bubbles, specks and scratches of other defects. All glass shall be cut to fit the sashes or other members as required. All glass shall be properly bedded, securely fixed and finished as indicated on the drawings. Beading finished as specified shall be provided for fixing the glass. No glazing shall be complete until all the stains and marks have been removed from the surface of glass.

11 Tolerances

Tolerance on nominal width and height shall be +3mm or -0mm and that on thickness shall be +/- 1.2mm. The thickness of the members shall be uniform throughout with a variation not exceeding +/- 0.8mm when measured at two end points.

SECTION – VII

EARTH WORK

1.0 GENERAL

1.1 Standards

Work shall be carried out to Indian Standards and Code of Practices. In absence, International Standards shall be followed. These shall be latest issue. List given hereunder is not to be considered as conclusive and is for reference and guidance only. Any discrepancies/conflict

noticed shall be directed to the Engineer-in-Charge for his direction/approval. However as a general rule more stringent specification shall take precedence.

1) IS 1498 Classification and identification of soils for general engineering purpose
2) IS 2720 Method of test of soil
3) IS 3764 Safety code for excavation work
4) IS 4081 Safety code for blasting and related drilling operation
5) IS 6313 Part 1 Code of practice for antitermite measures in buildings: constructional measures
6) Part 2 Code of practice for anti termite measures in buildings: Pre constructional chemical treatment measure
7) Explosive Rules 1940

2.0 SITE CLEARANCE

2.1 Prior to the start of any activity of earth-work, the area under construction shall be cleared of shrubs, vegetation, grass, brushwood, trees and saplings of girth upto 30 cm measured at a height of 1 metre above ground level. All rubbish must be removed and stacked at a distance of 50 m outside the periphery of the area under clearance or location as decided by the Engineer-in-Charge.

2.2 The rate of such clearance is to be included in the rate of other earthwork items and no separate rate shall be paid.

3.0 SETTING OUT

3.1 The contractor shall prepare detailed setting out drawings based on the layout of Architectural drawings and those shall be submitted to the Engineer-in-Charge prior to commencement of work. Bench Marks and Reference Lines shall be established, by the contractor with approval of the Engineer-in-Charge.

3.2 The contractor shall do the setting out with the use of theodolite and like instruments at site, based on details given to him. He shall erect timber profiles, masonry pillars, burjis, etc. for his use. All markings on these shall be painted with red colour and they shall be maintained for the entire duration of the project. Setting out shall be approved by the Engineer-in-Charge before the commencement of any work.

3.3 The rate for the earth-work items shall include expenses for all such work including labour, material and equipment/instruments, etc. No additional payment shall be eligible on this account.

4.0 EXCAVATION IN SOILS

4.1 Excavation over area

Excavation exceeding 1 m in width as well as 10 sq m in plan and 30 cm in depth shall be considered as excavation over area.

4.2 Surface dressing

Trimming of natural ground, excavated surfaces, and filled up areas to remove vegetation and/or small inequalities not exceeding 15 cm in depth shall be described as surface dressing.

4.3 Rough excavation

Excavation not requiring dressing of sides and bottom and reduction to exact levels, such as winning earth from borrow pits, hill side cuttings, etc. shall be described as rough excavation.

4.4 Surface excavation

Excavation exceeding 1 m in width as well as 10 sq m on plan but not exceeding 30 cm in depth shall be considered as surface excavation.

4.5 Trenches for pipes/cables

It shall be detailed with nominal dia of pipe/cable. Required bottom width, allowance for concrete foundation for laying pipes, working area, grip required for socketed pipe, return fill, ramming and removal of surplus soil shall be part of this item unless otherwise specified. It shall generally be measured in cubic metres unless specified specifically as running meter in the BOQ.

4.6 Post holes

Independent post holes (or similar holes) each not exceeding 0.5 cu m shall generally be enumerated. Rate shall include return fill, ramming and removal of surplus soil. However this shall be in cubic meters as part of excavation items.

4.7 General

4.7.1 The excavated earth shall be thrown or disposed off beyond 50 m periphery of the building. Earth suitable for backfilling shall be stacked separately.

Subsequent disposal of the surplus and unsuitable material shall be as per the respective items. Foundations, trenches shall be dug out to the exact dimensions as shown in the drawings or as directed by the Engineer-in-Charge.

4.7.2 In firm soil, the sides of the trench shall be kept vertical upto a depth of 2 m. If the trench is to be deeper, it shall be in the form of steps of 50 cm, at every 2 m depth. This shall be suitably increased or decreased as per site conditions and type of soil met with. This shall be to the approval of the Engineer-in-Charge. Sloping of sides also may be adopted.

4.7.3 The bed of trenches shall be firmly consolidated and leveled by watering and ramming of the soft soil. Defective spots shall be dug out and filled with concrete of the same mix as of PCC or as directed by the Engineer-in-Charge. Cost of digging and filling with concrete shall be paid extra if excavation and PCC is measured separately.

If excavation is done to a depth greater than that required, excess depth shall be back filled with the same mix as of PCC or as directed. Cost of such concrete shall be to the contractor's account.

4.7.4 Excavated trenches shall have to be approved by the Engineer-in-Charge prior to laying of PCC or any other Permanent Work.

4.7.5 Excavation for drains shall be carried out with extra care to cut the sides and bottom exactly to the required shape, slope and gradient. Filling for excess deeper excavation shall be done at the contractor's cost in consultation with the Engineer-in-Charge.

4.7.6 Excavated materials shall not be placed within 1 m of the edge of the trench or half the depth of the trench, whichever is more.

4.7.7 Excavations for column footings shall be carried to depths indicated in the drawings. Safe bearing capacity at such depth shall be verified to comply design requirements. If ordered by the Engineer-in-Charge, appropriate tests shall be carried out by the contractor.

4.8 Protection

4.8.1 Fencing and/or other suitable measures for protection against risk of accidents due to open excavation shall be provided by the contractor at his cost.

4.8.2 Where excavation is to be carried out below the foundation level of an adjacent structure, and to avoid underpinning, precautions such as shoring and strutting, etc. must be taken. No excavation should start till such measures are taken to the satisfaction of the Engineer-in-Charge. Payments for such work shall not be made separately unless specified otherwise.

5.0 EXCAVATION IN SOFT ROCK

5.1 This shall be carried out by crowbars, pickaxes or pneumatic drills or any other suitable means. Blasting may be permitted if the contractor so desires but no extra money shall be paid for blasting.

5.2 Other general details same as clause 4.7 and its sub clauses.

6.0 EXCAVATION IN HARD ROCK

6.1 General

6.1.1 On meeting hard rock that requires blasting, the contractor shall inform the Engineer-in- Charge. On approval in writing, blasting operation shall start if the contractor feels it necessary and so desires.

6.1.2 The contractor shall obtain the necessary license from the District Authorities for undertaking blasting work and explosive storing as per Explosives Rules 1940, and as updated. Explosives shall only be procured from an authorised dealer. He shall be responsible for the safe custody and proper accounting of explosives. The Engineer-in-Charge shall have access to the store.

6.1.3 The contractor shall be responsible for any accident to those working on the site, to the public or to property due to blasting operations.

6.2 Precautions

6.2.1 Safety measures to be adhered to shall be as detailed in IS 4081, Safety Code of Blasting (as amended from time to time, and to related drilling operations). Also digest No.37 of C.R.R.I and I.R.C.A. Road tariff No.18 shall be adhered to.

6.2.2 Blasting operation shall be carried out under the supervision of a responsible authorised agent of the contractor. Timings shall be as approved by the Engineer-in-Charge in writing. Lunch break will be preferred. The authorised agent of the contractor should be well conversant with the rules and regulations of blasting operations. Further the contractor shall employ licensed blasters for actual operation.

6.2.3 All proper precautions for safety shall be taken. All persons shall be moved away to a distance not less than 200 m. All entries shall be sealed and red flags displayed at prominent places.

6.2.4 Blasting shall be done only with gunpowder. Dynamite, gelignite, or any other high explosive shall be used only with written permission of the Engineer-in-Charge.]

6.2.5 The number of charges to be fired and the actual number of shots heard shall becounted and the contractor's agent shall satisfy himself by examining that all charges have exploded. Only then shall workmen be allowed to start work. Unexploded charges shall be flooded with water, a new hole drilled and exploded again.

6.2.6 The ER shall be informed about all misfires, their causes and the remedial steps taken.

7.0 CLASSIFICATION

7.1 All soils comprising any of the following:

a) Vegetable or organic soil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose murrum.
b) Any mixture of soils in (a).
c) Mud concrete below ground level.
d) Generally any material which yields to the ordinary application of a pickax and shovel or to phawra, rake or other ordinary digging implement and not affording resistance to digging greater than mentioned in (a) to (c).
e) Stiff heavy clay, hard shale, or compacted murrum requiring close application of a grafting tool or pick or both and shovel.
f) Gravel and cobblestone (cobblestone is a rock fragment), usually rounded, having maximum dia in one direction of 75-300 mm.

7.2 Soft rock comprising any of the following

a) Soling of roads, paths, etc. and hard core.
b) Macadam surfaces of any description (water bound, grouted, tarmac, etc.)
c) Lime concrete, stone masonry, in lime mortar and brick work in lime or cement mortar, below ground level.
d) Soft conglomerate, where the stones may be detached from the matrix with picks, crow bars, wedges, etc.
e) Limestone, sandstone, laterite, hard conglomerate or other soft or disintegrated rock which may be quarried or split with a crowbar.
f) Unreinforced cement concrete which may be broken up with crowbars or pickaxes and stone masonry in cement mortar, below ground level.
g) Boulders not requiring blasting, rock fragments usually rounded by weathering, disintegration and exfoliation or abrasion by water or ice, having maximum dia length in any direction of 500 mm, found loose, embedded, etc.
h) Other varieties of rock which would normally be removed with pick, crowbars, wedges and hammer with only a little difficulty.

7.3 Hard rock comprising any of the following

a) Any rock or cement concrete in excavation for which the use of mechanical equipment or blasting is required.
b) Reinforced cement concrete.

c) Boulders bigger than 1/2 cubic meter requiring blasting.

Hard rock as in (a) to (c) requiring blasting but prohibited from doing so for any reason and excavation has to be carried out by chiseling, wedging or any other agreed method.

8.0 FILLING

8.1 Filling shall be done where required with approved quality of earth. It may be from excavation and, where possible, cutting and filling shall be done simultaneously to avoid double handling.

8.2 Filling shall be done in layers not exceeding 20 cm in depth. Earth used shall be free from roots, grass and rubbish and all lumps and clods exceeding 8 cm in any direction shall be broken down. Each layer shall be watered with optimum moisture content to achieve 95% Procter density. Consolidation shall be done by mechanical roller of minimum 12 tons weight. The roller shall pass a minimum of 10 runs evenly to achieve dense consolidation. All undulation made up and final layer re-rolled.

8.3 Sand filling

The sand shall be free from any organic and deleterious materials as detailed in IS. It should be suitable for compaction. Filling shall be in layers of 15 to 20 cm watered with optimum moisture content and mechanical rammers.

8.4 Rubble soling

Good quality 150 mm to 230 mm thick rubble soling shall be carried out depending upon the grade of soil. Rubble used shall be at least 100 mm for 150 mm thick soling and 150 mm for 230 mm thick soling. Stone shall be hand packed as close as possible and bedded firmly with the broadest face downwards and the greatest length across, voids filled with chips and small stones. These shall be hammered down to achieve packing and the complete filling of interstices. To achieve the desired levels and slopes, pegs at suitable intervals (about 12 m) shall be fixed. Soling shall be watered and again packed with sand or murrum to fill interstices created by watering. Then it shall be rolled with 10 ton roller or vibratory compactor. Filling sand or murrum, watering and rolling shall continue till full compactness is achieved to satisfaction of the Engineer-in-Charge.

8.5 Metal packing

Coarse aggregate used for metal packing shall be crushed or broken stone, hard, durable and free from excess of flat, elongated, soft and disintegrated particles, dirt and other objectionable matter.

Prepared sub-base surface shall be uniformly spread with well graded metal. Templates shall be used for leveling. Leveling shall be true and checked with 3 m straight edge. Any raised areas or depressions of more than 12.5 mm shall be corrected. This shall be rolled with power wheel roller of 6 to 10 tons as required or as asked by the Engineer-in-Charge for the intended purpose. Rolling shall continue till aggregate is thoroughly keyed and the creeping of the aggregate ahead of the roller is no longer visible. The rolled surface shall be checked and all irregularities correctedby loosening the surface, adding or removing necessary amounts of aggregate and rerolling until the complete area conforms to the required datum. After the coarse aggregate has been thoroughly keyed and set by

rolling, screening shall be carried out to fill the interstices. This shall be done in 3 to 4 layers. Material shall be dry and no sprinkling of water shall be allowed.

9.0 PLANKING AND STRUTTING

In case of deep trenches where the soil is soft and not capable of being retained without the help of support, planking and strutting as required shall be carried out. It shall be the responsibility of the contractor to take steps to prevent slide/collapse. Method of planking/strutting will be largely influenced by the type of soil encountered and as approved by the Engineer-in-Charge.

10.0 DISPOSAL OF SURPLUS EARTH

10.1 Surplus earth shall be used to the maximum extent in the compound. Earth useful for filling shall be separately stacked as directed by the Engineer-in-Charge from time to time. Approved quality earth shall be used in the filling. It shall be consolidated as detailed and approved by the Engineer-in-Charge.]

10.2 Rate for excavation shall include sorting out of useful materials.

10.3 All surplus and unusable earth shall be disposed off outside the plot but at a location approved by local authority and conforming to their specification. The contractor shall quote his rate for disposing off or carting away the items considering requirements and standards of the local authority with whose permission surplus and unusable earth shall have to be disposed off.

11.0 DEWATERING

11.1 The works covered by this section of the specifications consist of furnishing all plant, labour, equipment appliances and materials and in performing all operations in connection with earthworks of all underground supplies and services and for all structural units, stock piling of suitable excavated materials, disposal of unsuitable and surplus excavated material, in accordance with this section of specifications and applicable drawings and subject to terms and conditions of the contract.

11.2 The Contractor shall acquaint himself of the nature of the ground, existing structures, foundations and subsoil which might he encountered during excavation of earthworks. The Employer does not guarantee or warrant in any way that the material to be found in the excavation will be similar in nature to that of any samples which may have been exhibited or indicated in the Report, Drawings or in any other Contract Documents or to material obtained from boring or trial pits. The Contractor shall be deemed to have made local and independent inquiries towards the nature of the ground, subsoil conditions or material to be excavated or penetrated. The Contractor shall not be entitled to receive any extra or additional payment on account of any variations.

11.3 All excavations, cuttings, and fills shall be carried out to the lines, levels and gradients specified with necessary allowance for consolidation, settlement and drainage. Any approval from Consultant shall not relieve the Contractor of any of his duties under the Contract.

11.4 The dewatering system shall consist of the basic dewatering system, a standby dewatering system, standby power system, monitoring devices, ditches, sumps, pumps and all associated equipment as specified herein. The basic dewatering system shall be the minimum dewatering system required to achieve the specified result.

11.5 The standby dewatering system shall be that system, which may be required to achieve the specified results, should part or all of the basic dewatering system becomes ineffective for maintenance or any reasons, other than a failure of power supply.

11.6 The standby power system shall be that independent generating system which may be required to keep the dewatering system fully operational in the event of a power failure.

11.7 DESIGN OF DEWATERING SYSTEM

11.7.1 The Contractor shall arrange to have the entire dewatering system designed in detail, installed, maintained and operated by qualified and experienced personnel throughout the course of the work. If the Contractor wishes to appoint some properly qualified dewatering sub-contractor, then his name, qualifications, record of previous jobs of a similar nature, personnel to be employed on the work, and other pertinent information shall be submitted to the Project Engineer for approval. Two weeks prior to commencement of installation of the dewatering system, Contractor shall submit to the Project Engineer for his technical approval, complete final plans, details and description of the dewatering system. Approval of the dewatering system by the Consultant shall in no way relieve the Contractor from his responsibility of satisfying the entire dewatering requirements as specified herein.

11.8 DEWATERING THE EXCAVATIONS

11.8.1 The Contractor shall install, maintain and operate a system of wells, trenches and pumps as required performing the excavations for the areas and subsequent construction of the structures and placement of backfill, in dry condition. Dewatering of the excavation shall be accomplished in a manner that will prevent seepage, boils, loss of fines, corrosion, softening of the strata, and that will maintain the stability of the bottom and slopes of excavation. In case any damage is caused to the work, in the opinion of the Project Engineer, due to inadequacy or failure of the dewatering system, in part or in whole, then the supply of all labour, materials and plant, and the performance of all work necessary to carry out additional or remedial work resulting from such damage shall be undertaken by the Contractor at his own cost. The cost of any damage caused to the structures or other equipment due to the failure of the dewatering system shall be borne by the Contractor and shall be covered by proper insurance to be provided by the Contractor, in accordance with insurance clauses ofthe "General Conditions of Contract".

11.8.2 The dewatering system shall be designed to operate on a continuous basis in such a manner that during excavation, the water level as observed in all piezometers installed near the periphery of the excavation with their tips located below the prevailing excavation level, is at least one meter below the prevailing excavation level.If the water level observed in any or all of the piezometers is higher than that specified, the excavation shall be halted until remedial measures to the dewatering system have been effected and the specified water levels in the piezometers attained or until the Contractor demonstrates to the satisfaction of the Project Engineer that it is safe to proceed with the excavation. Piezometers tips shall be installed near the bottom of the hole drilled for that purpose.

11.8.3 During construction of structures and subsequent backfill placement and associated work operations, the dewatering system shall operate on a continuous basis in such a manner that the water level, as observed in the piezometers located below the level of construction and backfill placement is at least one meter below the lowest point of

construction and backfill placement and the water level in the piezometers is maintained at such level till the concrete if any, has sufficiently hardened and until in the opinion of the Project Engineer, it is safe to allow the water level to rise up to a predetermined level.

11.8.4 The Dewatering System shall be maintained in operating condition so as to achieve the specified results until the construction of the structures and the backfill placement at all points, and installation of machinery and other associated equipment and embedded parts has reached a stage when, in the opinion of the Project Engineer Dewatering system can be cut off in stages as directed by the Project Engineer.

11.8.5 The Contractor shall not permit the accumulation of surface water within the confines of the excavation areas. The Contractor shall control, remove and divert surface water run-off, and water discharging from the dewatering system away from the excavations, to a point outside the working area as required by the Project Engineer.

11.8.6 The Contractor shall perform all work including, but not limited to, the construction and maintenance of ditches and sumps and provide, install, maintain and operate pumps and pipelines of adequate capacity as are necessary for the effective control of surface run-off and ground water not required to be intercepted by the dewatering system.

11.8.7 The Contractor shall supply, install, maintain and operate as required, the generators for power supply which shall be of sufficient capacity to maintain all pumps and equipment for both the Basic and Standby systems, operating on a continuous basis.

11.8.8 The Contractor shall supply, install and maintain an alarm system that will alert responsible personnel at the time of power failure and at the same time will automatically activate the standby units

11.8.9 The dewatering system shall be designed in such a manner that all or parts of the standby system may be directly connected to the basic system.

11.8.10 The standby dewatering systems shall be operated for a period of at least 3 hours duration each week to demonstrate its complete effectiveness. For such demonstrations, the Contractor shall not be entitled to any payment/ compensation.

11.9 OBSERVATIONS

11.9.1 Contractor's dewatering system shall include the supply, installation, data recording and maintenance of piezometers as may be required to demonstrate the satisfactory performance of the dewatering system.

11.9.2 In order to ascertain the continuous effectiveness of the dewatering system, Contractor shall supply all equipment and perform all work necessary to obtain and correlate records of the water elevation in each of the piezometric observation wells and records of the discharges from the dewatering system. These data shall be obtained on a continuous basis and shall be properly compiled and copies of the compiled data shall be submitted to the Project Engineer daily, or as required. The Contractor shall also keep the Project Engineer advised on a daily or as required basis on the equipment being utilized to effect the required results during the entire period when the dewatering system is in operation.

11.10 If at any time the Project Engineer is dissatisfied with the performance of dewatering system installed and operated by the Contractor, and if in his opinion it is necessary to make substantial changes in the dewatering system to achieve the desired results, the Contractor shall be entitled to do the same without any extra cost.

12.0 Soil Erosion Measures

12.1.1 Timing of Construction

Construction work and erosion control applications shall be scheduled and sequenced during dry weather periods when the potential for erosion is the lowest. Slope construction techniques to control erosion shall be used when construction during wet season is unavoidable. Sedimentation collection systems, drainage systems, and runoff diversion devices shall be installed before construction activity. The Landscape Architect/Architect/Engineer-in-charge shall monitor the site conditions and progress of work and schedule appropriate timing and sequencing of construction.

12.1.2 Preservation of Existing Vegetation

Protection of existing vegetation (including trees, shrubs, grasses and other plants) where possible, by preventing disturbance or damage to specified areas during construction is recommended. This practice minimizes the amount of bare soil exposed to erosive forces. All existing vegetation shall be marked on a site survey plan. A tree survey in prescribed format shall be carried out as indicated in Table below. The landscape plan should indicate trees, which have been preserved, and also those, which had to be transplanted or removed clearly differentiating between these three categories.

Plant Material Schedule for Tree Survey

Tree No	Botanical Name	Girth	Height	Spread	Condition

12.1.2.2 Trees retained on the project site shall be protected during the construction period by following measures:

a) Damage to roots shall be prevented during trenching, placing backfill, driving or parking heavy equipment, dumping of trash, oil, paint and other materials detrimental to plant health by restricting these activities to outside the area of canopy of trees.
b) Trees will not be used for support; their trunks shall not be damaged by cutting and carving or by nailing posters, advertisements or other material.
c) Lighting of fires or carrying out heat or gas emitting construction activity within the ground, covered by canopy of the tree shall not be permitted.
d) Young trees or saplings identified for preservation (height less than 2.00 m, 0.10 m trunk girth at 1.00 m height from finish ground, 2.00 m crown diameter) within the construction site have to be protected using tree guards of approved specification.
e) Existing drainage patterns through or into any preservation area shall not be modified unless specifically directed by the Landscape Architect/Architect/Engineer-in- charge.
f) Existing grades shall be maintained around existing vegetation and lowering or raising the levels around the vegetation is not allowed unless specifically directed by the Landscape Architect/Architect/Engineer-in-charge.
g) Maintenance activities shall be performed as needed to ensure that the vegetation remains healthy
h) The preserved vegetated area shall be inspected by the Landscape Architect/ Architect /Engineer-in-charge at regular intervals so that they remain undisturbed. The date of inspection, type of maintenance or restorative action followed shall be recorded in the logbook.

12.1.3 Staging Areas

Measures shall be followed collecting runoff from construction areas and material storage sites; diverting water flow away from such polluted areas, so that pollutants do not mix with storm water runoff undisturbed areas.

Temporary drainage channels, perimeter dike/swale, etc shall be constructed to carry the pollutant-laden water directly to treatment device or facility. The plan shall indicate how the above is accomplished on site, well in advance of the commencing of the construction activity.

12.1.4 Prevention of Topsoil

Topsoil removal and preservation shall be mandatory for development projects larger than 1.00 Hector. Topsoil shall be stripped to a depth of 200 mm from areas proposed to be occupied by buildings, roads, paved areas and external services. Topsoil is rich in organic content and is essential to establish new vegetation. It shall be stockpiled to a height of 400 mm in designated areas and shall be reapplied to site during plantation of the proposed vegetation. Topsoil shall be separated from subsoil debris and stones larger than 50 mm diameter. The stored topsoil may be used as finished grade for planting areas.

12.1.5 Spill Prevention and Control

Spill prevention and control plans shall be made, clearly stating measures to stop the source of the spill, to contain the spill, to dispose the contaminated material and hazardous wastes, and stating designation of personnel trained to prevent and control spills. Hazardous wastes include pesticides, paints, cleaners, petroleum products,fertilizers and solvents.

13.0 ANTI-TERMITE TREATMENT

13.1 Indian Standards

Indian Standards to be followed are

1) IS 4015 (Part-I & II) - Guide for handling cases of pesticide poisoning.
2) IS 6313 (Part-I) - Code of practice for Anti- termite measures in buildings constructional measures
3) IS 6313 (Part - II) - Code of practice for anti-termite measures in Building (pre constructional chemical treatment)
4) IS 8944 - Specification for Chloropyrifos Emulsified concentrates.

13.2 Materials

One of the following chemicals in water emulsion shall be used

13.2.1 For mound treatment

	Chemical	Relevant Indian Standard	Concentration By Volume
a	Cholopyrifosemulsifiable concentrate	IS : 8944	1.0%
b	Lindane	IS : 632	1.0%

13.2.2 For soil treatment

	Chemical	Relevant Indian Standard	Concentration By Volume
a	Cholopyrifosemulsifiable concentrate	IS : 8944	1.0%
b	Lindane	IS : 632	1.0%

13.3 Workmanship

13.3.1 Conditions of formation

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

13.3.2 Time of application

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

13.3.3 Disturbance

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

13.4 Termite mound treatment

If termite mounds are found within the plinth area, these shall be destroyed by pouring into the mounds at several places, after breaking open the earthen structure, and making holes with crow- bars, at the rate of approximately 4 litres of emulsion per cubic meter of mound.

13.5 Soil Treatment

13.5.1 Treatment of column pits foundation, trenches and basement excavations: The bottom surface and the sides (upto a height of 300 mm above concrete foundation level) of the excavations made for column pits, wall trenches and basements shall be treated with the chemical at the rate of 5 litres per sq m. ofsurface area. After the column foundation and retaining walls of the basement come up, the back fill in immediate contact with the foundation structure shall be treated at the rate of 15 litres per sq m. of the vertical surface of the sub-structure for each side. If water is used for ramming the earth fill the chemical treatment shall be carried out after ramming operation is done by rodding the earth at 150 mm centers close to wall surface and spraying the chemical with the above dose. As earth is filled in layers the treatment shall be carried out in similar stages. The chemical emulsion shall be directed towards the concrete or masonry surfaces of the columns and walls so that earth in contact with these surfaces is well treated with the chemicals. In the case of RCC framed structure with columns and plinth beams and RCC basements, the treatment shall start at the depth of 500 mmbelow ground level. From this depth the back fill around the columns beams and RCC basement wall shall be treated at the rate of 15 liters per sq m. of vertical surface. The other details of treatment shall be as described below:

13.5.2 Treatment to top surface of plinth filling:

After the earth filling is completed in the plinth area and before the rubblepacking or subgrade is laid, the entire surface of the filled earth shall be treated with the chemical emulsion at the rate of 5 litres per sq m. Light rodding may be carried out in the soil surface to facilitate absorption saturation of the soil with chemical emulsion.

b) For buildings where construction has advanced already for facility of construction, the treatment could also be done effectively, over the base concrete (lean mix) under the floor taking care that the emulsion, at the rate of 5 litres per sq m. soak fully into the concrete. The above application effectively prevents entry of termites through the floor structure.

13.5.3 Treatment of soil along external perimeter:

Finally the earth around the external perimeter of the building upto a depth of 30 cm shall be treated at the rate of 5.0 litres per running meter of the external wall.To facilitate this treatment solid MS rods should be driven into the soil as close possible to the plinth wall at intervals of 15 cm, and upto a depth of 30 cm, and the rods moved backwards and forwards in a direction parallel to the wall to break up the earth so that the emulsion mixes intimately with the soil.

13.5.4 Treatment of soil surrounding pipes, wastes and conduits:

When pipes, wastes and conduits enter the soil inside the area of the foundation,the soil surrounding the points of entry shall be loosened around each such pipe, waste or conduits for a distance of 15 cm, and upto a depth of 7.5 cm before the treatment is commenced. When they enter the soil external to the foundations,they shall be similarly treated unless they stand clear of the walls of the building by about 7.5 cm for a distance over 30 cm.

13.5.5 Treatment for expansion joints

Expansion joints at ground floor level are one of the biggest hazards for termite infestation. The soil beneath these joints should receive special attention when the

treatment under para 13.5.4 is carried out. This treatment should be supplemented by treating through the expansion joint after the sub-grade has been laid at the rate of 2 litres per linear meter

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13.6 Spraying Equipment

A pressure pump shall be used to carry out spraying operations to facilitate uniform spraying and penetration of chemical into the earth. The chemicals, concentration and dosage for horizontal and vertical surfaces are based on the IS code of practice for Anti- termite measures in Buildings. IS 6313 (Part-II).

13.7 Safety

Work shall be carried out as per safety measures instructions of manufacturer of approved pesticide & direction of Engineer-in-Charge. Also IS 4015 part I and II shall be followed.

13.8 Free Service Guarantee

The contractor shall note that termite proofing work is subject to a free service guarantee from the date of completion of the treatment. The contractor shall give an undertaking in writing to the effect that during the guarantee period any infestation of subterranean termites will be eradicated and necessary treatment carried out to prevent re-infestation, free of cost to the employer. The guarantee shall allow a minimum period of- 5 (Five) years for pre-constructional treatment.

Tenders must ensure that the work will be done through the professional Pest Control operator. They should be members of National Pest Control Association of USA, or Indian Pest Control Association or any other recognized professional body. They should furnish a list of Termite Control jobs carried out by them successfully for Government Department, Statutory bodies or large private organizations to prove that they are capable of handling anti termite work.

Technical specifications – SHEET PILING

Sheet piling shall be designed by the contractor to resist all dead and live loadings (earth pressures, hydrostatic pressures, traffic loads, point loads, line loads and surcharge loads) that the sheet piles may experience during the service life of the structure. In the design for sheet pile wall, account shall be taken of the following types of loads and forces:-

i. Active and passive earth pressure,
ii. Lateral earth pressure due to surcharge loads,
iii. Differential water pressure and seepage pressure,
iv. Earthquake force, and
v. Stresses due to handling and driving.

Sheet piling material may be of RCC piles, timber, reinforced concrete, pre-stressed concreteor steel. Depending upon the materials adopted by looking at various parameters, the conformance shall be as per the specifications given for the timber, reinforced concrete, prestressed concrete and steel sheet pile sheet pile in accordance with IS: 2911 (Part II)-1980, IS: 456-1978, IS: 1343-1980 and IS: 2314-1963 respectively.

The contractor shall submit design calculations, including soil design parameters used, methods of construction, and detailed drawings for all the design cases. He shall be responsible for the external stability of all temporary sheet piles. Differential and absolute settlements of sheet piles shall be limited to ensure minimal detrimental effects.

When a satisfactory bearing stratum is not encountered at a reasonable depth below the surface in front of the earth to be retained, then a sheet-pile wall may be provided. If the height of the wall and the pressure on the sheet-piles are such that an excessively thick pile is required, the provision of a tie at the level of the capping beam reduces the maximum bending moment. The tie can be provided at one level or at many levels. The ties are not only at top level but also intermediate levels also. The ties numbers can be either being reduced or increased depending upon the availability of anchorage n economy of design.

SECTION VIII

CONCRETE WORK

1.0 GENERAL

1.1 Standard

Work shall be carried out to Indian Standards and Code of Practices. In absence International Standards shall be followed. These shall be latest issue. List given hereunder is not to be considered as conclusive and is for reference and guidance only. Any discrepancies /conflict noticed shall be directed to the Engineer-in-Charge for his direction/approval. However as a general rule more stringent specification shall take precedence.

1) IS 269 Specification for Ordinary and low heat, Portland cement
2) IS 8112 Specification for 43 grade ordinary Portland cement
3) IS 12269 Specification for 53 grade ordinary Portland cement
4) IS 383 Specification for Coarse and fine aggregates from natural sources for concrete
5) IS 456 Code of practice for plain and reinforced concrete
6) IS 460 Specification for test sieves (Part I,II & III)
   i. Wire cloth test sieve
   ii. Perforated plate test sieve
   iii. Method of examination of test sieves
7) IS 515 Specification for natural and manufactured aggregates from natural sources for concrete.
8) IS 516 Method of test for strength of concrete
9) IS 875 Design loads for building structure. (Part I,II,III)
10) IS 1199 Method of Sampling and analysis of concrete
11) IS 1791 Batch type concrete mixers

12) IS 1893 Earthquake resistant design.
13) IS 2386 Method of test for aggregate for concrete (Part I,II & III)
    i. Particle size and shape
    ii. Estimation of deleterious materials and organic impurities
    iii. Specific gravity, density, voids, absorption and bulking.
14) IS 2505 General requirements for concrete vibrators
15) IS 2645 Specification for Integral cement water proofing compound
16) IS 3025 Methods of Sampling and test (Physical and Chemical for water)
17) IS 4326 Code of practice for earthquake resistant design and construction of building.
18) IS 4926 Specification for ready mixed concrete
19) IS 7861 Code of practice for extreme weather concreting
    i. Recommended practice for hot weather concreting
    ii. Recommended practice for cold weather concreting
20) IS 9103 Specifications for admixture for concrete
21) IS 12118 (Part I) Specification for two parts polysulphide based sealant : general requirements
22) SP 16 Handbook
23) SP 23 Handbook on concrete mix
24) SP 24 Explanatory handbook on Indian Standards code for plain and reinforced concrete (IS 456)

1.2 Quality Assurance

1.2.1 Concrete used on site shall comply to relevant parts of Standards, Codes of practices, technical specification given in particular or approved, designed mixes as prepared, approved and adopted for works to give designed strength, serviceability, long term durability etc.

1.2.2 Provide and monitor quality control over materials received from suppliers / manufacturers to ensure that materials comply with standard specified and are as approved.

1.2.3 Provide experienced supervision and work force to ensure that workmanship is of specified quality.

1.2.4 Work shall not be subjected to harmful, dangerous, damaging or deleterious exposures while it is in progress or on completion during contract period.

1.2.5 Contractor to under take quality assurance by documenting.

- Test report for material used in producing concrete.
- Mix design details with laboratory test report, actual site trial mix test and accepted modified design if any
- Pour cards with approval of the Engineer-in-Charge prior to placement
- Control charts
- Non conformance reports, changes, orders etc.

1.3 Submittals

1.3.1 Submit samples of all materials such as cement, sand, aggregate, admixtures, water etc to be incorporated into concrete along with test certificates from Govt .Engineering colleges like VGIT, IIT etc or Govt approved laboratories for the Engineer-in-Charge's approval.

1.3.2 Samples

During construction, the materials shall be sampled and tested as often as directed by the Engineer-in-Charge to the contractor. Samples shall be taken and tested in

accordance with latest revisions of Indian standard specifications and the cost thereof shall be borne by the Contractor.

1.3.3 Shop Drawings

Contractor shall prepare and submit method made of casting of slabs, beams with details of construction and expansion joint for approval of the Engineer-in-Charge.

1.4 Examination of conditions

Contractor shall inspect and examine sub stratas and confirm prior to start that.

- Substrate is acceptable and approved by Engineer-in-Charge.
- Conditions are satisfactory
- Setting out/Layout is verified
- Corrective measures needed if any are within reach and contractor proceeds with full responsibility for work.

2.0 MATERIALS

2.1 Cement

Cement shall be ordinary Portland cement conforming to IS and shall be of grade 53/43 for structural use .

It shall be received in bags of 50 kg or loose in tankers and each batch shall be accompanied with a test certificate of the factory. Also it shall be tested before use to ascertain its strength, setting time, etc. In case cement has been stored for over 3 months or for any reasons the stored cement shows signs of deterioration or contamination, it shall be tested as per the direction of the Engineer-in-Charge prior to use in the works.

2.2 Coarse aggregate

2.2.1 Coarse aggregate shall be obtained from natural sources such as stone, gravel, etc., crushed or uncrushed or a combination thereof from approved quarries. Aggregate shall be hard, strong, dense, durable, clean and free from veins and adherent coatings. It shall be free from soft, feeble, thin, elongated or laminated pieces and shall be roughly cubical in shape. It shall consist of coarse material, most of which is retained on 4.75 mm IS sieve.

2.2.2 Coarse aggregate shall not contain any harmful material such as iron, pyrites, coal, mica, shale or similar laminated material; neither shall it contain clay, alkali, soft fragments, sea shells, organic impurities, etc. in such quantities that adversely affects the strength and durability of the concrete. In addition to the above, in reinforced concrete the aggregate shall not contain any material which might attack the reinforcement. The maximum quantities of deleterious materials in the coarse aggregate, when determined in accordance with IS 2386 Part I and Part II "Method of

test for aggregates for concrete" shall not exceed the limits laid down in table 1 of IS 383.

2.2.3 Aggregate crushing value, impact value, abrasion value and soundness of aggregate shall respectively be in accordance with para 3.3, 3.4, 3.5 and 3.6 of IS 383.

2.2.4 Grading of coarse aggregate shall be in conformity with the requirements laid down in IS-383. See table 2 and table 3.

The grading of coarse aggregate shall be such that not more than 5% shall be larger than the maximum size and not more than 10% shall be smaller than the smallest size. Between these sizes the coarse aggregates shall be well graded.
For heavily reinforced concrete the aggregate shall be subjected to tests in accordancewith IS 2386 or and directed by the Engineer-in-Charge.

The maximum size of coarse aggregate should not be greater than one fourth of the minimum thickness of the member and it should be restricted to 5 mm less than the minimum clear distance between the main bars or 5 mm less than the minimum cover to the reinforcement.

2.2.5 Source of aggregate shall be from an approved Government location. It shall be tested prior to the approval of the Engineer-in-Charge from an approved testing laboratory. In case available aggregates do not meet certain requirements of IS 383 or any other specification, required processing shall be carried out by the contractor It shall be the duty of the contractor to make sure that aggregate material received by him is from Government approved quarries and with fully paid royalties, taxes, duties, etc. as may be in force from time to time for respective locations.

2.2.6 Coarse aggregate shall have a minimum specific gravity of 2.6.(Saturated surface dry basis).Aggregate below this specific gravity shall not be used without the special permission of the Engineer-in-Charge.

2.2.7 Once a specific source of supply of coarse aggregate is approved, the source shall not be changed without the prior approval of the Engineer-in-Charge.

2.3 Fine aggregate

2.3.1 Natural sand deposited by stream or glacial agencies as a result of disintegration of rock shall be used as fine aggregate. Fine aggregate shall pass through 4.75mm sieve in total. Crushed sand may be added to natural sand in approved proportions to achieve required grading. The fine aggregate shall conform to following standards.

i. For plain and reinforced concrete IS 383 Specification for coarse and fine aggregates from natural sources for concrete.
ii. Mortar and grout IS 2116 Specification for sand for masonry mortars.

2.3.2 Sea sand shall not be used unless special approval by the Engineer-in-Charge in writing is given. If approved, the required treatment shall be done at the contractor's cost.

2.3.3 Sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain any appreciable amount of clay. Sand shall not contain harmful impurities such as iron, pyrites, coal particles, lignite, mica shale or similar laminated material, alkali, and organic impurities in such form or quantities as to affect the strength or durability of concrete or mortar. Also it should not contain any material liable to attack the steel reinforcement.

2.3.4 When tested as per IS 2386 Part I and Part II, fine aggregate shall not exceed permissible quantities of deleterious materials as given in table 1 of IS 383.

2.3.5 Fine aggregate shall be thoroughly washed at site with clean fresh water such that the percentage of all deleterious material is within the permissible limits laid down.

2.3.6 Grading of fine aggregate shall conform to IS and shall fall within limits of one of the four zones given in table 4 of IS 383.

2.3.7 Due allowance for bulking due to damp and moist sand shall be made while preparing the mixes based on volume measurements. It shall be determined as per IS 2386 Part III Appendix A.

2.4 Water

2.4.1 Water used for mixing and curing shall be clean, reasonably clear and free from objectionable quantities of silt, oils, alkalies, acids, salts so as not to weaken mortar or concrete or cause efflorescence or attack the steel in RCC while curing it shall be free of elements, which significantly affects the hydration reaction or otherwise interferes with hardening of concrete during curing or those elements which produce objectionable stains or deposits. Potable water is generally satisfactory but it shall be tested prior to use in the works.

2.4.2 Water tested shall be in accordance with IS 3025. Maximum permissible limits of deleterious materials in water as given in IS 456.

2.4.3 Suitability of water shall be ascertained by the compressive strength and initial setting time test as specified under :

a. Average 28 days compressive strength of atleast three 15 cm concrete cubes prepared with water proposed to be used shall not be less than 90% of the average strength of three similar concrete cubes prepared with distilled water. Preparation and testing to be in accordance with IS 516.
b. The initial setting time of test blocks made with proposed cement and water to be used shall not be less than 30 minutes and shall not differ by + 30 minutes from the initial setting time of control test block prepared with the same cement and distilled water. Preparation and testing of block shall be in accordance with IS 4031.

2.4.4 The PH value of water shall not be less than 6 and not more than 9.

2.4.5 Water shall be tested and approved in writing by the Engineer-in-Charge prior to use in the works.

2.4.6 Sea water

Sea water in concrete shall not be permitted unless specifically approved in writing by the Engineer-in-Charge for purpose stated. The Engineer-in-Charge, under unavoidable circumstances, may allow mixing or curing by sea water in concrete construction which are permanently under sea water.

2.5 Admixture

2.5.1 These are substances other than cement, aggregate and water and shall be permitted to be used to modify the properties of concrete for single, or a combination of purposes. This shall be used only on the written approval for specific purpose and at the cost of the contractor. Good concrete shall be achieved without the aid of any admixtures.

2.5.2 Admixtures shall be free from chlorides and sulphates which might affect concrete or any other material which may cause problems to the concrete in the due course of time. Also it shall have no effect on the reinforcement in case of Reinforced Cement Concrete.

2.5.3 Admixtures generally in use are classified as under:

a. Accelerators
b. Retarders
c. Workability agents
d. Water repelling agents
e. Air-entraining agents
f. Gas-forming agents
g. Corrosion inhibitor additive

These are manufactured and sold by various companies under brand names. The contractor proposing to use any one of them shall submit to the ER technical literature with its chemical composition, purpose of use and method recommended by the manufacturer and what he proposes to follow at site for strict control.

2.5.4 The contractor's proposal shall accompany the followings with his request to use admixture.

a. The trade name of the admixture, its source and the manufacturer's recommended method of use.
b. Typical dosage rates and the possible detrimental effects of under and overdosage.
c. Whether the admixture contains chloride in any free form or any other chemical present as an active ingredient which is a likely cause of corrosion of reinforcement or deterioration of concrete.
d. The average expected air content of freshly mixed concrete containing an admixture which causes air to be entrained when used at the manufacturer`s recommended rate of dosage.

2.6 Miscellaneous

2.6.1 Integral cement water proofing compound specified for specific use shall conform to IS-2645.

2.6.2 Bituminous felts for water proofing and damp proofing course shall conform to IS 1322.

2.6.3 Bituminous compounds for water proofing purposes shall conform to IS 1580.

2.6.4 Expansion joint filler

Bituminous impregnated premoulded preformed expansion joint filler board conforming to IS 1838 part (I) specification for preformed filler boards shall be of approved quality and thickness at designated locations.

2.6.5 2.6.5 Polysulphide sealants

i. Expansion, construction or other joints shall be sealed with approved quality polysulphide sealants.

ii. One part gun grade polysulphide-based joint sealants shall conform to IS 11433(Part I).It shall be used with the approval of the Engineer-in-Charge and as per the manufacturer`s instructions. Correct primer shall be used at the specified location.

iii. Two part polysulphide based sealant gun grade or pouring grade shall conform to IS 12118 (part I). Pouring grade shall be used in horizontal joints. Gun grade shall be used in vertical, inclined and horizontal joints. Specified primer shall be applied prior to the use of sealant. Use of sealant shall be as per instructions of the approved manufacturer.

iv. Sealant shall be cured at ambient temperature and humidity when applied as per the approved manufacturer's instruction and received in suitable packs. Each package shall indicate

- Manufacturer`s name and trade mark
- Weight of the components
- Instructions for storage
- Type and grade of sealants
- Date of manufacture and expiry
- Instructions for use

2.6.6 Water bar

PVC or rubber water bar of type, quality and width shall be used as approved by the Engineer-in-Charge. Water bar shall be continuous and fixed at the indicated locations. Water bar should be welded or joined with the approved method. All angles and corners shall be purpose-made and shall be joined with the approved method.

2.7 Delivery and Storage

2.7.1 It shall be received in bags of 50 kgs and each batch shall be accompanied with a test certificate of the factory. Reject damp or torn bags.Cement shall be stored in dry and water proof shed so as to prevent deterioration due to moisture, dampness. Bags shall be stacked on rigid water-proof platforms about 15 to 20 cm clear above the floors and 25 to 35 cm clear or away from the surrounding walls. A maximum high stack of 10 bags permitted. Stacks shall be so arranged that the first batches are used first, (FIFO) and that they permit easy access for inspection and handling. Loose cement received shall be stored in silo's. Silo's shall be equipped to receive cement by pump and manually. Silo's shall be water tight and damp proof to keep cement fresh.

2.7.2 Coarse Aggregates and Fine Aggregates

Aggregate shall be stored in such a way that it does not get mixed with mud, grass, vegetables and other foreign matter. The best way is to have a hard surface platform made out of concrete, bricks or planks. It should be to the approval of the ER.

2.7.3 Water

Water storage tanks shall be such as to prevent any deleterious materials getting mixed with it.

2.7.4 Covered storages

Considering the atmospheric/ weather conditions at site storages, covering shall be arranged to take care of temperature controls at site.

3.0 CONCRETE

Concrete is prepared by mixing graded aggregate of stone or along with cement, in a specified proportion. Mixing shall be done by batching plant for better quality control. For PCC / Mass foundations mechanical mixers can be used with permission of Engineer-in-Charge. Manual hand mixing shall be permitted in specific cases with the written permission of the Engineer-in-Charge on account of small quantity or location or any other reason acceptable to the Engineer-in-Charge.

3.1 Cement concrete

This shall be classified as plain cement concrete or reinforced cement concrete. Plain cement concrete shall be in leveling course under foundations, floors, copings, etc. and shall include form work as part of the work.

Reinforced cement concrete shall be at all locations and comprises form work, reinforcement and concrete. Payment of reinforced cement concrete may be composite or item wise as specified in the BOQ. In PCC, payment for form work shall not be made.

3.1.1 Concrete shall be classified by its compressive strength at the 28th day. The concrete grades shall be as designated in table 2 of IS 456 “Grade of concrete”.

3.1.2 Design mix

Various types of concrete aimed are to be used in works. It shall be the responsibility of the contractor to carry out design mixes and approval of the same shall be obtained from the Engineer-in-Charge atleast 35 days in advance from the actual pouring of concrete at site in the permanent works.

i. Mix design of concrete shall be done as per IS 10262 & SP 23, 24. Following basic points shall be finalised.

- Characteristic compressive strength and targeted compressive strength required at design stage.
- Standard deviation factor based on site actual execution conditions.
- Minimum cement specified in BOQ or as per IS for strength and durability for location where concrete is to be used.
- Water cement ratio permitted by IS.
- Workability to be achieved for better workmanship and good quality concrete
- Admixtures to be used if any
- Aggregates being used are tested to IS383. Include for Alkali reactivity, chloride and sulphate contents independently and combination of cementand water.
- Water being used is tested.

Further the contractor shall ensure that designed mix meet minimum cement contents as specified in BOQ/drawings and proposed revision to IS 456 along with maximum water cement ratio, to different exposure condition from durability point of view. In addition contractor shall ensure

a) Alkali - reactivity

Aggregates containing material susceptible to attack by alkali's (Na2O and K2O) originating from cement or other sources and producing expansive reaction shall not be used.

The aggregates source shall be initially tested for alkali reactivity prior to being used in design mix.

b) Sulphate and chlorides in concrete.

Harmful salts coming from the concrete materials such as cement, aggregate, water and admixture, as well as by diffusion from environments shall be limited to following weight of cement.

- Total chlorides (as Cl) - 0.15 %
- Total soluble sulphate (as SO3) - 4 %

3.1.3 Compressive strength

For expected strength of cubes tested on the 28th day, the design mix at preliminary test and work site shall be as per IS 456 2000.

Water cement ratio

The water-cement ratio shall be between 0.42 to 0.55. Additional water may be permitted only at the discretion of the Structural Engineer. The slump shall depend upon the location and type of work. Higher slump with use of plastisizers shall be permitted.

3.1.4 Trial mixes

3.1.4.1 The contractor shall submit, at least 5 weeks in advance, to the Engineer-in-Charge the mix design that he proposes to use at site. The mix design in addition to points in 3.1.2 shall also give basic details (when tested according to IS 1199 and IS 2386-Part III 1963), as per followings

a) Slump/Workability
b) Bleeding
c) Compacting factor
d) Vee-Bee time
e) Cement required for one cubic meter of concrete
f) Wet and dry density
g) Air contents if applicable

3.1.4.2 On receipt of this, the Engineer-in-Charge may immediately order to carry out work site test before the final approval. This shall be done with mixer and materials actually being used at site. This shall give the contractor additional chance to check for himself actual workability and make sure that the mix proposed by him will be fully satisfactory with regards to slump, segregation, bleeding, water-cement ratio and workability. 6 cubes shall be taken from each of the 3 batches to test the mix. Cubes shall be cast, stored, cured, transported and tested to IS 516. The test may be carried out at site or laboratory as approved by the Engineer-in-Charge. Trial mixes shall be approved provided that average strength of 3 consecutive cubes is not less than that specified and that one out of three may give a value less than specified but limited to a maximum of 90% of the specified strength.

3.1.4.3 In case the trial mix falls below the above criterion, the Engineer-in-Charge shall order fresh trial mixes to be made as before, until the desired strength is arrived at.

3.1.4.4 This design mix and trial mix hold good so long as the materials continue to be of the same quality and from the same sources. For any change, the Engineer-in-Charge may order fresh design mix and trial mixes to be carried out before the same is used at site.

3.1.5 Mixing of concrete

3.1.5.1 Machinery and equipments.

a) Batching

Batching shall be done by weigh batchers conforming to IS 2722. A platform scale of capacity 300kg with fraction upto 100gms shall be at site. For water supply to mixture through metering system shall be organised. Design mix converted to volumetric may be permitted by Engineer-in-Charge.

Accordingly suitable size of boxes equivalent to 1 bag of 50kg cement shall be prepared by the contractor.

b) Mixer

Mixers used shall conform to IS. Type Capacity shall be as per size, extent and nature of work.

c) Transportation

Wheel borrows, cranes, mini dumpers, truck, agitators, belt conveyors, pumps with piping etc. as per requirement depending upon location, size extent and nature of work shall be deployed by the contractor with prior approval of the Engineer-in- Charge.

d) Vibrators

Internal and external vibrators working on electricity, Pneumatic or petrol shall be approved by the Engineer-in-Charge. Vibrators shall conform to IS.

e) All machineries and equipments shall be maintained regularly. Periodic calibration of all machines shall be done and records maintained in a register. As and when requested by the Engineer-in-Charge same shall be forwarded for his inspection.

3.1.5.2 At the start of mixing mixer shall be rinsed/coated by loading with cement, sand, water of the same proportion of batch to be used. Loading the mixer/charging the mixer shall be done mechanically and care to be taken that all material is fully loaded. The mixer shall be run for a minimum period of 2 minutes after all materials are loaded in full quantity. The concrete produced shall be uniform in colour and consistency. Unless agreed by Engineer-in-Charge the first batch of concrete from mixer shall contain two-third of normal quantity of coarse aggregate.

3.1.5.3 Transportation

Concrete shall be transported to place of pour as far as possible in most efficiently, conveniently and without loss of concrete characteristic. Method of transportation shall depend upon the location, size and nature of work. Concrete should be placed within ½ hour of production i.e. prior to initial set.

Use of admixtures such as air entraining agent, retarders etc. shall be adopted and incorporated into design mix stage.

Concrete shall be kept in agitating state when ambient temperatures are high. This shall increase placing time to 1 ½ hrs after water is added.

Points to be taken care are

- Method adopted do not permit segregation
- Containers used are leak proof
- Containers are well covered during rains, heavy winds
- Concrete does not get contaminated by oil, dirt etc.

3.1.5.4 Placing

The placing temperature of concrete shall not be more than 34^{o} C. If it is more, the ER may order addition of ice or chilled water to the concrete. Also the contractor shall take the following precautions :

a) Mixers and weigh batchers shall be painted with white colour
b) Aggregate storing bins shall not be exposed to the Sun
c) Water shall be sprinkled on aggregates well before concreting to keep the temperature low.
d) Use chilled water for mixing or add flake ice as a proportion of the mixing water.
e) Place concrete at night.

3.1.5.5 Ready mix concrete (RMC)

a) Concrete
Ready mix concrete as approved only shall be used. It shall comply all requirements of concrete. Batching plant, mixture, truck mixture, pump etc shall conform to relevant Indian standard. Daily returns shall be provided showing total volume of each class of concrete received.

b) Pumping of concrete

Stationery or mobile pumps as per requirements shall be deployed. Concrete shall be continuous to avoid any blockage within pump. Concrete mix shall be with slump as desired by pump manufacturer and most desirable at site to pump operator / supervisor. Required piping, bends, clamps, chutes etc. shall be well organised and placed in position prior to start so continuous concrete with minor changes will keep concrete flowing at predetermined location in approved manner.

Mix design adopted shall be approved by Engineer-in-Charge and shall conform all tests as detailed in specification.

Pump concrete shall flow quite fast and is placed with larger impact on formwork. Hence special precautions at design stage of formwork shall be taken and staging/scaffolds should be well restrained in all directions to withstand thrust.

Pumping shall be done with due care and safety. Recommendation of pump suppliers shall be followed strictly.

3.1.6 Shrinkage cracks

Concreting shall be avoided in very warm weather. If necessary, it shall be covered with damped hessian within 2 hours of placing of concrete. To achieve good results the concrete shall be immediately covered with a plastic sheet and not allowed any direct wind contact. This shall eliminate shrinkage cracks

3.1.7 Laying of concrete

a) Concreting shall commence only after formwork is approved, reinforcement is recorded and permission to proceed with concreting has been approved in writing from the Engineer-in-Charge.
b) Formwork should be clean, free from sawdust, pieces of wood or any other foreign material. It should have been treated by form releasing agent prior to the laying of reinforcement and concrete. Prior to placing concrete against old concrete, masonry, rock all loose materials shall be removed and surfaces washed down. Concrete shall be worked around ties and bond and in open joints.
c) Concrete shall be as gently deposited as is practically possible, in its final position to avoid rehandling and shall be so deposited that segregation of aggregates does not occur. In case of deep trenches and footings, it may be done with the help of a chute. Columns and walls shall be so adjusted in form work so that maximum depth is 1.5 metre unless consented to by the ER. Concrete from wheel barrows shall not be dumped away from the face of concrete already in place. It shall be dumped into the face of concrete already in place. In excavations prevent contamination of earth and concrete without disturbing unsupported sides of excavation. Concrete shall not be placed in water except where specified.
d) Concrete onto a sloping surface shall be discharged by providing a chute with a baffle and a drop at its end so that the concrete remains on the slope.
e) Columns and walls shall be concreted in one operation to their full height to avoid any horizontal construction joint as far as possible.
f) All slabs, beams, wooden planks, and cat-walks shall be provided clear of reinforcement.
g) Concrete shall be placed in position within 30 minutes from the time it is produced. Concrete shall be laid during normal working hours. Concreting at night or on holidays shall be permitted only on the written approval of the Engineer-in-Charge.
h) Placing in each section shall be a continuous between construction joints. The contractor shall make provision for standby equipment. In case of delay or break down stop ends are to be provided or concrete placed to be removed as per direction of the Engineer-in-Charge.
i) Placing shall not take in open during storms or rains, strong winds. Contractor to organise and provide required protection.

3.1.8 Compaction of concrete

Concrete shall be thoroughly compacted as depositing shall proceed by means of suitable vibrators. The vibrators shall maintain the entire concrete under treatment in nan adequate state of agitation and shall continue during the whole period occupied by placing of concrete. Care shall be taken not to over- vibrate the concrete. While withdrawing needles no holes should be visible in concreting. Compaction shall be completed before the initial setting time. Concrete already set shall not be disturbed by successive vibrations.

It shall be ensured that the needle vibrators are not applied on reinforcement which may destroy the bond between concrete and reinforcement.

When electric vibrators are in use, the standby petrol vibrator must always be available at the concreting point.

3.1.9 Construction joints

In large pours, it is practically not possible to carry on concreting continuously. Hence construction joints shall be provided. Location of construction joint shall be submitted by the contractor for approval of the Engineer-in-Charge. Such joints shall be kept to a minimum. The joints shall be at places where shear force is nil or minimum and these shall be straight and at right angles to the direction of the main reinforcement.

Stop ends provided shall be with necessary slots for reinforcement bars to pass freely without bending or any other obstruction. Also a trapezoidal fillet nailed on stop board shall be provided to form a regular keyed joint. Joints shall be straight and truly vertical or horizontal.

Before commencement of concrete, adjacent concrete stopper and surfaces shall be chipped and roughened to expose aggregate, then wire brushed and cleaned. The concrete surface shall be sprayed with water for 24 hours before casting and kept wet until casting.

True horizontal joints shall also be provided with a keyed joint by inserting planed greased timber.

Prepared joint shall be treated as above prior to the start of fresh concreting.

For vertical joints neat cement slurry shall be applied on the surface just before concreting. For horizontal joints, the surface shall be covered with a layer of mortar about 10 to 15 mm thick composed of cement and sand in the same ratio as the cement and sand in the concrete mix. This layer of cement slurry shall be freshly mixed and applied just before concreting.

3.1.10 Expansion joints

Expansion joints shall be formed and located as detailed in the drawing. Insert sealant to completely fill the joint and finish neat and smooth.

3.1.11 Curing

Curing of concrete is most important. There shall be no compromise on this activity and it is for the contractor to arrange for everything necessary to make sure that the concrete is cured to the complete satisfaction of the Engineer-in-Charge. As said above in clause 3.1.8, after concrete has begun to harden i.e. about 1 to 2 hours after laying, it shall be protected from quick drying with moist or damped hessian cloth or any other material approved by the Engineer-in-Charge. After 24 hours of laying of the concrete, the surface shall be cured by flooding with water or covering with damphessian cloth for a period of 7 days to keep it moist.

For the next 7 days the surface shall be kept wet all the time by sprinkling water continuously.

For membrane curing, details as listed in 12.5 of SP 24 shall be followed.

3.1.12 Finishing

Concrete shall be finished keeping in mind the next operation to be carried out over the surface. For guidance the following points shall be noted but the Engineer-in-Charge shall be consulted prior to start of concreting and his decision in this regard shall be final.

a) Roof slab shall be troweled even and smooth with a wooden float.
b) The surface that will receive plaster shall be roughened immediately.
c) Surfaces that will be in contact with any masonry work shall be roughened immediately.
d) The surface that will receive mosaic floor or IPS or any other type of tiled work shall be roughened while it is green. Every care shall be taken not to disturb the freshly laid concrete.
e) For dust proof (or hardened) finish, clean the concrete surface of oil and contamination and apply approved dust proof hardener as per manufacturer's instructions.

3.1.13 Inspection and corrective measures

3.1.13.1 On removal of form work, the surface shall be examined by the Engineer-in-Charge. Till such time, no remedial measures shall be carried out by the contractor. All patching, rectification or chipping shall be done only on the Engineer-in-Charge's instructions. In case of any violation of this rule, the concrete poured stands rejected. The decision of the Engineer-in-Charge in this regard shall be final and binding on all parties. Sagged, bulged, patched, honeycombed work shall stand to be rejected for surfaces that are exposed, or require fairface finish or decorative textured finish. The ER may permit any work found structurally safe and areas of unexposed faces, for repairing. As directed by the Engineer-in-Charge these works shall be retained and the cost of repair shall be at the contractor's account.

3.1.13.2 Cracks observed shall be brought to the notice of the Engineer-in-Charge who shall examine them. It shall be kept under observation and a record shall be maintained for a period of 45 days. It shall be shown to the Structural Engineer and the following procedure shall be followed:-

a) Cracks not developing further and in the opinion of Structural Engineer not detrimental to the strength of the construction shall be grouted with non-shrinking cement slurry or as directed by the Engineer-in-Charge.
b) Cracks developing further and, in the opinion of the Structural Engineer, detrimental to the strength of construction, shall be tested as per the relevant Indian standard.
c) Based on results of the test, the Engineer-in-Charge in consultation with the Structural Engineer shall order remedial measures or order the contractor to dismantle construction, cart away the debris, replace the construction and carry out all the consequential works thereto.
d) Cost of the above shall be borne by the contractor if the failure was on his part. In case it is due to design faults, it shall be borne by the employer.
e) The decision of the Engineer-in-Charge in this matter shall be final and binding on all parties. This decision shall not be open for arbitration.

3.1.14 Testing

3.1.14.1 Quantum of cubes and testing

The minimum frequency of cube casting shall be as follows. Each sample shall consist of 6 cubes.

Concrete quantity Number of Samples.

Upto 5 cu m in a day : 1

5 cu m to 15 cu m : 2

15 cu m to 30 cu m : 3

30 cu m to 50 cu m : 4

More than 50 cu m : 4 + one additional per each 50 cu m or part thereof

Three cubes shall be tested on the 7th day and other three cubes on the 28th day.

3.1.14.2 Field Tests

It is the responsibility of the contractor to prepare and get the cubes tested and to provide all the material, labour, moulds, equipment, casting and curing facility, charges for testing, etc.

Further, the contractor shall have to provide and maintain all the equipment and staff at the site throughout to carry out the following tests in a small laboratory or get these tests from approved laboratories without extra cost to the contract.

a) Grading of coarse and fine aggregates
b) Silt content of sand
c) Moisture content of coarse and fine aggregates
d) Slump test of concrete
e) Concrete cube test

3.1.14.3 The contractor shall maintain full records of all above tests in a register. The format of records shall be prepared in consultation with the Engineer-in-Charge and either he or his representative shall have full access to the contractor's laboratory. The contractor shall include charges for the above work in his rates and no extra whatsoever shall be admissible on this account of designing, testing, maintaining laboratory, etc.

3.2 Concreting under special conditions

3.2.1 Work in extreme weather conditions

During hot or cold weather the concreting should be done as per the procedure set out in IS 7861 Part I or IS 7861 Part II or as directed by the Engineer-in-Charge.

3.2.2 Underwater concreting

The procedure set out under 13.2 of IS 456 shall be followed or as directed by the Engineer-in-Charge.

3.2.3 Concreting in sea water

The procedure set out under 13.3 of IS 456 shall be followed or as directed by the Engineer-in-Charge.

3.2.4 Concreting in aggressive soils and water

Guidelines laid down in 13.4 of IS 456 shall be followed together with the instructions of the Engineer-in-Charge.

3.3 Precast concrete

3.3.1 Precast concrete can be plain or reinforced. It shall meet all requirements and specifications of concrete as stated hereof. Precast concrete shall be done for cellular roof units, drainage or specially designed for specific use taking into consideration achievements in flexibility, speed and economy in construction.

3.3.2 Precast concrete units shall be cast in a suitable mould so as to make sure that they are,

a) Easy to lift
b) Easy to transport
c) Excellently finished
d) Handy to erect and join at site

Units shall be sound and free from cracks or any other defects that would interfere with the proper placing of units or the strength or performance of units or the structure.

3.3.3 Precast units shall be lifted and handled with proper tools from points designated to avoid any cracking or developing of any undue stresses. If required, necessary tools and tackles shall be fabricated by the contractor. Precast units shall be removed from mould within 24 hours or the time allowed by the designer or as approved by the Engineer-in-Charge.
All units that are, in the opinion of the Engineer-in-Charge, cracked and unsafe, shall be stacked in the precasting yard in a proper manner. The date of casting shall be noted therein and wet curing for 15 days shall be done without fail. The yard shall have a duly dressed ground and sufficient supports at the required intervals to receive precast units.

Units shall be erected only after 28 days of casting and after the cubes of those days have given the strength specified.

Tolerances in units shall not be more than +3 mm as approved by the Engineer-in-Charge taking into consideration the purpose and location of use.

3.4 Plum Concrete

Stone plums shall be used only when specified. Size of stone plums may be from 150 to 300mm.

Plums shall be hard, double clean and free from soft or loose pieces or deleterious material and should not have sharp corners.

Generally first layer of concrete of specified mix shall be of thickness 2.5 time thickness of maximum size of plums to be used. Plums shall be laid when concrete becomes stiff but top portion is still green. No plums shall be used for concrete laid

under water. The thickness of next and successive layers shall be 2 times that of largest plums.

SECTION – IX

REINFORCEMENT WORK

1 GENERAL

1.1 Standards

Work shall be carried out to Indian Standards and Code of Practices. In absence International Standards shall be followed. These shall be latest issue. List given hereunder is not to be considered as conclusive and is for reference and guidance only. Any discrepancies /conflict noticed shall be directed to the Engineer-in-Charge for his direction/approval. However as a general rule more stringent specification shall take precedence.

i. IS 226 Specification for steel standard quality
ii. IS 228 Methods for chemical analysis of steels
iii. IS 280 Specification for mild steel wire for general engineering purpose.
iv. IS 432 Specification for mild steel and medium tensile steel burn and hard drawn steel wires for concrete requirement.
- Part 1 Mild steel and Medium tensile steel bars.
- Part 2 Hard drawn steel wire.

v. 5. IS 456 Code of practice for construction and design of reinforced concrete.
vi. 6. IS 816 Code of practice for use of metal arc welding for general construction in mild steel
vii. 7. IS 961 Specification for structural steel : high tensile steel bars
viii. 8. IS 1566 Hard drawn steel wire fabric for concrete reinforcement.
ix. 9. IS 1599 Method of Bend test
x. 10. IS 1642 General requirements for fire protection.
xi. 11. IS 1785 Cold drawn stress relieved wire (part I)
xii. 12. IS 1786 Specification for high strength deformed steel bars and wires for concrete reinforcement.
xiii. 13. IS 2751 Code of practice for welding of MS bars.
xiv. 14. IS 2502 Code of practice for bending and fixing of bars for concrete reinforcement.
xv. 15. IS 2751 Code of practice for welding of Bars
xvi. 16. IS 3696 Safety Code of scaffolds and ladders :
- Part 1 Scaffolds
- Part 2 Ladders

xvii. 17. IS 4014 Code of practice for steel (Part 1 & 2) tubular scaffolding
xviii. 18. IS 4082 Recommendation on stacking and storage of construction materials at site
xix. 19. IS 5525 Recommendation for detailing of reinforcement in RCC work.
xx. 20. IS 9417 Recommendation for welding cold worked steel bars for reinforced concrete construction
xxi. 21. IS 10790 Method of sampling of steel for prestressed and reinforced concrete

1.2 Quality Assurance

1.2.1 The Contractor shall procure and provide reinforcing steel bars conforming to IS specified and shall comply with all physical, chemical and mechanical test. Each type shall be from same manufacturer.

1.2.2 Steel manufacturers shall conform steel produced conforms IS requirements for reinforced cement concrete works. Steel shall not react chemically with ingredient of

reinforced cement concrete which are harmful to strength, durability of reinforced cement concrete.

1.2.3 Unit weights and diameter of rolled steel bars shall conform to IS.

1.2.4 Provide supervision and work force with minimum 5 (five) years experience to ensure workmanship of specified quality.

1.2.5 Contractor to undertake documenting of

- Test reports for steel brought at site for each lot

a) Chemical composition from factory
b) Mechanical
c) Physical

- Barbending schedule for cutting and bending
- Record of laps and anchors / development length

1.2.6 Work shall not be subjected to harmful, dangerous and damaging exposures.

1.3 Submittals

1.3.1 Submit for approval of the Engineer-in-Charge all details of Material / Product which conforms the specification laid down in documents.

1.3.2 Submittals shall include

- Product data sheet
- Manufacturers certificates
- Test report of laboratories
- Alternative product if any with tabulation for conformation that alternatives proposed meets / exceeds specification.

1.3.3 Samples

Samples of type of materials to be used. Further during construction samples shall be taken and tested by the Contractor as per specification and as directed / instructed by the ER. The cost of samples and test shall be borne by the Contractor within quoted prices.

1.3.4 Shop drawings

Contractor shall prepare and submit bar bending schedule based on structural detailed drawing prior to fabrication for approval of the Engineer-in-Charge.

1.4 Examination of Conditions

Contractor shall inspect and examine sub stratas and confirm prior to start that.

- Substrate is acceptable and approved by Engineer-in-Charge
- Conditions are satisfactory
- Setting out/Layout is verified
- Corrective measures needed if any are within reach and contractor proceeds with full responsibility for work.

2.0 MATERIAL

2.1 Reinforcing Bars

2.1.1 Reinforcement bars used in construction shall be mild steel or medium tensile steel round bars and high strength deformed bars. Steel shall be fresh and new. It shall be free of defects and free of rust, oil, paints, grease, loose mill scale or any other deleterious material undesirable for RCC or prevent adhesion of concrete with reinforcement. Steel should be from the original iron ore producers (like SAIL, TATA). If other steel is to be used then billets should be approved from SAIL, TATA. Other steel can be used only after prior approval of the Engineer-in-Charge.

2.1.2 M S Plain

Rolled mild steel and medium tensile steel plain round bars used in concrete shall conform to IS 432 Part I. Steel received shall conform to the following IS with regard to manufacturing and chemical composition.

i. M.S. bar Grade I Steel designation Fe 410-S of IS 226
ii. M.S. bar Grade II Steel designation Fe 410-O of IS 1977
iii. Medium Tensile Steel designation Fe 540 Steel bars W-HT IS 961

2.1.3 Nominal sizes and tolerances shall be as specified in IS 432 Part I. Physical requirements shall be determined in accordance with IS 1608, read in conjunction with IS 226. For reference of minimum requirements, properties are tabulated in IS 432 Table 1 “Mechanical properties of bars mild steel & tensile steel bars”.

2.1.4 Tor Steel

High-strength deformed bars for use as reinforcement in concrete shall be of grade Fe 500 and Fe 550 conforming to IS 1786.

2.1.5 Chemical composition shall conform to IS 1786 when made as a relevant part of IS 228.

2.1.6 Welding of cold work steel bars in reinforcement shall be permitted as per IS2751 and 9417. (Recommendation for welding cold worked steel bars for RCC).

2.1.7 Nominal sizes, cross sectional areas and their mass shall be as specified in IS 1786, allowing due consideration for tolerances specified therein.

2.1.8 Physical properties

a) It shall satisfy IS 1599 test for bend and rebend test in conjunction with IS 226.
b) Bond requirements shall be deemed to have been satisfied if it meets clause 4.0 of IS 1786.
c) Tensile, proof stress and percent elongation shall be as per table 3 of IS 1786.

2.1.9 Material received at site shall have ISI certification mark. Each bundle or coil containing the bars shall be suitably marked with ISI certification mark. Also bars shall be marked to identify categories. This shall be done as per IS 1387. In case bars are without ISI certification mark, the manufacturer shall give a certificate stating process of manufacture, chemical composition and mechanical properties. Each certificate

shall indicate the number or identification mark of the batch production/ cast to which it applies. Corresponding number or identification mark should be found on the material.

2.1.10 All reinforcement material shall be free from loose mill scale, excessive rust, loose rust ,pitting, oil, grease, paint, mud or any foreign deleterious material present on the surface. Cleaning shall be done to the satisfaction of the Engineer-in-Charge.

2.1.11 Each batch brought at site shall be tested prior to use for respective specification /physical properties. Cost of all such tests shall be borne by the contractor. Material acceptable as per IS shall be allowed into the works. All rejected material shall be removed from site by the contractor within 3 days of rejection. If the same is not done, the ER shall impose a penalty of Rs.500/- per metric ton per day. This will be without any appeal and shall not be subjected to arbitration.

2.2 Cover block

Cover blocks shall be of non-corrosive material such as plastic but not wooden or broken bricks or stone. Designed purpose made PVC cover spacers shall be used in the Works. Concrete cover spacers may be permitted by the Engineer-in-Charge. Such concrete spacers shall be cast from concrete and not cement-mortar. Strength of these blocks shall be equal to the strength of concrete in use. These should be fully cured prior to use in works.

2.3 Binding Wire

Binding wire shall be 16 or 18 gauge annealed wire conforming to IS 280. It shall be free from rust, oil, paint, grease, loose mill scale or any other deleterious material undesirable for the reinforcement and concrete or which may prevent adhesion of concrete with reinforcement

2.4 Mechanical Splices

Mechanical Splices fabricated out of steel pipes, sheets etc. capable of withstanding bending and compression stress equal to 1.25 times of those specified for reinforcing bars shall be used. Supplier of splices should submit details about quality of materials, mechanical test results and method of splicing. The Contractor shall arrange required hydraulic press and clipping equipment's. Samples pieces shall be prepared at site and shall be tested for torsion. Sample pieces results should give value of about 1.5 times than required for reinforcing bars.

2.5 Delivery and Storage

Reinforcing steel bars each batch should accompany manufacturers certificate. Reinforcement bars received at site shall be loaded and unloaded at site and stored with care such that it does not get bent or damaged. Steel received shall be as far as possible in straight length of 12 M. Steel shall be weighed in presence of representative of the contractor prior to delivery being received by him. Empty and loaded truck loads shall indicate correct quantity.

Reinforcement bars received at site shall be stored on hard concrete platform and clear of the ground with the use of timber sleeper, concrete sleeper or any other means. Reinforcement material shall be kept covered by tarpaulins or plastic to avoid excessive corrosion and other contamination. Each dia of bars shall be stacked separately. Bars without "ISI' / Tor marking shall not be brought to site.

3.0 SCOPE OF WORK

The contractor shall be responsible for

3.1 Material Procurement

a) The contractor will submit the Schedule of Procurement of steel in consultation with Engineer-in-Charge as specified and conforming to specifications detailed in drawings and bills of quantities.
The steel shall be delivered to site as per approved indent of the contractor to agreed schedule.
b) Purchase steel and stack with covering on firm platform free of contamination.
c) Collect samples of each type for every batch received and test as per IS for

- Unit weight per running meter
- Cross section area
- Bend / Rebend Test
- Ultimate tensile strength
- Yield stress
- Elongation

d) d) Procure binding wire, cover blocks splices etc.

3.2 Prepare bar bending / cutting schedule detailing schedule covering as under and obtain approval of Engineer-in-Charge.

- Cutting lengths
- Laps
- Rings for various locations and items
- Chairs

3.3 Transport, cut, bend and shift to site reinforcing bars.
3.4 Place in position and tie as detailed in drawing reinforcement with specified cover.
3.5 Provide attendance to keep reinforcement in position during concreting.
3.6 Disposal of surplus reinforcement steel as per approval of the Engineer-in-Charge.
3.7 Provide anticorrosive treatment to reinforcement bars including required handling, application, and touch up and maintenance till concreting.

a) CECRI System : Cement polymer composite coating system

b) Fusion bonded epoxy coating.

3.8 Providing required tools, plants, equipments such a

- Material cutting and bending tools
- Bending platform Bar cutting machine
- Bar bending machine
- Hydraulic clipping machines

3.9 Unit weights payable per metre shall be as follows-

i. 8 mm : 0.395 kg/Rmt
ii. 10 mm : 0.617 kg/Rmt
iii. 12 mm : 0.888 kg/Rmt
iv. 16 mm : 1.580 kg/Rmt
v. 20 mm : 2.469 kg/Rmt
vi. 25 mm : 3.858 kg/Rmt
vii. 32 mm : 6.320 kg/Rmt

4.0 WORKMANSHIP

4.1 Fabrication of reinforcement

Reinforcement shall be fabricated as per the drawing and approved bar bending schedule. Bending shall be done mechanically or with hand but to the correct radius, with proper tools and platform and shall conform to IS 2502. Bending of material shall be cold bending only. Material shall be inspected for visible defects such as cracks, brittle, excessive rust, loose mill scale, etc. Cracked ends of bars shall not be used in Works. Also the bars should be free from any deleterious material and hence the best practice shall be to hose down reinforcement just prior to concreting.

It is important that bending, straightening, cutting, etc. shall be carried out in a manner not injurious to the material and the safety of the persons working should be ensured.

4.2 Anchoring

Anchoring of bars and stirrup shall be provided exactly as detailed in the structural drawing or as directed by the Engineer-in-Charge.

4.3 Lapping of bar

Laps shall be strictly as per the drawing or as directed by the Engineer-in-Charge. For general guidance, the following principles shall be followed as given in IS 456.

a) Splices shall be provided as far as possible away from sections of maximum stress and be staggered.
b) Not more than half of the total bars shall be spliced at a section.
c) Where more than one half of the bars are spliced at a section or where splices are made at points of maximum stress, special precautions shall be taken, such as increasing the length of lap and/or using spirals or closely spaced stirrups around the length of the splice.
d) Lap splices shall not be used for bars larger than 36 mm diameter: For larger diameters, bars may be welded. In cases where welding is not practical, lapping of bars larger than 36 mm diameter may be permitted and additional spirals should be provided around the lapped bars.
e) Lap length including anchorage value of hooks in flexural tension shall be Ld (as defined in 25.2.1 of IS 456) or 50 dia whichever is greater.
f) When splicing of welded wire fabric is to be carried out, lap splices of wires shall be made so that the overlap measured between the extreme cross wires shall be not less than the spacing of cross wires plus 10 cm.

4.4 Spacing of bars

Bars shall be placed in position as shown in the drawing. Following guidelines as given in IS 456 shall be followed in case of difficulties or shall be carried out as directed by the Engineer-in-Charge.

a) Horizontal distance between two parallel main reinforcing bars shall usually not be less than the greatest of the following:
i. The diameter of the bar, if the diameters are equal.
ii. The diameter of larger bar, if the diameters are unequal, and

iii. 5 mm more than the nominal maximum size of coarse aggregate (By using reduced size of aggregate in congested reinforced area, conditions given hereof should be overcome).

b) Greater horizontal distance should be provided. But when needle vibrators are used, distance between bars of a group may be reduced to two-thirds of the nominal maximum size of the coarse aggregate, provided sufficient space is left between groups of bars to enable the vibrator to be immersed.

c) Where there are two or more rows of bars, the bars shall be vertically in line and the minimum vertical distance between the bars shall be 15 mm, two-thirds the nominal maximum size of the aggregate or the maximum size of bar, whichever is more.

4.5 Cover to reinforcement

Reinforcement shall have concrete cover and the thickness of such cover (exclusive of plaster or other decorative finish) shall be as specified in drawing or as directed by the ER. The following guidelines are to be observed in the absence of the above.

a) At each end of the reinforcing bar, not less than 25 mm, nor less than twice the diameter of such bar;

b) For a longitudinal bar in a column, not less than 40 mm, nor less than the diameter of such bar. In the case of columns of minimum dimension of 200mm or under, whose reinforcing bars do not exceed 12 mm, a cover of 25 mm.

c) For longitudinal reinforcing bar in beam, not less than 20 mm, nor less than the diameter of such bar.

d) For tensile, compressive, shear or other reinforcement in slab, not less than 15 mm, nor less than the diameter of such bar; and

e) For any other reinforcement, not less than 15 mm, nor less than the diameter of such bar.

f) Increased thickness shall be provided in case the concrete members are in the surrounding of harmful chemicals, saline atmosphere, etc. and the cover shall be 50 mm or more as directed by the Engineer-in-Charge.

g) For concrete members totally immersed in sea water, the cover shall be 40 mm more than specified above (a) to (f).
This shall be 50 mm more for periodical immersion in sea water.

h) Concrete cover should not exceed 75 mm in any case. Cover to reinforcement shall be as specified in the drawing or as directed by the Engineer-in-Charge. Details given in sub para (a) to (h) are for guidance and shall be followed in absence of any specific direction.

4.6 Welded joints or mechanical connections

a) Welded joints or mechanical connections in reinforcement may be used but in all cases of important connections, tests shall be made to prove that the joints are of the full strength of the connected bars. Welding of reinforcement shall be done in accordance with IS recommendation. Welded joints shall preferably be located at points where steel will not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that, at any one section, not more than 33 percent of the rods are welded.

b) Welding rods used shall conform to IS 814: covered electrodes for metal arc welding of structural steel. Work shall be carried out by a competent welder. Samples from work site shall be taken at regular intervals and tested. Frequency and number of samples shall be as directed by the Engineer-in-Charge.

4.7 Fixing in position

4.7.1 Correctly cut and bent bars shall be accurately placed in position as detailed in the drawing.Unless otherwise specified by the Engineer-in-Charge, reinforcement shall be positioned within the tolerance as under :

a) for effective depth 200 mm or less, + 10 mm
b) for effective depth more than 200 mm, + 15 mm

4.7.2 But in no case shall the cover be reduced by more than 5 mm of that specified. There shall be no compromise on cover for foundation work.

4.7.3 Reinforcing bars shall be held in position during the placing of concrete by use of PVC or concrete cover blocks (made of equal strength of well-cured concrete in use), steel chair spacers, steel hangers, supporting wires, etc. and secured by tying with an annealed binding wire of 16 to 18 gauge as approved by the Engineer-in-Charge.

4.7.4 Layer of bars shall be separated by precast concrete spacer blocks or spacer bars.Reinforcement shall be in correct position prior to start of concreting. No reinforcing bar shall be placed on freshly laid concrete for adjusting bar spacing. Care shall be taken
to maintain reinforcement in position and keep it clean, throughout the period till it is embedded in the concrete. For maintaining cover, pieces of broken stone or brick or wooden blocks shall not be used at any stage.

4.7.5 Where reinforcement bars are bent aside at construction joints and afterwards bent back into their original position, care should be taken to ensure that at no time is the radius of the bend less than 4 bar diameters in case of plain mild steel or 6 bar diameters for deformed bars. Care shall be taken when bending back bars to ensure that the concrete around is not damaged/disturbed.

SECTION – X

FORM WORK

1 GENERAL

1.1 Standards

Work shall be carried out to Indian Standards and Code of Practices. In absence International Standards shall be followed. These shall be latest issue. List given hereunder is not to be considered as conclusive and is for reference and guidance only.

Any discrepancies/conflict noticed shall be directed to the Engineer-in-Charge for his direction/ approval. However as a general rule more stringent specification shall take precedence.

i. IS 303 Specification for plywood for general purpose.
ii. IS 456 Code of practice for construction and design of reinforced concrete.
iii. IS 2751 Code of practice for welding of M.S bars used for RCC
iv. IS 3696 Safety Code of scaffolds and ladders :
- Part 1 Scaffolds
- Part 2 Ladders

v. IS 4014 Code of practice for steel (part 1 & 2) tubular scaffolding

vi. IS 4082 Recommendation on stacking and storage of construction materials
vii. IS 8989 Safety code of erection of concrete formed structures

1.2 Quality assurance

Contractor shall assume and take upon himself to

a) Design, construct, erect, maintain and struck form work proprietary or custom made
b) Form work shall provide required
- Shape, size and finish
- Rigidity and durability during placing(live levels)
- Rigidity and durability for receiving fresh concrete
- Leak proof water tight joints/junctions
- Easy removal without disturbing concrete
- Provide easy access for handling and placing

c) Form work shall provide safety and shall have adequate access for concreting
d) Workers shall work with required safety measures such as safety belts, helmet etc.

1.3 Experience

The contractor shall provide

a) Site supervisors and foremen qualified and experienced atleast 5(five) years on similar nature of form work.
b) Semi skilled/skilled labour shall be of minimum experience of 5(five) years in doing similar nature of form work

1.4 Examination of strata

The contractor shall examine, and convince himself prior to start of work that strata is firm, rigid and safe to erect scaffold. In absence, same shall be prepared by him and then work shall proceed. If it is not possible due site condition, method of erection support etc. shall be detailed and got approved from Engineer-in-Charge prior to start. In any case responsibility of formwork shall be that of the contractor.

2 MATERIAL

2.1 Material

Material used in form work shall be combination of timber, plywoods, steel props, steel plates, or specially designed and manufactured moulds out of plastic or reinforced fibre glass or steel or aluminium alloy or combination. Use of timber shall be limited to beam bottoms, runners, but not for sofit of slab, wall faces etc. Use shall depend upon its location, type of finish specified and subject to acceptability by the ER. Recommendations are as under:

i. Steel Props - Heavy duty, drop head and adjustable type or as per system to be adopted.
ii. Steel Plates - MS angles 45 x 45 x 4 mm thick frame work with minimum 16 gauge thick sheet.
iii. Ply wood - Marine ply: Plastic coated preferred.
    a. 12 mm thick with timber framing for sides of beam.
    b. 18 mm thick with timber framing for beam bottom and wall panels.

c. 12/18 mm thick for slab depending upon thickness and supporting system.

iv. Bracing - 40 mm dia MS steel tubes with clamps.

Formwork designed with proposed material in use should be able to retain its shape, lines, and dimensions shown in the drawings. It should safely carry the full load of concrete together with any live and impact load likely to occur during concreting. Specially when concrete pumps and large buckets with crane are deployed.

Material used shall conform to IS. It is the contractor's responsibility to entirely achieve the standard expected to the satisfaction of the Engineer-in-Charge.

Standard rolled steel sections shall be used with due fabrication of standard special moulds, unitised form work scaffolds, staging etc.

2.2 Timber

a) Jungle wood timber in form of planks, battens (runners), ballies, strong durable without cracks, able to sustain warping, twisting and distortion shall be allowed in work for type of requirements.

b) Teakwood /good quality jungle wood shall be used for special decorative moulds. Moulds may be smooth planed or finished with laminate

2.3 System

Patented proprietary designed metal (Steel, aluminium or fiber glass) form work best suited for type of work under taken and its requirements shall be used.

2.4 Wire nails confirming to IS and mating needs shall be used.

2.5 Bolts / Nuts /Clamps

MS bolts, nuts, clamps standard or purpose made shall be used. Use of these shall not be harmful to concrete and shall be easily removable or if left in concrete shall be inert to concrete in all respect.

2.6 Form release Agents

Emulsion and oil or chemical agent being used shall not react with reinforce concrete at any stage. No chemical reaction shall take place which may be harmful to reinforcement concrete for its durability strength. These shall not produce any stain and shall not stick to concrete surfaces which will reduce further bonding strength of masonry mortar, painting etc.

3.0 SCOPE OF WORK

3.1 Designing

The contractor shall design, draw, prepare and submit method of statement backed by designed calculations, taking into account the points noted in clause 1.2 here above atleast six weeks prior to the starting of activity. Required drawing and sketches shall be enclosed along with statement for the proposed area to be taken up for working. The statement shall give

- Loadings considered

- Materials proposed
- Repetitions expected
- Staging/supporting arrangement
- Deployment of proprietary metal form work system.
- Method of handling

It shall be responsibility of the contractor to get the design approved from Engineer-in-Charge atleast four weeks prior to start of formwork.

3.2 Equipments

The contractor shall provide required tools, plants, equipments including its proper maintenance during construction at site.

3.3 Proprietary metal formwork

The contractor shall arrange to provide proprietary system metal formwork applicable/adoptable to various areas of works. He shall be responsible to deploy with required mechanism for handling, shifting, transporting placing in position.

3.4 Supervision

The contractor shall be responsible to provide experienced foremen (atleast Five years) in supporting/executing similar nature and magnitude of work. He shall be able to read drawings and should be capable of guiding and getting work executed to quality.

3.5 Labour

The contractor shall provide experienced skilled carpenters to carryout work with system of formwork deployed and necessary plants and equipment shall be made available at site.

4.0 WORKMANSHIP

4.1 Form work shall be classified namely as follows :

a) Textured or decorative finish
b) Fair-faced finish
c) Rough finish

In BOQ, the contractor shall account for all material and labour etc. to achieve the above finishes to the satisfaction of the Engineer-in-Charge in his quoted price.

4.2

i. Erection of form work may be from pre-moulded, pre-fabricated, pre-assembled plates or forms reasonable enough to transport and erect at site to correct line and level as set out at site. Supports shall be firm and maintained in position by nails, cross bracings, tie rods, locking bolts and nuts. It shall be rigid and stiff so as to retain its

shape during and after concreting. The tie rods shall be terminated atleaset 40mm inside the finished surface.

ii. Joints shall be water-tight and no cement slurry shall be allowed to slip through. In joints foamed tapes shall be used.

iii. Pre-fabricated or site forms shall be assembled, so as to deshutter without any jerk to the green concrete. For this double wedges shall be used. Wedges shall be nailed, the heads reasonably left out, allowing easy removal while deshuttering.

iv. Pre-fabricated or on site fabricated forms shall be of sufficient thickness and with the required supporting runners in either direction. Supporting runners shall be standardized in size for easy replacement and universal use at site.

v. Props shall be of steel only. Teak ballies may be permitted with written permission of the Engineer-in-Charge for specific use. Size and verticality shall be approved by the Engineer-in-Charge. Its spacing shall be as per design. It shall be vertical and plumbed. Base shall be a proper steel plate or timber plank, for equal distribution of load.

vi. In repeated use, panels shall be clearly marked for using at defined locations.

vii. Successive lift shall be tightened with previous lift by fixing foamed strips at joints to avoid grout leakage.

viii. In fill pieces and panels shall be well dressed, leveled and jointed with main formwork so as to achieve smooth, even natural finish.

ix. Props, Soldiers, wallings, Shores, bearers, Clamps, wall & ties etc. shall be at required spacings.

x. Props, shores shall be securedly braced with firm bearing.

xi. Provide and fix or fix only inserts pockets, to correct line and level and with sufficient rigidity to keep in position while concrete placing is in progress along with vibration.

xii. Sloping, brackets, chajjasetc shall be well secured and firmly restrained.

xiii. Adequate access and working platform shall be arranged with required safety to avoid reinforcement displacement, damage to shuttering and easy movement of concrete gang.

xiv. Props and scaffolds are to be erected to correct plumb, line, level and with required tie. Load carrying capacity of props shall be as per table of manufacturer.

xv. Props and scaffolds shall not be loaded more than allowed by manufacturer of Props /scaffolds.

xvi. Heavy, medium and light duty props shall not be mixed up.

xvii. Beams and slabs shall have camber of 4 mm per metre or as directed by the Engineer-in-Charge.

xviii. All angles and corners shall be sharp and well defined. In places where concrete edges are permanently exposed and require no further treatment, they shall be chamfered in a tringle of 25x25mm

xix. Props of steel or timber (if approved in writing) shall be provided with adequate horizontal and cross - bracing. Steel props shall use steel pipes and steel couplers. If use of timber is permitted, planks of 100 x 25 mm shall be used and shall be secured by nailing them to timber props. No other material shall be permitted.

xx. At the design and erection stage, the following additional points shall be considered and incorporated into the shutters.

a. Openings for cleaning prior to start of concreting.

b. Pouring points shall avoid high drops and provide easy access to vibrator needles.

xxi. 21 Surfaces shall be treated with mould releasing oil or emulsion as approved by the Engineerin-Charge prior to reinforcement laying.

xxii. The following point shall be observed very carefully:

a. Joints of moulds shall be water-tight. It is easy to check from bottom and make sure that no light is visible.

b. Props shall be on solid base, plumbed, in one straight line, and braced horizontally and cross.

c. Tie bars in beams, walls and columns shall be at the correct place and fully tight.
d. Wedges shall be fully secured and nailed with head left out for easy removal.
e. All saw dust, dirt, shaving and any other unwanted materials shall be cleaned and hosed out.
f. Provision shall be made for watching form work while concreting and any other platform needed for movement of workers without any disturbance to reinforcement.

xxiii. Opening/inserts

All required openings and pockets shall be provided as detailed in the drawing. The contractor shall provide for the required material, labour for fixing and supporting during concreting, in his quoted price. It is imperative that all openings and pockets shall be deshuttered with care and all corners of openings shall be preserved. All openings/pockets shall be in a correct line and level. After concreting, the openings shall be secured by proper covering against any accident and guard rail and warning notice, if any will be incorporated.

xxiv. In case of multistory building, any upper floor shall be suitably supported on atleast one floor below the same or as approved by the Engineer-in-Charge. The concreting of upper floor shall be done only after lower floors have attained the strength.

xxv. In case of shear walls, lift walls, internal walls, the form work shall be done by removable
type tie rods within PVC sleeves.

4.3 Checking prior to concreting.

All props and struts are plumbed at right spacing properly tightened up and locked.

i. Formwork is correctly aligned and leveled.
ii. Stop ends are properly secured and sealed.
iii. All ties are properly tightened.
iv. All inserts, pockets etc are at desired level and secured.
v. Joints are sealed and no possibility of leakage of grouts.
vi. Reinforcement has proper covers and required spacers.
vii. All forms are cleaned, free from rubbish, tie wires etc.
viii. Proper access for concreting and compaction available.
ix. Required guard rails, toe boards are provided

4.4 Tolerances

4.4.1 Tolerance is a specified permissible variation from lines, grade or dimension given in drawings. No tolerances specified for horizontal or vertical building lines or footings shall be considered to permit encroachment beyond the legal boundaries. Unless otherwise specified, the following tolerances will be permitted.

4.4.2 Tolerances for RCC buildings

i. Variation from the plumb :
a. In the lines and surfaces of columns, piers, walls and in arises 3 mm per 2.5 m but not more than 10 mm.
b. For exposed corner columns and other conspicuous lines,
- In any bay upto 5 m maximum : 5 mm
- In 10 m or more : 10 mm

ii. Variation from the level or from the grades indicated on the drawings,

a. In soffits of slab, ceilings, beam and in arises

- In 2.5 m 5 mm
- In any bay upto 5 m maximum 8 mm
- In 10 m or more 10 mm

b. For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines,

- In any bay upto 5 m maximum 5 mm
- In 10 m or more 8 mm

iii. Variation of the linear building lines from established position in plan and related position of columns, wall and partitions.

- In any bay upto 5 m maximum 5mm
- In 10 m or more 10 mm

iv. Variation in the sizes and location of sleeves, openings in walls and floors 5mm (except in the case of and for anchor bolts).

v. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls - 5 mm + 10 mm

vi. Footings

a. Variation in dimension in plan - 5 mm + 50 mm

b. Misplacement or eccentricity

- 2% of footing width in the direction of misplacement but not more than 50 mm

c. Reduction in thickness

- 5% of specified thickness subject to a maximum of 50mm

vii. Variation in steps

	Riser	Tread
• In a flight of stairs	3 mm	5 mm
• Consecutive steps	1.5 mm	3 mm

4.4.3 Tolerances in other concrete structures.

i.

a. Variation of the constructed linear outline from established position in plan

- In 5 m : 5 mm
- In 10 m or more : 10 mm

b. Variations of dimensions to individual structure features from established positions

- In 20 m or more : 25 mm
- In buried construction : 50 mm

c. Variation from plumb, from specified batter or from curved surfaces of all structures

- Upto 2.5 m : 3 mm
- 2.5 m to 5 m : 8 mm
- 5 m to 10 m or more : 12 mm
- In buried construction : Twice the above

d. Variation in cross sectional dimensions of columns, beams, buttresses, piers and

e. similar members

- (-) 5 mm (+) 10 mm

f. Variation in the thickness of slabs, walls, arch sections, and similar members.

- (-) 5 mm (+) 10 mm

ii. Footings for columns, piers, walls, buttresses and similar members.

a. Variation of dimensions in plan

- (-) 10 mm (+) 50 mm

b. Misplacement or eccentricity

- 2% of footing width in the direction of misplacement but not more than 50 mm

c. Reduction in thickness

- 5% of specified thickness subject to a maximum of 50mm

4.5 Removal of form work

4.5.1 .Forms shall not be struck until the concrete has reached a strength at least twice the stress to which the concrete may be subjected at the time of removal of form work. Under normal circumstances and where 53/43 grade O.P.Cement is used, forms shall be removed after expiry of the following periods:

a. Walls, columns and vertical faces 24 to 48 hrs
b. Slabs (props left under) 3 days
c. Beam soffits (props left under) 7 days
d. Removal of props under slabs
   i. Spanning upto 4.5 m 7 days
   ii. Spanning over 4.5 m 14 days
e. Removal of props under beams and arches
   i. Spanning upto 6 m 14 days
   ii. Spanning over 6 m 21 days

For other cements, the stripping time shall be suitably modified in consultation with the Engineer-in-Charge.

4.5.2 Where the shape of elements is such that the formwork has re- entrant angles, the formwork shall be removed as soon as possible after the concrete has set, to avoid shrinkage or cracking that might occur due to the restraint imposed.

4.5.3 For precast moulds, the stripping time shall be 24 hours. The mould may be lifted and stored in the yard within 24 hours to 48 hours as approved by the Engineer-in-Charge.

4.6 Maintenance

It shall be responsibility of the contractor to protect, maintain and handover to next contractor / Employer in finished condition. Providing and fixing inserts is part of this

a. On completion of concreting inserts shall be cleaned and required treatment such as oiling, greasing, covering with plastic/plywood boxes, painting etc. shall be carried out by the contractor to approval of the Engineer-in-Charge. Inserts and pockets shall be protected from weathering/or damage in course of construction.
b. Opening and pockets shall be deshuttered with due care not to damage edges, falling of debries within pockets etc. Further all opening and pockets shall be preserved, secured against accident by covering, putting up guard rails, warning notice etc. as approved by the Engineer-in-Charge. Guarding and protecting pockets shall be responsibility of the contractor.

4.7 .Cleaning / stacking

All formwork deshuttered shall be cleaned with a stiff wire brush to remove dust, grout, concrete etc. and if required maintained/repaired prior to being reused. Steel plates, props, frames, proprietary formwork system shall be oiled, greased to protect against rusting, weathering etc.

Plywood and timber form shall also be applied with preservative agent if to be kept for long time without use. It shall be protected against heat, rains etc.

4.8 Opening/inserts

All required openings and pockets shall be provided as detailed in the drawing. The contractor shall provide for the required material, labour, for fixing and supporting during concreting, in his quoted price. It is imperative that all openings and pockets shall be deshuttered with care and all corners of openings shall be preserved. All openings/pockets shall be in a correct line and level. After concreting, the openings shall be secured against any accident by proper covering and guard rail and warning notice, if any.

The contractor shall clean and grout the pocket at a later date with a non-shrinking compound added to the grout mix or non-shrinking cement shall be used. It shall be well-cured and protected to correct line and level till handing over.

4.9 Inserts are material such as timber, steel, plastic, dowels, bolts, locks, brackets, pipes, etc. left in concrete partly or fully embedded to receive connection with foreign member at a later date. These may be fabricated by the contractor or provided by the owner as received from specialist, manufacturer, etc. These shall be protected from weathering and damage in course of the construction. The cleaning required after concreting and any treatment such as oiling, greasing or covering with paint etc. shall be carried out by the contractor at his cost.

4.10 It is very important that the providing and fixing shall be carried out with the "utmost precision" and to the entire satisfaction of the Engineer-in-Charge. Any deviation from that as shown in the drawings or instructions shall be rectified by the contractor at his own cost and responsibility.

4.11 Nos. of repetition of form work shall be as per approval of Engineer-in-Charge..

SECTION XI STRUCTURAL STEEL WORK

1 GENERAL

1.1 Description

This section covers the requirements for providing fabrication, erection and placing of structural steel work for building construction including temporary supports and all other work as required for structural steel construction.

1.2 Applicable Codes and Standards

The codes and standard generally applicable to the work of this section is listed hereinafter.

i. IS 210 Grey iron castings
ii. IS 226 Structural steel (Standard quality)
iii. IS 451 Technical supply conditions for wood screws
iv. IS 800 Code of Practice for use of structural steel in general building construction.
v. IS 801 Code of practice for use of cold formed light gauge steel structural members in general building construction.
vi. IS 803 Code of practice for design, fabrication and erection to vertical mild steel cylindrical welded storage tanks.
vii. IS 806 Code of Practice for use of steel tubes in general building construction.
viii. IS 808 Dimension for hot rolled steel sections.

ix. IS 813 Scheme of symbols for welding.
x. IS 814 Covered electrodes for metal arc welding of (Part I & II) structural steel.
xi. IS 816 Code of practice for use of metal arc welding and general construction in mild steel.
xii. IS 822 Code of Practice for inspection of welds.
xiii. IS 961 Structural steel (high tensile)
xiv. IS 1024 Code of practice for use of welding in bridges and structures subject to dynamic loads.
xv. IS 1030 Carbon Steel casting for general engineering purpose.
xvi. IS 1120 Coach Screws.
xvii. IS 1149 Specification for light tensile steel rivet, bars for structural purposes.
xviii. IS 1161 Steel tubes for structural purposes.
xix. IS 1182 Recommended practice for Radiograph examination of fusion welded butt joints in steel plates.
xx. IS 1200 Method of measurement in Building Civil Engineering work.
xxi. IS 1239 Mild steel tubes, tubulars and other wrought steel fittings
- Part I - Mild Steel
- Part II - Mild steel tubulars and other wrought sheet pipe fittings.

xxii. IS 1363 Black hexagonal bolts, nut and black hexagon screws product of Grade C (size range M25 to M64) (Part 1 to 3).
xxiii. IS 1365 Slotted counter sunk screws.
xxiv. IS 1367 Technical supply conditions for threaded fastners.
xxv. IS 1477 Code of practice for painting of (Part I and II) ferrous metal in buildings.
xxvi. IS 1852 Rolling and cutting tolerances for hot rolled steel products.
xxvii. IS 1915 Code of Practice for steel bridges.
xxviii. IS 1977 Structural steel (ordinary quality)
xxix. IS 2016 Plain washer.
xxx. IS 2062 Structural steel (fusion welding quality)
xxxi. IS 2079 Ready mix paint, air drying, red oxide zinc chrome and priming.
xxxii. IS 2595 Code of practice for Radiographic testing.
xxxiii. IS 3063 Single coiled rectangular section spring warms for bolts, nut and screws.
xxxiv. IS 3443 Crane rail sections.
xxxv. IS 3600 Code of practice for testing of fusion welded (Part-I) joints and weld metal in steel
xxxvi. IS 3658 Code of practice for liquid penetrant
xxxvii. IS 3757 Specification for High Tensile Friction grip bolts
xxxviii. IS 4000 High strength bolts in steel structures Code of practice.
xxxix. IS 4923 Hollow steel sections for structural use.
xl. IS 5334 Code of practice for magnetic particle flaw detection of welds.
xli. IS 5369 General requirements for plain washer and lock washers.
xlii. IS 5372 Taper washers for channels.
xliii. IS 5374 Taper washers for I beam
xliv. IS 5624 Specification for foundation bolts.
xlv. IS 6227 Code of practice for use of metal arc welding in tubular structure.
xlvi. IS 6610 Heavy washers for steel structures.
xlvii. IS 7215 Tolerances for fabrication of steel structures.
xlviii. IS 8500 Structural steel- Micro alloyed (medium and high strength qualities)
xlix. IS 9595 Recommendations for metal arc welding of carbon and carbon manganese steel.

2 SUBMITTALS

2.1 Material Report

Prior to start of delivery of structural steel required for contractor shall submit the following to the Engineer-in-Charge for review.

a. Certified copies of mill test reports including chemical analysis and physical properties as required by the applicable Indian Standards for dach consignment of steel.
b. Where such mill certificates are not available or if the Engineer-in-Charge feels it necessary to substantiate conformance of the mill test reports, the contractor shall employ an approved testing laboratory to perform the required tests and chemical analysis at his own cost.

2.2 Shop/Fabrication Drawings

Before commencement of any structural steel fabrication work, the contractor shall submit the following to the Engineer-in-Charge for his approval:

a. Fabrication drawings including details of connections.
b. Assembly, erection and installation drawings and manuals indicating the sequence of work, welding and bolting procedure to be used. Cambers for trusses and large span girders shall be shown.
c. For composite construction the details and calculation of details and calculation of false work and forms supporting the concrete work in steel structure shall be submitted.
d. The drawings prepared by the contractor and all subsequent revisions etc. shall be at the cost of contractor for which no separate payment will be made.

3 MATERIALS

3.1 Structural Steel

3.1.1 Structural Steel (Primary Structural)

All structural steel used shall be confirmed to IS 2062. As per table 2 of IS 2062:2011 steel grade E450 is used in design calculation of all members sizes with following properties.

Unit mass = 7850 kg/m3

E = 200000 N/mm2

Ultimate tensile strength = 570 N/mm2

Yield stress = 450 N/mm2 for thickness less than 20 mm

430 N/mm2 for thickness between 20 to 40 mm

Percentage Elongation = 15% (minimum)

Charpy V- notch energy = E>27J at -20 degree Celsius

3.1.2 Structural steel used in the works other than steel in reinforced concrete, rails and fastenings shall be either of the following type :

a. Mild steel conforming to IS : 226 - "Structural Steel (Standard quality)" or IS : 2062 - "Structural Steel (fusion welding quality)" whichever is approved.
b. Whenever high tensile steel is specified it shall be conforming to IS : 961 - "Structural steel (High Tensile)".
c. All steel tubes shall be hot finished seamless steel tubes (HFS) of the specified strength and as approved by the Engineer-in-Charge and shall conform to IS : 1161. Tubes made by other processes and which have been subjected to cold working, shall

be regarded as hot finished if they have been subsequently been heat treated and are supplied in the normalised condition,

3.2 Threaded Fasteners

3.2.1 Bolts (HSFG)

All high strength bolts being used in frames resisting seismic force should be high strength friction grip bolt with adequate pre-tensioning and should conform to relevant grade

3.2.2 All bolts exposed outside the building must have at least 60 micro meter zinc coating

3.2.3 A third party Contractor must be hired which will check 5% of the complete bolts in the structure are taut enough as per the manufacturers and structural engineers standards. The selection of third party shall be done in presence of client and after getting approval from the client, the team shall be selected.

3.2.4 All bolts and nuts shall comply with IS : 1367.

3.2.5 Black bolts, nuts and screws shall be In accordance with IS : 1363.

3.2.6 Wherever counter sunk screws are specified, they shall be precision grade,bslotted, counter sunk head, machine screws conforming to type 'R' of IS : 1364.

3.2.7 Wherever high tensile special quality bolts and nuts are specified, they shall comply with provision of IS : 800.

3.2.8 Coach screws shall be in accordance with IS : 1120 and wood screws shall conform IS : 451.

3.2.9 All plain washers shall conform to requirements of IS : 2016. Wherever spring washers for bolts, nuts and screws are specified, they shall be in accordance with the provision of IS: 3003.

3.3 Cast Iron

Cast iron shall be conforming to IS : 210. All cast iron goods shall be of best quality and make and as approved by Engineer-in-Charge.

3.4 Cast steel shall be conforming to IS : 1030. Unless specified otherwise, the steel shall be grade 2 and shall cater or all tests specified in the said standard.

3.5 Rails for the cranes shall comply with the requirements of IRST-12-64 or IS : 3443 if so instructed by the Engineer-in-Charge. They shall be obtained form an approved manufacturer.

3.6 Electrodes

Electrodes used for metal arc welding of mild steel shall be heavy coated type electrodes conforming to IS : 814 (Part I'& II and shall be of best quality approved by the Engineer-in-Charge.

3.6.1 All welds must be maximum 1.5 mm less than the connecting member thickness.

3.6.2 20 % of field welds and 10% of yard welds must be tested by dye penetration tests

3.6.3 All weld strength must have ultimate tensile strength higher than ultimate tensile strength of the structural members connecting it.

4.0 HANDLING & STORAGE

4.1 Structural steel shall be stored out of mud and dirt and proper drainage of the storage area shall be provided. Protect from damage or spoiling by adjacent construction operations.

4.2 Fabricated steel shall not be handled until the paint has thoroughly dried. Care shall be taken to avoid paint abrasions and other damager. Steel work shall be transported in the largest practical lengths and in such a way as not to overstress the fabricated sections. All pieces bent or otherwise damaged shall be replaced by the Contractor at his own cost.

4.3 Storage of fabricated steel at the job site shall be the responsibility of the Contractor. Material shall be stored at the Job site in a manner which does not overload the existing or newly constructed structures. Materials shall be protected against excessive deflection, corrosion or deterioration.

4.4 As far as practicable, stacking of fabricated steel shall be done in sequence of erection. But heavy members shall not be stacked on top of the light ones.

5.0 FABRICATION

5.1 Shop Drawings

5.1.1 The Contractor shall prepare required detailed shop drawings giving complete information necessary for the fabrication of the structure. All information should be clearly given and the drawings shall be in conformity with the best modern practice. A marking diagram allotting distinct identification marks to each separate piece of steel work shall be prepared in sufficient detail to ensure convenient assembly and erection. Symbol's used for welding in the drawings shall be in accordance with IS: 813.

5.1.2 The Contractors shall prepare comprehensive details of material sheets for each shop drawings giving therein all the items shown on the drawings together with their weights, marks, numbers, cutting lengths etc. Three copies of all working drawing and bill of material sheets shall be submitted to the Engineer-in-Charge for approval. Fabrication shall not commence until the approval of the relevant drawings has been obtained from the Engineer-in-Charge. While the shop drawings prepared by the Contractor and approved by the Engineer-in-Charge are deemed to represent the correct interpretation of the work to be done, the Contractor is not relieved of the responsibility for accuracy of detailed dimensions shown thereon.

5.2 Templates

All fabrication shall be in accordance with IS : 800 and IS: 1915. Extensive use of templates shall be made. The templates shall be steel bushed where considered necessary by the Engineer-in- Charge.

5.2.1 In case actual members are used as templates for similar pieces, it will be at discretion of the Engineer-in-Charge to decide whether such pieces are fit to be incorporated in the finished structure. The Contractor shall arrange for corresponding part of each unit manufactured from the same drawings to be interchangeable as far as economic manufacturing conditions permit, and shall advice the Engineer-in-Charge of the precise arrangement made in this respect, but prior approval of the Engineer-in-Charge in writing should be taken.

5.3 Straightening

All materials shall be straight unless required to be of curvilinear form and shall be free from twists. If necessary the materials shall be straightened and/or flattened by pressure. Heating of rolled sections and plates for purpose of straightening will not be permitted. Limited straightening may however be effected by local application of heat

with a gas torch, but prior approval of the Engineer-in-Charge, in writing, should be taken.

5.4 Cutting

5.4.1 Gas Cutting shall normally be permitted for mild steel only. Gas cutting of high tensile steel may be permitted provided special care is taken to leave sufficient metal to be removed by matching so that nil metal that liar, boon hardened by flame is removed. Gas cutting shall preferably be done by machine, Hand flame cutting; may only be permitted subject to the approval of the Engineer-in-Charge. Gas cut edges shall be free of gouge. Any gouges that remain after cutting shallbe removed by grinding.

5.4.2 Rolled sections shall be sawed or flame cut to length. Small plate pieces thegussets may be sheathed or chopped to size. Sawing, shearing and chopping shall be clean and free from any distortion. If necessary the edges shall be ground afterwards.

For tubular construction cutting of the pipe and preparation of joint surface shall be done in a neat manner for a good fit up. The ends of the tubes may be flattened or otherwise framed for connections provided that the methods adopted for such flattening do not injure the material. The change of section shall be gradual.

5.5 Holing

5.5.1 Holes shall preferable be done by drilling. Punching shall not be resorted to unless previously approved by the Engineer-in-Charge. In any case, punching of holes in materials having a thickness in excess of the connector diameter or in the materials thicker than 16mm shall not be permitted. Where punching is permitted the holes shall be punched 3 mm less in diameter than the required size and reamed after assembly to the full size.

5.5.2 Holes shall be drilled or punched at right angles to surface of the member, not more than 1.5 mm/2.0 mm (as the case may be depending upon whether the connector diameter Is less than or more than 25 mm) larger than the connector diameter. Holes shall not be formed or enlarged by burning or gas cutting. Holes shall be clean-cut without torn or ragged edges. Outside burrs resulting fromdrilling operations shall be removed.

5.5.3 Holes through more than one thickness of material of members such as compound stanchions and girder flanges shall be drilled after the members are assembled and tightly clamped or bolted together. They shall then be separated and burrs removed if so directed by the Engineer-in-Charge.

5.5.4 Steel members adjustment shall be provided with slotted holes as shown on the drawings. Suitable templates shall be used for proper location of the holes.

5.6 Fabrication Tolerances

Unless otherwise shown on the drawings, the fabricating tolerances shall generally be as follows:

a. Compression members shall not deviate from straightness by more than 1/1000 of the axial length between points which are to be laterally supported.
b. A variation of 1 mm is permissible in the overall length of members with both ends finished for contact bearing,

Members without ends finished for contact boarding which are to be framed together in parts of the structure, may have a variation from the detailed length not greater than 2mm for members 10 metres or loss in length and not greater than 3 mm for members over 10 metres In length.

6.0 ASSEMBLY

6.1 All connections shall be either bolted or welded as shown on the drawings. Contractor shall not redesign or alter any connection without prior approval ERs.

The component parts shall be assembled in such a manner that they are neither twisted nor otherwise damaged and shall be prepared so that the specified camber if any is provided. Drafting done during assembly shall not distort the metal or enlarge the holes. Poor matching of holes shall be cause of rejection. However if permitted by the Engineer-in-Charge, holes that must be enlarged due to mismatching shall be reamed.

6.2 Bolting

6.2.1 All steel work which bolted together shall be in close contact over the whole surface. Where two bolted surfaces are to be in permanent contact after assembly, each shall be thoroughly scrapped free of loose scales, dirt and burrs and a heavy coat of red oxide, zinc chrome or other approved paint applied after cleaning and drying.

All bolts shall be provided with washers under the nut tapered on the inside of the flanges of R.S. Joists and channels. Bolls and studs shall project not less than one full thread through the nut after tightening. Unless otherwise specified, the ends of the bolts shall be burred after erection to prevent the removal of nuts.

6.2.2 High strength bolts shall be used in bearing or friction as shown on the drawings. High strength bolted joints shall be made without the use- of erection bolls. Bolts shall be of a strength that will extend not less than 6 mm beyond the nuts. Bolts shall be entered into holes without damaging the thread-members shall be brought tightly together with sufficient high-strength fitting up bolts which shall be retightened as all the bolts are finally tightened. Bolts heads shall be protected from damage during placing. Bolts that have been completely tightened shall be marked for identification. Bolted parts shall fits solidly together and shall not be separated by interposed compressible materials. The contact surface in high strength bolted connections shall be free of oil, paints, lacquer, loose scale or other coatings. The facing surfaces shall be machined fiat. Final tightening of high strength bolts shall by turn-of-out method. Retightening shall not permitted. Whenever the Contractor Inlands to use other means of lightening he shall obtain prior approval of the Engineer-in-Charge.

6.2.3 Anchor bolts shall be set by use of templates secured firmly in place to permit true positioning of the bearing plates and assemblies. When in drawings anchor bolts are shown to be installed in sleeves, the sleeves shall be completely filled with grout.

6.3 Welding shall be done in accordance with IS : 816.

6.3.1 Welding procedures shall be bored on the specific analysis of any given heat of steel (based on the certified mill test reports) and shall be subject to the review of the Engineer-in-Charge.

These procedures shall call for one or all of the following

a. Proper bead shape
b. Minimized penetration to prevent dilution of the weld metal with the alloyelements.
c. Preheating, controlled interpass temperature and controlled heat input.

6.3.2 Welding shall be performed only by qualified and tested welders specifically trained and experienced for the type of job required to execute the welding work to the complete satisfaction of the Engineer-in-Charge. However periodical testing of welders shall be done as per IS 817, IS 7310 (Part I) and IS 738 (Part I).

6.3.3 Use of standard weld symbols as adopted by IS : 813 is mandatory. Pre-qualified joints which are detailed, prepared and welded in accordance with the requirement of IS : 816 shall be invariably used.

6.3.4 Structural welding shall not commence until joint elements are bolted or tacked in intimate contact and adjusted to dimensions shown with allowance for any weldshrinkage that is expected. Welding sequence shall be planned and controlled to minimise undue stress Increase or undue distortions in restrained members. Heavy sections and those having a high degree of restrain shall be welded with low hydrogen type electrodes.

6.3.5 If copper wire spacers are used between two surfaces to be welded to reduce transverse stresses in the weld, care shall be taken that it does not mix with the weld metal.

6.3.6 Concave bead shape shall be avoided. Ratio of weld width to weld depth shall preferably vary from a minimum of 1 to 1, to a maximum of 1.4 to 1.

$$\frac{\text{width-of-weld}}{\text{depth of fusion}} = 1 \text{ to } 1.4$$

6.3.7 Field welding shall not be permitted unless shown on the drawings.

6.3.8 Subsequent to fabrication, the overlapping or contacting surfaces, or other closed sections(such as tubular, box section) which are inaccessible to painting shall be seal welded. When the end of the tube is not automatically sealed by virtue of its connection by welding to another member the end shall be properly and completely sealed. Before sealing, the inside of the tube shall be made dry and free from loose scale.

6.3.9 Order of assembly of the tubular sections shall consist of welding the tensile member to the main member first. Compression members shall be cut back to overlap the tensile member and then welded to both of these members.

6.3.10 No welding shall be done when the surface of the member is wet nor during periods of high wind. No welding shall be done on base metal at a temperature below –5oC. Base metal shall be preheated to the temperature as per relevant IS codes.

6.3.11 Each layer of multiple layer weld except root and surfaces runs may be moderately peened with light blows from blunt tool. Due are should be taken to prevent scaling or flaking of weld and base metal from over peening.

6.3.12 Electrodes other than low-hydrogen electrodes shall not be permitted for thicknesses of 32 mm and above.

6.4 Inspection of welds

All welds shall be inspected for flows by any of the methods given in clause 7. The choice of method shall be determined by Engineer-in-Charge.

6.5 Tolerances

The dimensional and weight tolerances for rolled shapes shall be in accordance with IS 1852 for indigenous steel and equivalent applicable codes for imported steel. The tolerance for fabrication of structural steel shall be as per IS 7215.

6.6 End milling

Where compression joints are specified to be designed for bearing, the bearing surfaces shall be milled true and square to ensure proper bearing and alignment.

7.0 INSPECTION

7.1 The contractor shall give due notice to the Engineer-in-Charge in advance of the work getting ready for inspection. All rejected material shall be promptly removed from the site.
7.2 No materials shall be painted or erected or despatched to site without inspection and approval by the Engineer-in-Charge.
7.3 The Contractor shall provide all the testing and inspection services and facilities for shop works except where otherwise specified.
7.4 For fabrication work carried out at site, the same standard of supervision and quality control shall be maintained and inspection and testing shall be conducted in a manner satisfactory to Engineer-in-Charge.

7.5 Testing of welds

7.5.1 Magnetic particle test
Welds are to be tested in accordance with relevant IS codes. If heat treatment isperformed, the completed weld shall be examined after heat treatment. All defects shall be repaired and retested. Magnetic particle test shall be carried out using alternating current. Direct current may be used with the permission of Engineer-in-Charge.

7.5.2 Liquid penetrate inspection
These tests shall be carried out as per IS codes. All defects shown shall be repaired and rechecked.

7.5.3 Radiographic Inspection
All full strength butt weld shall be radiographed in accordance with the recommended practice from radiographic testing as per relevant IS codes.

7.6 Test failure

In event of failure of any member to satisfy inspection or test requirement, the contractor shall notify the same to Engineer-in-Charge. Before repairing, contractor shall obtain permission from Engineer-in-Charge. The quality control procedures to be followed to ensure satisfactory repairs is subject to approval of Engineer-in-Charge.

7.7 The contractor shall maintain records in all inspection and testing which shall be made available to the Engineer-in-Charge as and when required.

8.0 SHOP ERECTION

8.1 Steel work shall be temporarily shop erected completely or partially as directed by the ERs so that the accuracy of fit may be checked before dispatch. Due notice shall be given to the ERs so that the accuracy of fit may be checked before dispatch. Due notice shall be given to the ERs when the work is ready for inspection and the assembly shall not be dismantled until it has been inspected and approval obtained.

8.2 The parts shall be assembled with a sufficient number of parallel drifts to bring and keep the components in place. In the case of parts drilled or punched through steel jigs resulting in similar parts being interchangeable for portion of the steel work, trial assembly shall be carried out to the extent required by IS : 1915.

8.3 All erection marks shall be die-stamped and also distinctly stenciled in paints. The marking shall be as per the marking diagram approved by the Engineer-in- Charge.

9.0 ERECTION

9.1 As far as possible, the Contractor shall deliver the fabricated steel work to the site in the same sequence as that which he wishes to follow for the erection. Dispatch should be scheduled to avoid cluttering up of the site. The bolts required for erection shall be bagged according to size prior to dispatch.

9.2 All structural work shall be erected in accordance with IS : 800/IS : 806 and IS : 1915 and as per the approved erection drawings. The Contractor shall be responsible for setting out the works. The suitability any capacity of all plant and equipment used for erection shall be to the Satisfaction ERs. These shall be regularly serviced and maintained. Occupational safety practices shall be strictly adhered to and shall be to the satisfaction of the Engineer-in-Charge.

9.3 Individual pieces shall plumbed, leveled and aligned. Drift pins may be used only to bring together the several parts. They shall not be used in such manner as to distorter damage the metal. Temporary bracing, guy line and staging shall be provided to ensure proper alignment and to adequately protect all persons property and to withstand all loadings to which the structure may be subjected during erection.
Attachment of such temporary steel work to the permanent steel work shall only be done with the approval of the ERs. Temporary steel work shall remain in position until the structure is stable and self-supporting and until the structure is stable and self-supporting and permanently bolted or welded to the satisfaction of the ERs. After removal of temporary steel work, the permanent structure shall be made good to the complete satisfaction of the Engineer-in-Charge .No permanent bolting or welding shall

be done until proper alignment has been obtained. Erection of the parts with any moderate amount of reaming, chipping or cutting shall be immediate reported to the Engineer-in-Charge. The steel work shall be rejected unless corrective action is approved by the Engineer-in-Charge.

9.4 No erection shall be permitted more than 2 story above a complete bolted and/or welded floor or above a decked surface.

9.5 Placement of joists shall not start until the supporting work is secured. Temporary bridging, connections and anchors shall be provided to assure lateral stability during erection. Bridging to steel joists shall be installed immediately after joist erection, before any construction loads are applied. Horizontal or vertical bridging shall be provided in accordance with the type of span of the joists. Ends of the bridging lines shall be anchored at top mid bottom chords whom terminating to walls or beams.

9.6 Erection Tolerances

The Contractor shall control the erection of steel structures in such a way that in level no components are more than 10mm out of their correct position nor shall the lines of the structure depart from straightness and plumb by more than a 3mm in metres. The error shall be measured from the designed position of level given by the dimensions and co-ordinates on the drawings.

In structures where movements due to temperature change considerable the deviations listed above will apply at the morning position of the member being checked.

10.0 FILLED MODIFICATION

Correction to accommodate minor misfits in steel structure by moderate use of drift pins and reaming will be permitted. Errors that cannot be corrected by these measures, but require modifications must be reported immediately to the Engineer-in-Charge along with Contractors proposed solution.

11.0 GROUTING UNDER BASE PLATES

Grouting under base plates shall be done after erection of the structural steel unless otherwise approved by the ERs. All bearing plates, bearing assemblies and masonry plates shall be steel level and to the elevations shown on plans. These shall be shimmed with approved means and grouted to assure full bearings on the supporting substrata regardless of the tolerances otherwise permitted.

11.1 The grout to be used in superstructure stanchion bases shall be cement mortar 1 :2 (1 cement : 2 coarse sand) and shall have a 28 days compressive strength of atleast 300 kg/sqm. The surface which are to receive the grout shall be thoroughly cleaned immediately prior to the grouting operation. The grout shall be carefully worked under the base plates and shall completely fill the space under the base plates. Air pockets in the grout packing shall be avoided.

11.2 After the grout has had its initial set, the grout shall be cut back flush with the base plate and the surplus grout shall, be removed. Before leaving the site the Contractor shall retighten the nuts of all anchor bolts.

12.0 CLEANING & PAINT TOUCHING

After erection, exposed surfaces of filed connections, unpainted areas adjacent to tie connections and damaged area in the shop coat shall be cleaned to the same standards required or the shop cost. These shall then be painted with the same used in the shop coat.

13.0 INSERTS & EMBEDMENTS

Various steel inserts and embedment are required under the Contract to be fabricated, positioned and secured firmly into place inside the formwork prior to concrete being poured. There are also requirements of jointing, threading, bolting and welding inserts and embedment of different concrete and structural steel elements in order to establish structural continuity and connection. Great care

shall be exercised by the Contractor in executing all aspects of the work related to inserts and embedment - including tolerances so that the final assembly of the concrete elements can meet satisfactorily the continuity and contiguity requirements intended in the structure. The payment for the inserts and embedment shall be based on the weight of the fabricated puce at the same rate as that applicable to structural steel. The said rate shall be deemed to include supply of materials (Including rounds/bars), labour and all works related to steel inserts and embedments indicated in this specification.

SECTION XI PLUMBING TECHNICAL SPECIFICATIONS

SECTION – a SANITARY FIXTURES

1. SCOPE OF WORK

1.1 The work in general shall be carried out as per the latest CPWD Specifications.

1.2 The rules and regulations of Local Authority Having Jurisdiction, and as per the statutory regulations applicable.

1.3 Work under this section shall consist of furnishing all Material and labor as necessary and required to completely install all Sanitary Fixtures , brass and chromium plated fittings and accessories as required by the drawings and specified hereinafter or given in the Drawings. Indicative list for Fittings and fixtures is as given below:

1.4 Without restricting to the generally of the foregoing the Sanitary Fixtures shall include all Sanitary Fixtures, C.P. fittings and Accessories etc. necessary and required for the Building.

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

2. GENERAL REQUIREMENTS

2.1 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 specification & Drawings.

2.2 The flow rate and type of Fixtures will be as per IGBC gold rating Building requirements.

2.3 All Fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per Architectural/ Interior designer's requirements. Wherever necessary the fittings shall be centered to dimensions and pattern desired.

2.4 Fixing screws shall be half round head Chromium Plated brass with C.P. washers wherever required as per directions of Engineer-in-Charge / LIC OF INDIA .

2.5 All Fittings and Fixtures shall be fixed in a neat workmanlike manner true to Levels and Heights shows 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 Contractors cost.

2.6 When directed, Contractor shall install Fixtures and accessories in a mock-up room for the approval of the Engineer-in-Charge/LIC OF INDIA. Sample room Fixtures may be reused on the works if undamaged, but no additional payment for fixing or dismantling shall be admissible.

3. EUROPEAN W.C.

3.1 European W.C. shall be wash down, single or double siphonic type, wall mounted set, flushed by means of exposed or concealed type flushing cistern, as specified in drawings. Flush pipe/bend shall be connected to the W.C. by means of suitable rubber adapter. Wall hung W.C. shall be supported by C.I. floor mounted chair/bolts as per approval.

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

4. WASH BASIN

4.1 Wash Basins shall be white glazed vitreous chinaware of size not less than 470x420 mm , shape and type as specified in the drawings.

4.2 Each Basin shall be provided with R.S. or C.I. brackets duly painted. The clips and the basin securely fixed to wall and have accessories as mentioned in the drawings.

5. SINKS

5.1 Sinks shall be of precast Terrazzo marble or White Glazed fire clay or vitreous china or stainless steel or any other material as specified in the drawings.

5.2 Kitchen Sinks and Process Sinks shall be of stainless steel

5.3 Each sink shall be provided with R.S. or C.I. brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable angle iron clips or brackets as recommended by the manufacturer. Each sink shall be provided with 40 mm dia C.P. waste with chain and plug or P.V.C. waste. Fixing shall be done as directed by Engineer-in-Charge / LIC OF INDIA.

5.4 Supply fittings for sinks shall be mixing fittings as specified in the Drawings.

6. URINALS

6.1 Urinals shall be white glazed Vitreous China flat back half stall or lip type as specified in drawings.

6.2 Half stall Urinals shall be provided with sensor based flushing system , 32 mm dia C.P. domical waste and C.P. cast brass bottle trap with pipe and wall flange, and shall be fixed to wall by one C.I. bracket and two C.I. wall clips as recommended by manufacturers complete and as directed by Engineer-in-Charge/LIC OF INDIA.

6.3 Half stall urinals shall be fixed with C.P. Brass screws and shall be provided with 32 mm dia Domical Waste leading to Urinal trap.

6.4 Urinals shall be flushed by means of automatically sensor operated flushing system as specified in drawings.

6.5 Waste pipes for urinals shall be of the following:

a) G.I. / UPVC Pipes

Waste pipes may be exposed on wall or concealed in chase as directed by the Engineer-in -Charge / LIC OF INDIA. Specifications for waste pipes shall be same as given in Sub Section

7. URINAL PARTITIONS

7.1 Urinal partitions shall be white glazed vitreous china or 2x18mm thick Granite of size specified in the Drawings.

7.2 Porcelain 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 Engineer-in-Charge / LIC OF INDIA.

8. HAND DRYERS

8.1 The hand drier shall be no touch operating type with solid state time delay to allow user to keep hand in any position.
8.2 The hand drier shall be fully hygienic, rated for continuous repeat use (CRU).
8.3 The rating of hand drier shall be such that time required to dry a pair of hands up to wrists is approximately 30 seconds.
8.4 The hand drier shall be of wall mounting type suitable for 230V, single phase, 50Hz, AC power supply.

9. TOILETS FOR DISABLED

9.1 Where specified in washroom facilities designed to accommodate physically handicapped, accessories should be provided as directed by Engineer-in-Charge.

9.2 Stainless steel grab bars of required size suitable for concealed or exposed mounting and non-slip gripping surface shall be provided in all washrooms to be used by physically handicapped as directed by Engineer-in-Charge.

10. ACCESSORIES

10.1 Contractor shall install all Chromium Plated and porcelain accessories as shown on the drawings or directed by Engineer-in-Charge / LIC OF INDIA, and given in the Drawings.
10.2 All C.P. Accessories shall be fixed with C.P. brass half round head screws and cup washers in wall with raw plugs or nylon sleeves and shall include cutting and making good as required or directed by Engineer-in-Charge/LIC OF INDIA.
10.3 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.

11. PAN CONNECTOR

The WC pan connector shall be Flexible, soft and shall be made of single body construction with integral fins. The pan connector must be supplied with factory fitted spring loaded seal guard.

While fixing of the pan connector with the Soil pipe, the pipe must be reasonably clean and smooth on the inner surface; in case the soil piping is in C.I. then supplier supplied bush / adaptor shall be used. The connector socket is pushed fully home onto the pan spigot, thereafter the WC is placed in position gently pushing the fitment to ensure that the connector end fits into the Spigot of the pipe. The pan connector must be pushed in such a easy as to ensure that the seals and fins turn inward to ensure proper sealing.

12. MEASUREMENT

Rates for fixing of Sanitary Fixtures Accessories, urinal partitions shall include all items and operations stated in the respective specifications and Drawings and nothing extra is payable.

Rates for all items under specifications above shall be inclusive of cutting holes and chases and making good the same, C.P. screws, nuts, bolts and any fixing arrangements required and recommended by Manufacturers, Testing and Commissioning.

SECTION – b SOIL, WASTE & VENT PIPES

1. SCOPE OF WORK

1.1 Work under this section shall consist of furnishing all labor, materials, equipments and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes as required by the drawings and specifications

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

a) Vertical and horizontal Soil, Waste and Vent Pipes, Rainwater Pipes and Fittings, Joints Clamps and connections to Fixtures.
b) Connection of pipes to Gully Traps & Manholes etc.

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 / LIC OF INDIA.

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 required

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

2.6 All works shall be executed as directed by Engineer-in-Charge / LIC OF INDIA.

SECTION – c WATER SUPPLY SYSTEM

1. SCOPE OF WORK

1.1 Work under this section consists of furnishing all labor, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings.

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

a) All water lines to different parts of building and making connection from source etc. including risers, terrace lines, down take and distribution system.
b) Pipe protection and painting.
c) Providing Hot water supply lines and with insulation of hot water pipe lines.
d) Control valves, masonry chambers and other appurtenances.
e) Connections to all toilets, kitchen equipments, storage tanks and appliances.
f) Excavation and refilling of pipe trenches, wherever required.
g) Trenches for taking pipe lines for these services.

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 Engineer-in-Charge / LIC OF INDIA.

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. As far as possible all Bends shall be formed by means of a hydraulic pipe bending machine for pipes up to 65mm dia.

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

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

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

3. uPVC PIPES

3.1 Definition

uPVC pipe means unplasticized Polyvinyl Chloride pipe , confirming to IS: 4985. It has density of Approx. 1.43 g / Cm3 as such it is less than 1/6th the weight of C.I. and steel pipes, therefore easier to handle during installation andtransportation.

3.2 The uPVC Pipes to be used for Portable water to be odorless and hygienic, and should have inside surface mirror smooth.

3.3 The Pipes should have high corrosion resistance and should be immune to chemical electrolytic and galvanic action.

3.4 These Pipes should be longer lasting because of corrosion resistance property.

3.5 Handling Guidelines

Pipes should be kept on an even surface while storing. They should be properlysupported and should not be stacked for heights more than 1.5 meters for longer duration.

3.6 Jointing Instruction

The uPVC Pipes are of two types i.e. Selfit and Ringfit. The following procedure may be adopted while jointing the Pipes: -

a) Selfit Pipes

- Cut the Pipes as square as possible and ensure fitment of Pipes with socket of fitting is correct. Total length of insertion of sockets to be marked from the Pipe.
- The Pipe and the socket should be clean and dry. Dust, Oil, water, grease etc. should be wiped out with dry cloth or cleaner from the surfaces to be coated with Solvent Cement.
- Roughen the outside of Pipe and inside of Socket using sand Paper up to the entry mark. Stir adhesive i.e. Solvent Cement thoroughly.
- Apply thick coat of Solvent Cement using a flat clean brush evenly on the inside of the socket mouth for full length of insertion and then outside of the Pipe end up to the marked line.
- After application of Solvent Cement, insert the Pipe within one minute in to the Socket. Hold the Joint for few seconds and ensure that the Pipe does not come out of the fittings. Wipe off extra cement and allow it to dry for at least 24 Hours. The PVC Pipe with joint is ready for use.

b) Ring-fit Pipes

- Clean the inside of Socket. Remove all traces of mud, dirt, grease, gravel and also clean sealing ring.
- Form the EPDM ring into heart shape by pinching a portion of ring inside. Insert it into the socket and release to seat in to the groove.
- Mark the insertion depth on spigot portion of the pipe. Clean and apply lubricant to insertion depth before pushing in to the Socket. Ensure that no sand or dirt adheres to the lubricated surface of the Pipe.
- Push the Spigot into the Socket until it reaches the depth of entry mark, taking care not to over insert. This can be done manually. Make sure that the insertion of Spigot end inside the socket should be at correct angle. The Pipe and Joint are ready for use.
- In case of large diameter Pipes if crow bar does not give sufficient leverage, use of jointing jack may be helpful.

Precautions

a) uPVC Pipes and Fittings should not be cleaned by Solvent Cement.
b) For large diameter and Higher class Pipes (6 kgf/cm2 & above), use heavy duty Solvent cement.
c) uPVC pipes and fittings to be used of same Brand and Manufacturer.

4. CPVC PIPES AND FITTINGS

4.1 Description

CPVC piping shall be Fire Proof, Corrosion resistance with smooth, friction free interior surfaces and with anti - bacterial growth properties.

4.2 JOINING TUBING & FITTINGS

a) Cutting

CPVC tubing shall be cut with a wheel-type plastic tubing cutter, a hack saw or other fine toothed hand or power saws. Use of ratchet cutters shall be permitted, provided blades are sharpened regularly. A milter box should be used to ensure a square cut when using a saw.

b) Deburring/Beveling

Burrs and fillings can prevent proper contact between tube and fitting during assembly, and should be removed from the outside and inside of the tubing. A chamfering tool shall be used for this purpose. A slight bevel on the end of the tubing shall be provided to enable entry of the tubing into the fitting socket and minimize the chances of pushing solvent cement to the bottom of the joint.

c) Fitting Preparation

The surfaces shall be wiped clean of dirt and moisture from the fitting sockets and tubing end. Check the dry fit of the tubing and fitting. The tubing should make contact with the socket wall 1/3 to 2/3 of the way into the fitting socket.

d) Solvent Cement Application

Only approved type Solvent Cement shall used for jointing the CPVC pipes, which shall be procured as per the manufacturer recommendations. Apply an even coat of Cement Solvent on the Pipe end after cleaning of whole pipe and also inside the fittings socket. Old or deteriorated or thickened or Lumpy Solvent Cement shall not be used.

e) Assembly

Immediately insert the pipe into fitting socket, rotate the pipe ¼ to ½ turn while inserting. This motion ensures an even distribution of cement within the joint. Properly align the fitting. Hold the assembly for approximately 10 seconds, allowing the joint to set-up. An even bead of cement should be evident around the socket edge, it may indicate that sufficient cement was applied. In this case, remake the joint to avoid potential leaks. Wipe excess cement from the tubing and fitting surfaces for an attractive, professional appearance.

5. GUNMETAL VALVES

12.1 Valves 65mm dia and below shall be heavy Gunmetal Fullway Valves or Globe Valves or Ball valves conforming to I.S. 778-1971 of 20-25 Kg/cm2 class. Valves shall be tested at manufacturer's works and the same stamped on it.

12.2 All Valves shall be approved by the Engineer-in-Charge / LIC OF INDIA before they are allowed to be used on work.

6. BALL VALVES

Ball Valves have body material as Forged Brass Chrome plated with Spindle Brass Nickel Plating & Lever handle Steel Chrome plated with green plastic cover. The valve is suitable for water maximum working pressure up to 25 bar (PN 25). The valve is operated by turning. The rotation from open to close is a quarter turn (90o) which closes in a clock-wise direction.

7. BUTTERFLY VALVES

a) Butterfly valves of approved quality for pressure rating of 230 P.S.I. with locking arrangement and gearbox with handle operated or gearbox with lid shall be provided or as given in the Drawings.
b) Butterfly valves shall be of specified quality conforming to IS: 13095 or BS: 5155.
c) Joints for butterfly valves shall be made with suitable tail /socket pieces on the pipe line and flanged joints made with 3mm thick insertion rubber gasket with appropriate number of bolts, nuts and washers.
d) Butterfly valves shall be provided on all branches as shown in the drawings or as specified.

8. SLUICE VALVES

15.1 All valves 80mm dia and above shall be C.I. Double Flanged Sluice Valves. Sluice valves shall be Cast Iron double flanged, with rising spindle. 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.

15.2 Sluice valves shall be of best quality conforming to I.S: 780-1969 of class

15.3 Sluice valves shall be socketed type or double flanged type conforming to I.S:780.

a) Joints for socketed valves shall be lead-caulked joints as specified above.
b) Joints for double flanged sluice valves shall be made with suitable tail/socket pieces on the pipeline and flanges joints made with 3 mm thick insertion rubber gasket with appropriate number of bolts, nuts and washers.
c) Sluice valves shall be installed at all branches and as shown on the drawings.

9. SCOUR VALVES

Scour valves shall be C.I. sluice valves as specified above. They shall be installed at the lowest level or tail end of the system as shown on drawings and directed by Engineer-in-Charge / LIC OF INDIA.

10. AIR RELEASE VALVES

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

11. CAST IRON PIPES

18.1 Pipes for water supply mains where specified shall be cast iron pipes, centrifugally cast spun iron pipes, class LA conforming to I.S. 1536. Quality certificates shall be furnished.

18.2 Fittings and Inspection Chambers

Fittings and chambers shall be provided as required.

18.3 Anchor Block

Suitable anchor blocks shall be provided at all bends and tees to encounter the excessive thrust developed due to water hammer.

18.4 Rubber Joints

Joints between two pipes shall be made by premoulded rubber joints with suitable tackles in a manner recommended & approved by the manufacturer. No joints shall be covered until the lines are Hydraulically tested.

12. VALVE CHAMBERS

19.1 Contractor shall construct chambers for all full way valves, butterfly valves and other type of valves as specified in the Drawings. These shall be made, in brick masonry in cement mortar 1:4 (1 cement: 4 coarse sand) on cement concrete foundations 150mm thick 1:5:10 mix (1 cement: 5 coarse sand: 10 graded stone aggregate 40mm nominal size) 12 mm thick cement plaster 1:3(1 cement : 3 coarse sand) inside finished with a floating coat of neat cement with 8mm thick M.S surface box with hinged cover and locking arrangement, 150 mm thick reinforcement cement concrete top slab of 1:2:4 (1 cement : 2 coarse sand: 4 graded stone aggregate 20mm nominal size), as specified and shown in drawings, including excavation, back filling rammed complete or as specified in Drawings.

19.2 Valve chambers shall be constructed as specified in drawings but generally shall be of following sizes:

	Length (MM)	Width (mm)	Depth (mm)
For pipes diaupto 80 mm	600	600	1000
For pipes dia 80mm and above	750	750	1000

13. TESTING

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

20.2 Pressure shall be maintained for a period of at least two hours without appreciable drop in the pressure after fixing at site. (+10 %). A test register shall be maintained and all entries shall be signed and dated by Contractor(s) and Engineer.

20.3 In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages, and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and Fixtures shall be made good during the defects liability period without any extra cost.

20.4 After completion of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

14. DISINFECTION

21.1 After completion of the work Contractor shall flush clean the entire system with the city's filtered water after connection has been made.

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

15. PRE COMMISSIONING

22.1 Ensure that all pipes are free from debris and obstructions.

22.2 Check all valves and fire hydrant for effective opening and closing action. Defects should be rectified or valves replaced.

22.3 Ensure that all Connections to Branches has been made.

22.4 Ensure that mains have been connected to the respective pumps, underground and overhead tanks.

22.5 Water supply should be available at main Underground tank.

22.6 All main line Valves should be closed.

16. COMMISSIONING

23.1 Fill Underground tank with water. Add 1kg fresh bleaching powder after making a solution to be added near inlet.

23.2 Start Water Supply Pump and allow water to fill main Underground tank. Water will first fill the fire tank and then overflow to the Raw Water tanks.

23.3 After filling Overhead Reservoir drain the same to its one forth capacity through tank scour valve. (This is to ensure removal of all mud, debris etc. from the tank).

23.4 Fill Overhead tank to full. Release water in the main lines by opening Valves in each circuit. Drain out

23.5 water in the system through scour valves or fire hydrant in lower regions. Ensure clean water is now coming out of the system.

23.6 Open valves for individual clusters. Observe for leakages or malfunctions, check pressure & flow at end of line by opening Hydrants etc. Remove and rectify defects noticed.

23.7 Check all outlet points for proper operation by opening each valve and allowing water to flow for a few minutes. Also check for effective closure of valve.

23.8 The entire water supply system should be disinfected with bleaching powder and system flush cleaned.

23.9 Send four samples of water drawn from four extreme locations for testing for bacteriological test in sterilized bottles obtained from the concerned laboratory. (Laboratory personal may collect the samples themselves).

17. . RESPONSIBILITY

Responsibility for various activities in pre-commissioning and commissioning procedures will rest with the Contractor.

SECTION – d SEWERAGE / DRAINAGE SYSTEM

1. SCOPE OF WORK

Work under this section shall consist of furnishing all Labor, Materials, Equipments and Appliances necessary and required to completely finish Sewerage/Drainage system as required by the drawings and specified hereinafter or given in 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 the Engineer-in-Charge / LIC OF INDIA.
2.2 Drainage lines shall be laid to the required gradients and profiles.
2.3 All drainage work shall be done in accordance with the local Municipal byelaws.
2.4 Location of all manholes, catch basins etc., shall be got confirmed by the Contractor from the Engineer-in-Charge / LIC OF INDIA before the actual execution of work at site.
2.5 All works shall be executed as directed by Engineer-in-Charge / LIC OF INDIA.

3. ALIGNMENT AND GRADE

The sewer pipes shall be laid to alignment and gradient shown on the drawingsbut subject to such modifications as shall be ordered by the Engineer-in-Charge /LIC OF INDIA from time to time to meet the requirements of the works. No deviationsfrom the lines, depths of cutting or gradients of sewers shown on the plans andsections shall be permitted except by the express direction in writing of theEngineer-in-Charge / LIC OF INDIA.

4. SALT GLAZED STONEWARE PIPES

4.1 Pipes and Fittings shall be new and of the best quality, grade and shall confirm to IS: 651. The Glaze shall be free from crazing, fire cracks or hair cracks. There shall be no broken blisters. There shall be sharp clear tone when struck lightly. Pipes shall be with spigot and socket ends.

4.2 Laying and Jointing of Stoneware Salt Glazed Pipes

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

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

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

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

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)

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

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

5. HDPE PIPES

5.1 HDPE pipes used for external sewerage / drainage purpose shall conform to IS:14333 & to the grade as specified in the drawings.

5.2 All the HDPE pipes shall be jointed with Butt welding method complete as per manufacturer’s specifications including testing of joints etc.

6. ECO DRAIN PIPES

6.1 Pipes and Fittings shall be new and of the best quality, grade and shall confirm to IS: 16098 and European international standards for “Structured wall pipes and fittings” for U.G. Drainage and Sewerage. These are solid wall pipes which have a unique wall structure i.e. with a number of holes across, the pipe wall thickness in longitudinal direction. ECO Drain pipes are of long lengths and hence reducing the number of joints and potential for flow disturbances.

6.2 The joints are stable, water tight and can accommodate angular deflection and axial displacement. Joints are designed to resist loads from horizontal and vertical forces. These joints can accommodate 3° angular deflection in anydirection and hence offer good flexibility against lateral or vertical displacements.

Dimension and Stiffness class of Eco drain pipes as per IS: 16098

7. GULLY TRAPS

7.1 Gully traps shall be of the same quality as described for stoneware pipes in Clause 4.

7.2 Gully traps shall be fixed in cement concrete 1:5:10 mix (1 cement: 5 coarse sand: 10 stone aggregate 40mm nominal size) and a brick masonry chamber 30x30 cms inside in cement mortar 1:3 with 10 x 10 cms grating inside and 30x30 cms C.I. sealed cover and frame weighting not less than 7.2 kg to be constructed as per standard drawing. Where necessary, sealed cover shall be replaced with C.I. grating of the same size.

8. GREASE TRAP

Grease Trap shall be provided on Kitchen waste lines before discharging the waste into the main sewer line. Grease Trap shall be built in brick masonry and shall be similar in construction to manholes. The grease trap shall be construction to size as shown at the location on drawings. The grease trap shall be provided with drop inlet, drop outlet, galvanised wrought iron sediment pan and a baffle wall. Grease trap shall be provided with 2 Nos, double seal manhole cover and frame which shall be identified with lettering `Grease trap".

9. REINFORCED CEMENT CONCRETE PIPES

9.1 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. Throughoutcracked, 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.

9.2 Laying

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

9.3 Jointing

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

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10. CEMENT CONCRETE AND MASONRY WORKS FOR MANHOLES AND CHAMBERS ETC.

10.1 Materials

a) Water

Acidity , Alkalinity and percentage of Solids shall be in accordance with IS: 3025.The Ph value shall generally be not less than 6. In general potable water is considered

satisfactory for use. Sea water shall not be used. Testing shall be done individually for different source points before the start of the work and there after once in every three months.

b) Aggregate for Concrete

It shall be strong, durable and free from adherent coatings, sea shell, organic impurities, disintegrated pieces If dirty, shall be washed with water before actual use. Flaky and elongated pieceshall be avoided. It shall confirm to IS: 383 and IS: 2386.

c) Sand

It shall be hard, durable, chemically inert, clean and free from adherent coatings, organic matter etc. and shall not contain any appreciable amount of clay balls of pellets and harmful impurities and shall confirm IS: 2386. It shall not contain more than 8 % of silt as per the field test. Grading for masonry, plaster and concrete shall be as per IS: 2116, IS: 1542, IS: 383 respectively, Sea sand shall not be used. Testing for bulkage to be done and allowance be made at the time of use.

d) Cement

The cement used for all the constructional purposes shall be Portland pozzolana cement confirming to I.S. 1489 OR rapid hardening, Portland cement conforming to I.S. 269. Different types of Cement shall not be mixed together, shall be stacked and stored separately. Cement Bags shall be stacked in a manner to facilitate their removal and use in the order in which they are received. The site where it is stored shall be dry, leak proof and as far as possible moisture proof. Necessary precautions to be taken to avoid dampness through floor and walls. Stacking shall not be more than 10 bags high.]

e) Mild Steel Reinforcement

The mild steel for the reinforcement bars shall be in the form of round/ twisted/deformed bars conforming to all requirements of I.S. 432 (Grade I).

f) Bricks

Brick shall have uniform color, thoroughly burnt, smooth rectangular faces, with parallel slab, sharp and right angled edges, but not over-burnt. When struck should give clear ringing sound. The maximum permissible area of perceptible deposit of efflorescence shall be 50% of the surface area of the Bricks. The affected bricks should not be more than 80% of the lot. There shall be no powdering or flaking of the surface. The average water absorption shall not exceed 22% by weight after 24 hours immersion in water. The average minimum compressive strength for bricks of class designation 75 shall not be less than 75 kg / cm2.

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 / LIC OF INDIA before use.

11.1 Cement Concrete (Plain or Reinforced)

a) Cement concrete pipes bedding, cradles, foundations and RCC 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 / LIC OF INDIA. 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 Drawings.

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 pipe trenches and foundations shall be kept dry during the curing period.

11.2 Masonry Work

Masonry work for manholes, chambers, brick masonry pipe trench and such other works as required shall be constructed from 1st class bricks as specified in the Drawings in cement mortar 1:4 mix (1 cement: 4 coarse sand). All joints shall be properly raked to receive plaster.

11.3 Cement Concrete for Pipe Support

a) Wherever specified or shown on the drawings, all pipes shall be supported in concrete bed all round or in haunches. The thickness and mix of the concrete shall be given in the Drawings. Type of the bedding is as described as follows:

b) Unless otherwise directed by the Engineer-in-Charge / LIC OF INDIA cement concrete for bed, all round or in haunches shall be laid as follows:-

Description	Upto 3 M depth
Pipes in open ground (No sub soil water)	All round (1:4:8)
Pipes (all) in sub soil water condition	All round (1:3:6)
Pipes under the building or at road crossing orunder public places	All round (1:2:4)

c) R.C.C. pipes or C.I. pipes, may be supported on brick masonry or precast R.C.C or Cast insitu cradles. Cradles shall be as shown on the drawings.

d) Pipes in loose soil or above ground shall be supported on brick or RCC anchor blocks as shown on the drawings.

11. MANHOLES AND CHAMBERS

12.1 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 Drawings.

12.2 All Manholes, Chambers, etc., shall be supported on base of cement concrete of such thickness and mix be constructed as follows:-
(All dimensions internal clear in mm)

Size of Manhole Type(in mm)	900x800 Rect.	900X1200 Rect.	910 dia Circular	1220 dia Circular	1520 dia Circular

Maximum depth	Up to 900	Up to 2450	Up to 1620	From 1620 to 2290	From 2300 to 9000
Average thickness of R.C.C slab	150	150	-	-	-
Size of cover and frame (Internal dia)	610x455	560 dia	560 dia	560 dia	560 dia
Weight of cover and frame not less than	38 Kg. or as specified in drawing	116 Kg. or 170 Kg. or 208 Kg. or as specified in drawing	116 Kg. or 170 Kg. or 208 Kg. or as specified in drawing	116 Kg. or 170 Kg. or 208 Kg. or as specified in drawing	116 Kg. or 170 Kg. or 208 Kg. or as specified in drawing
Type of Cover & Frame	C.I. or SFRC as specified in drawing	C.I. or SFRC as specified in drawing	C.I. or SFRC as specified in drawing	C.I. or SFRC as specified in drawing	C.I. or SFRC as specified in drawing

12.3 All manholes shall be provided with cement concrete benching in 1:2:4 mix (1cement: 2 coarse sand: 4 stone aggregate 20mm nominal size). The benching shall have a slope of 10cm towards the channel. The depth of the channel shall be full diameter of the pipe. Benching shall be finished with a floating cost of neat cement.

12.4 All manholes shall be plastered with 12/15mm 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.

12.5 All manholes with depths greater than 1 M. shall be provided with plastic encapsulated 20mm square or 25mm round rods foot rungs set in cement concrete blocks 25 x 10 x 10cms in 1:2:4 mix 30cms vertically and staggered. Foot rests shall be coated with coal tar before embedding.

12.6 All manholes shall be provided with cast iron covers and frames and embedded in reinforced cement concrete slab or SFRC precast concrete covers as per instructions of the Engineer-in-Charge / LIC OF INDIA. Weight of cover, frame and thickness of slab shall be as specified in the Drawings or as given above.

12.7 All catch basins shall be having C.I. grating or SFRC precast Gully Grating as per instructions of Engineer-in-Charge / LIC OF INDIA. The grating along with frame shall be of approved design and quality as per instruction of Engineer-in-Charge/ LIC OF INDIA.

12. MAKING CONNECTIONS

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

13. RAIN WATER HARVESTING SYSTEM

Rain water harvesting system to be provided as per local site conditions.

14. COMMISSIONING

15.1 After successful testing of the different sewerage and drainage pipes in parts, the Contractor shall provide all facilities including necessary pipings, labours, tools and equipments etc. for carrying out testing and commissioning of the entire external sewerage and drainage system complete as per requirement in the presence of Client representative/LIC OF INDIA/consultant, whenever and as may be required. Generally, the following test/inspection has to be carried out:-

a) For any Leakages/seepages in the external sewerage and drainage pipes.
b) For checking the functioning of the entire external sewerage and drainage system including rainwater harvesting system and to ensure that the waste water is continuously flowing towards outfall without any intermediate stagnation.
c) For the functioning of the valves and accessories etc. by putting ON/OFF the controlling valves of the various diversions in the sewerage and drainage and rain water harvesting system.

SECTION – E

TECHNICAL SPECIFICATIONS:STP

1. SUMP PUMPS (Raw sewage relift pump for equalization tank & drainage sump for plant room)

1.1 Sump pump set shall be dry motor submersible type with SS304 Guide Rail, & SS304 Chain with level float switches & suitable for auto / manual operation with class “F” insulation of suitable capacity & RPM operating on 415volt ± 10%, 3 phase, 50Hz AC supply, with non-clog free flow open CI impellers, CI casing (Pump & Motor) and having solid handling capacity of required size for lifting domestic sewage or muddy water/drainage.

1.2 Pump shall inclusive of all necessary accessories like valves, piping, Control Panel and Cabling, Level Controllers, Test and/or air vent etc. as required within the quoted cost. The Contractor has to ensure for smooth and trouble free operation after the commissioning of the entire system.

1.3 The pump having dry run protection & high level alarm with audio and visual function/ indication shall automatically operate with high water level and stop at low water level in the sump by means of “Electronic Level Controller”, with necessary control cabling of the approved make upto control panel. The pump shall have the facility to cycle through the total number of pumps provided and in case of High Level shall be capable of cumulative operation.

1.4 The sump pumps shall be complete in all respect and shall be installed on the mentioned locations as shown in the drawing as per manufacturer’s recommendations. All accessories shall be In-Built as per manufacturer’s specification.

1.5 Contractor shall provide Electrical control panel having all necessary accessories, safety devices, Indication Lamp, Ammeter & voltmeter of approved make & standard specifications and shall be suitable for receiving incomer armored cable to connect complete within the quoted cost. It is manadatory to provide the control panel from the same pump manufacturers. Below are the functions of panel:

(i) All the working and standby pumps shall start/stop automatically and alternatively.
(ii) Each pump shall start/stop automatically at pre-set levels and work alternatively in cyclic operation.
(iii) In case of pump getting overloaded, indication shall come on the panel and hooter will give sound non-operation of pump.

(iv) In case of emergency due to high volume flow of incoming sewer all pumps shall start operating simultaneously

1.6 The entire system along with pumps & control panel must be sourced from single manufacturer only for unit responsibility.

2. AIR BLOWERS

2.1 The treatment plant shall be provided with rotary positive displacement roots type blowers with a common base and a central electric control panel, belt drive system, drip proof induction type electric motors, necessary valves including a pressure necessary to connect the blowers to the plant air header shall be provided. Flexible reinforced rubber connecting sleeves shall be provided wherever required. There shall be standby arrangements for blowers to enable cyclic operations.

2.2 The Air blower shall have min. requirements as mentioned below: Table No. 1 – Minimum Requirements for Air Blowers

3. AIR DIFFUSERS

3.1 Each diffuser shall be non-clog type diffuser. Supply pipes shall be of sufficient size to keep pressure loss through the drop-pipe assembly to a minimum. The air diffusion devices shall be designed to distribute air to cover the entire length of the tanks and to have efficiency such that an adequate supply of oxygen is maintained in the tanks to treat the effluent load for which the plant is designed.

3.2 The membrane diffuser shall be made of: -

(i) Pipe Aerator in Silicon material of construction & PP Support Tube of minimum 5 mm thickness with threaded type fixing arrangement having air throughput rate as per Approved Technical Annexures.

(ii) Disc Aerator in Silicon material of construction– With air throughput rate as per Approved Technical data sheets.

(iii) Disc type diffuser shall be of 5m3/hr and tube type diffuser shall be of 9 m3/hr.

4. SLUDGE RETURN / RE-LIFT PUMPS

4.1 Sludge return pumps shall be horizontal non-clog centrifugal pumps for the required discharge and head and of required specifications. Pump shall be directly connected to an electric motor by means of a flexible coupling and mounted on a common C.I. or G.I. base plate.

4.2 Each sludge return pump shall have a capacity suitable for re-circulating 100% sludge. The second pump shall be a standby in cyclic operation.

4.3 The Sludge return pumps shall have CI Impeller, Cast Steel Shaft, CI delivery casing, bronze sleeve & Mechanical Seal fitted coupled with suitable motor of efficiency class m IE-2 with required HP & RPM operated on 415 Volts ±10%, 3 phase, 50 Hz A.C. supply.

5. SLUDGE LOADING / DISPOSAL PUMPS

5.1 Sludge loading/ disposal pumps shall be horizontal non-clog screw type pumps for the required discharge and head and of required specifications.

5.2 The pump shall have following operating parameters:

(i) Pump Type :Screw Pump

(ii) Pumping Fluid :Sludge

(iii) Suction Head :Flooded

(iv) Motor : Suitable Motor of required HP & RPM operated on 415 Volts ±10%,3 Phase, 50 Hz A.C. supply.
(v) Flow :Suction on Gland
(vi) Suction / Delivery Position :Top/End
(vii)Type of drive :O/H Drive, V-Belt Driven
(viii) Mounting :M.S. Fabricated Common Base Plate

6. FILTER FEED PUMP

6.1 Water supply pumps shall be suitable for clean water. Pumps shall be multistage, Inline vertical, centrifugal pumps with SS casing, stainless steel impeller, stainless steel shaft, CI base with CED coating and directly coupled with TEFC induction motor of class "F" insulation & efficiency class IE-2, 2900 RPM, IP 55 enclosure, suitable for operation on 415 volts ±10%, 3 phase, 50 Hz, A.C. supply. Each pump should operate at maximum efficiency duty point at specified head. Bidders shall select their drives within 10% to 15% in excess of the maximum B.H.P of the pump plus transmission losses, if any.
6.2 Pump and motor shall be mounted on a common G.I. structural base frame.
6.3 Each pumping set shall be provided with a 150mm dia or of suitable size gunmetal “Bourden” type pressure gauge with gunmetal isolation cock and connecting piping.
6.4 Provide Anti vibration mounting pads, Lubrication fittings and seal piping, Test and/or air vent cocks, 25mm GI gland drain appropriate for each pump.
6.5 Provide vibration eliminators/expansion joints on suction and Discharge side of the Pump and wherever required.
6.6 All water supply pumps shall be provided with mechanical seals (cartridge type), of required specifications.

7. HYDRO-PNEUMATIC SYSTEMS

2.7 Hydro pneumatic systems (With Variable Frequency Drive)

7.1.1 The scope of this section covers supply, installation, testing and commissioning of compact packaged type skid mounted, self-contained variable frequency drive hydro pneumatic system. The skid mounted, factory assembled hydro-pneumatic system shall be provided with pressure transmitters, frequency convertor for noiseless operation of the pump at varying duty point. The convertor shall be provided with short circuit safety, earthing, over current, under voltage protection. The pump shall be complete with suction and delivery pipe. The system shall comprise of multiple pumps working and one stand-by to meet the system discharge requirements.
7.1.2 It shall conform to the following specifications:
a. Pumps shall be vertical, inline multistage centrifugal and fulfills all specifications as specified in the Clear water pump section.
b. Pressure vessel shall be of non corrosive FRP composite construction lined with NSF and/or FDA listed material, like high density polyethylene with fully replaceable polyurethane. Air cell burst pressure of minimum of five times the vessel operating pressure and cycle tested for 80,000 cycles with charging connections to discharge pipe line with necessary flanges, gaskets, isolating valve, nuts/ bolts etc. with suitable foundation bolts & other accessories, complete. Capacity provided shall be as per manufacture specifications.
c. Panel mounted microprocessor multi pump controller with large graphical display and variable frequency drive (VFD) mounted inside a panel complete with pressure sensor transmitter. The graphical display is capable to show number of pumps running & also

communicate with other controllers following with open protocol through RS485 port. System should be capable to compensate for frictional losses at lower flows. All alarms should be displayed in the controller. The panel should also have provision for manual / automatic alternate (cyclic) operation of pumps, ON/OFF switch, dry run protection, inter connecting power and control cabling etc complete.

2.8 Control Panel (For Hydro-Pneumatic Systems)

2.8.1 The control panel shall have terminals for:

(i) Remote monitoring.
(ii) Pump fault.
(iii) Analog output signal for frequency convertor (In case of VFD operated Hydro-pneumatic systems).
(iv) Pressure sensor / Pressure switches as per system requirement.

2.9 General

2.9.1 The hydro pneumatic system shall be capable of maintaining a constant pressure at varied consumption. The hydro pneumatic system shall be complete with pressure sensor and microprocessor based controller for flow control by means of frequency variation (in case of VFD operated system). The controller should have time control switch to adapt pump operation to actual requirement in peak load situation. The control panel should also have manual operation.

2.9.2 The pumping system shall perform the following functions:

(i) Shut off the pump at zero demand.
(ii) Shut off the pump at zero suction(Dry Run protection)
(iii) Protect the pump from overvoltage, under voltage, overload & earth fault.
(iv) Vary the time of pump speed acceleration and deceleration (For VFD operated Hydro pneumatic system).
(v) Compensate for higher friction losses at high flow rates.
(vi) Send out a signal for remote monitoring of flow as well as pressure.
(vii)Conduct automatic test run of pumps at set times.
(viii) Keep track of run time for pumps.
(ix) Perform run time equalization of all pumps in system.

2.10 Installation

2.10.1 Hydro pneumatic systems shall be mounted on a common base frame & installed as per manufacturer's recommendations. Pump sets shall be mounted on machinery isolation cork or any other equivalent vibration isolation fitting. The vibration isolation pads, foundation bolts etc. shall be supplied by the Contractor. Contractor shall ensure that the foundation bolts are correctly embedded.

2.10.2 Pump-sets shall be factory aligned, wherever necessary, site alignment shall be done by competent persons. The entire system along with pumps & control panel must be sourced from single manufacturer only for unit responsibility.

3. DUAL MEDIA FILTERS & ACTIVATED CARBON FILTERS

3.1 Water filter shall be of dual media pressure filter (comprising of minimum 300mm bed depth of Anthracite and support media and minimum Height on Straight 1500mm) of downward or upward flow type suitable for a rate of filtration of 17500 LPH per square meter.

3.2 Filter shall be vertical type of required diameter. The shell shall be fabricated from M.S. plate suitable to withstand a working pressure of 3 Kg/cm2. The minimum thickness of

shell shall be 10mm and dished ends shall be of 12mm thick. The quality of Steel shall be as per IS:2062 Grade B, dish ends- IS:2002/SA 515 grade 60, thickness as per ASME Section 8. The filter shall have at least one pressure tight manhole cover. Filter shall be provided with screwed or flanged connections for inlet, outlet, individual drain connections and all other connections necessary as required. Filter shall be painted inside with two or more coats of coal tar epoxy paint or internally FRP Lined, one coat of zinc chromate yellow primer outside with two or more coats of synthetic enamel paint of approved shade. The Filter media shall comprise of 0.5 to 1.00 mm fine filtering silica sand for removal of turbidity and suspended matter. The initial charge of filter media as specified in above para's shall be the responsibility of contractor. The pressure filter shall be complete with cleaning cycle controller adjustable to meet application requirement, actuating control valves in required sequence for back wash.

3.3 Under Drain System]

3.3.1 Filter shall be provided with an efficient under drain system comprising of collecting pipes, gunmetal/polypropylene nozzles of manufacturer's design. The entire under drain system be provided on adequate cement concrete supports.

3.4 Face Piping

3.4.1 Filter shall be provided with interconnecting face piping comprising of inlet, outlet, and backwash pipe complete with pipes, valves and accessories, as per requirement. Piping shall be G.I. piping, heavy duty, as per I.S: 1239 and valves shall be cast iron double flanged sluice valves with C.I. body and Neoprene rubber diaphragm.

3.5 Accessories

3.5.1 Each filter shall be provided with following accessories:

a) Air release valve with connecting piping.
b) 150mm dia dial burden type gunmetal pressure gauges with gunmetal isolation cock and connecting piping on inlet and outlet.
c) SS Sampling cocks on raw water inlet and filtered water outlet.
d) Individual drain connection with gunmetal fullway valve should be piped through a properly sized G.I. pipe to nearest drain point.

3.6 Activated carbon filters shall have minimum Height on straight 1500mm comprising of minimum 450mm bed depth of Activated carbon, support media as required, consisting of downward or upward flow type as suitable.

3.7 Backwash System for Filters

3.7.1 Mixed air & Water Stream shall be pushed up through the filter material causing the Filter Bed to expand and carrying away the particles in suspension.

4. PH Dosing System / Chlorinator

4.1 Chemical dosing should consist of electronic / electro mechanical metering pump with suction and delivery flexible connections and fittings. The pump shall be mounted on

HDPE tank of 100 ltr capacity having in-built basket for holding alumblocks and lime blocks. The system should be completed with electrically operated single phase motor driven stirrer having stainless steel shaft. This should be suitable for working against a pressure of 1.5 kg/Sq.cm and should be capable of ejecting Sodium Hypo-chloride solution with a dose of 1 ppm.

Indicative details of dosing system

Parts	Material
Head	CF8M
Suction & Discharge Valve Plug	SS-316
Ball	CERAMIC
Ring Seal	PTFE
Diaphragm	TEFLON FACED HYPALON
Pressure Relief Valve	SS-316
Anti-syphon Valve	SS-316
Suction Strainer	CF8M Y TYPE

10. CENTRIFUGE (SLUDGE DEWATERING MECHANISM)

10.1 The Centrifuge shall comprise of a rotating bowl, consisting of a feed pipe, a cylindrical section where the separation of the suspension takes place and a conical section where the scroll removes the dewatered sludge.

10.2 The Centrifuge shall be high efficiency type system for de-watering of sludge. The separation of the solid-liquid sludge suspension shall be accomplished using high bowl speeds and low scroll differential speeds at high scroll torques.

10.3 Provision shall be made for the feed suspension to enter the rotating feed compartment through the feed pipe. There it shall accelerate in the direction of rotation and enter the rotating bowl via feed ports. The settled solids shall be moved by the scroll to and through the conical section, at the end of which shall be discharged through the discharge ports of the bowl as dewatered solids / cake.

10.4 The liquid effluent shall be discharged from the bowl over adjustable weir plates at the feed end.

10.5 The rotating bowl shall be supported by the main bearings, mounted in pillow blocks, pinned to the base frame. The base frame shall be mounted on hollow rubber buffers. Lubrication of the main bearings and the scroll bearing shall be done by grease lubrication.

10.6 The dried sludge from centrifuge shall be made available as a fertilizer for utilizing for horticultural purposes within the site and excess, if any, to be carted away from the site premises by Contractor at his own cost until Operation & Maintenance period end. Output Filtrate from centrifuge may be disposed back into the equalization tank.

10.7 The centrifuge complete with VFD Control panel.

11. UV DISINFECTION SYSTEM: As per approved design

12. BIO- MEDIA FOR MBBR & SECONDARY SETTLING TANK

12.1 The Bio-Media shall be in PVC/PP/ suitable plastic media, having shape and design such that there is uniform and continuous distribution of air and water throughout with self supporting shape.
12.2 The surface area shall be for effective attached growth of bacteria & shall increases the contact time of waste water within media, providing high efficiency with minimum recirculation.
12.3 The media shall have low resistance to air flow to provide better aeration & shall have excellent wetting so that there should be zero fly nuisance.

13. PIPING

13.1 G.I. Pipes confirming to I.S:1239 upto 150mm nominal bore and as per I.S:3589 for 200mm nominal bore and above to be used in the STP. Galvanizing shall conform to IS 4736 and IS 2629. Pipes and fittings shall be jointed with screwed/flanged joints, flanges shall be either screwed or welded complete and jointed with 3mm thick rubber gasket as per requirements complete with nuts, bolts and washers etc. All Fittings shall be new and from approved manufacturers, Fittings shall be of malleable iron galvanized of pressure ratings suitable for the piping system. Fitting for G.I. pipes shall include couplings, bends, tees, reducers, nipples, unions, bushes, puddle flanges etc.
13.2 UPVC pipes being used for the airlines shall be un-plasticized Polyvinyl chloride pipe, confirming to IS: 4985.
13.3 All metal pipes should have high corrosion resistance and should be immune to chemical, electrolytic and galvanic action. These pipes should be long lasting as it would be corrosion prone.
13.4 Pipes should be kept on an even surface while storing. They should be properly supported and should not be stacked for heights more than 1.5 meters for longer duration.
13.5 For the connection of PVC pipe to metal pipes, a piece of special thick wall PVC connecting tube threaded at one end shall be used. The other end shall be connected to the normal PVC pipe by means of glued spigot and socket joint.
13.6 All piping shall be tested to hydrostatic test pressure of minimum 10 kg/cm² or 1.5 times the design pressure whichever is higher for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer-in-Chief.
13.7 They include cost of painting shall be given two finish coats of 150 micron each, of approved colour over and a coat of zinc chromate yellow primer. To measure the thickness of paint elcometre shall be provided by the contractor.
13.8 The direction of flow of all fluids in the pipes shall be visibly marked in white arrows or as directed by the Engineer-in-Chief.
13.9 Following table is indicative of the piping materials for different applications for the STP.

Table No. 7 – Piping Materials for Different Applications

Sl no	Type of pipe material	Class of pipe	Installation	Remarks
1	GI	Heavy duty Call C	Installed for all suction & Delivery of clear water supply pumps, and air lines wherever required.	Dia. of pipe shall be as per

2	UPVC	6 kg/cm2 as per IS 4985	Use for Air supply lines & Raw Sewage wherever required.	approved design
3	CI	LA class/as per IS 3989	Use for Raw Sewage & Sludge Transfer etc	
4	RCC PIPES	NP3	External Drainage / Sewerage within STP Site Area	

14. VALVES

14.1 Sluice / Gate Valves

Sluice Valves above 50 mm (inside screw and non-raising screw type) shall be of Cast Iron body and Gunmetal seat with double flanged ends and valve wheel. They shall conform to type PN 1.6 of IS:780. Sluice valves upto 50mm (outside screw raising spindle type) shall be of Gunmetal Full way Valve with wheel tested to 20 Kg./cm2 class-II as per I.S: 778 with female screwed ends. Valve wheels shall be of right hand type and have an arrow head engraved or cast thereon showing the direction for turning open and close. Wherever necessary, suitable chamber of required depth shall be provided, and in case of deep location of sluice valve, necessary key/level/extension rod shall be provided for operation.

14.2 Butterfly Valves

14.2.1 The Butterfly Valve shall be suitable for wastewater / waterworks. The Valves conforming to IS: 13095 shall be provided. All valves shall be suitable to withstand the pressure in the system and rating shall be PN 1.6. All valves shall be right handed (i.e. handle or key shall be rotated clock wise to close the valve).

14.2.2 The direction of opening and closing shall be marked and an open / shut indicator fitted.

14.2.3 The material of valves shall be as under:

a) Body - Cast iron

b) Style of disk - Wafer end type

c) Disc - Ductile Iron

d) Seat - EPDM / nitrile rubber

e) Shaft - Stainless Steel

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

14.3 Non-Return Valve

Non-return valves shall be of Cast Iron body ball type and Stainless Steel seat for Sewage water handling up to clarified water tank. They shall conform to API-594 and

have companion flanges. They shall be Stainless steel Dual Plate Type for Clear water suitable for both horizontal and vertical installation. An arrow mark in the direction of flow shall be marked on the body of the valve.

14.4 Ball Valve

14.4.1 The Ball Valve of size below 50 mm dia shall be made from forged brass and tested to 20 Kg/ cm² pressure. The valve shall be internally threaded to receive pipe connections.

14.4.2 The Ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body bonnet gasket and gland packing shall be of Teflon.

14.4.3 The handle shall be of chrome plated steel with PVC jacket. The handle shall also indicate the direction of 'open' and 'closed' situations. The gap between the ball and the Teflon packing shall be sealed to prevent water seeping upto 14 Kg / cm² pressure.

14.4.4 The handle shall also be provided with a lug to keep the movement of the ball valve within 90 degree.

14.5 Strainer

14.5.1 Strainers shall be of the approved type with SS body with SS304 Strainer Basket designed to the test pressure of 10 Kg/ cm². Strainers shall be fabricated with minimum 1.2mm thick stainless steel sheet with 3 mm dia. perforation holes. Strainers shall be provided with flanges or threaded sockets as required. They shall be designed so as to enable blowing out accumulated dirt and facilitate removal and replacement of screen without disconnection of the main pipe.]

14.6 Pressure Gauges

14.6.1 Pressure gauges shall be of 150mm dia. dial and of 0 to 10 Kgs / Sq. cm. and be complete with shut off gauge valve etc. duly calibrated before installation. Diaphragm seal type Pressure Gauges shall be provided with proper isolation valves. Flow meters shall also be provided with isolation valves and by-pass arrangement to enable of maintenance of the flow meter as and when required Care shall be taken toprotect pressure gauges during pressure testing.

14.7 Flexible Connection for Pumps

14.7.1 All suction and delivery lines shall be provided with double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure 0 to 10 Kgs / Sq. cm. of each pump. Length of the connector shall be as per manufacturer's details.

15. INSTALLATION

15.1 Pump shall be installed as per manufacturer's recommendations. Pump sets shall be mounted on machinery isolation cork or any other equivalent vibration isolation fitting. The vibration isolation pads, foundation bolts etc. shall be supplied by the Contractor. Contractor shall ensure that the foundation bolts are correctly embedded and providing 1:2:4 cement concrete foundation.

15.2 Pump-sets shall preferably be factory aligned, wherever necessary, site alignment shall be done by competent persons.

16. TESTING

16.1 The contractor shall submit the performance curves of the pumps supplied by them.They shall also check the capacity and total head requirements of each pump to match his own piping and equipment layout. On completion of the entire installation, pumps shall be tested, wherever possible, for their discharge, head, flow rate, B.H.P. Where it is not possible at least the discharge, head and B.H.P. (as measured on the input side) shall be field tested. Test results shall correspond to the performance curves.

17. PAINTING

17.1 After complete installation and testing, pumps accessories and fittings shall be given two coats, 75 microns each of approved color synthetic enamel paint.

18. ELECTRICAL CONTROL PANEL

18.1 Motor Control System

The main switchboard shall be floor mounted, free standing, cubical type, compartmentalized and shall be factory built fabricated as per list of approved make fabricators. The board shall be fabricated from 2mm thick CRCA sheet and powder coated after seven tank process. The board shall be fabricated with IP 54 degree of protection suitable for operation of 415 volt ± 10%, 3 phase, 4 wire, 50Hz, AC supply. The switch board shall have provision for termination of cables from top as well as bottom with suitable knockouts. The layout shall be designed for convenientconnections and inter-connections with various switchgears. Connections from individual compartments to cable alleys shall be such as not to shut down healthy circuits in the event of maintenance work becoming necessary on a defective circuit. A base channel of 75mm x 5mm thick shall be provided at the bottom. A maximum of 200mm space between the floor and bottom most panel of unit shall be provided. The bus bar shall be of aluminium complete with heat shrinkable PVC sleeves. The fabrication of switch board shall be taken up only after the drawings for the fabrication of the same are approved by the Engineer –in – chief.

Control panel shall contain starters and safety protection for different types of pump motors & various feeders along with its controls. It shall also house the switchgears for incoming as well for outgoings supply. Provision of voltmeter (for incomer) & ammeter for incomer as well as for other feeders with selector switch, a set of LED indicating light for incoming phases as well as status indication of each equipment. The voltmeter & indication lamps shall be protected by MCBs. The feeders for all those motors having more than 7.5 HP capacity shall be provided with fully automatic Star Delta starters with motor duty MCCBs for short circuit protection only (ICS = 100% ICU)& Overload Relays with contactors of suitable range & ratings, for overload protection, while less than or equal to 7.5 HP motor shall have Motor protection circuit breaker(MPCB) with suitable rating contactor. Single phase preventers shall be provided for all 3 phase motors. Single phase preventer shall be in conformity with relevant ISI standards. Single phase preventers shall act when the supply voltage drops down to 90 % of the rated voltage or failure of one or more phases. Single phase preventer shall be voltage operated and of approved make.

Other feeders of the panel which don't require starter shall be housed with:

a) MCCB with Thermal magnetic release & should provide adjustable setting for overload and short circuit protection with ICS = 100% ICU.

b) MCB used for controlling shall be with tripping characteristics of C curve. The miniature circuit breakers shall be 1/2/3/4 pole as per requirement. The breaking capacity of MCBs shall have minimum 10KA.

ON-OFF switches for each motor / equipment should not be provided on the cover of the control panel. But at the same time interlocking shall be provided between switch and the door in such a way that the door of the panel cannot be opened when the supply is ON.

The panel shall be provided all identification tags, danger board etc as per IS standard.

All control panels shall be provided with detailed control circuit diagram indicating the terminal numbers and color coding of the wires used in the panels. This diagram shall be pasted on the inner side of the cover and protected with PVC transparent lamination.

All MCCBs / MPCB's shall be equipped with extended front operated rotary handles on the doors. Rotary handle should have provision for pad lock.

Outgoing from each of the MCCB shall be extended to the cable alley by providing necessary busbar of suitable rating and supports etc. for terminating the outgoing feeders.

The detailed specification of switch gears and other accessories shall follow as described in electrical package of tender specifications.

All dosing tanks and process tanks/sumps shall be provided with level indicators/switches for low and high level alarm as well as for dry run protection, indications of which shall be provided in the main Electrical Control Panel.

19. POWER / CONTROL CABLING

Contractor shall provide all power /control cables from the motor control centre to various motors, level controllers and other control devices. All power cables shall be copper conductor XLPE insulated, armoured and PVC sheathed. Therefore all control cables shall be of copper conductor, PVC insulated, armoured and PVC sheathed. All cables shall have stranded conductors of 1100 Volt grade. The cables shall be in drums as far as possible and bear manufacturer's name. Specification of cable laying shall be followed as per latest CPWD Specifications. Cables and wires in conduits shall be laid on the metallic trays.

20. CABLE TRAYS

Cable trays shall be in galvanized steel construction. All other aspects shall conform with the specification as per latest CPWD Specifications. Galvanizing shall be as per the IS 2629.]

21. EARTHING

21.1 Main Electrical power upto the Electrical panel(s) in Pump Room shall be provided by the contractor.
21.2 All three phase motors / equipment shall be earthed with two independent earth conductors as per the requirement of Indian Electricity Rules and Regulation - 1956.

21.3 Earthing specifications shall be as per latest CPWD Specifications.]

22. INSTRUMENTATION & LABORATORY EQUIPMENT

Work under this section shall consist of providing detailed design, materials, labour and equipment for all Instrumentation and testing apparatus for laboratory.

23. GENERAL

23.1 Contractor shall provide, install and commission instrumentation system / equipments for the proper and efficient functioning of the Sewage Treatment Plant.
23.2 Contractor shall be fully responsible for design, sizing and selection of the proper instruments for the system.
23.3 All equipments supplied shall be approved both with respect to design and materials. No prototype instrument or instrument of an experimental nature shall be offered or supplied.
23.4 No instrument requiring special maintenance or operating facilities shall be offered or supplied as far as possible.
23.5 Contractor shall prepare and submit a P & I (Process & Instrumentation) Diagram for the system within the scope of his supply, showing all the instruments and interlock/trip operations. Each instrument shall be given individual tag numbers from blocks of numbers allotted by the purchaser.
23.6 All instrument design shall be intrinsically safe wherever applicable.
23.7 All instruments and equipment shall be suitable for use in a hot, humid and tropical industrial climate (in which corrosive gases and/or chemicals may be present).
23.8 All the panel-mounted instruments i.e. indicators, recorders, controllers etc shall be provided as per approved technical data sheets to be submitted by the Contractor.
23.9 All the controllers shall be single loop dedicated controllers. All the recorders shall be 3-pin type.
23.10 The contractor shall submit to the Engineer-in-Chief the Technical Specifications for all instruments supplied giving manufacturers name, model number etc. Instrument specification must include process data, minimum/normal/maximum values or variable and all information required to define instrument specification and application.
23.11 Electronic instruments shall generally operate on 220v, 50 Hz and shall have transmission and output signal generally of 4 to 20 mA DC. Transmitters shall be two wire and shall be capable of delivering rated current into external load of at least 600 ohms when powered with 24v DC.

23.12 All receivers shall be suitable for voltage input of 1 to 5 V or 0.25 to 1.25 V DC
23.13 All electronic instruments shall be immune to Radio interference.

24. TESTING & MONITORING SYSTEM

24.1 The scope of work includes establishing fully equipped in-house Testing Laboratory at the STP so as to perform regular testing and monitoring of the quality of the incoming raw effluent, as well as the treated effluent from the various main components/stages of the sewage treatment plants. The monitoring system shall ensure that a strict vigilance may be kept on the functioning of the plant and to enable smooth operation & maintenance of the plant.

24.2 Parameters to be Monitored

24.2.1 Physical:

a) pH
b) Colour&Odour (Indicative only)
c) Turbidity
d) Total Suspended Solids

24.2.2 Chemical:
a) Chemical Oxygen Demand
b) Oil & Grease
c) MLSS
d) MLVSS
e) F/M Ratio

24.2.3 Biological:

a) Biochemical Oxygen Demand

24.2.4 Microbiological:
a) Coliform
b) E. Coli
c) Total Plate Count
d) Faecal Coliforms

24.3 Protocols & Frequency of Tests to be followed

SL NO	Parameters	Protocol of analysis	In house testing	External lab testing
i	PH	B.I.S. Codes / CPCB Norms / American Public Health Association (APHA) (Electrometric Method)	Daily	Monthly
ii	Total suspended Solid	B.I.S. Codes / CPCB Norms / American Public Health Association (APHA)	Daily	Monthly
iii	Chemical oxygen demand	B.I.S. Codes / CPCB Norms / American Public Health Association (APHA) (Open Reflux Method)	Weekly	Monthly

iv	Oil and Grease	B.I.S. Codes / CPCB Norms / American Public Health Association (APHA) (Partition Gravimetric Method)	Weekly	Monthly
v	MLSS	In house	Daily	Not required
vi	MLVSS	In house	Daily	Not required
vii	F/M ratio	In house	Daily	Not required
viii	Biochemical Oxygen demand	B.I.S. Codes / CPCB Norms / American Public Health Association (APHA)	Weekly	Monthly
ix	Microbiological Examination	Bureau of Indian Standards	Weekly	Monthly
Note: Provisions of BIS will prevail wherever available.				

24.4 Equipment & Apparatus required shall be as specified in the tender document.

25. CHEMICALS REQUIRED FOR O&M

Following is an indicative list of the different type of chemicals / consumables required and are not exhaustive. Contractor shall provide all necessary chemicals/consumables during operation and maintenance and submit the list of the same for approval. He shall maintain stock register of all chemicals/consumables and up-date the same on daily basis:

a) Sulfuric Acid
b) Hydrochloric Acid
c) Petroleum Ether
d) Sodium Hydroxide
e) Potassium Hydroxide
f) Potassium Dichromate
g) Glucose and Glutamic Acid
h) Magnesium Sulphate
i) Sodium Iodide
j) Potassium Iodide
k) Mercuric Sulfate
l) Ferrous Ammonium Sulphate
m) Silver Sulphate
n) Potassium Hydrogen Phthalate
o) Sulphonilic
p) Sodium Sulphate Anhydrous
q) Trichlorotrifluoroethane
r) Sodium Azide
s) Starch
t) Salicylic Acid
u) Potassium Bi-iodate
v) Sodium Thiosulphate

w) pH buffer Solution
x) Chlorine
y) Polymer
z) Distilled water

26. COMMISSIONING OF THE SEWAGE TREATMENT PLANTS

26.1 After successful testing of the different items in parts, the Contractor shall provide all facilities including necessary piping, labor, tools and equipments etc. for carrying out testing and commissioning of the entire treatment plant complete as per requirement in the presence of Engineer-in-Chief or his representative whenever and as may be required. Contractor shall carry out the Operation & Maintenance of Sewage Treatment Plant during trial run/ start-up/ stabilization upto complete stabilization of the plant indicating satisfactory performance of the plant for a continuous period of two weeks as per approved work-wise schedule based on which successful commissioning of the system shall be considered. Supply of as-built drawings (3 sets) after completion, O&M Manual, Catalogues, Guarantee & Warrantee Cards etc., shall also be prepared and submitted by the contractor as a part of successful commissioning.

26.2 Sewage Treatment Plant shall be handed over as per the approved schedules of completion.

27. EQUIPMENT FOR REMOVAL OF SCREENING ETC.

27.1 The following equipment shall be supplied by contractor for removal and transportation of screening, girt, sludge a solid waste from STP structure to collection point.

a) Sludge trolley in Galvanized Steel with minimum dimensions of 950 mm x 600 mm x 500 mm depth (minimum sheet thickness 2.0 mm) with handle and wheel barrow for transport of sludge complete as per requirements as specified.
b) Folding Aluminum ladder of height 10 feet made up of aluminum side 'C' section of size 66.6 mm x 31.8 mm with steps made up of 25.4 mm dia and non slipperychequered pipe.

28. ABBREVIATIONS USED

(i) W : Working
(ii) S : Standby
(iii) Nos. : Numbers
(iv) Min. : Minimum
(v) LPM : Liters per Minute
(vi) LPH : Liters per Hour
(vii) M3/hour : Cubic Meters per Hour
(viii) mm : Millimeters
(ix) ppm : Parts per million
(x) EIC : Engineer-in-Charge

SCOPE OF WORKS & TECHNICAL REQUIREMENTS FOR MBBR BASED STP PREAMBLE

The provisions contained in this document are to be read in conjunction with the Bill of quantities and tender drawing as contained in this tender document.

The Contractor shall execute the work of STP in compliance with the technical specifications and requirements contained in the contract, codes of practices as published by the Bureau of Indian Standard (BIS) or its equivalent standard aswell as "Manual on Sewerage and Sewage Treatment" as published by the Central Public Health and Environment Engineering Organization (CPHEEO) of the Ministry of Urban Development, Government of India, New Delhi. Wherever, the codes, standards and manual not provide for the design and execution of some component i.e. required to be designed and executed, the Contractor shall follow the standard engineering practices or as directed by EIC. The Technical Standards and Specifications contained in this contract shall be read along with the indicative conceptual drawings enclosed with the tender document and also with the following standard specifications (latest versions) published by the Bureau of Indian Standard listed below (The list is not exhaustive and the Contractor shall be responsible to follow the appropriate standards):

i. IS 6280:1971- Specification for Sewage Screens
ii. IS 8413 :1982 - Requirements for Biological Treatment Equipment– Part II and its modifications (Activated Sludge Process and its modifications)
iii. IS 10037 – Part I– 1981 Requirements for Sludge Dewatering Equipments: Sludge Drying Beds Sand, Gravel and Under drains & Part II & III– 1983 – Sludge dewatering equipment
iv. IS 10261 – Requirements for settling tank (Clarifier Equipment) for waste water treatment
v. IS 105533 – Part I, II, III–Chlorination Plants
vi. IS 5600 – 2002 Pumps: Sewage and Drainage -Specification
vii. IS 6279 – 1971 –Specification for equipment for Grit Removal devices

The Contractor shall be responsible for any discrepancies, errors or omissions in the specifications, drawings and other technical documents, desired output / performance of the STP, whether specifications, drawings and other documents have been approved by the Engineer-in-Charge or not, provided that such discrepancies, errors or omissions are not because of inaccurate information furnished in writing to the Contractor by Engineer-in-Charge.

The proposed work consists of the complete Design, Supply, Installation, Testing & Commissioning, Handing over after successful commissioning of the system. It is the responsibility of the successful contractor that the desired effluent characteristics specified elsewhere in the document are met with from the STP executed and commissioned by him and same to approved by the Pollution control board.

1.1 Scope of work under this contract:

1.1.1 The scope of execution of electro-mechanical works only of MBBR technology as per scope of this tender document shall be as per the following details:**STP:25 KLD (Underground)**

1.1.2 The contractor shall be fully responsible for the final quality of treated effluent and getting final certifications from the Engineer-in-Charge & all the relevant Government & Environmental Authorities as applicable.

1.1.3 Basic scheme for Sewage Treatment and disposal is enclosed consisting of concept layout and schematic diagrams for which the bidder has to work out the detailed design for quoting. The bidder is required to furnish the Technical Schedules duly filled-in.

1.2 Generally, but not limited to the following, the main activities that are expected from the Contractor are listed below in a sequential manner:

1.2.1 Planning and design: The Contractor shall submit nine (9) sets of design & shop drawings for the entire Sewage Treatment Plant(s). The working drawings shall be got vetted by the contractor from EIC with-in 30 (Thirty) days of award of work. The Contractor shall then prepare and submit all required shop drawings for approval of Engineer-In-Charge before proceeding with the work. The complete design information along with the supporting design calculations, charts, single line diagrams, panel designs equipment layout etc. shall be submitted in both hard and soft formats. He shall also furnish all clarifications and explanations as may be desired by Engineer-In-Charge promptly for early finalization of the shop drawings. The work shall be executed as per approved shop drawings & technical submittals by the contractor.

1.2.2 Execution of civil works: The Civil work shall be got executed by the main civil Contractor as designated by the NBCC.

1.2.3 Execution of electrical works: Design, supply, installation, testing and commissioning of all electro-mechanical equipment as required for the satisfactory performance of the sewage treatment plant including all pumps, blowers, pipes, fittings, valves, panels, cabling, control system and other accessories to complete the works.

1.2.4 Operation & Maintenance: Operation and Maintenance with supply & consumption of all consumables, chemicals, etc. for satisfactory performance of STP, including maintenance of mechanical, electrical, pipes, fittings & other accessories for a period as specified and handing over to the Engineer-in-Charge in working condition.

1.2.5 Setting up of the testing laboratory at STP as per requirement mentioned under relevant clause

1.2.6 Obtaining successful periodic test results from Laboratory / Contractor recognized by the relevant local Pollution Authorities of Ropar or suitable testing Contractor as approved by the Engineer-in-Charge.

1.3 Codes/Standards to be followed for Designing are as follows (the list is indicative and not exhaustive):

a) Tolerance Limit as prescribed in IS: 2490 (Part I) – 1981 and environment (Protection) Rules 1986.
b) Water (Prevention and Control of Pollution) Act, 1974, 1977& 1978.
c) Environment (Protection) Act, 1986
d) Environment (Protection) Rules, 1986
e) Hazardous Wastes (Management Handling, and Trans boundary Movement)Rules, 2008
f) Manufacturer, Storage and Import of Hazardous Chemical Rules, 2000.
g) Manufacturer, use import and storage and Hazardous Micro-Organizers, Genetically Engineered organizations or Cell Rules, 1989.

h) Manual of sewage and sewage treatment CPHEEO.
i) The Public Liability Insurance Act, 1991.
j) All Standards as laid down by Central Pollution Control board and any other relevant statutory Authority.
k) 100% recycle of waste water and removed sludge with no water to be discharged outside the premises.
l) National Building Code 2016
m) CPWD Specifications 2009 volume I and II with latest correction slips for Civil Works
n) Energy Conservation and Building Code(ECBC)
o) Indian Electricity Rules and Regulations 1956

1. CIVIL DESIGN DATA

On the basis of GFC drawings issued by the department with soft copy, the Contractor shall prepare all their design calculations, detailed drawings for civil works, electro-mechanical and fabrication layouts, charts etc, for the entire Sewage Treatment Plant for approval by the Department, before proceeding with the work. The contractor shall be responsible for the complete design, supply & installation of all electro-mechanical components, design of all civil works, complete with commissioning of sewage treatment plant, start-up and obtaining satisfactory results from approved testing agencies, as per norms of the relevant Environmental Authorities. Supply of materials and Execution of the Civil Works shall be done by the main Civil Contractor as designated by the Department. The STP contractor shall however be completely responsible for the design of all components, structural details & supervision of civil works without any extra cost

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2. ACCESSIBILITY OF SITE

4.1 The site for STP(s) is shown in the conceptual drawings enclosed with the tender documents.

4.2 The internal roads, hardscaping and chain link fencing in the STP areas shall be provided by the client under different contract. If required, the contractor shall give un-hindered access to the Contractor providing the internal roads, hardscaping, chain link fencing or any other work during construction and O/M period of STPs on the instructions of EIC.

3. CONSTRUCTION MATERIAL AVAILABILITY

5.1 The Contractor shall be fully responsible for establishing the availability, procurement and transport of all materials, machinery, tools & plants and labourers as required for completing the entire scope of work.

4. INFLUENT CHARACTERISTICS

6.1 Type of Waste Water:

The influent is the product of the wastewaters from different activities such as:

i. Soil and waste water that comes from the toilets and bathroom faucets, baths, and showers etc.
ii. Oil, grease and food waste from kitchens & pantries etc.

6.2 Design Criteria

6.2.1 It shall be the Contractor's sole responsibility to ensure the quality of the treated Sewage to comply with the local Authorities requirement for the various applications and the following characteristics, whichever is stringent. The contractor should read the tender document carefully and understand the scope of work to be executed under present tender. It should be brought to his notice that complete design and drawings shall be made availiable to him along with tender document. The successful contractor should also be given the opportunity to suggest the modifications if required in the given design and drawings so that the desired effluent characteristics specified elsewhere in the document are met with from the STP executed and commissioned by him based on design and drawing supplied by the department.

6.2.2 Details

a) Daily Flow : As per design
b) Peak factor : As per degin
c) Expected peak flow : 3 times of normal flow/ as per design
d) Duration of flow to STP : 24 hours
e) Annual mean Max. : Max. 43OC
f) pH : 7.15 to 8.2
g) Colour : Mild
h) Total suspended solids (mg/l) : 250 to 350
i) BOD (mg/l) : 200 to 250
j) COD (mg/l) : 300 to 400
k) Oil & Grease : 10 - 50 mg/lit.

Desired Effluent Characteristics after Tertiary Treatment

a) pH : 6.5 to 9
b) Total suspended solids : < 20 mg/l
c) BOD : < 10 mg/l
d) COD : < 50 mg/l
e) Oil & Grease : <2mg/l
f) Phosphate (PO4) : <1 mg/l
g) NH4-N : <5 mg/l
h) N total : <10 mg/l
i) Fecal coliform(MPN/100ml) : <100
j)

It may clearly be understood that the Client intends to make re-use of treated effluent. The filtered water after above treatment shall be used for flushing in water closets/ urinals and irrigation purposes .The soft water obtained after the softening treatment shall be used for air conditioning system cooling tower makeup purposes. The water from the tertiary treatment only shall be re-used for above purposes. Hence, it is imperative that the contractor ensures that the effluent meets the specified parameters and is usable for above purposes.

5. SPACE AVAILABILITY

The following provisions are presently proposed for the construction of the Sewage Treatment Plant(s). However the details are subject to change as per the final planning, architectural approval and coordination, and at present should only be considered for guidance purpose. At the time of detailing, the contractor shall get approved the exact space and location from Engineer-in-Charge. The STP shall have to be accommodated at the finally designated area. The design shall be as per final architectural approval and final architectural planning requirements. The contractor shall provide the STP in the designated area .

6. PROPOSED LOCATION OF SEWAGE TREATMENT PLANT

8.1 The proposed location of the plants shall be as shown in the Site Plan drawings enclosed with tender document.

7. INFLUENT LEVELS

9.1 Influent levels given on the tender drawings are approximate and no extra payment shall be admissible for any change in the same. The influent will be received from the gravity outfall of the plant. The contractor shall, however, be permitted to revise levels of his plants to suit the new levels without any change in quoted price. The change in levels shall be permitted by EIC only on the basis of detailed technical justification to be submitted by the contractor.

8. TREATMENT PROCESS

10.1 The treatment process is aimed to convert the influent quality as mentioned above, into the required quality standards so that the treated effluent can be reused for non-potable use specified above. It is proposed to perform the treatment of the effluent by the biological aerobic process. The process is designed to induce the growth of bacteria, which by physical and physio-chemical action retain the organic pollution and live on it. This growth is obtained by putting a bacterial culture disposal as a flock in the aeration tank.

10.2 To have an efficient treatment system, this aeration system is proposed consisting of Moving Bed Bio film Reactor Tank.

9. PROCESS DESCRIPTION

11.1 Incoming Wastewater from Last Manhole should be collected through gravity pipes into the screen chamber. This manually cleaned screen should be provided to remove floating and big size particles

11.2 Manual cleaned bar screens will be installed to screen any large pieces. After screening, the waste water should be allowed to pass through a oil & grease trap to remove the grit material. The screens and grit chambers shall be accessible so that they may be manually cleaned from time to time.

11.3 The waste water from the OGT should then pass into the Equalization Tank. The design of Equalization tank should cater for the condition that the waste water generation may not be uniform and higher quantity may come out during peak hours.

There may be very low flow condition for few hours. To optimize the size of the plant, the plant design should cater for continuous operation and hence a buffer should be provided to store the waste water during its peak hour generation and supply the same during lean or no flow hours. The equalization tank is provided to homogenize the waste water quality and also even out flow fluctuations and feed waste water of uniform quality at constant rate to subsequent treatment units. Air mixing should be provided to mix the contents of the equalization tank. An aeration grid should be provided to mix the contents of the equalization tank and also to avoid septic conditions in the tank. From the equalization tank the wastewater will be pumped into anoxic tank forremoval of nitrogen & phosphorous through denitrification process in the absenceof oxygen. By-pass line shall be provided from the pumping system which shallonly be provisional for disposal of sewage to mobile sewage tanker foremergency purposes.From the anoxic tank the wastewater will be oveflowed into MBBR Tank.

11.4 The MBBR process uses small plastic carrier elements to provide growth sites for bacteria attachment in a suspended growth medium. The carrier elements shall allow a higher biomass concentration to be maintained in the reactor. This shall increase the biological treatment capacity for the given reactor volume.

11.5 The carrier elements shall be continuously kept in suspension by the aeration system. The agitation pattern in the reactor shall be designed to provide an upward movement of the carriers across the surface of the retention screen which creates a scrubbing effect to prevent clogging. Combination of fine & coarse bubbles may be provided to provide oxygen as per detailing.

11.6 From the MBBR tank mixed liquor shall flow by gravity into the secondary settling tank. The solids will settle in the tank. The sludge that settles down shall be transferred to sludge holding tank via sludge loading pumps, with provision of sludge return to the bioreactor if necessary.

11.7 From the settling tank, treated wastewater will flow into clarified water tank.

11.8 Treated water after CWT shall be clear, odorless, low BOD, low suspended solids, which shall be of quality which is acceptable as per standards prescribed by CPCB/Environmental norms for disposal directly into public/natural drain.

11.9 The treated water from Clarified water tank is fed by means of filter feed pump sets to pass through dual media filters, activated carbon filters and stored in the treated water tanks. The activated carbon filters shall ensure removal of all coloration and odours present in the treated effluent. Backwash of Filters and shall be done intermittently as per requirements. The filtered water being stored in the filtered water tank shall again be dosed with chlorine by a suitable chlorinator/Dosing system and a residual Chlorine level of 1 PPM shall be maintained.

11.10 The filtered, clean and odourless water from treated water tank is then fed through a variable frequency drive hydro-pneumatic system to the external treated effluent rings as per the masterplan, for flushing & irrigation system as per detailing.

11.11 The treated water from treated water tank is fed by means of softner feed pump sets to pass through softner and stored in the soft water tanks. The softened, clean and odourless water from soft water tank is then fed to HVAC cooling towers & DG set cooling ring mains by a variable frequency drive hydropneumatic system.

11.12 According to the guide lines of Ministry of Environment and Forest the UV system will be provided on the discharge point of treated effluent supply lines to ensure 100% pathogen free treated water for recycling and re-use. The UV system shall be provided as online installation on the treated water supply line being supplied to the external distribution ring.

11.13 Excess sludge from the settling tank will be taken periodically into sludge holding tank. In this tank sludge will be aerated for self-stabilization. Air will be shut off periodically and superannuate water will be transferred to the aeration tank creating stabilized sludge. The final sludge shall be de-watered through a centrifuge mechanism. Sludge loading arrangements shall also be provided for direct disposal of sludge to sludge tankers / trolleys.

10. MAIN ELECTRO-MECHANICAL COMPONENTS OF THE PLANT

12.1 Without restricting to the generality of the fore-going, the scope of work shall consist of design ,supply, erection, testing, commissioning and satisfactory handing over of all Electro-mechanical equipments and works for the satisfactory performance of the plant as per Technical Annexure, generally comprising of but not limited to:-

a) Bar Screen (coarse & Fine) with frame.
b) Air Blowers with motor and related accessories
c) Air diffusers.
d) Bio media for MBBR & secondary settling tank.
e) Submersible type Raw Sewage Relift pumps
f) Sludge Return / Relift pumps
g) Filter feed pump/Softner feed pump
h) Sludge Loading pump
i) Treated effluent pump such as for Flushing water, Garden hydrants water &softwater pump
j) Dual Media filter, Activated Carbon Filter &softner.
k) PH dosing system.
l) Ozonator.
m) Centrifuge / Sludge handling Mechanism.
n) Submersible type Drainage sump pumps with SS 304 guide rail and SS 304 chain for STP plant room area.
o) UV for supply for treated water line.
p) All pipelines with necessary accessories and valves.
q) Motor control center complete with all internal wiring and accessories, Electrical cables from M.C.C panel to all electric motors and units, level indicators/switches for low and high level alarm for all tanks, sumps as well as for dry run protection of pumps.
r) Instrumentation Equipments and Laboratory apparatus.
s) Agitator for Anoxic tank.

12.2 12.2 All units shall be as shown on the tender drawings and as per the relevant Technical Annexures. These are enclosed for guidance of the bidder. The contractor shall work out detailed layout and flow scheme with levels. The contractor may suggest minor changes in the proposed flow scheme, ensuring that the basic design data and the treatment process /methodology conform to these tender stipulations. The Contractor shall prepare and submit all design calculations, documents and detailed drawings as mentioned above. Contractor shall verify/check all levels and

other information given in the tender/drawings. No extra payment shall be admissible on account of any variation in levels or other site data.

12.3 The contractor shall own responsibility for the specified characteristics of the final effluent and shall make appropriate addition/alterations to the equipment or plant,if the same fails to meet the required standards, without any extra cost. These additions/ alterations shall be made after obtaining approval of EIC.

12.4 Construction of all elements of the plant unless otherwise specified including,internal& external lighting, and finishing work as per requirement, within the battery limits as per the site plan / master plan.

12.5 Interconnecting piping between all units, valves, gates and all other appurtenances and devices as required.

12.6 All mechanical / fabricated equipment shall be duly protected against corrosion.

13. DETAILED INFORMATION TO BE SUBMITTED ON AWARD OF WORK

13.1 A detailed working program showing events of execution, procurement of electromechanical equipment, deployment of staff etc. shall be submitted within one week of award of work and shall be got approved by EIC. Contractor shall submit nine (9) sets of detailed shop drawings of related works.

13.2 The Contractor shall furnish all process, hydraulic calculations and related working drawings and got vetted by EIC at the Contractor's own cost and nothing extra shall be payable for vetting charges and associated incidental charges. The vetted drawings in nine sets and the design information in duplicate in both hard and soft format shall be submitted to the EIC for final approval for execution. The whole process shall be completed within 60 days of award of work.

13.3 All structures and civil works shall be designed based on information given in this document and shall be subject to strict architectural control. The specifications, shape, layout and external finishes shall be as per the prior approval of the Engineer-in-Charge.

13.4 All Hydraulic Calculations for the different components of the plant.

13.5 All technical submittals and data sheets required related to the electromechanical components of the plants including manufacturer drawings, single line diagrams, Hydraulic Flow Diagrams, Process & Instrumentation drawings etc. and shall be got approved by EIC.

13.6 All Quality Assurance Plans, Method Statements, Construction schedules and CPM/PERT Chart, safety plans etc. and any other document for approval with in specified time as specified by the Engineer – in – Charge.

SECTION –XIII WATER SUPPLY PUMPS, EQUIPMENTS, WATER TREATMENT

I SCOPE

Pumps & Water Treatment Equipment

Work under this sub-head consists of furnishing all labour, with appropriate T&P scaffolding & staging as required to completely install pumping system for various water supply services and water treatment as per drawings.

Without restricting to the generality of the foregoing, the work of pumps and water treatment equipment shall include the followings:

i. Filter Feed/ Raw Water pumps
ii. Domestic water pump hydro-pneumatic cyclic pattern for supply to Overhead tank.
iii. Sump pumps for disposal of Drainage from Plant Room
iv. Water treatment units consisting of Pressure Sand Filters, Softener, chemical dosing pumps, and related equipment and accessories etc.
v. Controller & Indication System for Tanks & Pumps
vi. Centralized R.O. System for Hotel and other areas as per requirements.
vii. Pipes, valves, accessories, hangers, supports, delivery and suction feeders and connection to proposed pipe work.

Successful Bidder should submit water test quality report before designing the WTP shall accommodate without any price implication.

Successful Bidder shall submit warrantee & guarantee certificates of WTP Electro – mechanical equipments.

1. MATERIAL

1.1 Clear water pump

1.1.1 Water supply pumps shall be suitable for clean water. Pumps shall be multistage, Inline vertical, centrifugal pumps with SS/CI casing, stainless steel impeller, stainless steel shaft, CI base with CED coating and directly coupled with TEFC induction motor of class "F" insulation & efficiency class IE-2, 2900 RPM, IP 55 enclosure, suitable for operation on 415 volts ±10%, 3 phase, 50 Hz, A.C. supply.Each pump should operate at specific duty point of max. efficiency. Tenderersshall select their drivers within 10% to 15% in excess of the maximum B.H.P ofthe pump plus transmission losses if any.

1.1.2 Pump and motor shall be mounted on a common M.S. structural or C.I. baseplate or as required as per site conditions.

1.1.3 Each pumping set shall be provided with a 150mm dia or of suitable size gunmetal “Burden” type pressure gauge with gunmetal isolation cock and connecting piping.

1.1.4 Provide vibration-eliminating pads appropriate for each pump.

1.1.5 Provide vibration eliminators/expansion joints on suction and Discharge side of the Pump and wherever required.

1.1.6 Provide rate of flow measuring meter with bypass arrangement with every set of pumps as shown on the drawings.

1.1.7 All water supply pumps shall be provided with mechanical seals of required specifications.

2 HYDRO-PNEUMATIC SYSTEMS

2.1 Hydro pneumatic systems (With Variable Frequency Drive)

2.1.1 The scope of this section covers supply, installation, testing and commissioning of compact packaged type skid mounted, self-contained variable frequency drive hydro

pneumatic system. The skid mounted, factory assembled hydro-pneumatic system shall be provided with pressure transmitters, frequency convertor for noiseless operation of the pump at varying duty point. The convertor shall be provided with short circuit safety, earthing, over current, under voltage protection.

The pump shall be complete with suction and delivery pipe. The system shall comprise of multiple pumps working and one stand-by to meet the system discharge requirements.

2.1.2 It shall conform to the following specifications:

a. Pumps shall be vertical, inline multistage centrifugal and fulfills all specifications as specified in the Clear water pump section.
b. Pressure vessel shall be of non corrosive FRP composite construction lined with NSF and /or FDA listed material, like high density polyethylene with fully replaceable polyurethane. Air cell burst pressure of minimum of five times the vessel operating pressure and cycle tested for 80,000 cycles with charging connections to discharge pipe line with necessary flanges, gaskets, isolating valve, nuts/ bolts etc. with suitable foundation bolts & other accessories, complete. Capacity provided shall be as per manufacture specifications.
c. Panel mounted microprocessor multi pump controller with large graphical /digital display and variable frequency drive (VFD) mounted inside a panel complete with pressure sensor transmitter. The graphical /digital display is capable to show number of pumps running & also communicate with other controllers following with open protocol through RS485 port. System should be capable to compensate for frictional losses at lower flows. All alarms should be displayed in the controller. The panel should also have provision for manual / automatic alternate (cyclic) operation of pumps, ON/OFF switch, dry run protection, inter connecting power and control cabling etc complete.

2.1.3 CONTROL PANEL (FOR HYDRO-PNEUMATIC SYSTEMS)

The control panel shall have terminals for:

- Remote monitoring.
- Pump fault.
- Analog output signal for frequency convertor

In case of VFD operated Hydro-pneumatic systems).

- Pressure sensor / Pressure switches as per system requirement.

2.1.4 GENERAL

The hydro pneumatic system shall be capable of maintaining a constant pressure at varied consumption. The hydro pneumatic system shall be complete with pressure sensor and microprocessor based controller for flow control by means of frequency variation (in case of VFD operated system). The controller should have time control switch to adapt pump operation to actual requirement in peak load situation. The control panel should also have manual operation.

The pumping system shall perform the following functions:

- Shut off the pump at zero demand.
- Shut off the pump at zero suction(Dry Run protection)

- Protect the pump from overvoltage, under voltage, overload & earth fault.
- Vary the time of pump speed acceleration and deceleration
- (For VFD operated Hydro pneumatic system).
- Compensate for higher friction losses at high flow rates.
- Send out a signal for remote monitoring of flow as well as pressure.
- Conduct automatic test run of pumps at set times.
- Keep track of run time for pumps.
- Perform run time equalization of all pumps in system.

2.1.5 INSTALLATION

Hydro pneumatic systems shall be mounted on a common base frame & installed as per manufacturer's recommendations. Pump sets shall be mounted on machinery isolation cork or any other equivalent vibration isolation fitting. The vibration isolation pads, foundation bolts etc. shall be supplied by the Contractor. Contractor shall ensure that the foundation bolts are correctly embedded.

Pump-sets shall be factory aligned, wherever necessary, site alignment shall be done by competent persons. The entire system along with pumps & control panel must be sourced from single manufacturer only for unit responsibility.

3 Pressure sand Filters

3.1 Water filter shall be of dual media pressure filter (comprising of minimum 300mm bed depth of Anthracite and support media and minimum Height on Straight 1500mm) of downward or upward flow type suitable for a rate of filtration.

3.2 Filter shall be vertical type of required diameter. The shell shall be fabricated from M.S. plate suitable to withstand a working pressure of 3 Kg/cm2. The minimum thickness of shell will be 10 mm and dished ends shall be 12 mm. The quality of Steel shall be as per IS:2062 Grade B, thickness as per ASME Section 8. The filter shall have at least one pressure tight manhole cover.

3.3 Accessories

Each filter shall be provided with following accessories:-

a. Air release valve with connecting piping.
b. 150mm dia dial burden type gunmetal pressure gauges with gunmetal isolation cock and connecting piping on inlet and outlet.
c. SS Sampling cocks on raw water inlet and filtered water outlet.
d. Individual drain connection with gunmetal full way valve should be piped through a properly sized G.I. pipe to nearest drain point.

6. ELECTRICAL CONTROL PANEL

9.1 Motor Control System

The main switchboard shall be floor mounted, free standing, cubical type, compartmentalized and shall be factory built fabricated by CPRI approved fabricators. The board shall be fabricated from 2mm thick CRCA sheet and powder coated after

seven tank process. The board shall be fabricated with IP 54 degree of protection suitable for operation of 415 volt ± 10%, 3 phase, 4 wire, 50Hz, AC supply. The switch board shall have provision for termination of cables from top as well as bottom with suitable knockouts. The layout shall be designed for convenient connections and inter-connections with various switchgears. Connections from individual compartments to cable alleys shall be such as not to shut down healthy circuits in the event of maintenance work becoming necessary on a defective circuit. A base channel of 75mm x 5mm thick shall be provided at the bottom. A maximum of 200mm space between the floor and bottom most panel of unit shall be provided. The bus bar shall be of aluminium complete with

heat shrinkable PVC sleeves. The fabrication of switch board shall be taken up only after the drawings for the fabrication of the same are approved by theEngineer –in – Chief.

Control panel shall contain starters and safety protection for different types of pump motors & various feeders along with its controls. It shall also house the switchgears for incoming as well for outgoings supply. Provision of voltmeter (for incomer) & ammeter for incomer as well as for other feeders with selector switch, a set of LED indicating light for incoming phases as well as status indication of each equipment. The voltmeter & indication lamps shall be protected by MCBs.

The feeders for all those motors having more than 7.5 HP capacity shall be provided with fully automatic Star Delta starters with motor duty MCCBs for short circuit protection only (ICS = 100% ICU)& Overload Relays with contactors of suitable range & ratings, for overload protection, while less than or equal to 7.5 HP motor shall be provided with automatic DOL starters shall have Motor protection circuit breaker(MPCB) with suitable rating contactor. Single phase preventers shall be provided for all 3 phase motors. Single phase preventer shall be in conformity with relevant ISI standards. Single phase preventers shall act when the supply voltage drops down to 90 % of the rated voltage or failure of one or more phases. Single phase preventer shall be voltage operated and of approved make.

Other feeders of the panel which don't require starter shall be housed with:

a. MCCB with Thermal magnetic release & should provide adjustable setting for overload and short circuit protection with ICS = 100% ICU.
b. MCB used for controlling shall be with tripping characteristics of C curve. The miniature circuit breakers shall be 1/2/3/4 pole as per requirement. The breaking capacity of MCBs shall have minimum 10KA.

ON-OFF switches for each motor / equipment should not be provided on the cover of the control panel. But at the same time interlocking shall be provided between switch and the door in such a way that the door of the panel cannot be opened when the supply is ON.

The panel shall be provided all identification tags, danger board etc as per IS standard.

All control panels shall be provided with detailed control circuit diagram indicating the terminal numbers and color coding of the wires used in the panels. This diagram shall be pasted on the inner side of the cover and protected with PVC transparent lamination.

All MCCBs / MPCB's shall be equipped with extended front operated rotary handles on the doors. Rotary handle should have provision for pad lock.

Outgoing from each of the MCCB shall be extended to the cable alley by providing necessary busbar of suitable rating and supports etc. for terminating the outgoing feeders.

The detailed specification of switch gears and other accessories shall follow as described in electrical package of tender specifications.

All dosing tanks and process tanks/sumps shall be provided with level indicators/switches for low and high level alarm as well as for dry run protection, indications of which shall be provided in the main Electrical Control Panel.

7. PUMP MOTOR CONTROLLER CUM WATER LEVEL INDICATING PANEL

The Pressure Transducers shall be used for water level measurement, and it shall be convenient to mount on the water tanks. Hydrostatic pressure level sensors shall be submersible or externally mounted pressure sensors suitable for measuring the level of liquids in deep tanks or water in reservoirs. Level measurement shall be based on the pressure measurement principal, also referred to as hydrostatic tank gauging (HTG). It shall work on the principle that the difference between the two pressures (d/p) is equal to the height of the liquid

(h, in inches) multiplied by the specific gravity (SG) of the fluid.

d/p=h(SG)

Therefore, the Transducers reading will represent the tank level. These sensors sense increasing pressure with depth and because depth is proportional to Volume for a regular tank, the Volume of Water can be easily calculated using a PLC.

The Centralized PLC control panel shall be front operated, cubicle construction, wall mounted type, fabricated out of 1.6 mm thick CRCA Sheet, with hinged lockable doors, dust and vermin proof, powder coated of approved shade, interconnections, having, internal wiring, earth terminals, Top / Bottom control cable entry, numberings etc. comprises of touch-screen display board (Minimum Diagonal size 8") along with all accessories for complete Programmable logical

controls & indications, having necessary interlocks, Inputs/Outputs, required number of repeater amplifiers, all audio-visual alarms as per the requirements listed below i/c emergency stop push button on the panel etc. The panel shall have BMS compatible with open protocol.

Water level indicators and controllers: The hydrostatic pressure sensor (Water level indicator) is working on hydrostatic pressure measurement principle made of Stainless Steel for installation in storage tanks, and capable of providing 4 to 20 mA analog signal compatible with PLC signal inputs and all control outputs to

MCC panel (Plumbing/Water supply),for various water tanks as per the Drawing.

10.1 Power / Control Cabling

Contractor shall provide all power /control cables from the motor control centre to various motors, level controllers and other control devices. ,Cables and wires in conduits shall be laid on the metallic trays.]

10.2 Earthing

Main Electrical power upto the Electrical panel(s) in Pump Room shall be provided by other Contractor. All three phase motors / equipment shall be earthed with two independent earth conductors as per the requirement of Indian Electricity Rules and Regulation - 1956.

10.3 Commissioning

After successful testing of the different items in parts, the Contractor shall provide all facilities including necessary piping, labour, tools and equipments etc. for carrying out final commissioning of the entire water treatment plant complete as per requirement in the presence of Engineer-in-chief or his representative whenever and as may be required. Generally, the following test/inspection has to be carried out:

8. PIPES & JOINTING

Pipes for suction and delivery shall be galvanized steel pipes (heavy duty) confirming to I.S:1239 upto 150mm dia and as per I.S:3589 for dia 200mm and above or as specified.

11.1 Valves & Accessories

Sluice / Gate Valves

Sluice Valves above 65 mm (inside screw and non raising screw type) shall be of Cast Iron body and Gunmetal seat with double flanged ends and valve wheel. They shall conform to type PN 1.6 of IS:14846. Sluice valves upto 65mm (outside screw raising spindle type) shall be of Gunmetal Full way Valve with wheel tested to 20 to 25 Kg./cm2 class-II as per I.S: 778 with female screwed ends. Valve wheels shall be of right hand type and have an arrow head engraved or cast thereon showing the direction for turning open and close.

Butterfly Valves

The Butterfly Valve shall be suitable for waterworks. The Valves conforming to IS: 13095 shall be provided. All valves shall be suitable to withstand the pressure in the

system and rating shall be PN 20 to 25kg/cm3. All valves shall be right handed (i.e. handle or key shall be rotated clock wise to close the valve).

The direction of opening and closing shall be marked and an open / shut indicator fitted.

The material of valves shall be as under:-

Body - Cast iron
Disc - Ductile Iron
Seat - EPDM / nitrile rubber
Shaft - Stainless Steel

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

Non-Return Valve

Non-return valves shall be of Cast Iron body and Stainless Steel seat. They shall conform to IS:5312 and have companion flanges. They shall be Dual Plate Type suitable for both horizontal and vertical installation. An arrow mark in the direction of flow shall be marked on the body of the valve.

Ball Valve

The Ball Valve shall be made from forged brass and tested to 20 to 25 Kg/ cm^2 pressure. The valve shall be internally threaded to receive pipe connections.

The Ball shall be made from brass and machined to perfect round shape and.subsequently chrome plated. The seat of the valve body bonnet gasket and gland packing shall be of Teflon.

The handle shall be of chrome plated steel with PVC jacket. The handle shall also indicate the direction of ‘open’ and ‘closed’ situations. The gap between the ball and the teflon packing shall be sealed to prevent water seeping upto 20 Kg / cm^2 pressure.

The handle shall also be provided with a lug to keep the movement of the ball valve within 90 degree.

Strainer

Strainers shall be preferably of the approved type with fabricated steel bodies designed to the test pressure of 20 to 25 Kg/cm^2. Strainers shall be fabricated by minimum 1.2 mm thick stainless steel sheet with 3 mm dia. perforation holes. Strainers shall be provided with flanges or threaded sockets as required. They shall be designed so as to enable blowing out accumulated dirt and facilitate removal and replacement of screen without disconnection of the main pipe.

Pressure Gauges

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

Flexible Connection for Pumps

All suction and delivery lines shall be provided with double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump. Length of the connector shall be as per manufacturer's details.

11.2 Jointing

Galvanising shall conform to IS 4736. Pipes and fittings shall be jointed with screwed/flanged joints, flanges either screwed or welded complete and flanged joints with 3mm thick rubber gasket as per requirements complete with nuts, bolts and washers etc.

All Fittings shall be new and from reputed manufacturers, Fittings shall be of malleable iron galvanized of pressure ratings suitable for the piping system. Fitting for G.I. pipes shall include couplings, bends, tees, reducers, nipples, unions, bushes.

11.3 Installation

Piping layout shall take due care for expansion and contraction in pipes. All pipes using screwed fittings shall be accurately cut to the required sizes. Care shall be taken to remove burr from the end of the pipe after cutting by a round file. Genuine red lead with grumet and a few strands of fine hemp shall be applied and threaded in accordance with IS: 554. Open ends of the piping shall be locked as the pipe is installed to avoid entrance of foreign matter. Wherever reducers are to be made in horizontal runs, eccentric reducers shall be used if the piping is to drain freely, in other locations, concentric reducers may be used.

Drain shall be provided at all low points in the piping system and shall be of the following sizes:
Mains Drains
Upto 300mm dia 25mm dia
Over 300mm dia 40mm dia

Drains shall be provided with forged brass ball valve of equal size. Drains shall be piped through equal size G.I. pipe to the nearest drain or floor waste or as shown on the drawings. Piping shall be pitched towards drain points.

Piping installation shall be carried out with vibration elimination fittings wherever required.

9. TESTING

12.1 Pumps & Water Treatment Equipment

Tenderers shall submit the performance curves of the pumps supplied by them. They shall also check the capacity and total head requirements of each pump to match his own piping and equipment layout. On completion of the entire installation, pumps shall be tested, wherever possible, for their discharge, head, flow rate, B.H.P. Where it is

not possible at least the discharge, head and B.H.P. (as measured on the input side) shall be field tested. Test results shall correspond to the performance curves.

12.1.1 Painting

After complete installation and testing, pumps accessories and fittings shall be given two coats, three mils each of approved finishing paint.

12.2 Piping

All pipes, fittings and valves shall be tested by hydrostatic pressure of min. 1.5 times, the working pressure and subject to minimum of 10 kg/cm2 in any case and with the consent of Engineer-in-Chief.

Pressure shall be maintained for a period of at least two hours without appreciable drop in the pressure after fixing at site. A test register shall be maintained and all entries shall be signed and dated by Contractor(s) and Engineer.

12.2.1 Painting

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

SECTION XIV

SPECIFICATIONS FOR FALSE CEILING WORKS

MODULAR FALSE CEILING:

Materials shall be of the best-approved quality obtainable and they shall comply with the respective latest Standard Specifications. Samples of all materials shall be got approved before placing order and the approved sample shall be given to LIC, which will be displayed at site as a control sample.

If directed, materials shall be tested in any approved Testing Laboratory and the test certificate in original shall be submitted and the entire charges connected with testing including charges for repeated tests if ordered shall be borne by the Contractor. The Contractor without any extra cost shall provide all equipment and facilities for carrying out field tests on materials if asked by.

It shall be obligatory for the Contractor to furnish certificates, if demanded, from manufacturer or the material supplier that the work has been carried out by their material and as per their recommendations and specifications.

MINERAL FIBRE MODULAR FALSE CEILING SYSTEM TILES:

Modular false ceiling tiles shall be of the following material composition and specification of recommended make.

Size of the boards : 600 x 600 x **19/ 15mm**

Edge Style : Tegular suitable for 24 OR 15mm T grids

NRC : In the range of 0.55 - 0.65

Fire performance : Class O/ Class 1 as per BS 476

Relative humidity : In the range of 95%

Light Reflectance : Greater than - 83 %

Colour : White or to shade as approved.

Material Composition: Homogenous mineral fibre comprising slag wood, starch, clay, Guar Gum etc.

HYDRATED CALCIUM SILICATE & FIBRE MODULAR FALSE CEILING SYSTEM TILES:

Modular false ceiling tiles shall be of the following material composition and specification of recommended make:

Size of the boards : 600 x 600 x 15mm

Edge Style : Tegular suitable for 24 OR 15mm T grids

NRC : In the range of 0.10 - 0.50

Fire performance : Class O/ Class 1 as per BS 476

Relative humidity : In the range of 100%

Light Reflectance : Greater than - 85 %

Colour : White or to shade as approved.

Material Composition: Hydrated Calcium Silicate with reinforcing fibres and natural fibres with-out formaldehyde and other harmful toxic ingredients.

FIBER-CEMENT CEILING BOARD, THICKNESS, THICKNESS 3.2 MM,

Size of the boards :

- 0.32 x 60 x 240 cm.
- 0.32 x 600x 240 cm.
- 0.32 x 120 x 240 cm

Moisture Content :ASTM C 1185 Standard , ≤15%
Water Absorption: ASTM C 1185 Standard, ≤35%
Density: ASTM C 1185 Standard, 1350±50 kg./m3

SUSPENSION SYSTEM AND PROCEDURE OF WORKS:

Supply and installation of suspension grid system with main Tee and cross Tees to provide a stable suspension system for quick laying of acoustic ceiling tiles of nominal size 600 mm x 600 x 19/ 15 mm. The width of flange of all Tees shall be 15 mm as per the manufacturer's specification. The Tees shall be double webbed with **bake enamelled fascia cap** and all other exposed surfaces galvanised or suitably treated against corrosion. Free ends of tees shall be mounted with quick release high tensile spring steel clips to provide a plug-in positive-lock for easy removal without tools. Suspension points shall not exceed centre-to-centre distance of 1200 ~ 1250 mm and shall be professionally executed with twin 4-mm GI suspension rods and adjustable suspension clip of spring steel. The entire grid system shall be designed to bear a distributed load of minimum 18 kg/sqm.

GYPSUM FALSE CEILING WORKS

Design of grid layout shall be produced with co-ordinating suspension points in tandem with other service duct / cable tray layouts. The grid layout is to be superimposed on the ceiling service ducting / cabling layout and got approved.

SUSPENSION SYSTEM AND MATERIAL :

The false ceiling shall include providing and fixing GI perimeter channels of size 0.55 mm thick having one flange of 20 mm and another flange of 30 mm and web of 27 mm along the perimeter of the ceiling, screw fixed to brick wall/ partition with help of nylon sleeves and screws, at 610 mm centre to centre. The suspended GI intermediate channels of size 45 mm, 0.9mm thick with two flanges of 15 mm each from the soffit at 1220 mm centre to centre with ceiling angles with ceiling angle of width 25mm x 10mm x 0.55mm thick fixed to soffit with GI cleat and steel expansion fasteners. Ceiling section of 0.55 mm thick having web of 51.5 mm and two flanges of 26 mm each with lips of 10.5mm are then fixed to the intermediate channels with help of connecting clips and in direction perpendicular to the intermediate channel centres. The 12.5 mm tapered edge Gypboard (Confirming to IS-2095-1982) is then screw fixed to ceiling section with 25 mm dry wall screws at 230mm centre to centre. Screw fixing is done mechanically either with screwdriver or drilling machine with suitable attachment.

FINISHING :

The boards are to be joined and finished so as to have a flush look which includes finishing the tapered and square edges of the board with joining compound, fibre tape and two coats of primer suitable for Gypboard (As per the recommendations/ practice of India gypsum or equivalent). This includes providing the surface of false ceiling to be painted with approved quality of Plastic emulsion paint. The false ceiling surfaces shall be prepared to the satisfaction of LIC and shall be applied with two coats of primer, two coats of putty and touch up putty if required to achieve smooth finish. The surface shall be painted with two coats of**acrylic**emulsion paint of approved make to the satisfaction of LIC.

METAL CEILING SYSTEM :

The metallic ceiling shall have regular beveled /plain edge powder Coated aluminium / GI ceiling tiles In size 600mm x 600 mm x 0.6 mm &colour RAL 9003 white & having perforation of 1.8 dia circle with a backing of factory pressed black non woven tissue the epoxy powder coat should electro statically be applied in a controlled environment and then be baked to achieve the perfect fusion with the metal surface to be laid on to be exposed grid system 24mm comprising main runner, cross tees and wall angles. for installation to comprise intermediate channel of size 45mm x 0.55mm thick with two flanges of 15mm each suspended at 1200 mm clipped to spring runner, bracket and connectors for spring runners securely fixed to structure using GI soffit cleats fixed to ceiling with 6mm dia and 50mm long dash fasteners, 4mm GI adjustable rods with galvanized level clips spaced at 1200mm center to center along with the runner by approved suspension and bracket and connectors for spring runners. Wall angles 19mm x 22mm with clips to be secured to the wall at 450mm maximum center to the successful completion of the job to the satisfaction of the Engineer-in-charge. The rate shall be inclusive of making openings for light fittings, grills, diffusers, cut-outs, wastage and necessary hardware etc.

SECTION XV

TIMBER DOORS 1.

TIMBER DOORS, WINDOWS & VENTILATORS:

Doors, windows and ventilators etc., shall be in accordance with the drawings in every detail and all joiner's work shall be accurately set out, framed and finished in a proper workman like manner. Frames of doors, windows & ventilators, shutter styles and rails shall be of best solid wood of quality specified in the finishing schedule. The scantlings shall be accurately planed smooth. Rebates, rounding and mouldings shall be made **as shown on the drawings**. Patching or plugging of any kind shall not be allowed. Joints shall be simple, neat and strong. Framed joints shall be coated with suitable adhesive like glue or synthetic

resin approved by the Employer/Employers Representative or his representative before the frames are put together.

All mortise and tenon joints shall fit in fully and accurately without wedging or filling. The joints shall be pinned with hard wood or bamboo pins of 10mm to 12mm dia or rust resisting star shaped metal pins of 8mm diameter. All portions of timber abutting against or embedded in masonry or concrete shall be treated against termites by giving a coat of an approved wood preservative, for which no extra cost will be paid.

Putty shall not be used to cover any defects. All door frames shall have four holdfasts. Holdfasts shall be provided to the ventilators also. Holdfasts shall be M.S. flats bent to shape with fish tail and shall be fixed to frame with sufficient number of screws as directed. When door/window frames are to be fixed to RCC column or RCC wall, holdfasts shall be substituted by suitable arrangements such as coach screws, rawl bolts/grip bolts etc., to secure frames to RCC column or RCC wall as directed by LIC. The frame shall be fixed only after getting the approval of LIC.

1.1 PANELED SHUTTERS:

a) Panels shall be of pattern and size **as shown in the drawings** or as directed by LIC. Solid wood panels shall be in one piece wherever possible. Panels shall be framed into grooves made in styles and rails to the full depth of groove.

b) Partly panelled and partly glazed shutter shall be similar to panelled shutters except that such parts as are directed shall be glazed as specified, styles and rails shall be rebated 12mm to receive glass. Sash bars shall be moulded and rebated and mitred on sides to receive the glass which shall be fixed with eading.

c) The fixing of hardware shall be done in the best workman like manner and in accordance with the manufacture's specifications. The contractor shall be held responsible for working of all moving parts dependant on the proper fixing.

1.2 FLUSH DOOR SHUTTERS:

Flush shutters shall be solid core (Block board Type Core) construction of kiln seasoned timber, faced with high quality commercial ply or decorative type as specified. They shall be Phenol formaldehyde resin bounded. They will have teakwood lipping all-round as specified with full width machine pressed along with core. The shutter should generally conform to ISI 2202 part I.

1.3 PAINTING AND POLISHING

All exposed glazing; frames shall be treated with solignum stained to the tint approved by the Employers Representative. Door shutters, internal faces of cupboards/cabinets etc., shall be enamel painted to approved finish. All painting, polishing, oiling, etc., shall be carried out as specified under `PAINTING'.

1.4 PROTECTION OF WORK

The contractor shall be responsible for the temporary doors and closing in openings necessary for the protection of work during progress. He shall also provide and maintain any other temporary covering required for the protection of 1finished wood work that may be damaged during the progress of work if left unprotected.

1.5 COLLAPSIBLE STEEL GATE

These shall be of approved manufactured and shall be fabricated MS section. These shall consist of double or single collapsible gate depending on the size of opening. These shall consist of vertical double channel each 20 x 5mm and top and bottom rail of T 40 x 40 x 6mm with 38mm dia. steel pulley or ball bearing in every fourth double channels.

Whenever collapsible gates is not provided within the opening and is fixed along the outer surface T iron at top may be replaced by flat 40 x 10mm.The gate shall be provided with necessary bolts, nuts, locking arrangement, stopper, handles, springs, catches, etc.

The gate shall be of best quality and shall open and close smoothly and easily. The fixing of T and channels shall be permanent, rigidly fixed with anchor bolts, holdfasts.

All the damaged work shall be got repaired and matching as per surrounding. All the members of the gate shall be painted with one coat of red lead and two coats of enamel paint after removing rusts, scale, dust, etc. The payment shall be including T or channel in sqm.

1.6 ROLLING SHUTTER:

Rolling shutter of approved quality, make & type, 18 gauge (MS solid laths or grill) with all the accessories such as top cover (in or out), handles, bearings, springs, axles, locking arrangement guide rails, iron pulleys, push & pull arrangements should be purchased from reputed firm and provided and fixed with holding down bolts with **PCC 1:2:4** as specified i.e., outside or inside or below lintel or between jambs of the opening. The shutter shall be either push and pull type or operated with special type of reduction/bevel gear arrangements operated with mechanical device.

Shutter upto 10.2 sqm or outside width less than 3m shall be push & pull and above 10.2 sqm and width more than 3m will be mechanically operated. No extra payment shall be made for lath. The spring shall be best Indian make and manufactured from tested high tensile steel wire to balance the shutter in all positions. Spring pipe shaft shall be supported on strong mild steel or CI brackets.

Both the side guides and bottom rail shall be jointless and single piece of pressed steel. The top cover of shaft, spring, etc., shall be of same materials as that of lath and no extra payment shall be made for this. The side guides fixed with plates, welded to guides shall be properly fixed with screws, bolts, and concealed in plaster. The operation of shutter should be easy and smooth.

The shutter should be applied with 2 coats of enamel paint of required shade and primer coat of red oxide.

1.7 MS GRILL These shall be made from MS section as per the Architects details. The item includes fixing with screws or necessary anchor bolts and flats to fix the railing rigid in position. The members shall be welded together and all the welded joints shall be filed to make smooth joints. The rate includes two coats of enamel paint of required shade and primer coat of red oxide.

1.8 GLAZIER'S WORK:

All glass shall be as specified in the drawings and finishing schedule and free from air bubbles, specks and scratches of other defects. All glass shall be cut to fit the sashes or other members as required. All glass shall be properly bedded, securely fixed and finished as indicated on the drawings. T.W. beading finished as specified shall be provided for fixing the glass. No glazing shall be complete until all the stains and marks have been removed from the surface of glass.

1.9 VISION PANEL FOR FIRE DOORS:

Vision panel to be of size as mentioned in detailed drawings, thickness to withstand 2 hours fire rated clear wired borosilicate glass make: Pyran IRONMONGERY. The sets shall be as indicated and to be used for the respective doors, and indicated in the joinery drawings.

1.10 IRONMONGERY SETS:

All locks shall be master keyed floor wise and grand mastered for the whole building. All cylinder locks shall include escutcheon plates. The Ironmongery shall consist of sets as defined in the detailed drawings with typical item like:

- Butt hinges of brush steel finish,
- Mortice cylinder dead lock of brush steel finish
- D type pull handles of brush steel finish
- Push Plates of brush steel finish
- Flush bolts of brush steel finish
- Over head door closer of brush steel finish
- Easy clean floor socket of brush steel finish)
- Provision for Access controlled locking system of brush steel finish
- Mortice Cylinder dead lock with lever handle
- Panic bars of Dorma or equivalent make
- Mortice Cylinder dead lock with knob**Signage as shown in the signage drawings to be referred**.

1.11 MOCKUP

Samples of all doors (glass frame section) Iron mongery and accessories to be approved by LIC prior to fabrication. It is to be noted that materials used for this work are conforming to the respective standards as mentioned in the document.

STEEL FIRE DOORS AND FRAMES:

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division and Specification Sections, apply to this Section.

Summary:

This includes furnishing and installing ofSteel fire doors & frames & assemblies. Vision Panels, frame trim in doors.

Submittals Product Data:

For each type of door and frame indicated, include door designation, type, level and model, material description, core description, construction details, label compliance, sound and fire-resistance ratings, and finishes.

Shop Drawings:

Shop Drawings show Elevations of each door design; Details of doors including vertical and horizontal edge details; Frame details for each frame type including dimensioned profiles; Details and locations of reinforcement and preparations for hardware; Details of each different wall opening condition; Details of anchorages, accessories, joints, and connections; Coordination of Doors with works of other vendors *& their requirements.*

Door Schedule:

Use same reference designations indicated on drawings in preparing schedule for doors and frames.

QUALITY ASSURANCE:

Steel Door and Frame standard complies with CBRI testing standards, unless more stringent requirements are indicated.

Fire-Rated Door Assemblies:

Assemblies that are listed and labelled by a testing and inspecting Contractor acceptable to authority having jurisdiction (CBRI), for fire-protection ratings indicated, based on testing according to IS 3614 Part 2.

DELIVERY, STORAGE, AND HANDLING:

Shutters are to be wrapped in protective 70-micronpolyethene sheets and duly strapped. All frames and shutters are to be duly marked as per as per approved door schedule for easy identification at site. The doors and frames shall be cardboard-wrapped or crated to provide protection during transit and job storage. Additional protection to prevent damage to finish of factory-finished doors and frames shall be provided.

Inspect doors and frames on delivery for damage and notify shipper and supplier if damage is found. Damaged items shall be removed and replaced as directed. All knocked down frames shall be stacked flat & shutters vertically on minimum 4-inch- (100-mm-) high wood blocking under cover in ventilated areas. Provide spaces between stacked doors to permit air circulation.

Sequencing and Scheduling:

Submit data and schedule at earliest possible date, particularly where acceptance of schedule must precede fabrication of units that must be built into other work.

Products Manufacturers : Products Manufacturers shall be selected subject to compliance with requirements, provided for Fire steel door and frame units and to be produced by one of the approved vendors and Materials of product shall be Steel Sheet.

General: Thickness dimensions, including those referred in IS 277, are minimums for both uncoated steel sheet and the uncoated base metal of metallic-coated steel sheets with Honey combed Kraft paper core and Borosilicate clear toughened Glass.

Primer: Manufacturer's standard rust-inhibitive primer, suitable as a base for specified finish paints such as Zinc Phosphate Stoving Primer (35 microns DFT) Thermosetting Paint (35 microns DFT)

Anchors and Accessories: Manufacturer's standard units suitable for type of wall construction. Provide square profile stops with mitred corners for glazing. Use galvanized items for units built into exterior walls. Provide countersunk flat or small oval head fasteners where exposed to view.

Doors and Frames: HOLLOW METAL FIRE DOOR (2 Hours Fire Rating) WITH HONEY COMB CORE Fire door shall be 2-hour fire rated and door quality shall be approved by CBRI and tested conformed to IS: 3614 Code or its Equivalent British Standard.

Unless otherwise specified, maximum size of door in this type: Single shutter door: 1200 mm x 2400mm; Double shutter door: 2000 mm x 2400 mm; For doors above 2200 mm height (Single Doors) and 2400 mm height (Double Door).

The construction of above panel shall be designed similar to that of a shutter in case of flush panel to match the exteriors.

Frame Material - Frame to be manufactured from 1.60 mm (16 gauge) galvanised steel sheets complying with latest IS 277 Code or its Equivalent British Standard.

Profile - Door frame profile to be double/ single rebated of dimensions & bending radius as per relevant IS code, Manufacturers specifications & approved drawings.

Manufacture - Frame to be manufactured from 1.60 mm thick galvanised steel sheet to the specified profiles and dimensions. Frames manufactured at factory shall be knock down form with butt joints for bolted assembly at site.

Door frame preparations – Frames to be provided with 3 mm thick back plates on all jambs with provision for anchor bolt fixing to wall openings. All frames to have reinforcement pads for fixing of door closer, at appropriate location as per manufacturer's details. Frames to have factory finish-pre-punched cut outs to receive specific hardware and iron mongery. Frames to be provided with hinge plates 3 mm thick pre-drilled to receive hinges for screw mounted fixing. All cut outs including hinge plates, strike plates to have mortar guard covers from inside to prevent cement, dust ingress into cut outs at the time of grouting. Frames to have rubber shutter silencer on strike jambs for single shutter frames and on the head jambs for double shutter frames.

Finish - Door frames to be suitably cleaned with solvents and etch primered for receiving primer and top coats. Door frames to be primered in zinc phosphate stoving primer (35 microns DFT). Door frames to be finished in thermo setting Polyurethane Paint (35 microns DFT) of approved colour and make as specified.

Fire door shutter Material - Fire door shutter to be manufactured from 1.25 mm (18 gauge) galvanized sheets conforming to latest IS: 277 Code of GPL Grade with Z 120 coating or its Equivalent British Standard.

Manufacture - Shutters to be press formed to 46 mm thick double skin hollow door with lock seam joints at stile edges. Shutters to have no visible screws or fasteners on either face. Internal reinforcement to be provided at top bottom and stile edges for desired fire rating.

Door Shutter Cores – Shutters to be provided with honeycomb Kraft paper core to be bonded to the inner faces of the shutter.

Door shutter preparations – Shutters to be factory prepared with pre-punched cut-outs and reinforcements to receive iron mongery as per final finish hardware schedule. The shutter should have an interlocking arrangement at this stile edges for flat surface on either side. Shutters to have pre-drilled hinge plates with hinge guard covers. Shutters with locks to have concealed lock box with lock fixing brackets with pre-tapped holes. For shutter with door closer reinforcement pads to be provided at appropriate location as per manufacturer's design. All iron mongery preparation to have adequate reinforcement for flushes fixing at site.

Vision panel for Fire rated door - Vision panel to be provided with Borosilicate Clear Toughened Glass of the thickness 6 mm for upto two hours fire rating. Glass to be fixed with clip on frames for square and rectangular vision panels and with spin turned rings for circular vision panels and Glazing Tape with one side adhesive. Vision Panels to be fixed with clip-on frames for square and rectangular Vision Panels with no visible screws. Unless otherwise specified standard sizes are 200 mm x 300 mm and 360 mm diameter.

Finish - Shutters to be suitably cleaned with solvents and etch primered for receiving primer and top coats. Shutters to be primered in zinc phosphate stoving primer (35 microns DFT).

Shutters to be finished in thermo setting Polyurethane paint (35 microns DFT) of approved colour and make as specified.

FABRICATION :

General: Fabricate steel door and frame units to comply with relevant IS standards (IS 3614 & IS 277) and to be rigid, neat in appearance, and free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify that product is factory assembled only before shipment, to assure proper assembly at Project site.

Exterior Door Construction: For exterior locations and elsewhere as indicated, fabricate doors, panels, and frames from metallic-coated steel sheet. Close top and bottom edges of doors flush as an integral part of door construction or by addition of 0.053-inch- (1.3-mm-) thick (old 16 gauge), metallic-coated steel channels with channel webs placed even with top and bottom edges.

Interior Door and Panel Faces: Fabricate exposed faces of doors and panels from cold rolled sheet steel.

Core Construction: Manufacturer's standard core construction of the type specified that produces a door complying with CBRI tests.

Clearances for Non-Fire-Rated Doors: Not more than 1/8 inch (3.2 mm) at jambs and heads, except not more than 1/4 inch (6.4 mm) between pairs of doors. Not more than 3/4 inch (19 mm) at bottom.

Clearances for Fire-Rated Doors: As required by IS 3614.

Single Acting, Door-Edge Profile: Square edge, unless bevelled edge is indicated.

Tolerances: Comply with by IS 3614. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and mouldings from either cold or hot rolled steel sheet.

Exposed Fasteners: Unless otherwise indicated, provide counter sunk flat or oval heads for exposed screws and bolts.

Thermal-Rated (Insulating) Assemblies: At exterior locations and elsewhere as shown or scheduled, provide doors fabricated as thermal-insulating door and frame assemblies and tested according to IS 3614 on fully operable door assemblies. Unless otherwise indicated, provide thermal-rated assemblies with U-value of 0.41 Btu/sq. ft. x h x deg F (2.33 W/sq. m x K) or better.

Sound-Rated (Acoustical) Assemblies: Where shown or scheduled, provide door and frame assemblies fabricated as sound-reducing type, tested according to IS 3614. Unless otherwise indicated, provide acoustical assemblies with STC sound ratings of 33 or better.

Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with requirements as per good practice for door and frame preparation for hardware.

Door frame preparation: Frames to be provided with 3 mm thick back plates on all jambs with provision for anchor bolt fixing to wall openings. All frames to have reinforcement pads for fixing of door closer, at appropriate location as per manufacturer's details. Frames to have factory finish-pre-punched cut outs to receive specific hardware and iron mongery. Frames to be provided with hinge plates 3 mm thick pre-drilled to receive hinges for screw mounted fixing. All cut outs including hinge plates, strike plates to have mortar guard covers from inside to prevent cement, dust ingress into cut outs at the time of grouting. Frames to have rubber shutter silencer on strike jambs for single shutter frames and on the head jambs for double shutter frames.

Door shutter preparation: Shutters to be factory prepared with pre-punched cut-outs and reinforcements to receive iron mongery as per final finish hardware schedule. The shutter should have an interlocking arrangement at this stile edges for flat surface on either side. Shutters to have pre-drilled hinge plates with hinge guard covers. Shutters with locks to have concealed lock box with lock fixing brackets with pre-tapped holes. For shutter with door closer reinforcement pads to be provided at appropriate location as per manufacturer's design. All iron mongery preparation to have adequate reinforcement for flush fixing at site.

Frame Construction: Fabricate frames to shape shown. For exterior applications and frames installed in masonry, fabricate frames with mitred or coped and continuously welded corners, rabbets, stops, and seamless face joints. Provide welded frames with temporary spreader bars. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site. Locate hardware as indicated on Shop Drawings or, if not indicated, according to the following:

I. Hinges:

1. Bottom Hinge: 255mm from door bottom to bottom of hinge. 2. Top Hinge: 125mm from door top to top of hinge. 3. Centre Hinge: Centre between top and bottom hinge. 4. Extra Hinge: 150mm from bottom of top hinge to top of extra hinge.

II. Lock: 965mm from finished floor to centre of lever or knob.

III. Push Bar: 1120mm from bottom of door to centre of bar.

IV. Push Plate: 1120mm from bottom of door to centre of plate.

V. Pull Plate: 1065mm from bottom of door to centre of pull.

VI. Exit Device: 1010mm from finished floor to centre of pad. VII. Deadlock Strike: 1120mm from floor, centred.

Glazing Stops: Manufacturer's standard, formed from 0.8-mm steel sheet. Provide non-removable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors. Provide screw-applied, removable, glazing stops on inside of glass, louvers, and other panels in doors.

Astragals: As required by applicable standards to provide fire ratings indicated.

Finishes: Shutters to be suitably cleaned with solvents and etch primered for receiving primer and top coats. Shutters to be primered in zinc phosphate stoving primer (35 microns DFT). Shutters to be finished in thermo setting Polyurethane paint (35 microns DFT) of approved colour and make as specified.

Execution of Door frame fixing: The door frames should be assembled adjacent to the place of installation as the frames are not designed for transporting in an assembled condition. After assembly it is to be ensured that all threaded preparations are covered from the back of the frame using self adhesive strip to prevent penetration of mortar back-fill into screw threads. The head member of assembled frame shall be positioned against jambs ensuring correct alignment and secured using M8 x 20 long plated bolts together with nuts spring and flat washers. The assembled frame shall be kept in position within the opening by means of bracing. In order to correctly position the frame against finished floor level or equalise on adjustable floor anchors where specified, shim shall be used under jambs. The frame shall be checked for squareness, alignment, twist etc. with carpenters bevel and plumb. A tie rod shall be fixed to the frame during installation to ensure the correct dimensions between the frame rebated and the same may be removed after installation. Where a 2nd fix application is required a shim detail is suggested to take up gap between frame and existing opening.

Existing masonry wall openings: Metal expansion shields Brace, position, level etc. Mark all positions of fixings on wall. Remove frame and drill wall to appropriate specified size. Fit rod anchor shells metal expansion bolts into the wall. Fit jamb spacer bracket into back of frame

profile. Reposition frame back into opening and realign. Lightly screw machine screws into shells, shim behind frame. Slowly tighten screws continually checking plumb, square etc. Finally ensure frames are not deformed as tightened. After fixing the frame shall be grouted with cement mortar 1:3 or Plaster of Paris or Gypsum powder as approved. Gap between frame and wall to be closed by cement pointing using cement mortar 1:3. Back full the frame through holes provided and insert nylon plugs.

Door shutter fixing: Fix all the hardware to the door shutter like hinges, flush bolts, bolts, mortice locks, door closer, door stoppers, handles etc. with the appropriate screws and bolts supplied. The shutter is to be then fixed to the frame which is already installed. Align the shutter to match the hardware to the cut-outs in the frame. Tighten the hinge screws. iii

Seal: Application of Fire / Smoke UL 10 C / UL 1784 (2001) classified seal (for smoke check if specifically required)

Astragals: As required to provide fire ratings indicated. ADJUSTING, CLEANING & CALIBRATION

Cleanup: Remove excess weld splatter by grinding flush with adjacent surfaces, without grinding skips or gouging parent metal. Refer to Section 09900 - Paints and Coatings for surface preparation, primer and field applied finish coats.

Prime-Coat Touch-up: Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touch up of compatible air-drying primer & apply final finish wherever required.

Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly.

Manufacturer/Distributor's Field Services: After installation is complete, provide the services of hardware supplier's for an inspection and will inspect completed door openings to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final approved submittals. Further adjust hardware as necessary during inspection. Perform inspection in the presence of the Engineer.

1. Check closers to ensure proper operation. 2. Check latch set, lockset, and exit devices are properly installed and adjusted to ensure proper operation. 3. Verify levers are free from binding. 4. Ensure latch bolts and dead bolts are engaged into strike and hardware is functioning. 3. Report findings, in writing, outlining corrective actions and recommendations.

Final Adjustment: Whenever hardware installation is made more than one month prior to occupancy of a space or area, as applicable, return to work during the week prior to occupancy and make final check and adjustment of all hardware items in such space or area.

Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for operation of heating, ventilating and cooling equipment.

1. For door closers- Provide final adjustment of door closers to ensure that all doors close and latch properly to prevent false door held alarms or intrusions and compliance with maximum opening pressure. a. Adjust closer to complete full closing cycle in less than 4 to 6 seconds without abrupt change of speed between "sweep" and "latch" speeds. b. Adjust "back-check" according to manufacturer's instructions.
2. Power Up and Test: Provide powered up testing of doors in the presence of the installer of electrified hardware, as applicable, to ensure final adjustments to electrified components.

3. During final adjustment of hardware, instruct LIC personnel in proper adjustment and maintenance of hardware and hardware finishes. This training shall be coordinated with training conducted in accordance with Demonstration and Training.

uPVC WINDOWS/DOORS

uPVC WINDOWS/DOORS

COMPOSITION

Un-plasticized PVC (Polyvinyl Chloride) meeting the requirement of ASTM D 1748 / BS 7413/ EN 12608 shall be used. No reworked material is to be used in any profile; whether used internally or externally.

PROFILE MARKING

The main frame profile shall be permanently marked at approximately 1 meter intervals with an identifying mark which enables the name of the profile Systems supplier, date of manufacture and extruder to be identified without extraction of the window.

DURABILITY

The Systems shall be resistant to chemicals, and be fungal and vermin proof. The profiles must be colorfast, being able to withstand weather and light resistance test of 4000 hours on xenon and weathering apparatus.

COLOUR

The Systems color should be uniform and consistent.

FIRE RESISTANCE

The uPVC should be classed as self extinguishing to prevent support or enhancement of accidental fires.

QUALITY CONTROL

The extrusion process must be quality controlled and the appropriate standards relating to impact strength, technical performance and consistency.

PROFILE CONSTRUCTION

The profile depth should be minimum of 58mm with a nominal wall thickness, internally and externally of 2.8mm. The profile shall have a minimum of two sealed chambers for transoms and mullions and 3 sealed chambers for frames and sashes.

INTERNAL PROFILE DRAINAGE

The internal drainage shall be isolated from chambers into which reinforcements can be placed or through which frame fixing pass. Drainage shall be either through the base or alternatively to the face, concealed by face drainage caps.

PRESSURE EQUALIZATION

Pressure equalization for glazing rebates and for frame rebates shall be carried out in accordance with the recommendation of the profile Systems supplier to ensure efficient drainage in adverse conditions.

WINDOW PERFORMANCE

Windows must meet the requirements with respect to air permeability, water tightness and wind resistance upto 2400 pa.

STRENGTH AND SAFETY OF MOVING PARTS

The moving parts of the Windows must have sufficient strength and robustness to withstand accidental Static and Dynamic loads in use, without any permanent deflection or breakage. The overall evaluation will be based on the experience from use and subject to approval by the Design Consultant/ Client.

GLAZING BEADS

Glazing beads shall be of the one foot snap in design and shall be extruded U PVC mitred at the corners. All glazing beads shall be with a co-extruded gasket of a multi-fin design to maintain security and weather performance. Gasket material shall be thermo Plastic Elastomer.

GLAZING GASKETS

All glazing gaskets as well as weather seals are to be extruded from non migratory EPDM . Glazing gaskets shall be a continuous length. Gasket may be subjected to random testing and shall be obtained from the profile Systems supplier.

WEATHER SEALS

Weather seals shall consist of a double sealing Systems. Seals on the sash and the frame shall be continuous length and for outward opening windows the seal on the sash shall be joined to a 50mm length of pressure relief seal at the bottom of the opening whereas the seal on the frame shall be joined on the top of opening. Weather seals and pressure relief seals, which shall be obtained from the profile Systems supplier, shall be capable of removal without disturbing the glazing Systems or removal of the frame or sash.

GLAZING

All glazing shall be internally beaded. The windows shall be constructed in such a manner that the glazing or deglazing can take place without the removal of the sash or frame.

WELDED JOINTS

All corner joints shall be homogeneously fusion heat welded in accordance with the instructions of the profile Systems supplier. The resulting joints shall be finished by the grooving/knifing method. Solvent welded joints shall not be allowed.

REINFORCEMENT

All transoms and mullions shall be fully reinforced, irrespective of size, with corrosion resistant galvanized steel. All other profiles to be reinforced as per the specification of the profile Systems supplier which shall suit the proposed style application relative to exposure, elevation

and height above the ground level. Reinforcing shall be secured by suitable screws in accordance with the instructions of the profile Systems supplier.

All galvanized steel reinforcing profiles shall comply with BS 2989 1982 Grade G 275N / IS 4759-1996 or equivalent.

MECHANICAL JOINTS

The mechanical jointing of mullions and transoms shall be carried out in strict accordance with the instructions/recommendations of the profile Systems supplier using only approved mechanical coupling components.

HARDWARE GENERAL

All hardware shall be manufactured from corrosion resistant material and to be approved.

All ferrous screws, nuts, bolts and other fastening or fixing shall be of stainless grade or of a suitable coated steel recommended for use in the fabrication of UPVC windows. Metal that are in contact with each other shall be compatible so as to prevent galvanic corrosion of dissimilar metals by electrolytic action. All hardware should ideally be fixed by attachments through the UPVC to the reinforcement; alternatively it should be fixed in purpose designed screw ports or at least two thickness of UPVC.

Hardware with provision for adjustment shall be accessible for adjusting after the window has been installed. Hardware used to open and close the window shall be replaceable without removing the outer frame from the structure.

FRICTION HINGES

Top hung and side hung opening out lights shall have two friction stays per light and be of stainless steel construction.
The size of the friction stay will depend on size, weight, hanging and exposure of the relevant sashes. This will be determined from table provided by the hinge manufacturer. All side hung friction stays are to be incorporate a riser block to allow the sash to be supported in its closed position.

BUTT HINGES

Where external butt hinges are used they must be of the security pin type which do not allow removal of the hinge pin from outside.

ESPAGNOLETTE HANDLES

All espagnolette striking plates are to be purpose designed and secured to the outer frame by approved screw fixing. The espagnolette mechanism shall be of multi locking points dependants on size. All ironmongery where possible shall be screwed into frame reinforcing, or fixing screws must penetrate a minimum of two wall thickness or an equivalent screw port, to obtain sufficient purchase.

FIXING THE FRAME TO THE BUILDING

The gap between the structural opening and the uPVC frame shall be between 5 to 10mm all round, which should be filled by injectable PU foam after completion of fixing for best frame and wall bonding, and for sound and thermal insulation and finally applying neutral cure low modules Silicone sealant to make joint water proof.

Fixing points shall be to all four sides of a frame, spaced 150mm to 250mm from corners and not more than 600mm apart elsewhere. Fixing shall be by direct drilling 10mm hole through U PVC frame to building wall. Each fixing shall penetrate into building structure by no less than 40mm.and ultimate fixing with anti corrosive plated anchor bolts through these holes. All heads of all fixing screws shall be covered with appropriate plastic cover caps.

HANDING AND TRANSPORT

Windows may be transported either glazed or unglazed. All windows or prefabricated units shall be transported and stacked in a vertical position and properly anchored to prevent movement in transit, windows shall be separated from each other by adequate packing piece during transport.

S.NO.	TECHNICAL SPECIFICATION	VALUE
1.	Impact strength down to 400C	No breakage
2.	Notch impact strength	> 30 kJ/m2
3.	Ball impact hardness	100 N/mm2
4.	Tensile strength	> 40 N/mm2
5.	E module	> 2500 N/mm2
6.	Linear Thermal Expansion	Coefficient 300C to+500C 0.80 x 10-4 K-1
7.	Thermal Conductivity	0.16W/mK
8.	Specific volume resistance	10 16 Ω cm
9.	Relative Permittivity	3.3 at 50GHz 2.9 at 106 Hz
10.	Fire behaviour	Self extinguishing
11.	Weathering stability RAL GZ 716/1	After 8.0GJ/m2 irradiation energy better than authenticity grade 4 of grey scale
12.	Special Resistance	Resistance to termites, decay, chemicals e.g. alkalines, acids, salts, salty solutions, seawater, petrol, oil, lime, cement, any kind of emissions Physiological Behaviour and environmental characteristics Inert, Neutral, The weathering stability and the resistance against chemical and decay ensure that there exist no health and environmental risks during handling.
13.	Physiological Behaviors and environmental characteristics	Inert, Neutral, The weathering stability and the resistance against chemical and decay ensure that there exist no health and environmental risk during handling
14.	Wind resistance	Up to wind pressure of 2400PA
15.	Acoustic	Class 5
16.	Water Tightness	Watertight upto 600PA
13.	Physiological Behaviors and environmental characteristics	Inert, Neutral, The weathering stability and the resistance against chemical and decay ensure that there exist no health and environmental risk during handling
14.	Wind resistance	Up to wind pressure of 2400PA
15.	Acoustic	Class 5
16.	Water Tightness	Watertight upto 600PA

PAINTING AND DECORATING:

1.1 This Specification describes the general requirements of painting and decorating on internal and external surfaces, woodwork and metalwork and varnishing and polishing to be executed on projects.

1.2 Applicable Codes IS 75 Specification for raw and refined linseed oil, IS 345 Specification for transparent liquid wood filler IS 348 Specification for French polish, IS 427 Specification for distemper – dry colour, IS 428 Specification for distemper – oil emulsion colour, IS 533 Specification for gum spirit of turpentine, IS 1477 Code of Practice for painting of ferrous metals in buildings – Parts I and II (Pretreatment and Painting), IS 2338 Code of Practice for finishing of wood and wood-based materials – Parts I and II (Operation and workmanship and Schedule), IS 2395 Code of Practice for painting concrete, masonry and plaster surfaces, IS 2932 Specification for enamel synthetic exterior undercoating and finishing, IS 2933 Specification for enamel exterior undercoating and finishing, IS 3140 Code of Practice for painting asbestos cement building products, IS 3537 Specification for ready-mixed paint, finishing, interior, for general purposes to IS colours, IS 3631 Specification for ready-mixed paint for finishing interior, alkyd and non-alkyd for general purposes to IS colours, IS 4597 Code of Practice for finishing of wood and wood-based products with nitrocellulose and cold catalysed materials, IS 5410 Specification for coloured cement paints, IS 6005 Code of Practice for phosphating iron and steel, IS 6278 Code of Practice for whitewashing and colour washing.

1.3 Painting

1.3.1 Oil Bound Distemper Washable oil bound distemper shall conform to IS 428 and be of approved make and shade and shall be applied only in dry weather with a broad stiff brush in long parallel strokes. Priming coats shall be applied to completely dry surfaces as recommended by the manufacturers of patent distempers and approved by LIC and allowed to dry thoroughly before the next coat is applied. Surfaces shall be cleaned and all cracks, holes and surface defects repaired with gypsum and allowed to set hard. All irregularities shall be removed by sand papering smooth and wiped clean and surfaces so prepared shall be completely dry and free from dust before distempering is commenced. In the case of newly plastered surfaces special care shall be taken to ensure that they are completely dry before any application is attempted. Existing, previously distempered surfaces shall be cleaned of grease, dirt, dust and other deleterious matter and cracks, holes and surface defects repaired with plaster of Paris, allowed to set hard, sand papered smooth and wiped clean. Flaking from previous coatings, if any, shall be thoroughly removed.

1.3.2 Plastic Emulsion Paint Plastic emulsion paint shall be of approved make, colour and shade to the satisfaction of LIC. Plastic emulsion paint shall be diluted by the addition of a quantity of water equivalent to half the volume of the paint to be applied. The paint and water shall be thoroughly mixed and then strained through cloth.

Priming coats shall be applied to surfaces by brush and allowed to dry properly, holes and depressions being filled with putty prepared with whitening and plastic emulsion paint and rubbed smooth and dry and touched up with plastic emulsion paint. Subsequent coats, diluted by the addition of a **quantity of water equivalent to about 15% to 20% of the volume of paint** to be applied shall be applied to surfaces by brush and allowed to dry thoroughly so that no brush marks shall be seen.

Surfaces shall be cleaned and all cracks, holes and surface defects repaired with gypsum and allowed to set hard. All irregularities shall be removed by sand papering smooth and wiped clean and surfaces so prepared shall be completely dry and free from dust before painting is commenced.

In the case of newly plastered surfaces special care shall be taken to ensure that they are completely dry before any application is attempted. Existing, previously distempered or painted surfaces shall be cleaned of grease, dirt, dust and other deleterious matter and cracks, holes and surface defects repaired with **wall putty**, allowed to set hard, sand papered smooth and wiped clean. Flaking from previous coatings, if any, shall be thoroughly removed.

1.3.3 Waterproof Cement Paint Waterproof cement paint shall be of approved makes, colour and shade by LIC, brought to Site in original airtight containers with seals intact. Dry cement paint shall be thoroughly mixed with clean fresh water to produce paint of the required consistency to LIC and strained through a paint strainer. Paint shall be constantly stirred during application and applied within the specified or recommended time, hardened or damaged paint not being allowed to be used. Paint shall be applied by brush, each coat being properly cured and inspected and approved by LIC before the application of each subsequent coat. Absorbent surfaces shall be thoroughly wetted so as to provide even absorption. In dry weather freshly painted surfaces shall be kept damp for at least two days and protected from direct sunlight. Surfaces shall be free from dirt, dust, grease and other deleterious matter and thoroughly cleaned by brushing and washing down with clean water. Existing lime wash and/or water bound distemper shall be thoroughly removed by washing, brushing and if necessary, accumulated coats of oil paint removed by brushing and/or scraping and washing to obtain clean and even surfaces. Roughcast and pebbledash surfaces shall be thoroughly brushed and washed to remove dust, dirt, grease and other deleterious matter.

1.3.4 Oil Painting

1.3.4.1 Oil paint shall conform to the relevant Standards and be of the specified make, colours and shades as approved by LIC. Materials shall be obtained directly from approved manufacturers and brought to Site in manufacturers' sealed drums and tins for inspection by LIC. Paint for undercoats and finishing coats shall be ready mixed. Mixing by the Contractor shall not be allowed except with the prior written permission of LIC, in which case preparation of the ingredients and the control of quality shall be in strict conformity with the manufacturers' recommendations and the relevant Standards and Codes of Practice. Materials shall be properly stored and protected when not in use with the lids of containers kept tightly closed. Paint in open containers during painting operations shall be covered with a thin layer of turpentine to prevent the formation of skin on the surface. If required by LIC paint supplied by the Contractor shall be quality tested in an approved laboratory as described in IS 101. Rejected paint shall be removed immediately from Site.

1.3.4.2 Unless otherwise specified, paint may be applied by brush or spray. Brushes of appropriate size shall be either round or oval shaped and shall be maintained carefully throughout the work so as to be pliable and free from loose bristles. All brushes, rollers, implements and the like used for painting shall be cleaned of all foreign matter prior to beginning different operations. Contents of drums and tins shall be well stirred before use and constantly during operations with a small, clean and smooth stick to prevent sedimentation at the bottom of containers. Painting shall be carried out, as far as possible, in dry, warm weather. Primer coats shall be applied as soon as surfaces have been cleaned and before the deterioration of surfaces by rust and/or contamination by dust, dirt or any other deleterious material. Sufficient time shall be allowed for one coat of paint to dry before the next is applied. Painted surfaces shall be protected from **sun**, rain, condensation, contamination or other surface damage until they are completely dry, "Wet Paint" boards being placed where necessary. Surface preparation, the application of priming coats, undercoats and finishing coats shall be carried out as specified below or as recommended by the manufacturer.

New plaster shall be carefully rubbed smooth and thoroughly cleaned with fresh water to leave dry and smooth surfaces free from dirt. Surfaces shall not be primed or painted until they are completely dry and hard and have been approved by LIC. Steel surfaces shall be degreased using mineral turpentine or petroleum and other petroleum solvents, such as trichloroethylene or other equal and approved alkali solutions or detergents or proprietary brand solvent cleaners approved by LIC.

De-rusting of steel surfaces shall be done by manual scraping using wire brushes, fine steel-wool, sand paper and the like, mechanically by sand blasting, shot blasting or by flame cleaning or chemical cleaning by methods approved by LIC.

Oil paint shall not be applied to woodwork that is not well seasoned. Surfaces of woodwork to be painted shall be thoroughly dry, clean and smooth and prepared by using coarse and medium grade sandpaper with finished surfaces free from scratches.

Before applying primers to surfaces of woodwork knotting shall be done with two coats of varnish made by dissolving Shellac in methylated spirits of wine or as directed.

On plastered surfaces, priming coats shall consist of equal parts of white and red lead mixed in boiled linseed oil to the required consistency applied uniformly over surfaces to be painted. When dry, all cracks, holes and other such defects shall be filled with a mixture of one part of white lead and 3 parts of ordinary putty. Surfaces shall then be rubbed with sandpaper and dusted clean and an undercoat thinly applied so that plastered surfaces are saturated.

On Steel surfaces, priming coats shall consist of red lead conforming to IS 102 applied uniformly over surfaces to be painted. On old or previously painted surfaces and new surfaces already primed with red lead, surfaces shall be thoroughly cleaned and primed with red lead on exposed surfaces as necessary or over whole surfaces as directed by the Employers Representative or his representative.

On woodwork surfaces, priming coats shall consist of red lead, white lead, raw and boiled linseed oil and patent dryers applied uniformly over surfaces to be painted. When dry, small holes, cracks, open joints and other minor defects shall be stopped with putty made from whitening mixed to proper consistency with raw linseed oil and white lead to facilitate hardening of putty. Surfaces shall then be lightly rubbed down smooth with sandpaper and dusted clean.

Finishing coats: Unless otherwise specified, finishing of all surfaces shall consist of two coats of paint of approved make, colour and shade. The second coat of paint shall give a flat, semi-glossy or glossy finish as specified or as directed by LIC and shall present on even appearance and show no brush marks. **Stipple finishes**, if directed, shall be provided as required.

1.3.5 Enamel Painting

1.3.5.1 Enamel paint shall conform to the relevant Standards and be of the specified make, colours and shades as approved by LIC. Materials shall be obtained directly from approved manufacturers and brought to Site in manufacturers' sealed drums and tins for inspection by LIC. Paint for undercoats and finishing coats shall be ready mixed. Mixing by the Contractor shall not be allowed except with the prior written permission of LIC, in which case preparation of the ingredients and the control of quality shall be in strict conformity with the manufacturers' recommendations and the relevant Standards and Codes of Practice. Materials shall be properly stored and protected when not in use with the lids of containers kept tightly closed. Paint in open containers during painting operations shall be covered with a thin layer of turpentine to prevent the

formation of skin on the surface. If required, paint supplied by the Contractor shall be quality tested in an approved laboratory as described in IS 101. Rejected paint shall be removed immediately from Site.

1.3.5.2 Unless otherwise specified, paint shall be applied by brush. Brushes of appropriate size shall be either round or oval shaped and shall be maintained carefully throughout the work so as to be pliable and free from loose bristles. All brushes, rollers, implements and the like used for painting shall be cleaned of all foreign matter prior to beginning different operations. Contents of drums and tins shall be well stirred before use and constantly during operations with a small, clean and smooth stick to prevent sedimentation at the bottom of containers. Painting shall be carried out, as far as possible, in dry, warm weather. Primer coats shall be applied as soon as surfaces have been cleaned and before the deterioration of surfaces by rust and/or contamination by dust, dirt or any other deleterious material. Sufficient time shall be allowed for one coat of paint to dry before the next is applied. Painted surfaces shall be protected from **sun**, rain, condensation, contamination or other surface damage until they are completely dry, "Wet Paint" boards being placed where necessary.

Surface preparation, the application of priming coats, undercoats and finishing coats shall be carried out as specified below or as recommended by the manufacturer. New plaster shall be carefully rubbed smooth and thoroughly cleaned with fresh water to leave dry and smooth surfaces free from dirt. Surfaces shall not be primed or painted until they are completely dry and hard and have been approved by LIC.

Steel surfaces shall be degreased using proprietary brand solvent cleaners approved by LIC or mineral turpentine or petroleum and other petroleum solvents, such as trichloroethylene or other equal and approved alkali solutions or detergents.

De-rusting of steel surfaces shall be done by manual scraping using wire brushes, fine steel-wool, sand paper and the like, mechanically by sand blasting, shot blasting or by flame cleaning or chemical cleaning by methods approved by LIC. Enamel paint shall not be applied to woodwork that is not well seasoned. Surfaces of woodwork to be painted shall be thoroughly dry, clean and smooth and prepared by using coarse and medium grade sandpaper with finished surfaces free from scratches. Before applying primers to surfaces of woodwork knotting shall be done with two coats of varnish made by dissolving Shellac in methylated spirits of wine or as directed.

On plastered surfaces, priming coats shall consist of equal parts of white and red lead mixed in boiled linseed oil to the required consistency applied uniformly over surfaces to be painted. When dry, all cracks, holes and other such defects shall be filled with a mixture of one part of white lead and 3 parts of ordinary putty. Surfaces shall then be rubbed with sandpaper and dusted clean and an undercoat thinly applied so that plastered surfaces are saturated.

On Steel surfaces, priming coats shall consist of red lead conforming to IS 102 applied uniformly over surfaces to be painted. On old or previously painted surfaces and new surfaces already primed with red lead, surfaces shall be thoroughly cleaned and primed with red lead on exposed surfaces as necessary or over whole surfaces as directed by the Employers Representative or his representative.

On Woodwork surfaces, priming coats shall consist of red lead, white lead, raw and boiled linseed oil and patent dryers applied uniformly over surfaces to be painted. When dry, small holes, cracks, open joints and other minor defects shall be stopped with putty made from whitening mixed to proper consistency with raw linseed oil and white lead to facilitate hardening of putty. Surfaces shall then be lightly rubbed down smooth with sandpaper and dusted clean.

Unless otherwise specified, finishing of all surfaces shall consist of two coats of synthetic enamel paint of approved make, colour and shade. The second coat of paint shall give a flat, semi-glossy or glossy finish as specified or as directed by LIC and shall present on even appearance and show no brush marks. **Stipple finishes**, if directed by LIC, shall be provided at no extra cost.

1.4 French Polishing

1.4.1 Materials French spirit polish shall conform to IS 2338 and shall be made by dissolving 0.15 kg of best quality shellac, free from resin or dirt, in 1 litre of methylated spirit. Suitable pigment shall be added to obtain the required shade or colour.

1.4.2 Workmanship Surfaces to be polished shall be cleaned and all unevenness rubbed smooth with sandpaper, knots, if visible, being covered with a preparation of red lead and glue. Holes and indentations in surfaces shall be filled with putty made of whiting and linseed oil. Surfaces shall then be given a coat of filler comprising 2.25 kg of whiting dissolved in 1.5 litres of methylated spirit. When dry surfaces shall again be rubbed down perfectly smooth with sandpaper and wiped clean.

Polish shall be applied by using pieces of clean fine cotton cloth wrapped around cotton wool made into pads. Pads shall be moistened with polish sparingly, but uniformly, and completely over the entire surface. When dry a further coat shall be applied in the same way. Finishing shall be carried out with pads covered with a fresh piece of clean, fine cotton cloth, slightly dampened with methylated spirit, rubbing lightly and quickly with a circular motion, to give a uniform, high class texture.

1.5 Wax Polishing

1.5.1 Wax polish shall be of approved quality and make and brought to Site in sealed containers as marketed by the manufacturers.

1.5.2 Woodwork to be polished shall be thoroughly cleaned, stopped and rubbed down perfectly smooth with different grades of sandpaper, the final rubbing done with sandpaper slightly moistened with linseed oil. Polish shall be applied evenly with clean cloth pads in such a way as to leave no blank patches and rubbed continuously for at least thirty minutes. When surfaces are dry, the second coat shall be applied and rubbed for not less than two hours until surfaces have assumed a uniform gloss, showing no signs of stickiness when touched.

1.6 Varnishing

1.6.1 Varnish shall be of an approved make and quality.

1.6.2 Surfaces to be varnished shall be cleaned and all unevenness rubbed smooth with sandpaper, knots, if visible, being covered with a preparation of red lead and glue. Holes and indentations in surfaces shall be filled with putty made of whiting and linseed oil. Surfaces shall then be given a coat of filler comprising 2.25 kg of whiting dissolved in 1.5 litres of methylated spirit. When dry surfaces shall again be rubbed down perfectly smooth with sandpaper and wiped clean

1.7 Textured Paint to external faces wherever called for shall be carried out by specialist agencies approved by the Architect. The Textured Paint materials shall be prepared and used in accordance with the recommendations of the manufacturer. Preparation of surface, brushing, removal of dust, etc. shall be carried out as described earlier. Mixing and application shall be strictly as per the manufacturer's instructions. The finished surface shall be subject to the approval.

1.8 Melamine Polish shall be applied by a pad of woollen cloth covered by a fine cloth. The pad shall be moistened with the polish and rubbed hard on the surface on a series of overlapping circles applying the polish sparingly but uniformly over the entire area to

give an even surface. A trace of linseed oil on the face of the pad may be added which shall facilitate this operation. The surface shall be allowed to dry and one more coat shall be applied and shall be left for drying. After drying the French polish, two coats of melamine polish shall be sprayed. The finished surfaces shall present a uniform texture and high gloss. Works deemed included for Painting, Polishing and Varnishing Work. For painting, polishing and varnishing work shall include the Contractor shall provide all materials, labour and equipment required to execute the work as specified; scaffolding (single/double) including erection and removal and prepare surfaces and apply specified number of coats of approved paint, polish or varnish, including priming coat and where proper even surfaces or shades are not obtained, apply extra coat(s) as directed and to the final approval of LIC. Application of additional priming or other preparatory coat(s) to obtain thoroughly saturated surfaces and filling with putty as required and/or directed. Painting of smooth and/or rough surfaces, such as precast concrete pardis, rough cast plaster, sand faced plaster and the like. Curing cement paint as directed for a minimum of 7 days. Protection of doors, windows, floors, furniture and fittings, including ironmongery and metalwork from splashing and droppings, including cleaning surfaces as directed. Repair of cracks, developing in plaster prior to or after final painting, by filling with suitable putty and painting surfaces again as directed to give even surfaces to the satisfaction of LIC. Surfaces damaged due to any reason before painting shall be redone by using wall putty as directed. Clean all surfaces after painting, polishing and varnishing.

ELECTRICAL WORKS SPECIFICATIONS FOR PROPOSED BUILDING

1.0 ELECTRICAL GENERAL PROVISIONS:

1.1 GENERAL

1.1.1 Work Description

The scope of works for all electrical works and system comprises of design, engineering, supply, delivery, installation, testing and commissioning, handover, training, maintenance and warranty all as described or reasonably implied in the Contract. The EPC Contractor is obliged to provide fully functioning works and systems in conformance with the requirements of the Contract and approved design and development documents prepared by the EPC contractor.

In the event certain items are not fully described or indicated in the Contract, but deemed essential by the EPC contractor for the performance of the works and systems then the provision of such items shall form part of the EPC Contractors scope of works at no additional cost to the Owner.

The drawings and documents from LICI shall be used as guidance for the EPC contractor in producing his detail design and shop drawings for carrying out works at site.

The EPC Contractor shall be responsible to co-ordinate the equipment and services and shall produce properly co-ordinate shop drawings to demonstrate the installation comply with the performance requirement with shop drawings, calculations and details. The LICI shall monitor the process of shop drawings and document preparation.

Shop drawings shall take into account actual measurement and setting out dimensions/levels obtained and determined by the EPC Contractor on site, actual equipment / material used, actual routing of services, co-ordination with all installation, and site conditions/constraints.

1.1.2 Scope of Work:

HT, LT, DG, Lift, Fire Fighting & Fire Alarm, Mechanical ventilation, CCTV, EPBAX, and ELV installation shall generally include the following:

Common Services: Liaison with all concerned authorities to obtain and coordinate for provision of incoming electricity supply. As well as since we are making the residential flats, so our scope of work will start from the LT side after metering of individual flats, Commercial Area and for common areas.

Complete earthing systems for connection with component electrical systems.

Internal Services: Complete LT distribution system including main LT switchboard, Automatic power factor correction devices, sub-boards and distribution boards, and associated distribution main and sub-main cabling and associated accessories.

Complete lighting with wiring and power installation including all final circuiting work and associated accessories.

Normal and emergency lighting supply and installation and associated accessories.

Complete earthing system.

Complete lightning protection system and associated accessories.

Complete telephone cabling system and associated accessories.

Complete wiring work to external/landscape and public area architectural/special lighting and dimming systems as per lighting design and associated accessories.

Complete internal cable system and outlets for Telephone and MATV system and associate works.

Wiring for complete Security systems

Miscellaneous works like providing and fixing of rubber mats, fire buckets, first aid box, fire extinguishers, etc.

All associated interfacing power supply work to other mechanical installations.

Fire Alarm System

Voltage drop, power factor and other parameter shall be as per Central electricity Authority and IGBC requirement.

Lighting density shall be furnished through energy.

All associated interfacing works with other M&E installations.

Other works as shown on the Drawings and described elsewhere in the Contract documents.

All equipment shall be of the class most suitable for working under the conditions specified and shall withstand the atmospheric conditions without deterioration.

EPC Contractor shall co-ordinate with all other agencies working at site for interconnection and safety aspects.

Also the EPC Contractor shall furnish combined guarantee minimum for one year from the date of successful commissioning of the equipment. In case there is any defect, the free replacement of any part or in whole will be made immediately at no extra cost to Owner.

1.1.3 Fee, Permits & Tests:

The EPC contractor shall obtain all sanctions and permits required for the above said works from all the relevant authorities. On completion of the work, the EPC Contractor shall obtain N.O.C from concerned authorities including, Chief Electrical Inspectorate of State. The original of the same shall be delivered to the Owner/ LICI.

The Owner shall have full power regarding the equipments/ materials get tested by authorized/ recognized independent Contractor at the EPC contractor's expense in order to prove their soundness and adequacy. The EPC contractor will rectify the defects/ suggestions pointed out by independent Contractor through Owner at EPC contractor's expense.

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, there under and special requirements, if any, of the State Electricity Boards etc. The EPC contractor shall be 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.

1.1.4 Codes & Standards:

The design, manufacture, inspection, testing and performance shall comply with all the currently applicable statutes, safety codes, relevant Bureau of Indian Standards (BIS), British Standards (BS), International Electro Technical Commission (IEC) publication, NEMA & VDE Standards amended up to date. The design engineering, manufacturing and the installation shall be in accordance with established codes, sound engineering, practices and specifications. Further, the same shall conform to the statutory regulations applicable in the country/state.

EPC Contractor shall obtain all approvals from statutory authorities, e.g. electrical inspector, local Electricity authorities or any other Contractor as applicable before commissioning of electrical system if required.

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

- Recommended Design guidelines of LICI
- International standards & requirements.
- Local codes of practice
- Approved design development documents

1.1.5 Design:

The EPC Contractor shall be fully responsible for the complete design of all works for the Contract, including all temporary works.

It is the responsibility of the EPC Contractor to ensure that his design does not compromise the design intents of the LICI's approved design development documents, all statutory authorities' compliances and approvals.

The design and workmanship shall be in accordance with the best engineering practices, to ensure satisfactory performance and service life. The equipment offered by the EPC 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 completion of the system and satisfactory & trouble free operation and maintenance of the equipment shall be provided without any extra cost to the Owner. This shall also include spares for commissioning of the equipment.

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

1.1.6 EPC contractor shall be responsible for:

- Detailed co-ordination with other services, shop drawings for various electrical layouts such as equipment layout, cabling layouts, earthing layouts, including equipment installation and cable termination details etc. prior to start of work.
- Preparation of bill of materials for electrical works.
- Protection co-ordination drawings/ tables for complete power system.
- Shop inspection and testing procedures.
- Field-testing and commissioning procedures.
- Preparation of as built drawings.

EPC contractor shall also be responsible for: Any other work/activity which is not listed above however is necessary for completeness of electrical system.

1.1.7 Date of Commencement and Completion Period:

The EPC contractor shall be allowed admittance to the site on the date of commencement as described in the General Conditions and he shall there upon and forthwith begin the works and shall regularly proceed with and complete the same on or before the date of completion subject, nevertheless to the provisions for the extension of time.

The time being the essence of the contract, the EPC Contractor will adhere to the time, progress chart and project schedule and will give proportional output/progress in proportional time.

1.1.8 Schedule and Manner of Operations:

Time being the essence of this Contract, the EPC Contractor will be expected to furnish all labor and materials in sufficient quantities and at appropriate times, expedite and schedule the work as required and so manage the

operation that the work will be completed within the time stated in the Contract.

1.1.9 Design Conditions:

Shall be as per relevant standard.

1.1.10 Coordination of Work

Contract documents establish scope, materials and quality but are not detailed installation instruction.

Coordinate work with related trades and furnish, in writing, any information necessary to permit the work of related trades to be installed satisfactorily and with the least possible conflict or delay.

The drawings show the general arrangement of equipment and appurtenances. Follow these drawings as closely as the actual construction and the work of other divisions will permit. Provide off-sets, fittings, and accessories which may be required but not shown on the drawings. Investigate the site, and review drawings of other divisions to determine conditions affecting the work, and provide such work and accessories as may be required to accommodate such conditions.

The locations of thermostats, switches, panels and other equipment indicated on the drawings are approximately correct. Exercise particular caution with reference to the location of panels, thermostats, switches, etc., and have the precise and definite locations accepted by the Engineer before proceeding with the installation.

The drawings show only the general run of services and approximate location of equipment, outlets, panels, etc. Any significant changes in location of equipment, outlets, panels, etc., necessary in order to meet field conditions shall be brought to the determine attention of the LICI for review before such alterations are made. Modifications shall be made at no additional cost to the Contract.

Carefully check space requirements with other division works to ensure that equipment can be installed in the space allotted.

Wherever work interconnects with work amongst different installation, coordinate with other trades to insure that they have the information

necessary so that the EPC Contractor may properly install the necessary connections and equipment. Identify items requiring access in order that the Ceiling Trade will know where to install access doors and panels.

Furnish and set sleeves for passage of risers through structural masonry and concrete walls and floors and elsewhere as required for the proper protection of each riser passing through building surfaces.

Provide fire stopping around all pipes, conduits, ducts, sleeves, etc, which pass through fire compartments.

Provide required supports and hangers for equipment suitably so as not to exceed allowable loading of structures.

Wherever the work is of sufficient complexity, prepare additional detail drawings to scale to coordinate the work with the work of other trades. Detailed work shall be clearly identified on the drawings as to the area to which it applies. Submit these drawings to the Engineer for review. At completion include a set of these drawings with each set of record drawings.

Coordinate with the local utility companies/authorities for their requirements for service connections and provide all necessary provisions, grounding, materials, equipment, labor, testing, and appurtenances.

Before commencing works, examine adjoining works on which this work is in any way affected and report conditions which prevent performance of the works. Become thoroughly familiar with actual existing conditions to which connections must be made or which must be changed or altered.

The EPC Contractor is responsible to any modifications required due to service not properly coordinated.

1.1.11 Electrical Power Supply Interfaces

The EPC Contractor shall provide power supply points/isolators at certain designated locations within the Project for all mechanical and electrical installations. It is the responsibility of the Contractor to coordinate and make connections to these power supply points/isolators and to provide all the necessary 'down-stream' power supply distribution board/network to the mechanical system's control panels, equipment, sensors, field devices, etc.

1.1.12 Interfacing With All Services and Systems

General

- The EPC Contractor shall provide all necessary provisions for interfacing amongst installation, services, and equipment. All necessary sensors, current/voltage transformers, voltage-free contacts, relays, auxiliary contacts, terminals, transducers etc. for interfacing works shall be provided by the EPC Contractor.
- All control/monitoring wiring from sensors, equipment, and components for the interfacing shall be terminated at a separate interfacing compartment located at the respective equipment/system's switchboard or control panel. The interfacing compartment shall be completed with all necessary connectors, terminals, and with proper identifications to allow interfacing works to be easily carried out. The compartment shall clearly indicate "Extra Low Voltage Cable Only. No Power Cable Connection". Where there is no equipment/system switchboard or control panel involved, the EPC Contractor shall provide separate interfacing panels with provisions same as the interfacing compartment as described above. The locations of the switchboard/control panels and the interfacing panels shall be properly coordinated.
- For every control panel and each module of the switchgears , spare terminals shall be provided for future interfacing works.
- Wiring and cables for interfacing with the fire alarm system and other fire protection and life safety systems shall be fire rated to comply with Civil Defense's requirements.
- All the interface provisions shall be DC operated and rated not more than 50 mA.
- The EPC Contractor shall provide and make all power cable connections from mechanical equipment, local control panels, and distribution boards to the electrical isolators or power points (including cable termination) provided under Division 16 works. Location of power supply isolators and power points shall be properly coordinated.
- In addition to the interfacing requirements shown on the Drawings, interfacing provisions as described below shall also be provided and included in the Contract.

Electrical Installation

The Electrical Installation shall provide the following:

Isolators and power points (fused spur units) for all mechanical equipment and systems. Where shown on the Drawings, the Electrical installation shall include direct power cable connections to the mechanical system's main motor control centers.

Earthing terminal in the Fire Command Centre and all other plant rooms for supplementary equipotential bonding of mechanical equipment and systems.

1.1.13 Examination of Site

Prior to the submitting of bids, visit the project site and become familiar with all conditions affecting the proposed installation and make provisions as to the cost thereof.

The Contract Documents do not make representations regarding the character or extent of the sub-soils, water levels, existing structural, mechanical and electrical installations, above or below ground, or other sub-surface conditions which may be encountered during the work, based on examination of the site or other information. Failure to examine the drawings or other information does not relieve the EPC Contractor of responsibility for satisfactorily completion of the work.

1.1.14 Excavation and Backfill

Where ever required provide trenches details, duly approved by the LICI with all relevant section etc. as per IS codes, minimum before 1 month of laying the pipes, etc. Co ordinate with during the excavation, and ensure that the excavation and backfilling is being properly done as per requirement.

Where ever it is asked by the Owner/ LICI for providing trenches in EPC Contractor's scope. It is deemed that the cost of the pipe is inclusive of trench digging and backfilling. The following points needs to be taken care of while making the trenches.

The trench shall be of widths necessary for the proper execution of the work. Grade bottom of the trenches accurately to provide uniform bearing and support the work on undisturbed soil at every point along its entire length.

Except where rock is encountered, do not excavate below the depths indicated. Where rock excavations are required, excavate rock to a minimum over depth of four inches below the trench depths indicated on the drawings or required. Backfill over depths in the rock excavation and unauthorized over depths with loose, granular, moist earth, thoroughly machine tamped to a compaction level of at least 95% to standard proctor density or 75% relative density or as specified by the Engineer. Wherever unstable soil that is incapable of properly supportingthe work is encountered in the bottom of the trench, remove soil to a depth required andbackfill the trench to the proper grade with coarse sand, fine gravel or other suitable material. Excavate trenches for utilities that will provide the following minimum depths of cover from existing grade or from indicated finished grade as required by local authorities. Trenches should not be placed within 3 meters of foundation or soil surfaces which must be resist horizontal forces.

Do not backfill until all required tests have been performed and installation observed by the Engineer. Comply with the requirements of other sections of the specifications. Backfill shall consist of non-expansive soil with limited porosity. Deposit in 15 cm layers and thoroughly and carefully tamp until the work has a cover of not less than 30 cm. Backfill and tamp remainder of trench at 30 cm intervals until complete. Uniformly grade the finished surface.

1.1.15 Cutting and Patching

All kinds of cutting and repairing of brick Walls or Partitions, etc. for the proper routing of pipe, cutting and repairing of RCC wall, or ceiling shall be in the scope of the EPC contractor. Where cutting, channeling, chasing or drilling of floors, walls, partitions, ceilings or other surfaces is necessary for the proper installation, support or anchorage of conduit or other equipment, layout the work carefully in advance. Repair any damage to the building, piping, equipment or defaced finish plaster, woodwork, metalwork, etc., using skilled trade people of the trades required at no additional cost to the Contract. Provide slots, chases, openings and recesses through floors, walls, ceilings, and roofs as required. Where these openings are not provided, provide cutting and patching to accommodate penetrations at no additional cost to the Contract.

1.1.16Sealingof Penetrations

Air Tight Seals

All penetrations through the building fabric subject to suction or pressurization shall be sealed airtight.

Holes in Roof

Roof penetrations for passage of conduits or circular PVC and PVC Cables shall be sealed watertight using a flexible polypropylene conical sleeve manufacturer to seal the cable to the roof structure, regardless of the roof profile. All sharp metal edges, which may come in contact with the cable, shall be suitably bushed.

Fire Rated Penetrations

Where services penetrate any fire rated barrier, the EPC Contractor shall seal the penetration with the use of an appropriate material to ensure the integrity of the fire barrier. The EPC Contractor shall seal the cable enclosures through fire rated barriers to ensure the integrity and rating of the fire barrier.

Acoustic Penetrations

Where services penetrate acoustic barriers, sealant shall be supplied and installed to maintain the acoustic separation at least equal to the barrier penetration.

1.1.17 Mounting Heights

Verify exact locations and mounting heights with the Engineer before installation.

1.1.18 Supports

Support work in accordance with the best industry practice. Provide supports, hangers, auxiliary structural members and supplemental hardware required for support of the work.

Provide supporting frames or racks extending from floor slab to ceiling slab for work indicated as being supported from walls where the walls are incapable of supporting the weight. In particular, provide such frames or racks in electric

closets and equipment room. Provide supporting frames or racks for equipment which is installed in a free standing position.

Supporting frames or racks shall be of standard angle, standard channel or specialty support system steel members, rigidly bolted or welded together and adequately braced to form a substantial structure. Racks shall be of ample size to assure a workman like arrangement of all equipment mounted on them. Adequate support of equipment (including outlet, pull and junction boxes and fittings) shall not depend on ducts, pipe, electric conduits, raceways, or cables for support. Equipment shall not rest on or depend for support on suspended ceiling media (tiles, lath, plaster, as well as splinters, runners, bars and the like in the plane of the ceiling). Provide independent support of equipment. Do not attach to supports provided for ductwork, piping or work of other trades.

Provide required supports and hangers for equipment so that loading will not exceed allowable loading of structure. Equipment and supports shall not come in contact with work of other trades.

1.1.19 Fastenings

Fasten equipment to building in accordance with the best industry practice. Where weight applied to the attachment points is 45kg or less, conform to the following as a minimum:

1. Wood : Wood screws
2. Concrete and solid masonry : Dash - Fastener of appropriate ratings HILTI/FISHER
3. Solid metal : Machine screws in tapped holes or with welded studs

Where weight applied to the building attachment point exceeds 45 kg, but is 135 kg or less, conform to the following as a minimum:

- At concrete slabs provide 60cm x 60cm x 13cm steel fishplates on top with through bolts. Fishplate assemblies shall be chased in and grouted flush with the top slabs screed line, where no fill is to be applied.

- At steel decking or sub-floor for all fastenings, provide through bolts and threaded rods. The tops of bolts and rods shall be set at least one inch below the top fill screed line and grouted in. Suitable washers shall be used under bolt heads or nuts. In cases where the decking or sub-floor manufacturer produces specialty hangers to work with his decking or sub-floor such hangers shall be provided.

Where weight applied to building attachment points exceeds 135 kg, coordinate with and obtain the approval of LICI and conform to the following as a minimum:

- Provide suitable auxiliary channel or angle iron bridging between building structural steel elements to establish fastening points. Bridging members shall suitably weld or clamped to building steel. Provide threaded rods or bolts to attach to bridging members.

For items which are shown as being ceiling mounted at locations where fastening to the building construction element above is not possible, provide suitable auxiliary channel or angle iron bridging tying to the building structural elements. Wall mounted equipment may be directly secured to wall by means of steel bolts. Groups or arrays of equipment may be mounted on adequately sized steel angles, channels, or bars.

1.1.20 Identification

Identify equipment with permanently attached black phenolic name plates with 13 mm high white engraved lettering. Identification shall include equipment name or load served as appropriate. Name plates shall be attached with cadmium plated screws; peel and stick tape or glue on type name plates is unacceptable. Services runs shall be properly identified as per the requirements in the Contract. See individual section for additional identification requirements.

1.1.21 Prohibited Labels and Identifications

In all public areas, tenant areas, and similar locations within the project, the inclusion or installation of any equipment or assembly which bears on any surface any name, trademark, or other insignia which is intended to identify the manufacturer, the vendor or other source(s) from which such object has been obtained is prohibited. Required test lab certification labels shall neither

be removed nor shall identification specifically required under the various technical sections of the Specifications be removed.

1.1.22 Equipment Pads and Anchor Bolts

Provide all details with proper sections for the equipment pads and anchor. The equipment pads casting and making provision for anchor fastening shall be as per the final UNALTERED drawing duly approved by the LICI , shall be in the scope of EPC contractor.

All equipment pads for all vibrating equipments shall have cork vibration pads sandwiched between the finish surface and the bottom surface of required thickness suggested by the EPC contractor to ensure that the minimum vibration can travel below.

Provide galvanized anchor bolts for all equipment placed on concrete equipment pads, inertia blocks, or on concrete slabs. Provide bolts of the size and number recommended by the manufacturer of the equipment and locate by means of suitable templates. Equipment installed on vibration isolators shall be secured to the isolator. Secure the isolator to the floor, pad, or support as recommended by the vibration isolation manufacturer.

Where equipment is mounted on gypsum board partitions, the mounting screws shall pass through the gypsum board and securely attach to the partition studs. As an attached to 15 cm square, galvanized metal back plates which are attached to the gypsum board with an approved non-flammable adhesive. Toggle bolts installed in gypsum board partitions are not acceptable.

1.1.23 Miscellaneous:

A site order book will be maintained at site, which will be in the custody of the Owner, or his representative and all instructions given to the EPC contractor will be recorded in the site order book and the same has to be signed by the EPC contractor to comply with the instructions given therein.

After completion of the work the whole installation shall be tested by the EPC contractor. The tests shall comply the following I.E.E. Regulations and shall be submitted along with the final bill:

- The result of the insulation test shall comply with the I.E.E. Regulations 1101 to 1108A and 1008B as may be applicable.

- Test shall be carried out to ascertain that all the non-linked SP switches have been connected to the phase conductor.
- The continuity test of the earthing system shall comply with I.E.E. Regulations 1108 to 1109 to the latest addition.

If the result of the above tests does not comply with the I.E.E. Regulations, the EPC contractor shall be bound to rectify the faults so that the required results are obtained.

The EPC contractor shall be responsible to provide all the necessary test certificates of testing instruments, such as megger insulation tester, earth tester multi-meter, AVO meter etc for carrying out the above tests. The work will not be considered as complete and taken over by the Owner till all the components of the work after being completed at site in all respects have been inspected / tested by the LICI/Owner to his entire satisfaction and a completion certificate issued by the Owner/LICI to this effect.

Shop drawing for electrical work e.g. equipment, cable earthing and conduit layout for all systems shall be prepared by the contractor and got approved before starting of the work. At the completion of the work and before issuance of certificate of virtual completion, the EPC contractor shall submit 6 sets of drawing and two tracing of each drawing to Owner of each layout drawings drawn at approved.

EPC Contractor's Superintendence:

- The contractor shall provide all necessary superintendence during the execution of the works and as long as there is necessity. The contractor or his competent and authorized agent or representative approved of in writing by the owner (which approval may at any time be withdrawn) is to be constantly on the works and shall give his whole time to the superintendence of the same. Such authorized agent or representative shall receive on behalf of the contractor, directions and instructions from the Engineer-in-charge or his representative.
- The contractor shall provide detailed organization of the execution team deployed for the works with names and CV's, of all key staff before the commencement of work and get it approved of in writing by the Owner/

LICI . Contact telephone or pager numbers for emergency and/or twenty-four (24) hour call shall also be included.

- If in any case of withdrawal of any worker/ technician/ Engineer from the execution team, the replacement of the same shall be done with equivalent qualification, and shall be approved in writing by the Owner/ LICI .

1.2 PRODUCT, TESTING & COMMISIONING

1.2.1 Design Criteria

Electrical Details for Incoming Supply:

Supply Voltage: 11 KV

Voltage Regulations: + 10%

Frequency Regulations: + 3%

Combined Regulations: + 10%

Frequency: 50 Hz

Neutral: Grounded

Short Circuit Fault withstand capacity: as per calculations

LT Power Distribution System:

Voltage: 415 V

Frequency: 50 Hz

Neutral: Grounded

Short Circuit Fault withstand capacity: 10kA to 65kA for 1Sec., as per calculations.

Control supply for Electrical System:

The various supply voltage to be used in the control panels for the main equipment shall be as under:

Spring charge motor :	230V, AC or 24V DC (Universal Motor)
Closing/ Trip Coil :	24V, DC

Alarm/ Indication/ Relays :		24V, DC
Heaters	:	230V, AC

Painting of Panels:

Powder coating of approved shade as per Specification. (Refer clause of painting)

Painting of Cable Trays and Structural steel:

Powder coating of approved shade as per Specification. (Refer clause of painting)

Cable Details:

LT Control Cables: Copper conductor armoured PVC insulated 1.1 KV grade.

LT Power Cables: Aluminium conductor armoured XLPE insulated.

Grounding Conductors: Copper/ G.I. as per specifications

1.2.2 Drawings/ Specifications

The EPC contractor of his responsibility to carry out the work as per the approved Drawings / specifications. Additional information required by the bidder for successfully completing the work shall be obtained by him.

1.2.3 Shop Drawings

The EPC contractor shall prepare detailed coordinated electrical shop drawing indicating Panel layout, with other relevant services. 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. Control and Relay Panel and fixing details 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 full proof system including any missing component/accessories to meet with the intent of the specifications. Contractor will submit 2 (two) prints for preliminary approval and finally 6 (six) prints for distribution.

1.2.4 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, manufacturer's instructions should be followed.

1.2.5 Completion Documents and Drawings

Three copies of operation manuals/catalogues of all standard equipment are to be furnished by the contractor immediately after commissioning of plant. Three copies of write up on preventive maintenance, trouble shooting and operating instructions of the system along with as-built drawings are to be supplied by the Contractor at the time of commissioning. On completion of the work in all respects, the Contractor shall supply five portfolios (300x450 mm), each containing complete set of drawings on approved scale, clearly indicating complete layouts, location; wiring and sequencing of automatic controls, location of all concealed wiring and other services. Each portfolio shall also contain consolidated control diagrams and technical literature on all controls. The Contractor shall frame under glass, in the Panel rooms, one set of these consolidated control diagrams.

1.2.6 Materials and Equipment

All the materials and equipments shall be of the approved make and design. Unless otherwise called from LICI, only the best quality materials and equipment shall be used.

Space Heaters:

Suitable number of 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.

Fungi static Varnish:

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will

interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

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.

Degree of Protection:

The enclosures of the control cabinet, junction boxes and marshalling boxes, panels etc to be installed shall provide degree of protection as detailed here under.

1.	Installed Outdoor	:	IP-55
2.	Installed indoor in air-conditioned area	:	IP-31
3.	Installed in covered area	:	IP-42
4.	Installed indoor in non air-conditioned area where possibility of entry of water is limited	:	IP-41
5.	For LT Switchgear (AC and DC distribution boards)	:	IP-42

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.

Rating plates, Name plates and Labels:

LT panel and auxiliary items installed in the building is 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 loading conditions of equipment in question has been designed to operate and such diagram plates as may require by the owner. The rating plate of each equipment shall be in accordance with IEC requirement. All such name plates, instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates on with Hindi and another with English inscriptions may be provided.

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 the Owner's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance program to control such activities at all points necessary. Such programme shall be outlined by the Contractor and shall be finally accepted by the Owner 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 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 authorizing release of manufactured product to the Owner.
- System for maintenance of records.
- System for handling storage and delivery.

The Owner 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.

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 satisfactory.

1.2.7 Inspection, Testing and Inspection Certificates

The Owner and the LICI or duly authorized representative shall have at all reasonable times free access to the EPC 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 EPC Contractor shall obtain permission to inspect as if the works were manufactured or assembled on the EPC Contractor's own premises or works. Inspection may be made at any stage of manufacture, dispatch or at site at the option of the Owner 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 EPC Contractor shall intimate the Owner/LICI the detailed programme about the tests at least three (3) weeks in advance in case of domestic supplies. If for any item type test were pending payment would be made on successful completion of type/routine test(s) actually carried out as per LICI/Owner instructions.

The EPC Contractor shall give the LICI/Owner thirty (30) days written notice of any material being ready for testing. Such tests shall be to the EPC Contractor's account. The LICI /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/ LICI and he shall forthwith forward to the LICI duly certified copies of tests in triplicate.

The LICI/Owner 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 LICI/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 LICI/Owner, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the LICI/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 Owner 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 material inspection clearance certificate by the Owner.

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 labor, materials, electricity, fuel, water, stores, apparatus and instruments as may be required by Owner/LICI or this authorized representative to carry out effectively such tests of the equipment in accordance with the Specification.

The inspection by Owner/LICI 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 LICI/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/LICI 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.

1.2.8 Tests

Charging (Pre-commissioning tests):

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Owner/LICI 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. / vendor/ bidder submittal and as included in the Contractor's quality assurance programme.

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, immeasurable parameters shall be taken into account in a reasonable manner by the Contractor for the requirement of these tests. T

- 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 reimburse by Owner on production of requisite documents.

1.2.9 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.

1.2.10 Protection

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which

are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

1.2.11 Finishing Of Metal Surfaces

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 galvanize. All steel conductors used for earthing/grounding (above ground level) shall be galvanized according to IS: 2629.

Painting:

- All sheet steel work shall be degreased, pickled, and phosphated in accordance with the IS-6005 "Code of practice for Phosphate 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 swab 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 Phosphate process 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, stowing type zinc chromate primer. The first coat may be "flashing dried" while the second coat shall be stoved.
- Powder coating/electrostatic painting of approved shade shall be applied.
- The exterior color of the paint shall be as per IS-5 or as approved by LICI . 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.

1.2.12 Handling, Storage and Installation

In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Owner 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 site procedure for transporting of materials, unloading, and safe storage. The equipments after collection from store shall be erected, tested and commissioned as per contract specification, manufacturer guidelines and Engineer-in-charge instruction.

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

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

The Contractor shall submit to the Owner every week, a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site.

Any demurrage, wharf age and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.

The Contractor shall be fully responsible for the equipment/material until the same is handed over 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.]

1.2.13 Protective Guards

Suitable guards shall be provided for protection of personnel on all exposed rotating and / or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose. The Contractor shall also conform to the general regulations governing personnel on the site and must keep to the working space allocated for their use. The contractor shall be responsible for any kind of mishap, etc. happened with personnel. The Owner shall not take the responsibility for any of such kind.

1.2.14 Tools and Tackles

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dismantling and maintenance of the equipments.

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

2.1 GENERAL

2.1.1 Work Description

This section describes the supply and installation of wiring facilities systems include conduits, cable trays, cable ladder and Trunking system, c/w associated fittings and accessories. All cables running above the suspended

false ceiling, columns, or on surface shall be supported by proper clamps, on cable tray or cable ladder system. No free hanging of cable is allowed. The cable routes shown in the drawings shall be used as a guide only. The cable routes may be physically examined and coordinated with other services before undertaking the installation work in hand. Uncoordinated and inaccessible routes after other services are installed, shall be relocated at the expense of the Contractor. All conduits, trunking, cable trays and cable ladders shall be earthed in accordance to IS:4043.

2.1.2 Standards

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

PVC Conduit and Fitting Accessories	IS-9537/1983 (Part-III)/BS6099 & BS4607
Cable Tray	BS729
Cable Ladder	BS729
Cable Trunking	BS4678

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

2.1.3 Submissions

All technical submissions shall be approved by the EPC contractor prior to the respective stages of construction with respect to the approved design and development documents. In case of major deviations, it shall be brought under the notice of LICI for its review and approval. Routing of installation Sample of proprietary factory-made accessories, elbows, risers, reducers, tees, crosses, etc.

2.2 PRODUCTS

2.2.1 PVC Conduit and Accessories

FRLS 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 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 of M.S. or otherwise mentioned.
- Conduit shall be terminated with adopter/PVC glands as required.

PVC Conduit Accessories

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

2.2.2 Conduit Installation

Layout

- The conduit layout and conduit routes shall be submitted for approval. Allowance for adjustments due to site conditions shall be made at no extra cost.
- Conduit routes shall be chosen for easy, straight runs with minimum bends and crossings. Generally they shall follow the structure of building, running at right angles or in parallel to floors and ceilings. Conduits shall be kept within 300 mm of floors and ceilings when running parallel to them.
- Outlet boxes for housing accessories shall be used as draw boxes. The total number of draw boxes shall be kept to a minimum and shall be provided so that conduit runs do not exceed 12 m or have more than two right angle bends.
- All conduits shall be kept clear of gas and water pipes. In particular, conduits shall be at least 150 mm away from gas pipes. Where proximity to these pipes is unavoidable, they shall be effectively segregated e.g. using rubber or other insulating material to prevent appreciable voltage differences at possible points of contact. Segregation from extra low voltage circuits and telecommunication circuits shall also apply unless these are wired to the same voltage requirements as lighting and power circuits.
- Conduits from different distribution boards shall not be connected to the same junction box. Each run of conduit shall be assembled complete with draw-in-wires.

Joints and Terminations

- Electrical and mechanical continuity shall be maintained throughout all conduit joints and terminations. Conduit threads shall be thoroughly cleaned and tightly screwed. The conduit system shall be watertight after installation.
- Conduits shall be connected using couples or via boxes. With a coupler, the ends of the conduit shall butt close together and the running coupler is screwed tightly on and tightened by a locknut.
- Conduits terminating into boxes provided with spouts shall be threaded so that there are no exposed threads. For boxes with no spouts, the

termination shall be made using a brass bush and a coupler. The conduit is pushed through the knockout or drilled entry and the bush is screwed tightly onto its end. The coupler is screwed to butt firmly against the exterior wall of the box.

- Where conduits are not jointed or terminated in boxes, they shall be terminated in a screwed brass bush.
- In all joints and terminations, conduit threads shall not be exposed. Where this cannot be avoided as in a running coupler, the exposed threads shall be coated with red lead paint to seal against the ingress of water.

Bends

- Conduits shall only be bent cold with an approved type of bending block or bending machine, without altering the dimensions of their sections.
- All conduit bends shall be such as to permit compliance to the requirements for bends in cables to as stated in the BS 7671.
- Bends shall be made with as large a radius as the position of the conduit within the building permits. Where the bend is more than 90 degree, circular or rectangular junction boxes are to be used for connecting conduits.

Cabling

- The conduit system must be installed free of obstructions and sharp corners before any cables are drawn in. Conduits shall be thoroughly swabbed to remove moisture and dirt immediately prior to the drawing in of cables.
- Cables shall be drawn without crossing each other and shall not be pulled against the walls of the draw boxes. Slack cables shall left in all draw boxes.
- Cables shall be continuous throughout conduit lengths and no joints are permitted. There shall be no kink in cables, neither any cut, abrasion or chink in the cable insulation.

- The same conduit shall carry the lead and return conductors bunched together. However, the same conduit shall not house cables from different distribution boards.
- Cables for power and lighting circuits and extra low voltage systems shall not be drawn into the same conduit. Lighting and power circuits shall run in separate conduits except, where an adopter box is employed as final distribution point, a number of final circuits are grouped together in larger conduits between the distribution board and the adopter box provided that all final circuits in one conduit are of the same phase. In the case of three phase circuits, all three phases including neutral, if any, shall be drawn into the same conduit.
- Conduits shall not constitute the earth continuity path for the electrical circuit. A separate circuit protective conductor shall be installed within the conduit. The whole conduit system shall be effectively earthed.
- Flexible conduits shall have a separate earthing conductor installed within the tubing and connected at conduit ends. Flexible conduits in general shall not be used for more than 3m length.

2.2.3 Maximum number of PVC insulated 650/1100V grade/copper conductor cable conforming to IS:694-1990

Nominal	20mm		25mm		32mm		38mm		51mm		64mm	
Cross-Sectional area of Conductor in Sq.mm												
		B	S S	B	B	S	B	S	B	S	B	S
1.0	2	3	4	5	6	7	8	9	10	11	12	13

1.5	5	4	10	8	18	12	-	-	-	-	-	-
2.5	5	3	8	6	12	10	-	-	-	-	-	-
4.0	3	2	6	5	10	8	-	-	-	-	-	-
6.0	2	-	5	4	8	7	-	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	2	3	3	5	5	10	7	12	8
25	-	-	-	-	3	2	5	3	8	6	9	7
35	-	-	-	-	-	-	3	2	6	5	8	6
50	-	-	-	-	-	-	-	-	5	3	6	5
70	-	-	-	-	-	-	-	-	4	3	5	4

Notes:

- **The above table shows the maximum capacity of drawing in of cables in conduits**
- The columns Head 'S' apply to runs of conduits which have distance not exceeding 4.25 m between draw in boxes and which do not deflect from

the straight run by an angle of more than 15 degrees. The columns heads 'B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.

- Conduit sizes are the nominal external diameters.

Access and Drainage

- The conduit system shall be rewirable, that is, draw boxes must be accessible for the purpose. Where boxes are concealed, their covers shall be flushed with the finished surface.
- The need for accessibility notwithstanding, the conduit system shall be protected against the ingress of water and impurities. When installed, conduits shall be kept dry and free of debris with approved pipe plugs or caps. Such plugging is especially essential prior to pouring concrete for concealed installation. As for boxes, they shall be covered by steel plates prior to concreting.
- When installed outdoor, and in situations liable to condensation of moisture, conduits shall be arranged to be self draining, so that water may drain to low points which are fitted with a drain plug. Conduits laid under concrete floors shall have watertight floor-traps of approved detail for access of these drainage points.
- Conduits run on surfaces other than structural steel members shall be secured using galvanized space bar saddles and brass fixing screws. Spacing of saddles shall not exceed 1.2 m for conduit sizes up to and including 25 mm and 1.8 m for sizes 32 mm and above.
- Conduits run on structural steel shall be secured using girder clips or an approved clamp. These conduits and those run in the vicinity of structural steel shall be bonded to the steelwork using an efficient and permanent metallic connection. The conduits shall not in any way be under mechanical stress.
- All conduit boxes except loop-in patterns shall be fixed direct to the building structure in addition to the support provided by the conduits.
- Conduits terminating into surface boxes shall be secured by a minimum of 3 saddles at not less than 32 mm, 150 mm and 300 mm respectively from the box.

- Conduits shall be painted with an approved paint to blend with visual environment. A zinc rich undercoat shall be provided before painting the final coat.

2.2.4 Cable Tray/ Cable Ladder

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

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

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

Cable Ladder	60	200 - 600	-	225	150	110	45	-
	110	200 - 600	-	310	-	140	65	50

	Safe Working Load (SWL) with a span length up to 10 meters							
Description	**Side Height (in mm)**	**Width (in mm)**		**Span length (in meters)**				
			1.5m	**2m**	**2.5m**	**3m**	**4m**	**5m**	**10m**
			Permitted Load (in kg/meter)						
Perforated Cable Tray for long span distance	110	200 - 300	160	110	75	-	20	-	-
		400 - 600	200	150	100	-	40	-	-
	160	200 - 300	230	180	140	100	70	-	-
		400 - 600	250	200	160	130	100	-	-
Cable Ladder for	110	200 -	160	110	80	40	-	-	-

long span distance		300							
		400 - 600	210	150	100	70	-	-	-
	160	200 - 300	230	180	140	100	70	-	-
		400 - 600	250	200	160	130	100	-	-
	200	200-300	250	200	140	100	-	-	-

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

Cable Tray:-

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

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

All the cable tray accessories like Bend's, TEES's, Cross over's etc. should be designed in accordance with IEC 61537 and shall be factory fabricated. The accessories shall be from the same material as of the tray and modular type,

it should be connected with the trays by using fasteners. Typical details of trays, fittings and accessories.etc. are shown in the enclosed drawings.

For Cable trays designed, tested and confirming to IEC 61537, thickness of cable tray should be according to the manufacturer's catalogue. For locally fabricated and non-tested tray, thickness should be 2 mm up to span length of 1.5 meter, 2.5 mm for span length between 2 to 3 meter and 3 to 4 mm for span length between 4 and 10 meter

Cable ladder:-

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

Width: 200 to 600 mm in multiples of 100 mm

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

For Cable Ladders designed, tested and confirming to IEC 61537, thickness of cable Ladder should be according to the manufacturer's catalogue. For locally fabricated and non-tested Ladder, thickness should be 2.5 mm up to span length of 1.5 to 2 meter, 3 mm for span length between 2.5 to 4 meter and 3 to 4 mm for span length between 5 and 10 meter.

Mounting Accessories (supports and Brackets):-

The mounting accessories shall be fabricated from steel and has to be hot dip galvanized against corrosion confirming to ISO 1461-1999 for installations in

both indoor and outdoor applications and should be of completely modular type.

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

Corrosion Protection:-

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

Testing and Certification:-

Cable tray / Ladder, bend, T Bend, cross, and all supports are to be tested for Safe Working Load (SWL), deflections, Impact resistance, Salt Spray & Electrical continuity test according to IEC 61537. The cable tray/ladder should not deflect more than 1/100th of the span length at SWL in Mid span and the transverse deflection of all mounting accessories at SWL shall not exceed 1/20th of the length. The cable tray/ cable ladder should be tested up to 1.7 times SWL at minimum and maximum room temperature. The temperature classification of cable tray system should be - 5 to + 150°C.

2.2.5 Cable Trunking

Cable trunking shall be manufactured from 1.6 mm minimum electro-galvanized mild sheet steel to BS4678 finished in oven-baked electro statically coated epoxy powder coating with color.

All trunking shall have removable lids extending over their entire lengths. Lids shall be fixed at interval not exceeding 1 meter by means of brass steel screws

which and protected against corrosion by a finish of zinc coating or equivalent to zinc coating.

Factory- made bends, joints, elbow, riser, tee, reducer and accessories with same material shall be provided throughout the installation for trunking.

Trunking space factor shall be in compliance with latest IS standards.

Copper earth link bar shall be fixed at every joint of the cable trunking run.

Note: All items mentioned in this section shall be manufactured to comply with the specifications of National Electrical Code (NEC) and National Electrical Manufacturer's Association (NEMA).

3.0 WIRES AND CABLES

3.1 GENERAL

3.1.1 Work Description

The design, manufacturing, testing and supply of single core PVC insulated 1.1 KV grade stranded twisted wires shall comply with following standards with update amendments under the specifications.

IS-3961: Current rating for cables.

IS-5831: PVC insulation and sheath of electric cables.

IS-694: PVC insulated cables for working voltage up to and including 1100 volts.

IEC-54 (I): PVC insulated cable.

Copper/ Aluminum stranded twisted conductor PVC insulated wires shall be used in conduit as per item of work. Aluminum wires for power cables and copper wires for control cables shall be used.

The wires shall be color coded - (red, yellow, blue) for Phases, black for Neutral and green for Earth.

Progressive automatic in line indelible, legible and sequential marking of grade, voltage, capacity and length in meters shall be embossed at every meter on the outer sheath of cable.

The design, manufacture, testing and supply of the cable under these specifications shall comply with following standards latest edition of:

IS: 8130: Conductors for insulated electric cables and flexible cords.

IS: 5831: HRPVC / HR PVC insulation and LSZH sheath of electric cables.

IS: 3975: Mild steel wires, strips and tapes for armoring cables.

IS: 3961: Current rating of cables.

The routing and minimum rated current carrying capacity of the LV power cables shall be indicated on the Drawing. The Contractor shall consider the manufacturer data and engineering for cable sizing and to ensure that it meets the conditions of grouping, ambient temperature etc.

All LT cables for normal power/control circuits within buildings shall be XLPE insulated and PVC sheathed Aluminum conductor and control cables shall be PVC insulated and PVC sheathed copper conductor respectively.

All LT cables, for emergency power circuits serving emergency light, Fire Protection System, Security Systems, emergency communication systems, and sump pump system and fire lifts etc. with back-up from UPS systems or incoming and outgoing from the Emergency Main Switchboard, shall be fire resistant as required.

Cables in service duct, open trench, direct-laid underground in soil shall be by means of armoured cables. Non-armoured cables shall only be laid in conduits, trunkings or tray/ladder for mechanical protection.

3.1.2 Standards

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

1.	**IS: 694**	**: HRPVC/XLPE insulated (heavy duty) electric cables for working voltage up to and including 1100 volts.**

- **IS: 424-1475(F- : Power cable-flammability test. 3)**
- **IS: 7098(I): Specification for cross-linked polyethylene insulated**

  LSZHPVC sheathed cable for working voltage up to 1.1

  KV.

4.	**IS: 1554**	**:**	**Specification for PVC insulated (heavy duty) electric cables for working voltages up to and including 1100 volts.**

- **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 tests Class-IE, Electric cables, field splices and connections for power generation station.**
- **ASTME:662/ : Standard test method for specific optical density of**

  IEC: 754(x) smoke generated by solid materials

9.	**IS: 10418**	**:**	**Cable drums.**
10	**IS-10810**	**:**	**Testing method of cable.**
11.	**IS-6121**	**:**	**Cable glands.**
12.	**IS-9537**	**:**	**Rigid steel conduit.**

The manufacturing of the cable shall also conform to the requirements of all relevant local codes, as applicable, together with the additional requirements referred to in the approved Specification and Drawings of EPC contractor. Only more stringent specification shall be followed.

3.1.3 Submission

All technical submissions shall be approved by the EPC contractor prior to the respective stages of construction with respect to the approved design and development documents. In case of major deviations, it shall be brought under the notice of LICI for its review and approval. As a minimum requirement, the submission shall include the following:

Equipment submission with manufacturer's data

Sample submission

- **Shop Drawings of the cable route showing the co-ordinated routing of cables, arrangement on cable trays, methods of fixing of cable trays and cables, etc. All conduits including concealed conduit routing drawings shall also be included**
- **Cable test reports and IS Certification**
- **Cable schedule indicate the following data include:**
- **Cable code and type and installation method**
- **Cable feed from and serve to**
- **Cable route length and voltage drop**
- **Cable capacity and**
- **Upstream protection breaker rating**

The cable schedule shall be prepared in accordance to the cable manufacturer's data.

3.2 PRODUCT

3.2.1 LT Cables

Service connection cable shall be ISI marked, XLPE insulated copper conductor armoured cable upto 10sqmm size, Aluminium conductor armoured XLPE cable shall be used above 10sqmm size.

- The cables shall be suitable for laying in racks, ducts, trenches conduits and under-ground buried installation with uncontrolled back fill and chances of flooding by water.
- They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating condition.
- The aluminum/ 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.
- The cable should withstand 2.5 kA for 1 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.
- The fillers and inner sheath shall be of non-hygroscopic fire retardant materials and shall be suitable for the operating temperature of the cable. Filler and inner sheath shall not stick to insulation and outer sheath.
- Progressive automatic in line indelible, legible and sequential marking (grade, voltage, capacity, length - in meters) shall be embossed at every meter on the outer sheath of all cables and at every 5 meter 'LSZH marking in case of 'LSZH cables.
- IS: 3975 method (b) for strip / wire armouring shall only be acceptable. For single core cable aluminium wire armouring shall be used.
- Allowable tolerance on the overall diameter of the cables shall be + 2mm.
- The normal current rating of all HRPVC/XLPE insulated cables shall be as per IS: 3961.
- A distinct inner sheath shall be provided by pressure extrusion process for all multi cores armoured and unarmoured cables as per IS: 5831.
- Outer sheath shall be provided by extrusion process as per IS: 5831.
- 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.

- In plant repairs to the cables shall not be accepted.
- All the cables shall be supplied in non-returnable drums as per IS: 10418.
- Fire Survival Cables

  Multi core Al / Cu Conductor XLPE/ Cross linkable Low Smoke Halogen Free insulated with Fire rated Glass Mica Tape, LSZH inner and outer Sheathed, Armoured with GI Strip/ Wire Fire Survival Cable.

  Basic design shall be as per BS: 7846-2009, Fire resistance of the cable shall be as per BS:8491-2008 & 8434-2:2003

Inspection

All cables shall be inspected on receipt of the same at site and checked for any damage during transit.

Joints in Cables

Cable drum length and sizes of cable lengths required may be checked carefully before cutting the cables from drum.

The contractor shall take care that the cables received at site are distributed to various locations in single length as far as possible to ensure maximum utilization. Where the joints are unavoidable, the same is to be done with approval from the Owner/LICI . The joints shall be done by qualified jointer strictly in accordance with manufacturer's instruction / drawings in presence of Engineer-in-charge.

Joint Boxes for Cables

The cable joint boxes shall be of appropriate size suitable for type of cable of particular voltage rating.

Cable Joints

- All cable joints materials shall be of standard make and suitable to requirement. On jointing of cables in the joint box the cable compound shall be filled in accordance with manufacturer's instructions and in approved manner. 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 hardware 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 solder less 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 Meter on either side of cable joint.
- The contractor shall liaise fully with all other contractors to achieve an efficient and properly coordinated installation where equipment has to be re-positioned due to lack of site liaison; no extra cost shall be incurred by the client.

XLPE HT Cables (Upto 11KV)

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 HT cable shall be laid at least 1200mm for cable up to 33 KV (E) below the ground level in a trench 450mm wide.

After laying and jointing work is completed High Pot test shall be performed in presence of Engineer-in-charge and test results submitted for approval in order to ensure that they have not been damaged during or after the laying of cables. 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.

Note: All other procedure will be followed as per L.T. cables.

3.3 EXECUTION

3.3.1 Erection of Cables

Notwithstanding the cable routes indicated on the Drawings the Contractor shall be entirely responsible for the supply of correct lengths of the cables to be installed and for all allowances for connecting and terminating the cables to the switchgears and transformers respectively. The Contractor shall submit proposed cable routes including details of supports for the cables for approval before installation. The cable shall not be run in places other than corridor, passageway, electrical riser or other designated areas subject to the Engineer's approval. The cost of support shall be deemed to have included in the Contract.

3.3.2 Cable Pulling

Winching of cables through ducts / pipes shall only be carried out with the approval of the Engineer-in-charge in which event a pulley eye shall be attached to the conductors. Cable shall be run in neat and orderly manner to allow space for future cabling and maintenance. Under any circumstances the cable shall not run diagonally across a room, cable basement, corridor, etc.

A cable sheath stocking may be employed or cables where no undue stress in the sheath is likely to occur. Care shall be taken to ensure that the draw strain is applied to the armouring and protected during drawing against damage.

3.3.3 Cable Laying

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 375 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 inter axial spacing between the cables except where otherwise specified is at least 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 200 mm (minimum). Cable shall be laid in reasonably straight line, where a change in direction takes place a suitable curvature shall be i.e. either 20 times the dia meter of the cable or the radius of the bend shall not be less than twice the diameter of the cable drum or whichever less is. Minimum 3 meter long loop shall be provided at both sides of every straight through joint & 3 meters at each end of cable or as directed at site.

Greater care shall be exercised in handling the cable in order to avoid forming 'Kinks'. The cable drum shall in-verbally convey on wheels and the cable unrolled in right direction as indicated on the drum by the manufacturer. The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains.

Cables laid in trenches in single tier formation, 10 cms all- around sand cushioning is provided below and above the cable before a protective cover is laid. For every additional vertical tier. The 30 cm of sand cushion is provided over the initial tier. The cable shall be protected by 2nd class brick of size not less than 230 x 115 x 75mm, 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 sand cushioning and tiles or bricks lying and inspection is carried out by 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 & consolidated before laying the next layer.

PVC pipe shall be provided on all road crossing. The size of the pipe shall be above the size of the cable. Minimum 100mm dia. pipes are to be provided. The pipe shall be laid in ground with special arrangement and shall be cement jointed and concreting of 1:5:10 shall be provided as per relevant IS with latest amendment. Nothing extra shall be paid on this account. Cable route markers at interval of 30 meters and at the point of direction change shall be provided to indicate cable path. Aluminum strip cable tag of 20mm wide with engraved tag no. shall be provided at both ends of cable.

Where the cables are laid in ducts (pucca trenches) inside the building, they will be laid on MS rack/ cable trays grouted on trenches walls. Cables passing through floors shall be protected from mechanical damage by steel channel to a height of one meter above the floor. Sleeve shall be provided in the wall for crossing of cables.

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 multi core 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/fiber glass.

Cable openings in wall/floor shall be sealed by the contractor suitably by Hessian tape & Bitumen compound or by any other proven material to prevent ingress of water.

After the cables are laid, shall be tested as per IS and the results submitted to LICI Engineer and in case the results found unsatisfactory, all the repairing/ replacing of cables will be done by the contractor free of charge.

3.3.4 Internal Wiring

The scope of work under this section covers installation and wiring for lights, fans, exhaust fans, call bells, fan coil units, geysers and power sockets etc., The wiring shall generally be done using ISI FRLS PVC insulated stranded copper

conductor wires in ISI FRLS PVC Heavy duty conduits as called for including providing switches, sockets, plug tops, electronic fan regulators, outlet boxes etc. 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 pulled into conduits. They shall be twisted copper conductors with thermoplastic insulations of 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 LICI . No reduction of strands is permitted at terminations. No wire smaller than 1.5 sq.mm shall be used. 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 sub main sub-circuit wiring. The ferrules shall be provided at both end of each sub main 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 two meters of each other. 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 polycarbonate 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.

3.3.5 Fire Seal System

All the floor/wall opening provided for cable crossing shall be sealed by fire seal system. The fire proof sealing system shall fully comply with the requirements of

relevant IS/BS:476 Part-B. The fire proof seal system shall have minimum one hour fire resistance rating.

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.

The material used in fire proof seal system shall be non-toxic and harmless to the working personnel.

Type of fire proof seal system shall be foaming type or flame mastic type compound or approved equivalent.

After laying and jointing work is completed, high voltage test should be applied to all cables to ensure that they have not been damaged during or after the laying operation and that there is not fault in the jointing.

Cables for use on low and medium voltage system (1.1KV grade cables) should withstand for 15 minutes a pressure of 3000V, DC applied between conductors and also between each conductor and sheaths. In the absence of pressure testing facilities it is sufficient to test for one minute with a 1000V insulation tester In case the test results are unsatisfactory the cost of repairs and replacements and extra work of removal & laying will be made good by the contractor.

Cable shall be installed so that separations shown in the table below are observed.

Si No	Particulars	Distance
1.	ELV & LT 230 V/433 V-ELV & LT 230V/433V	50 mm
2.	HT cables to ELV& LV cable	300 mm
3.	LT cables to Control cable (Network)	350 mm
4.	All cables to hot pipe work	200 mm

3.3.6 Factory Tests

Each type of cable specified shall be fully type tested according to IEC 502 and the appropriate British Standards. The types and sizes of cables required are shown on the Drawings. Should the Engineer require it, the Contractor shall submit reports issued by a national or international testing authority on

type test that have been successfully performed on the cable for his approval. The type test shall include the following test:

- Partial discharge test;
- Bending test, plus partial discharge test;
- Tan measurement as a function of the voltage and capacitance measurement;
- Tan measurement as a function of the temperature;
- Heating cycle test plus partial discharge test ;
- Impulse withstand test, followed by a power frequency voltage test;
- Medium-voltage alternating current test;
- Type test (non-electrical) as stipulated in IEC 502, Table VI.
- Cable routine test shall be conducted at factory in accordance with IEC 502 for the following tests:
- Measurement of the electrical resistance of conductors
- Partial discharge test,
- 4-hour HT test

3.3.7 Site Acceptance Test

The Contractor shall supply all necessary testing equipments for site testing. When required, these testing equipments shall be calibrated at the expense of the Contractor at a recognized national laboratory.

The Contractor shall engage an Authorised Medium Voltage Testing Engineer who is recognized by SEB to perform all site tests. In addition to SEB's requirements and those recommended by the manufacturer, the following tests shall be carried out:

- Continuity test
- Earth test
- Polarity test
- Insulation resistance test
- DC high voltage test.

The test voltage shall be in accordance with SEB's requirements and Engineer's approval.

4.0 WIRING DEVICES

4.1 GENERAL

4.1.1 Work Description

The drawings for the lighting and power points indicate approximate position of all lighting fittings, switches, power outlet points, isolating switch points etc. The actual position of all fittings, switches, the wiring details and cable routes shall be co-ordinated with other trades at site and submitted for the approval of the Engineer-in-charge. All time and cost required for adjusting the layout or complete installation to suit site requirement is included.

To determine the exact positioning of lighting and power points due consideration shall be given, for selection of the most accessible routes for wiring, convenience of switching and operational requirement of the installation.

No extra cost will be paid should the final positions be relocated within the same room.

For the purpose of specification and related drawing, each lighting & power point circuit shall be coded with a prefix to indicate the corresponding distribution board number.

The electrical equipment/system may develop sudden changes due to low frequency or direct electric current components such as fluorescent lamps, contactors, etc. shall be fitted with radio and television interference suppression components suitable to meet the levels specified in BS: 800 “Limits of Radio Interference”.

This section included the specification of the following:

- Distribution boards
- Miniature circuit breakers
- Earth leakage circuit breakers
- 6A Switch Socket Outlet
- 16A Switch Socket Outlets
- Shaver Outlets
- Isolating Switches

- Conduit Boxes
- Contactors
- Dimmers Switch
- Time Switch
- Cooler Control Units / Power points in rooms, kitchen
- Water Heater Switches
- Bell Push Switches

4.1.2 Standards

The complete wiring installation shall be engineered according to manufacturer data and constructed in accordance with the latest revision of the IS and the appropriate BS/IEC

In the adoption of standards and requirements, the Contractor shall take the following precedence:

- Engineer's decision
- Local codes of practice
- Drawings
- Specification
- International standards and requirements

4.1.3 Submission

All technical submissions shall be approved by the EPC contractor prior to the respective stages of construction with respect to the approved design and development documents. In case of major deviations, it shall be brought under the notice of LICI for its review and approval. The submission shall include the following as a minimum requirement

- Equipment catalogues submission with manufacturer's data
- Sample submission include all wiring accessories
- Shop Drawings of the lighting and power positions, circuit numbers, cable routings, switching arrangement, mounting height, etc. The

positions and mounting heights shall be coordinated with other services. Fixing details of all wiring accessories shall also be included.

- Drawings showing the installation details
- Labeling system
- Builder's works requirement.

4.2 PRODUCT

4.2.1 Lighting Point Installation

The various types of light fittings to be supplied and installed are described in the Schedule of Lighting Fittings on Drawing

Surface mounted light fitting shall terminate at junction box having entries appropriate to the run of conduit. This shall be complete with porcelain / PVC connector suitable for the size and number of connections and wiring points to be connected with the specified fitting. Wiring to the light fittings within the false ceiling space shall be by means of heat resistant (butyl or silicon rubber insulated to BS 6500) cables i.e. between the junction box and the lamp holder/terminal blocks, in flexible conduits.

At every light fitting an approved type earth terminal shall be provided for connection of the circuit protective conductor of the final circuit. Ferrous metal work shall be of minimum of 1mm thickness and treated against corrosion by galvanising after welding or lead primer or other approved process. Metal work shall be painted with one priming coat, one under-coat and two final coats with stove-enamelled matt white paint unless otherwise specified.

Cables used for internal wiring of the lighting fittings shall be with appropriate type and size, number with conductor of size not less than 1.5 sq mm single core. The insulation of the cables shall withstand the maximum temperature throughout the life of the fitting. It will be subject to normal use without deterioration which could affect the safety of the fitting.

Cables within the lighting fittings shall be neatly bundled by nylon self locking cable ties. Wiring shall be properly routed and secured away from control gear etc. wherever possible.

All cable terminations within the light fittings shall be suitably shrouded.

All light fittings shall be supported with appropriate fixing accessories such as clips, supporting brackets, suspension sets, nuts, washers, screws etc. for their proper installation on different types of ceiling panels. Suspension sets shall be of adjustable type suitable to carry the weight of the lighting fittings unless otherwise stated or indicated on drawings. The suspension sets shall be generally of 900mm length. Exact lengths required shall be provided to suit the site requirement.

All lamps in operational condition with proper control gear shall be provided together with the light fittings as required and specified.

4.2.2 Modular Switches

Lighting switches unless otherwise specified, shall be single pole, quick make and break, silent action type with solid silver alloy contacts and totally enclosed for flush or surface mounting as required. Lighting switches shall be suitable for indoor or outdoor service according to location housed in standardized purpose manufactured galvanized steel boxes completed with conduit knockouts made up into single or multi-gang units employing a grid switch system of fully interchangeable components at standardized fixing centers of matching switches of different types and ratings but of identical dimensions, push buttons, neon indicator lamps, blanking units, grids, steel boxes and plates all capable of integration into standard composite assemblies in any combination as required.

Grids shall be adjustable for variation in depth of plaster and for squaring errors and of the same type for surface or flush mounting.

Switches in mechanical plant rooms and electrical sub-stations and switch rooms shall be of the metal clad type approved by the Engineer-in-charge mounted in flush or surface conduit boxes as specified.

Switches located on brick or concrete walls shall be mounted in horizontal arrangement in plaster depth steel boxes or in galvanized steel boxes using box suspension straps and cover plates. Countersunk screws shall be provided for fixing to the conduit boxes. Switches for external use shall be of weatherproof construction with IP-65 rating unless otherwise specified. Samples of all switches, conduit boxes and plaster depth boxes shall be submitted to the Engineer for approval prior to installation.

Switches shall be rated for 6Amps (minimum light switch rating 6Amps), 16Amps or 20Amps (as determined by circuit load). Inductive lighting circuit shall be assessed at twice the steady state connected load current. One or two ways switch as indicated on the drawings be fixed generally at a height of 1200mm from floor level in rooms. The switch shall possibly be located inside the room on the handle side of the door as close as practicable.

Earth continuity terminal shall be provided and connected to the circuit protective conductor at every lighting switch position. Single pole switches shall be connected to break the phase wire of the supply. The neutral wire shall not be routed through switch boxes. Switches which are mounted in the same location shall be of multi-gang type, of the maximum number of gangs available. All switches used shall be of approved or prescribed items as required by local Authorities. Circuit from different phase and circuit from emergency power should have separate switch plate.

4.2.3 Isolation Switch

Isolating switches shall be of the current ratings and number of poles (generally double pole for single phase and 4-pole for three phases).

Isolating switches shall be of the totally enclosed pattern, metal-clad or polycarbonate with positive quick-make and quick-break action.

Switches shall be capable of passing and interrupting their full rated current safely and without damage.

Ferrous materials shall be galvanised, switch handles shall be interlocked to prevent opening the cover with the switch "ON".

4.2.4 6AMP Modular Switch Socket Outlets

Switch socket outlets shall be as per BS: 1363 single pole 6Amp 3round pin shuttered outlets, one or two gang for indoor service except otherwise specified and suitable for surface or flush mounting according to location.

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

Generally switch socket outlets shall be positioned 300mm above floor level except in plant rooms, kitchen, etc. where they shall be positioned 1400mm above floor level or 150mm above counters or benches as per requirement.

Switch socket outlet in all mechanical plant rooms, electrical switch rooms shall be of the metal clad type, with recessed or protected switch dolly, mounted in flush or surface conduit boxes as specified. All switch socket outlets used shall be of an approved quality.

4.2.5 16 AMP Modular Switch Socket Outlets

16Amp switch socket outlets shall be 3pin round type to BS: 546 shuttered, of finished similar to 6Amp switch socket outlets and flush mounted in galvanised steel conduit boxes to BS: 4662 requirements.

4.2.6 Weatherproof Isolator

Weatherproof enclosure shall be of the high impact, water resistant to IP-65. The isolator provided shall complete with lockable device. Isolators shall be 2-pole, 4-pole as specified.

4.2.7 Floor Box-Access Outlet.

All plates shall be made from stainless steel or equal approved, heavy duty trap cover. All plates are to be mounted flush with surface and are to be aligned correctly. Access Outlet should carry service plates for providing services i.e. Power, Data & Telecom. The system must comply the relevant specification & IEC 61084 standards. The system should have Positive Double Earthing connections.

4.2.8 Lighting Dimmers Switch

Lighting dimmer switch shall be solid state, variable load and thyristor controlled type suitable for controlling fluorescent or incandescent lighting circuits operating at 230V ± 6%, 50Hz single phase AC supply. Dimmer switch shall be manufactured to eliminate TV and radio frequency interference in compliance with IS. The ratings of the dimmer units shall be suitable for lighting circuit specified on Drawing.

4.2.9 Time Switches

Time switches shall be self-contained unit suitable for mains operation. All units shall have self-starting synchronous motor with single-pole fuse in the

motor circuit, 3-way terminal block and thirty-six (36) hours spring reserve complete with an automatic solar dial. The solar dial shall be capable of switching ON The lighting at sunset and OFF at sunrise throughout the year by control of a secondary calendar dial with month and day settings. The automatic switching time shall be adjustable. Time switches shall be encased in dust-tight metal casing having hinged front cover with clear Perspex window. The casing shall be effectively earthed. A manual bypass switch shall be incorporated with the time switch to facilitate maintenance of the latter.

4.2.10 Miniature Circuit Breaker

The MCB shall be suitable for manual closing, opening and automatic tripping under overload and short circuit. The MCB shall also be trip free type. Single pole / three pole versions shall be furnished as required. The MCB shall be rated for 10KA fault level.

The MCB shall be suitable for housing in the lighting boards and is suitable for connection at the outgoing side by tinned cable lugs and for bus-bars connection on the incoming side. The terminal of the MCB and their open and close conditions shall be clearly / indelibly marked. The MCB shall generally conform to IEC/ IS: 60898

4.2.11 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 required. These shall be suitable for manual closing and opening and for automatic tripping under earth fault circuit of 30-300 mA 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 with stand high temperature. All parts of switching mechanism shall be non-greasing, self lubricating material so as to provide consistent and trouble free operation. Operation of ELCB shall be independent of mounting position and trip free type.

4.2.12 Lighting/Small Power Distribution Boards

Distribution boards shall be of standard make with MCBs as per approved make given. Distribution boards shall be of steel sheet construction double door all welded enclosure of IP42 protection and powder coated painted.

Ample clearance between the conductors of opposite pole and sheet steel body shall be maintained in order to obviate any chance of short circuit. Removable conduits entry plates shall be provided at top and bottom to facilitate drilling holes at site to suit individual requirements.

Additional / separate adopter box of suitable size shall be provided to accommodate wires, cables and No. of conduits etc. at no extra cost.

The MCB shall be mounted on high grade rigid insulating support and connected by electrolytic copper bus bars. Each incoming MCB isolator shall be provided with solder-less 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 or mounted on surface of wall with necessary mounting arrangement. The mounting height shall not exceed 1200mm from finished floor level. Distribution board shall be provided with proper circuit identification name plate and danger sticker/plate as per requirement.

All the distribution boards shall be provided with engraved name plates with 'lighting', 'power' or 'UPS' with DB Nos., as the case may be.

Each DB shall be provided with 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 separate neutral and earth connection bar mounted within the DB each having the same number of terminals as the total number of outgoing individual circuits from the distribution board. Conduit & cable 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.

DBs, ACB, MCCBs, MCBs, ELCB/RCCB will be used of suitable capacities as per load and electricity rules. Breaking capacity for MCCB, min-25kA and for MCB-10kA.

4.2.13 Telephone Outlets

Telephone outlets where called for shall be single or twin flush mounted type suitable to receive the plug-in telephone cable lead to the approval of the Telecom. The finish of the telephone outlet plates at various areas shall be as specified for lighting switches.

4.2.14 Bell Push Switches

Bell push switches shall be flush-mounted having single-pole AC switch of 6Amps rating and marked with bell symbol.

4.2.15 Water Heater Switches

Water heater switches shall be flush mounted having double pole AC switch rated at 20amps fitted with pilot lamp and marked "water heater". The cover plates shall be of the same finish as those specified for the other switches. Associated connector units shall be provided next to the water heater units.

4.2.16 Power Supply for Lighting at Wet Condition

Residual Current Circuit Breakers shall be provided individually for each circuits serving lighting subject to wet condition.

5.0 LOW VOLTAGE SWITCHGEAR AND TESTED ASSEMBLY

5.1 GENERAL

This section covers the detailed requirements of medium voltage switchboard for 415 volts, 3 phase, 50 Hz, 4 wire system.

5.2 STANDARDS & CODES

Updated and current Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract.

Low Voltage Switchgear Assemblies	IEC61 439-1 & 2
Low Voltage switchgear & control gear	IEC 60 947 /IS 13947: 1993
Part I :	General rules
Part II :	Circuit Breakers
Part III :	Switches, disconnectors, switch disconnectors and fuse

combination units

Part IV : Contactors and Motor starters

Part V : Control circuit devices and switching elements

Degree of Protection of Enclosures for low voltage switchgear. IEC60529 /IS 2147: 1962

Internal arc – IEC 61641

5.3 SWITCH GEARS

5.3.1 General

The LV switchboards shall be as per the standards IEC 61439-1 & 2. The switchboards and the associated equipment including switchgear, control gear, Busbar supports, Busbar orientation, Busbar links etc. shall be identical in construction to the assembly which has undergone the type test. The drawings of the type-tested assemblies shall be made available for inspection.

The designs of the switchboards should be with switchgear manufacturer, and all the mechanical drawings must be available in the factory beforehand.

Panel shall be tested of design as per Seismic Zone 4 of IS 1893 Part -1 2002.. The enclosures shall be designed to take care of normal stress as well as abnormal electro-mechanical stress due to short circuit conditions. All covers and doors provided shall offer adequate safety to operating persons and provide ingress protection of IP 42 unless otherwise stated. Ventilating openings and vent outlets, if provided, shall be arranged such that same ingress protection of IP 42 is retained. Suitable pressure relief devices shall be provided to minimize danger to operator during internal fault conditions.

The Main LT Panels have to be designed in such a way that no CTs are being used for metering so as to eliminate the re-calibration for meter due to CT saturation and CT burnout on fault. All metering and protection needs to be done via inbuilt CT of the breakers.

The Panel Should be Ethernet ready, all ACB, MCCB shall have RS845 port for communication and Ethernet Gateway Module for Energy Meter shall be connected over IP network using Din Rail Mounted Managed Ethernet Switch

in such a way that all electrical panel data shall be able to be communicated to SCADA via single ethernet port from the panel or by using External PLC module and Ethernet adapter.

The switchboard along with ACBs and connections should have been be type tested design at CPRI /Independent international test house for short circuit, temperature rise and dielectric tests of the ratings required.

Panel shall be rated for Impulse withstand capability as per standard for main circuit as per IEC 61439 Clause 5.2.4 Rated impulse withstand voltage (Uimp) (of the ASSEMBLY).

For operator safety IP2 X (touch proof) protection to be available even after opening the feeder compartment door. The compartmentalization to be achieved by using metal separators, use of PVC sheet / Hylem sheets shall not be allowed.

Main switchboard shall be form 4b, for form of separation only metallic covers shall be used, Hylem/ PVC sheets shall not be allowed, rest of the panels shall be minimum conform to form 4b design. All ACB, MCCB of Main LT panel MCCBS shall have inbuilt earth fault protection. TTA panels shall be allowed from OEMs only.

5.3.2 Switchgears Configuration

The Switchboard shall be configured with Air Circuit Breakers, MCCB's, MCB’s and other equipment as called for.

The MCCBs shall be arranged in multi-tier formation whereas the Air Circuit Breakers shall be arranged in Single or Double tier formation only to facilitate operation and maintenance.

The Switchboards shall be of adequate size with a provision of spare space to accommodate possible future additional switch gear.

The switchgear devices and the enclosure design should be of same manufacturer having valid Type Test Certificate.

All panels above 630A and above shall be design verified / TTA (IEC61439-1&2). The TTA Panel design of the Switchboard shall be proven design from the main switchgear manufacturer (OEM).

All switchboards shall be factory built and design, project management, design warranty, including performance warranty on the switch boards shall be from original equipment (switchgear) manufacturers. The Panels shall be manufactured by switchgear OEMs or their authorized system integrators / assembly manufacturers/ franchisee, However the final responsibility & warranty shall be of Switchgear OEM only.

5.3.3 Constructional Features

The Switchboards shall be metal clad totally enclosed, floor mounted free-standing type of modular extensible design suitable for indoor mounting.

Switchboards construction shall employ the principle of compartmentalized and segregation for each circuit.

Incomer and bus section panels or sections shall be separate and independent and shall

not be wired with sections required for feeder. The incomer panel shall be suitable for receiving bus trunking or MV cable of size specified.

Switchboards shall be made up of requisite vertical sections, which when coupled together, shall form continuous dead front switchboards. Switchboard shall be readily extensible on both sides by addition of vertical sections after removal of the end covers.

The switchboards shall be designed for use in high ambient temperature and humid tropical conditions as specified. Ease of inspections, cleaning and repairs while maintaining continuity of operation shall be provided in the design.

Neoprene gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof to provide a degree of protection of IP 42/IP 54 as stipulated. The unused openings within the switchboards shall be closed using suitable grommets.

Degree of Protection shall be IP42 or better.

Special care to be taken to ensure effective earthing of the frame and doors of the switchboards. Each vertical section shall be provided with a rear or side cable chamber housing the cable end connections and power/control cable terminations. There should be generous availability of space for ease of

installation and maintenance with adequate safety for working in one vertical section without coming into contract with any live parts. The design of the switchboard shall allow standard extension chambers if required to accommodate cables.

Some switchboards may be required to be installed against the wall, for such application-documented designs shall be available.

Switchboard panels and cubicles shall be fabricated with CRCA Sheet Steel of thickness not less than 2.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be fabricated from CRCA sheet steel of thickness not less than 2 mm. Joints of any kind in sheet metal shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal. The external covers provided should have been subjected to minimum mechanical impact of IK09/10 as per IEC to ensure specified degree of protection.

All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned.

Switchboard shall be provided with "Danger Notice Plate" conforming to relevant Indian Standards.

Internal arc tests as per IEC 61641, 0.1 to 0.5 sec as per system design fault level at HBB, VBB and cable chamber. Copies of the test certificates shall be submitted along with the tender. Copies of the test certificates shall be submitted along with the tender.

5.3.4 Switchgears Dimensional Limitations

The overall height of the switchgears /enclosures shall be limited to 2400 mm for all the Busbar

ratings and type of switchboards.The height of the operating handle, push buttons etc. shall be restricted between 250 mm and 1800 mm from finished floor level. Other dimensional limits if any are specified separately.

5.3.5 Switchgears Compartmentalization

For compartmentalized switchboards, separate totally enclosed compartments shall be provided for horizontal bus-bars, vertical bus-bars, ACBs, MCCBs, and cable alloys.

The main board shall be with Form 4b Construction with metallic shrouding only, FRP is not acceptable.

Earthed metal or insulated shutters shall be provided between draw-out and fixed portion of the ACB such that no lives parts are accessible with equipment drawn out. Degree of protection within compartments shall be at least IP 2X.

Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker in "ON" and "OFF" position.

For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, bus-bars and connections.

For Some MCCB feeders for critical loads like UPS it may be required to have operation only after opening the door, all other facilities like pad lockable rotary handle to be provided for such feeder. It shall be possible to do this change during execution of order Each switchgear cubicles shall be fitted with label in front and back identifying the circuit, switchgear type, rating and duty. All operating device shall be located in front of switchgear only.

A horizontal wire way with screwed cover shall be provided at the top to take interconnecting control wiring between vertical sections.

Separate cable compartments running the height of the switchboard in the case of front access boards shall be provided for incoming and outgoing cables.

Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top. The construction shall include necessary and adequate and proper support shall be provided in cable compartments to support and clamping the cable in the cable alley / cable chamber.

5.3.6 Switchgears Bus Bars

Busbars shall be made of high conductivity, high strength **copper** Busbars shall be of rectangular cross sections, suitable for full load current for phase

bus bars and half/ full rated current for neutral bus bar or as stipulated . Busbar shall be suitable to withstand the stresses of fault level as specified .

Main Horizontal busbar and Neutral should be in same compartment. The bus bar system may comprise of a system of main horizontal bus bars and auxiliary vertical bus bars run in bus bar alloy on either side in which the circuit could be arranged with front access for cable entrances.

The bus bars shall be supported on non-breakable, non-hygroscopic epoxy resin or glass fiber reinforced polymer insulated supports able to withstand operating temperature as per Type Test Report of at regular intervals, to withstand the forces arising from a fault level as stipulated . The material and the spacing of the Busbar supports should be same as per the type tested assembly

Auxiliary buses for control power supply, space heater power supply or any other specified service shall be provided. These buses shall be insulated, adequately supported and sized to suit specific requirement. The material for auxiliary supply bus will be insulated electrolytic copper wires. Clearances between phases should be higher than IEC.

5.3.7 Switchgears Interconnection

All connection and tap offs shall be through adequately sized connectors appropriate for fault level at location. This shall include tap off to feeders and instrument/control transformers.

For unit ratings up to 250 amps, PVC insulated 105 dg withstand, copper conductor wires of adequate size to carry full load current shall be used. The terminations of such interconnections shall be crimped. Solid connections shall be used for all rating of above 250 amps.

All connections, tapings, clamping, shall be made in an approved manner to ensure minimum contact resistance. All connections shall be firmly bolted and clamp with .even tension. Before assembly joint surfaces shall be filed or finished to remove burrs, dents and oxides and silvered to maintain good continuity at all joints. All screws, bolts, washers shall be zinc plated.

5.3.8 Draw out Features

Air Circuit Breakers shall be provided in fully draw out cubicles, unless otherwise stated. These cubicles shall be such that draw out is possible

without disconnection of the wires and cables. The power and control circuits shall have self -aligning and self- isolating contacts. Mechanical latches shall be integrated in ACB at service, test and isolated position to ensure that Breaker is firmly latched in respective position. It shall not be possible to move the breaker from the position unless latch is manually operated.

5.3.9 Instrument Accommodation

Al voltmeter and ammeter and other instruments shall be flushed mounted type of size 96 sq. mm conforming to class 1.5 to IS 1248 for accuracy. All voltmeter shall be protected with MPCBs.

Instruments and indicating lamps shall not be mounted on the Circuit Breaker Compartment door for which a separate and adequate compartment shall be provided and the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switchboard.

For MCCBs, instruments and indicating lamps can be provided on the compartment doors. The current transformers for metering and for protection shall be mounted on the solid copper/ aluminum busbars with proper supports.

On all the incomers of switch boards ON/OFF indicators lamps shall be provided suitable for operation on AC 230 volts supply. All lamps shall be protected by MCBs.

For Incomer and important outgoing feeders comprehensive power meters shall be provided which shall display A , V, Pf , Hz ,Kw , KVA, KVAr, Kwh , Kvarh, average and maximum values , demand values , THD on current and Voltages, Individual harmonics up to 31st level.. Also add on modules for RS485 port, programmable contacts, analogue output etc. to link to SCADA system.

5.3.10 Wiring

All wiring for relays and meters shall be with PVC insulated copper conductor wires. The wiring shall be coded and labeled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 2.5 sq. mm. Runs of wires shall be neatly bunched and suitably supported and clamped. Means shall be provided for easy identification of wires.

Identification ferrules shall used at both end of wires. All control wires meant for external connections are to be brought out on a terminal board. The cables and control wires shall be suitable for withstanding 105 deg C.

5.3.11 Space Heaters

Anti- condensation heaters shall be fitted in each cubicle together with an ON/OFF isolating switch suitable for electrical operation at 230 volts A.C 50 Hz single phase of sufficient capacity to raise the internal ambient temperature by 5O C. The electrical apparatus so protected shall be designed so that the maximum permitted rise in temperature is not exceeded if the heaters are energized while the switchboard is in operation. As a general rule, the heaters shall be placed at the bottom of the cubicle.

5.3.12 Ventilation Fans

The Switchboard shall be provided with panel mounting type ventilation fans in each panel with switchgear rated for 4500 amp and above. The fan shall be interlocked with switchgear operation. The degree pf enclosure protection to be maintained even with Fans.

5.3.13 Earthing

Continuous earth bus sized for prospective fault current to be provided with arrangement for connecting to station earth at two points. Hinged doors / frames to be connected to earth through adequately sized flexible braids.

5.3.14 Sheet Steel Treatment and Painting

Sheet steel used in the fabrication of switchboards shall undergo a rigorous cleaning and surface treatment seven tank process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognised phosphating process after which a coat of primer paint compactively with the final paint shall be applied over the treated surface. Final paint coat of oven baked powder coating, of minimum 50 micron thickness, of sheet approved by Engineer-in-Charge shall then be provided.

5.3.15 Name Plates and Labels

Suitable engraved white on black name plates and identification labels of metal for all Switchboards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

5.3.16 Type test reports.

Switchboard configurations offered shall be CPRI /Independent international test house tested for all the tests as per IEC61439-1 & 2 and internal arc tests as per IEC61641. Copies of the test certificates shall be submitted with the tender.

5.3.17 Testing At Works

Copies of type test carried out at ACB/ MCCB manufacturers works and routine tests carried out at the switchboard fabricators shop shall be furnished along with the delivery of the switchboards. Engineer-in-Charge reserves the right to get the switchboard inspected by their representative at fabricators works prior to dispatch to site to witness the followings. Physical variation and dimensional check. Verification of bill of materialFunctional check

HV test

IR test

6.0 MEDIUM VOLTAGE PANELS

6.1 GENERAL

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

6.2 CONSTRUCTION

All switch board panels or power control centers of free standing type shall have a bus bar chamber at the top and the cable compartment at the bottom or as approved by the Developer/LICI s depending upon the specific requirements of the job. The space between the bus chamber and cable compartment shall be suitably compartmentalized to accommodate either air circuit breakers or molded case circuit breaker of various ratings. The cable terminations shall be carried out on the rear side of the panels for which adequate space and clamping arrangements shall be provided. Where panels have to be installed with very little access space at the rear, the cable

terminations shall be carried out in suitable cable alleys provided on the front of the panel. All the live parts shall be properly shrouded with Bakelite barriers. All the equipment shall be accessible from the front. However, protection relays, KWH meters, etc. may be mounted on the rear side/front side. Arrangements and marking of bus bars, main connections and wiring shall be in accordance with latest IS code. The structure of the panel shall be robust and provided with adequate bracing's to withstand the operation of the equipment and stresses due to system short circuit. The panels shall be fabricated out of best quality heavy gauge sheet steel. The panel shall be machine pressed with punched openings for meters, indicating lamps etc. The enclosure system shall be Modular in nature with bolted on construction. Enclosure parts/kits shall be interchangeable to reduce downtime during modification or maintenance work. Enclosure system and switchgear components shall be from same manufacturer.

6.3 DIMENSIONS

All power control centers shall have dimensions of not more than that given on the layout drawings. Panels arranged side by side shall have the same height and depth. The height of the panel should be limited to 2400 mm. All the operating levers, handles etc. of the highest unit shall not be at a height more than 1700 mm from F.F.L. For all incoming cables a removable gland plate will be provided in the panel and a minimum distance of 300 mm will be provided between the gland plate and the nearest terminal for proper dressing and termination of the cable. All the components of a module will be mounted on a component plate using the machine screws and taped holes (excepting the components mounted on the door). These component plates should be fixed with bolts for easy replacement. Standardization will be adopted while making these plates so that the component plates of the same size modules can be changed from one module to another. In case of panel of lengths more than 4 meters the fabrication of any single section will be limited to a maximum length of 4 meters for the purpose of shipping and shifting at the site. These sections will be assembled at the location of installation with the help of nuts and bolts. While making these sections consideration will be given to the place of sectionalizing and select the location where the minimum electrical connections are transferred from one section to another. All the

hardware used in the assembly will be electroplated for protection and neat appearance.

64 BUS BARS

The bus bars shall be suitable for 4 wire, 415 Volts, 50 Hz, system. The main bus bar shall be made of high conductivity electricity conductor grade **electrolytic tinned copper bus bar** and at the time of joining of two copper buses tinning will be done on the copper strips ends to a length equal to the lap length of the joint plus one each. The bus bars shall have uniform cross section throughout. The bus bars shall be capable of carrying the rated current at 415 Volts continuously. The bus bar will run in a separate bus bar chamber using bus insulators made of non- deteriorating, vermin proof, non hygroscopic materials such as epoxy fiber, reinforced polyester or molding compound. The interval between the two insulators will be designed after considering:

- Strength and safe load rating of the insulator,
- The vibrating force generated during a fault,
- A Factor of safety of 1.8
- A set of insulators at both ends of the bus.

The size of the bus bar calculations must be approved by the LICI s. The bus bars shall be designed to withstand a temperature rise of 45oC above the ambient. To limit the temperature rise in the bus bar chamber a set of louvers can be provided at strategically places considering the air circulation. The louvers provided will have a brass wire mesh covering from inside with more than 100 openings per sq. inch. The overall temperature of bus bar shall not exceed 85°C in any case. A current density of 1.0 Amps/Sq. mm shall not be exceeded for Aluminum bus bars.

All the bus bars shall be insulated with PVC heat shrinking sleeves suitably throughout (except at joints) the length. The electro galvanized galvanized high tensile steel nuts, bolts, plain or spring washers of suitable size will be used in connecting the various section of the bus bar. A minimum of 1.6 times the width of bus bar will be the lapping length of each joint.

6.5 EARTHING

The panels shall be provided with an aluminum or copper earth bus of suitable size running throughout the length of the switchboard. Suitable earthling eyes/bolts shall be provided on the main earthing bus to connect the same to the earth grid at the site. Sufficient number of star washers shall be provided at the joints to achieve earth continuity between the panels and the sheet metal parts.

6.6 INTERLOCKING

The panels shall be provided with the following interlocking arrangement. The door of the switch-fuse compartments is so interlocked with the switch drive or handle that the door can be opened only if the switch is in `OFF' position. De-interlocking arrangement shall also be provided for occasional inspection.

It shall not be possible for the breaker to be withdrawn when in `ON' position.

It shall not be possible for the breakers to be switched on unless it is either in fully inserted positions or for testing purposes in fully isolated position.

The breaker shall be capable of being raked in to `testing' `isolated' and `maintenance' positions and kept locked in any of these position.

A safety latch to ensure that the movement of the breaker as it is withdrawn, is checked before it is completely out of the cubicle shall be provided.

6.7 PROTECTION & INSTRUMENTATION

Protection and instrumentation shall be as per standard specifications. All ACBs, MCCBs of Main LT Panel and Incomer MCCBs shall have inbuilt Earth Fault Protection.

6.8 CONTROL WIRING

The control wiring of all the panels will be done with PVC single core flexible FRLS copper wires of cross section 1.5 sq. mm and 2.5 sq. mm. All the wiring involving current transformers or circuits with currents of more than 5 Amps will be wired with 2.5 sq. mm cross section wire and the others with 1.5 sq. mm. Similarly all the interconnecting between the incoming bus and the outgoing of 100 Amps and above rating shall be done by insulated copper strips of suitable sizes and equipment below 100 Amps rating shall be wired with insulated copper conductors. All of the control wiring will be done by properly dressing all the wires in a laminar manner either in PVC duct of

liberal size or bunched together by PVC strapping tapes at a distance not exceeding 150 mm. Each wire will terminate with a copper ferule crimped to the wire. The PVC ferules will be used to identify each wire of the circuit and the same number will be marked on the drawing for the corresponding wire. Only one outgoing wire will be connected to one connector. When the control wiring is crossing from fixed parts to moving parts such as door etc. the wire will be run in PVC sleeve of suitable size and the same will be mechanically clamped at both the ends i.e. one end of the fixed part and the other on the moving part. Under no circumstances the wiring should be under any kind of stress for which sufficient length of control wiring in the PVC sleeve should be provided. All the potential circuits shall be protected by fuses mounted near the tap off point from the main connections.

6.9 SURFACE TREATMENT

The each part of the fabricated panel will be subjected to seven tank treatment and all sheet metal accessories and components of power control centers and switchboard panels shall be thoroughly cleaned, degreased, de-rusted and hot dip phosphatized before red oxide primer is applied. The panel shall be stove enameled gray shade finish and the Interior surfaces of the panel shall be painted to an off-white shade.

6.10 ENCLOSURE

The panel enclosure shall be totally dust and vermin proof and shall be suitable for indoor installation. All the cubical will be adopted with front located, outward openings, lockable doors having hidden hinges and a bolted back cover both using no deteriorating neoprene rubber gasket. Enclosure design shall be in accordance with degree of protection IP 54 as per latest IS code. All the nut bolts handles, meters, knobs etc. appearing from outside of the panel should be in symmetry so as to give a neat appearance.

6.11 NAME PLATE

The panel as well as the feeder compartment doors shall be provided with name plate giving the switchboard/feeder descriptions as indicated on the drawings. The above shall be mounted in metal holder with a clear plastic sheet on inside surface of the front door.

6.12 TESTING

The power control centers shall be tested at factory after assembling of all components and completion of all interconnections and wiring. Tests shall be conducted in accordance with the requirements of BS:3659.

Insulation Test

- Insulation of the main circuit, i.e. the insulation resistance of each pole to the earth and that between the poles shall be measured.
- Insulation resistance to earth of all secondary wiring should be tested with 1000 Volt megger. Insulation test shall be carried out both before and after high Voltage test. High Voltage Test A High Voltage test with 2.5 KV for one minute shall be applied between the poles and earth. Test shall be carried out on each pole in turn with the remaining poles earthed, all units raked in position and the breakers closed. Original test certificate shall be submitted along with panel.

6.13 STORING, ERECTION AND COMMISSIONING

The panels shall be stored in a well ventilated, dry place, with a suitable polythene covers shall be provided for necessary protection against moisture.

Erection

Switch boards shall be installed on suitable foundation. Foundation shall be as per the dimensions supplied by the panel manufacturer. The foundation shall be flat and leveled. Suitable grouting holes shall be provided in the foundation. Suitable MS base channel shall be embedded in foundation on which the panel can be directly installed. The switch boards shall be properly aligned and bolted to the foundation by at least four bolts. Cables shall be terminated on the bottom plate or top plate as the case may be, by using high quality brass compression glands. The individual cables shall then be led through the panel to the required feeder compartments for necessary terminations. The cables shall be clamped to the supporting arrangement. The switchboard earth bus shall be connected to the local earth grid.

Pre-commission Tests

Panels shall be commissioned only after the successful completion of the following works.

All main and auxiliary bus bar connections shall be checked and tightened.

All wiring termination and bus bar joints shall be checked and tightened.

Wiring shall be checked to ensure that it is according to the drawing.

All wiring shall be tested for insulation resistance by a 1000 Volts magger.

Phase rotation tests shall be conducted

Suitable injection tests shall be applied to all the measuring instruments to establish the correctness and accuracy of calibration and working order.

All relays and protective devices shall be tested for correctness of settings and operation by introducing a current generator and an Ammeter in the circuit.

6.14 METERING, INSTRUMENTATION AND PROTECTION.

Current Transformers

CTs shall confirm to latest IS codes in all respects. All CTs used for medium Voltage application shall be rated for 1 kV. CTs shall have rated primary current, rated burden and class of accuracy as specified in drawings. Rated secondary current shall be 5A unless otherwise stated. Minimum acceptable class for measurement shall be 0.5 to 1 and for protection class 10. CTs shall be capable of withstanding magnetic and thermal stresses due to short circuit faults. Terminals of CTs shall be paired permanently for easy identification of poles.

CTs shall be provided with earthing terminals for earthing chassis, frame work and fixed part of metal casing (if any). Each CT shall be provided with rating plate indicating:

- Name and make
- Serial number
- Transformation ratio
- Rated burden
- Rated Voltage
- Accuracy class

CTs shall be mounded such that they are easily accessible for inspection, maintenance and replacement. Wiring for CT shall be with copper conductor

PVC insulated wires with proper termination works and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

Potential Transformer

PTs shall confirm to latest amendment up to to date IS Codes.

Measuring Instruments

Direct reading electrical instruments shall conform to latest IS codes in all respects. Accuracy of direct reading shall be 1.0 of Voltmeter and 1.5 for Ammeters. Other instruments shall have accuracy of 1.5. Meters shall be suitable for continuous operation between -100C and +5000C. Meters shall be flush mounting and shall be enclosed in dust tight housing. The housing shall be of steel or phenolic mould. Design and manufacture of meters shall ensure prevention of fogging of instrument glass. Pointer shall be black in colour and shall have Zero position adjustment device operable from outside. Direction of deflection shall be from left to right. Selector switches shall be provided for Ammeters and Volt meters used in three phase system.

7.0 MULTI FUNCTION METER

7.1 GENERAL PROVISIONS:

All setup parameters required by the Multifunction Meter shall be stored in non-volatile memory and retained in the event of a control power interruption.

The Multifunction Meter may be applied in three-phase, three- or four-wire systems as well as single phase

The Multifunction Meter shall be capable of being applied without modification at nominal frequencies of 45 to 65 Hz.

7.2 MEASURED VALUES:

The Multifunction Meter shall provide the following, true RMS metered quantities:

Real-Time Readings

Current (Per-Phase)

Voltage (L–L, L–N)

Real Power (Total)

Reactive Power (Total)

Apparent Power (Total)

Power Factor (Total)

Frequency

Energy Readings

Signed Accumulated Energy (Real kWh*, Signed Reactive kVArh*, Apparent kVAh)

(Absolute)

Demand Readings

Demand Current Calculations (Per-Phase):

Present

Peak

Demand Real Power Calculations (Total):

Present

Peak

Demand Reactive Power Calculations (Total):

Present

Peak

Demand Apparent Power Calculations (Total):

Present

Peak

KWh and kVArh are signed net consumption values.

7.3 DEMAND

All power demand calculations shall use any one of the following calculation methods, selectable by the user:

Block interval, with optional sub-intervals. The window length shall be set by the user from 1-60 minutes in 1 minute intervals. The user shall be able to

set the sub-interval length from 1-60 minutes in 1-minute intervals. The following Block methods are available:

Sliding Block that calculates demand every 15 seconds with intervals less than 15 minutes and every 60 seconds with an interval between 15 and 60 minutes.

Fixed Block that calculates demand at the end of the interval.

7.4 SAMPLING

The current and voltage signals shall be digitally sampled at a rate high enough to provide true rms accuracy to the 15th harmonic.

The Multifunction Meter shall provide continuous sampling at a minimum of up to 32 samples/cycle, simultaneously on all voltage and current channels in the meter.

7.5 CURRENT INPUTS

The Multifunction Meter shall accept current inputs from standard instrument current transformers with 5 amp secondary output and shall have a metering range of 0-6 amps with the following withstand currents: 10 amp continuous, 50 amp 10 sec per hour, 120 amp 1 sec per hour.

Current transformer primaries through 327 kA shall be supported.

7.6 VOLTAGE INPUTS

The Multifunction Meter shall allow connection to circuits up to 480 volts AC without the use of potential transformers. The Multifunction Meter shall also accept voltage inputs from standard instrument potential transformers. The Multifunction Meter shall support PT primaries through 1.6 MV.

The nominal full scale input of the Multifunction Meter shall be 277 Volts AC L-N, 480 Volts AC L-L. The meter shall accept a metering over-range of 20%. The input impedance shall be greater then 2Mohm (L-L) or 1Mohm (L-N).

7.7 ACCURACY

The Multifunction Meter shall comply with ANSI C12.16 and IEC-62053-21, Class 1

Functions performance class according to IEC 61557-12 (with CT ratio=1:1 and PT ratio=1:1) are, Class 0.2 for Voltage L-L from 30 Vac–480 Vac. Class

0.2 for Phase Current from 25%In < I < Imax Class 1.0 for Total Active Power from 1% In < I <Imax and 0.5 Ind to 0.8 Cap. Class 1.0 for Total Active Energy from 0 - 9999999.9 kWh. Class-1.0 for Power Factor Vector from 0.5 Ind to 0.8 Cap. And Class 0.02 for Frequency from 45Hz - 65 Hz. (PM700)

No annual calibration shall be required to maintain this accuracy when the Multifunction

Meter operates under specification.

7.8 INPUT/OUTPUT

The Multifunction Meter shall be capable of operating a solid state output to provide output pulses for a user definable increment of reported energy. Minimum relay life shall be in excess of one billion operations. The standard pulse output shall operate up to 240 volt AC, 300 volt DC, 96mA max, and provide 2.41 volt rms isolation.

All meters shall communicate on Modbus RTU for necessary integration wherever required.

7.9 CONTROL POWER:

The Multifunction Meter shall operate properly over a wide range of control power including 110-415VAC, +/-10% or 125-250VDC, +/-20%.

7.10 COMMUNICATIONS:

The Multifunction Meter shall communicate via RS-485 Modbus protocol with a 2-wire connection at speeds up to 19.2 kBaud.

It shall be possible to field upgrade the firmware in the Multifunction Meter to enhance functionality. These firmware upgrades shall be done through the communication connection and shall allow upgrades of individual meters or groups. No disassembly or changing of integrated circuit chips shall be required and it will not be necessary to de-energize the circuit or the equipment to perform the upgrade.

7.11 DISPLAY

The Multifunction Meter display shall be back lit LCD for easy viewing, display shall also be anti-glare and scratch resistant.

The Display shall be capable of allowing the user to view four values on one screen at the same time. A summary screen shall also be available to allow the user to view a snapshot of the system.

The display shall include two different modes of visualization, IEEE and IEC for all quantities.

The Display shall show 3 phase bar graphs

The Multifunction Meter display shall provide local access to the following metered quantities:

- Current, per phase rms
- Voltage, phase-to-phase, phase-to-neutral
- Real power, 3-phase total
- Reactive power, 3-phase total
- Apparent power, 3-phase total
- Signed Power factor, 3-phase total
- Frequency
- Demand current, per phase
- Demand real power, three phase total
- Demand apparent power, three phase total
- Signed Accumulated Energy, (kWh, kVAh, and kVARh)

Reset of the following electrical parameters shall also be allowed from the Multifunction Meter display:

- Peak demand current
- Peak demand power (kW, kVAr, kVA)
- Energy (MWh) and reactive energy (MVARh)

Setup for system requirements shall be allowed from the Multifunction Meter display.

Setup provisions shall include:

- CT rating
- PT rating (Single Phase, 2-Wire)

- System type [three-phase, 3-wire] [three-phase, 4-wire] [2 wire]
- Watt-hours per pulse (PM200P Only)
- Communication parameters such as address and baud rate

7.12 UPGRADES

It shall be possible to field upgrade the firmware in the Multifunction Meter to enhance functionality. These firmware upgrades shall be done through the communication connection and shall allow upgrades of individual meters or groups. No disassembly, changing of integrated circuit chips or kits shall be required and it will not be necessary to de-energize the circuit or the equipment to perform the upgrade.

7.13 INSTALLATION

To ensure safety of goods and people, the installation category of the Multifunction Meter shall be III. The communication circuit shall be of SELV type (security extra low voltage) and shall provide a class II insulation level between distribution system connection and communication port. The meter shall withstand a Uimp of 6kV. (Uimp: impulse withstands voltage). The Multifunction Meter shall be rated for an operating temperature range of 0°C to +60°C. Depth of the Multifunction Meter behind panel with communication port shall be equal or less than 50mm.

7.14 STANDARD

The multifunction meter shall comply with the following standards.

- IEC 62053-22 – Active Energy Class 1
- IEC 61557-12
- IEC 61010-1 – Safety

8.0 AIR CIRCUIT BREAKER (ACB) FOR LT PANEL

8.1 GENERAL:

ACB shall comply with standards IS/IEC 60947-1 & 2. The ACB shall conform to the requirements of IEC 60947-2 / IS 60947- 2 and shall be type tested & certified for compliance to standards from–CPRI, ERDA / any accredited international lab. The circuit breaker shall be suitable for 415 V ±

10%, 50Hz supply system. Manufacturer should submit Combined sequence test certificate from CPRI/ERDA

The circuit breakers shall be for continuous rating at 50 deg C ambient temperature around switchgear.

ACB shall have a rated operational voltage of 415V AC, rated insulation voltage of 1000 volts AC, rated impulse voltage of 12kV.

ACB shall be of 3pole or 4pole air break, molded case design for longer life along with less maintenance requirement.

All ACBs shall preferably be of single frame size up to 1600A to optimize requirement for spares management.

All EDO ACBs ready to close indication contact which shall be used to give a single indication via indicating lamps after checking all interlocks on panel door if ACB is ready to be closed, after checking all the given conditions (UV release energized, Shunt release de-energized, spring charged, Breaker is not "ON", Breaker has not tripped on fault,

ACB is not racked in completely in-service position) ensuring safety for user and electrical distribution. ACB shall comply with the environmental directives like RoHS.

8.2 PERFORMANCE:

ACB shall have the breaking performance Ics = Icu = Icw (1sec) = 65kA/50kA as per fault level mentioned in /SLD.

The operating mechanism of ACB shall be of the Open/Closed/Open stored-energy spring type. The closing time shall be less than or equal to 60ms, and of fast opening type with break time of breaker should be <30ms to ensure higher life of distribution cables.

8.3 ACCESSORIES & AUXILIARIES:

Shunt trip and closing coil (having common AC/DC supply upto 250V) shall be suitably rated. For Incomer ACBs delayed type under voltage release shall be used to avoid nuisance tripping during voltage surges.

ACBs shall have minimum 4 change-over auxiliary contacts, available to be used for indication and interlocking, rated at minimum 10A 240/380V 50 Hz

and shall be wired on chassis/cradle. There should be facility to add one more set of 4 contacts if required.

ACB shall be provided with two programmable contacts for fault/Alarm indications on panel door via LED lamps. It shall be possible to program the contacts for pre- overload alarm and pre- earth alarm. Panel builder shall wire these contacts to LED lamps on panel's front door. Suitable modules shall be considered for the same.

External neutral CT- To avoid nuisance Tripping due to unbalance load 4 Pole ACB shall be used for Earth Fault Sensing.

The ACB shall be provided with a door interlock i.e. door should not be open when circuit breaker is closed and breaker should not be closed when door is open. Mechanical operation counters for breakers.

8.4 SAFETY:

Draw-out ACBs shall preferably be provided with a mechanical latch on chassis which latches the ACB at Connected-Test-Disconnected positions while racking in and racking out the circuit breaker. This feature will help the operator in placing the circuit breaker at right position inside the chassis and can help in avoiding the accident. Interlocks:

The racking handle shall be stored on the air circuit breaker in such a manner as to be accessible without defeating the door interlocking.

8.5 TERMINATIONS:

All air circuit breaker shall be fully tropicalized as standard & suitable for terminating copper or aluminum bus bars. Both fixed & draw-out circuit breakers shall have single pole-pitch.

8.6 PROTECTIONS:

Air circuit breaker (except Bus couplers) shall be provided with microprocessor release, which should be self-powered type without the need of any auxiliary power supply during normal operation of the breaker.

Wherever communication is required Breaker release will be supplied with 24V DC auxiliary power supply.

The circuit breaker control unit shall measure the true r.m.s value of the current, Circuit breaker trip unit shall have a display for measurement of

fault current & Percentage Loading. It shall be possible to view last 10 trip cause on trip unit with real date and time stamping along with interrupted value. This display unit shall be mounted on the panel door. Breaker release shall have 4 Line LCD/LED display to display multiple measured values

All trip units provided shall have thermal memory as standard

All trip units shall be EMC/EMI tested

The protection release shall have following protections as standard: -

- Adjustable over load current (Ir) settings from 40% to 100% of rating of ACB (In). Over load time setting (tr) from 0.5s, 1s, 2s, 4s…….24s as field selectable curves.
- Short circuit setting (Isd) from 1.5 to 10 times of Ir setting, Short circuit time delay adjustable from 0 to 400msec.
- Instantaneous (Ii) protection with an adjustable pick-up and an OFF position.
- Earth fault setting adjustable in absolute Ampere with time delay settings from 0 to 400ms.

Separately powered, individual fault trip indication LED/LCD display (For overload, short circuit, earth fault and trip unit failure) shall be available on the trip unit which shall function even if the display fails.

I2t ON / I2t OFF options shall be available for short-circuit & earth fault protections which can be used to ensure discrimination with upstream circuit breaker or fuse

The trip unit shall have integral test facility to verify the healthiness and to avoid external calibration.

All Incomer ACBs of Main LT panel shall have release with following functions :Protection for O/C, S/C, E/F and Metering for Current- I1,I2,I3,In,Iavg,Imax, Voltage- Vph, V(line), Power- KW, KVA, KVAR, Power factor, Energy –KWh, KVAh, KWArh, Maximum Demand Demand power-KWh and additional protections for Under & over frequency, current & Voltage unbalance, reverse power (for DG sets), phase seq. reversal, Last 10 faults with date and time stamping, Last 10 alarms with date and time stamping, Current and Voltage.

All Main Incomer ACBs shall have inbuilt Temperature rise protection for protection against abnormal Temperature rise at terminals or at ACB release.

All Outgoing ACBs of Main LT panel shall have release having release with following functions: Protection for O/C, S/C, E/F and Metering for RMS values of highest current, % loading, Ammeter, Current- I1,I2,I3,In,Iavg,Imax etc

It shall be possible to change the protection settings on line and the circuit breaker need not be switched off while adjusting the settings.

All 4 Pole ACBs shall have fully rated neutral equal to rating of the breaker & shall be protected against over -load faults with provisions for settings neutral unprotected, neutral protection at 0.5In and neutral protection at 1.0 In to ensure precise neutral protection.

8.7 COMMUNICATION:

The advanced communication system needed for the project shall be able to show the basic data inside the trip unit of the ACB without using any external software. However communication shall be considered on Modbus/ Profibus.

Communication testing of the circuit breakers at panel builder's shop floor and generating the communication check report.

- Basic parameters (A, V, kWh, no. of operations etc.) viewing on Ethernet network from anywhere in LAN network and from any laptop, computer or smart phone
- Easy replacement of the Ethernet modules without the involvement of system integrators, in case the modules become faulty.

9.0 MCCB, MCB & RCCB'S FOR MAIN LT PANEL

9.1 GENERAL:

DBs, ACB, MCCBs, MCBs, ELCB/RCCB will be used of suitable capacities as per load and electricity rules. Breaking capacity for MCCB, min-25kA and for MCB-10kA.

MCCBs shall comply with standards IS/IEC 60947-1 & 2. The breaking capacity performance certificates shall be available for category A to the above mentioned standards.

MCCBmin breaking capacity-25kA shall have a rated operational voltage (Ue) of 415V, insulation voltage (Ui) of 750 V (AC 50/60 Hz) & impulse voltage (Uimp) of not less than 8kV. MCCBs shall be current limiting type with trip time of less than 10 m sec under short circuit conditions. The MCCBs should be either 3 or 4 poles fixed type. The design is required to minimize the effects of short circuit currents i.e. limit the let through energy and improve the life of cables. MCCB shall not have any line load bias.

9.2 PERFORMANCE:

The MCCBs shall have a rated service breaking capacity (Ics) equal to the ultimate breaking capacity (Icu) at 415V and as per system fault levels.

9.3 SAFETY:

For maximum safety, the power contacts shall be insulated in an enclosure made of a thermosetting material from other functions such as the operating mechanism, the case, the trip unit and auxiliaries (ON/OFF/Trip Contact, Shunt, Under Voltage etc.). All poles shall operate simultaneously for circuit breaker opening, closing and tripping.

MCCBs shall be actuated by a toggle or rotary-handle that clearly indicates the three distinctive positions: ON, OFF and TRIPPED. MCCB shall clearly indicate the suitability

for isolation in the name plate identified by the symbol  . MCCBs shall be equipped with a “push to trip” button in front to test operation and simultaneous opening of all poles together.

The electrical life of MCCBs shall be 8,000 operations up to 250A & 4000 operations up to 630A

All MCCBs termination should be done using circular lugs or cross bolted being bolted to MCCB can be terminated by crossing the bolt between the lugs/busbars and MCCB connections to enhance safety and reliability of the terminations.

9.4 AUXILIARIES AND ACCESSORIES:

Following separate Field installable auxiliary contacts for signalizing ON/OFF indication shall be provided with all MCCBs. Rotary handle shall ensure IP40 for direct type and IP 55 for extended Rotary handle.

9.5 PROTECTIONS REQUIREMENTS:

All MCCBs upto 250A shall be thermal magnetic type with adjustable overload settings from 0.8 to 1 times In and magnetic settings.

All MCCBs above 250A upto 630A shall be self-powered microprocessor based type having adjustable O/L, S/C & Earth Fault protections

In case of 4 pole microprocessor based MCCBs neutral shall be protected & adjustable as a Neutral unprotected / Neutral protected at 0.5 In/ Neutral protected at In.

In case of 3 Phase 4 Wire Systems, if 3 Pole MCCBs specified then Earth Fault Protection shall be inbuilt feature of MCCB. No external Earth Fault module shall be used.

For Motor application, motor duty type MCCBs shall be selected with reference to Type 2 coordination chart provided by the manufacturer.

9.6 METERING:

Microprocessor based MCCBs in Main LT Panels shall be capable of measuring the following data

ON, OFF and Trip status, current, voltage, energy, power, power factor and THD for current and voltage

- Last 10 trip histories with date and time stamping
- Additional protections for Current & Voltage unbalance, Under & Over Voltage, Under & Over Frequency, Maximum demand etc.
- Panel door mounted display for display of Current, Voltage, Energy & Power parameters

All MCCBs shall have Phase Barriers & Extended Rotary Operating Handles. The Rotary operating mechanism shall be of robust design and should be with door interlock & padlock facility.

All MCCBs above 63A shall be provided with Silver Plated Copper Spreader Links for enhancing termination capacity

9.7 MINIATURE CIRCUIT BREAKERS & RESIDUAL CONTROL DEVICES

Miniature circuit breakers shall be of approved design and make and must be tested and validated as per IS/IEC 60898 and IEC 60947-2 standards.

MCBs shall be suitable for operation at 240V/415V, 50Hz supply. The MCB ratings shall be available from 1--125A in 1P/2P/3P/4P versions. The rated short circuit capacity shall be 10KA as per IS/IEC 60898 and electrical life shall be 10,000 operations. MCBs shall be offered with B, C or D tripping characteristics as per the requirements. The MCBs shall be suitable for mounting on a 35mm DIN rail.

MCBs shall carry ISI and CE marking. The MCB manufacturer (through the bidder) has to submit the valid BIS license certificate at the time of offer submission.

MCBs shall ensure complete electrical Isolation of downstream circuit or equipment, when the MCB is switched OFF (to be marked on the MCB in symbolic form)

IP 20 Degree of Protection shall be ensured to prevent electrical shocks by accidental touch to any live parts, by providing finger touch proof terminals.

Energy Limitation Class-3 shall be to ensure minimum let through energy in the event of a fault, for safety & longevity of downstream circuit equipment. (to be mentioned on the as per standards)

MCBs shall be line-load reversible with no derating @ 35 deg C.

MCBs shall have bi-connect facility to terminate fork type busbar and wires, simultaneously. Terminal capacity shall be minimum 25 sq.mm. for ratings up to 25A, and 35 sq.mm. for ratings 32A & above to ensure perfect termination of wires and cables. Terminals of MCBs shall have captive screws.

Basic technical parameters, rating, operating voltage, energy limiting class 3 etc. shall be printed on front face of MCB for ease of identification. MCB should have clear indication on front facia for tripping on Short circuit faults for differentiation between O/L & S/C faults

The devices must be capable of heavy-duty operation and to that end, the manufacturer shall guarantee the following performance levels, defined by IEC / EN 60947-2 standards:

- suitability for isolation (section 7.2.7)
- rated insulation voltage (section 4.3.1.2): 500 V
- pollution degree (Part 1, section 6.1.3.2): 3

- rated impulse-withstand voltage (section 4.3.1.3): 6 kV
- Discrimination for power continuity
- Validated Cascading tables as per standard IEC 60947-2

Operating knob shall have provision to lock in ON / OFF condition without affecting any automatic tripping

Circuit- breakers shall be capable of operation under ambient temperature up to 35 °C, without derating of their overload tripping threshold with respect to their rated operating current. The same must be tested and validated as per IEC 60947-2 standard.

MCBs shall be suitable for field-fittable Protection auxiliaries (viz. Over-voltage release, Under -voltage release, Shunt trip) and Indication Auxiliaries (like Auxiliary Contact, Trip alarm contact).

For critical application feeders wherever specified for remote monitoring of circuit breakers status is required, MCB shall be communication ready to indicate the status of the device (On/Off/Trip), Number of On/Off cycles and Number of Tripping over universally open Modbus protocol so as to have seamless connectivity with any Energy and Building Management System.

9.8 RESIDUAL CURRENT CIRCUIT BREAKERS (RCCBS):

RCCBs must conform to IS12640 -1 and IEC/EN 61008 standards.

RCCBs shall be suitable for operation at 240V/415V, 50Hz supply. The RCCB ratings shall be available from 25A-125A in SPN and TPN versions with the sensitivity of 30mA (for personal protection) and 100/300mA (for Fire protection), as per the requirements. Rated conditional short circuit shall be 10KA RMS

RCCBs shall carry ISI marking. The RCCB manufacturer (through the bidder) has to submit the valid BIS license certificate at the time of offer submission.

RCCBs shall have clear indication of 'Tripping on earth leakage fault' on front facia.

RCCBs shall have Electrical life of 10,000 operations for all ratings

RCCBs shall have bi-connect facility to terminate fork type busbar and wires, simultaneously. Terminal capacity shall be minimum 25 sq.mm. for ratings

up to 32A, and 35 sq.mm. for ratings above 32A, to ensure perfect termination of wires and cables. Terminals of RCCBs shall have captive screws.

9.9 AUTOMATIC TRANSFER SWITCH

Rated short circuit making capacity Icm (KA) shall be as per standard.

9.9.1 SCOPE

In order to ensure the long- time continuous power supplying for the critical loads, this project needs to purchase ATS with international well-known brands. The critical parameters and technical features requirements of the ATSs are listed as below.

9.9.2 CODES AND STANDARDS

The automatic transfer switches and accessories shall conform to the requirements of:

EN 60947-6-1 / IEC60947-6-1: transfer switching

EN60947 -3 / IEC60947-3: Suitable for Isolation

EN55022: Radiated and Conducted Emission,Class A

EN61000-3-2: Harmonic Current Emission, Class A

EN61000-3-3: Limits of Voltage fluctuation and Flicker

EN 61000-4-5: Immunity to Surge

EN 61000-4-4: Immunity to Electrical Fast Transient:

EN61000-4-2: Immunity to Electrostatic Discharge

EN61000-4-3: Immunity to Radiated Electric Fields

EN 61000-4-6: Immunity to Continuous Conducted Interference

9.9.3 TECHNICAL DETAILS OF AUTOMATIC TRANSFER SWITCH

The ATS must comply with the IEC 60947-6-1 standard, and pass strict tests in a third party test lab. A valid type test report should be made available to prove that ATS complies with the latest IEC 60947-6-1 standard. The ATS must comply to minimum AC33B utilization category without derating of operational current (Ie). The mechanism should have reliable electrical and mechanical interlock, which can prevent two sources from connecting

simultaneously. The main contacts can operate at Three operation positions. When operating at three operation positions mode, two sources can be isolated in the center-off position. An isolating position lock is required to ensure safe maintenance when operating at center-off mode. The automatic transfer switch need to be having self acting controller connected to ATS switch that performs voltage sensing , Frequency sensing, Power loss, Phase loss, under voltage, over voltage, over frequency, under frequency Transfer.

Operating voltage range (AC) need to be from 0.7% to 1.15 % of nominal voltage.

Mechanical operational life need to be atleast 10,000 cycles.

Need to comply to standards for harmonic current Emission, CLASS A.

Making and breaking capacity need to be 10 times of rated operational current.

9.9.4 CONTROLLER

Different Optional Modes (Source I priority /No Source priority)

Controller Display Having Indicator - Switch position indicator lights, Source acceptability indicator lights on the front door panel.

Controller should be capable of detection of under and over voltage settings on source I and source II, Under and over frequency settings on source I and source II,

High frequency switching power supply, and wide power voltage range Diagnosis fault intelligent with self – protection function (Motor-Blocked)

Center-off with time delay and center-off with protection - The center-off time delay can be set to avoid large current rushes to inductive loads, Center-off with protection is available to protect critical loads (e.g.Fire Pump).

9.9.5 POWER SWITCHING

Rotating dual contactor design extinguishes the arc quickly and effectively Clamping contactors are self cleaning wiping action type High short circuit capability

9.9.6 SWITCHING MECHANISM

Automtic or manual operation provided

Unique contact design avoids contact bounce

Electrical and mechanical interlocks prevent both sources being connected simultaneously

Innovative motor breaking technique, provides precision control

Cast steel bevel gear mechanism provides for high transmission efficiency.

Operational Current (Ie)	16A to 800A
Rated insulation voltage Ui (V)	800-1000
Rated impulse withstand voltage Uimp (kV)	8-12
Rated operational voltage Ue (V)	220、230、240、380、400、415
Rated frequency (Hz)	50/60
Rated Short-Time Withstand Current Icw (kA)	10kA (0.1s) up to 160A, 15kA (0.1s) up to 250A ,25kA (0.1s) up to 400A, 40 kA(0.1s) upto 800A.
Rated Short-Circuit Making Capacity Icm (kA)	17kA (up to 160A), 31.5kA (up to 250A), 65 kA (up to 400A), 80 kA(up to 800A)
Making and breaking capacities	10 Ie
Mechanical operational performance	10,000
Utilization categories	AC - 33B

10.0 AUTOMATIC POWER FACTOR CORRECTION PANEL

10.1 SCOPE

Design, assembly/ fabrication, installation, testing and commissioning of 3 phase, 440 V, 50 Hz TP&N PFC system (Auto + manual option) with Heavy

Duty type capacitors, microprocessor based controller and Copper wound detuned filter. The unit shall improve the monthly average power factor and mitigate harmonic distortion on the LV bus. It should also be responsible for load balancing and neutral compensation. Power factor correction shall be done through Automatic Power Factor Correction panels with passive detuned filters.

There should be compliance for the following:

IS16636/ IEC61921: Power capacitors–Low voltage power factor correction banks.

IEC 61439- 1 : Low-Voltage Switchgear and Control gear Assemblies - Part 1: Type-Tested and Partially Type-Tested Assemblies.

IEC 62208 : Empty enclosures for low-voltage switchgear and control gear assemblies – General requirements

IEC 62262 : Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)

IEC 61326-1 : Electrical equipment for measurement, control and laboratory use - EMC

requirements - Part 1: General requirements.

IEC 61000-6-4 : Electromagnetic compatibility – Generic standards – Emission standard for industrial environments.

Detailed specifications of Active Harmonic Filter and detuned APFC panel shall separate panels as below:

10.2 Electrical Ratings:

- System Voltage: 415V AC ± 10%, 3ph 4 Wire/3 wire
- Line voltage tolerance: ±10%
- System Frequency: 50 Hz
- Frequency tolerance: 50 Hz ± 5%
- Harmonic Cancellation Current: [30, 60, 100, 150, 200, 300 amps]. Multiple filter units for parallel connection may be used to achieve total current requirements for combined power factor correction and harmonic mitigation.

- Possible units of same ratings connected in parallel: Up to four (4).
- Current transformers shall be with Class 1 or better with 15VA rating.
- Flexibility to select CT ratio shall be also be available.
- Remote indication contacts: 1No. potential free contact.
- Surge withstand capability per ANSI/IEEE STD C62.41-1991.
- Should comply with IEC/IEEE 62040 – 2 category C3 ripping.

10.3 Construction:

- Constructed on metal panel with minimum IP 20.
- Filter shall be suitable for operation within an ambient temperature between 0°C and 40°C.
- Shall be able to work with higher temperature with automatic de-rating (80% capacity at 50 °C).
- Storage temperature shall be from 0°C to 70°C.

Active filters shall be suitable for operation in relative humidity up to 95% non-condensing **10.0 APFC Panels with passive filters:**

Automatic Power Factor Correction panel shall be totally enclosed, metal clad, sheet steel fabricated, fixed feeder type, dust and vermin- proof, free standing, floor mounting type. The enclosure shall be pre-treated as per 11 tanks process and finished with powder coating of shade RAL 7032. The panel shall be factory build to ensure Proper thermal design, by providing louvers and fans in appropriate location, Accurate selection of switchgear, capacitors-reactors and others in the panel. Safety during operation, inspection and maintenance

BASIC DESIGN SPECIFICATIONS

An automatic power factor correction relay, microprocessor based, with arrangement for sensing the power factor of the inductive load (maximum 14 channels) and giving signal to the feeders of power capacitors as per the setting of P.F. and electronic circuit to ensure that once a capacitor gets cut off, it is not put on at least for a minute. The relay should automatically manage capacitor banks according to the reactive power required to correct the power factor of the load to the power factor set on the relay. The capacitors must be turned “on” and “off” to correct the power factor of the load to the power factor set on the

relay. The relay should have automatic and manual mode of operation with an LED to indicate the operating mode. The auto / manual function makes it possible to turn the capacitor banks “on” and “off” manually regardless of the line value measured.

Rated System Voltage	440V/415V/380V/400V	
Rated Frequency	50 Hz	
Short Circuit Rating	> 36 kA	
Altitude	1000 m	
Duty	Continuous	
Ambient temperature	-5° C to 45° C	
Power Supply	Three phase, four line	
Relay current input	-- / 5A, from CT on line	
Signal		
	The load bearing structure is made of 2 mm sheet steel	
Enclosures	The front door and partition are made of 1.6 mm sheet steel	
	The internal switchgear components are accessible on opening the front door and Capacitors & Reactors shall be accessed through back door	
	Ingress protection - IP42	
Installation	Indoor, wall mounted (up to 100 kVAr), floor mounted (100 kVAr and above) in a well-ventilated, non-dusty environment, cable entry from bottom	
Control	Auto + Manual	

Incomer	3 Pole MCCBs up to 630 A(400 kVAr) , 3 Pole ACBs above 630 A(above 400kVAr)

Other important features required are:

Various system parameter display on APFC Relay Fully automatic / manual setup and operation

Minimal joining in all the connections to ensure better reliability and lower losses. Use of special connecting cables suitable for high temperature withstands.

Flush mounted meter to indicate line voltage and current.

10.1 CAPACITOR BANK:

Capacitor voltage shall be minimum 525 V when used with 14% reactors. Capacitors shall be MPP Heavy Duty type. The capacitor element used in unit shall have metallized polypropylene film (MPP) having low loss dielectric and impregnated with such impregnate, which shall have high dielectric constant, low viscosity and high chemical stability. The impregnate should be resin filled. The capacitor unit shall have over pressure dis-connector protection. Discharge resistance shall reduce the residual voltage to less than 50 volts within one minute.

General specifications:

3 phase, delta connected, 50 Hz

Overvoltage +10% (for 8h / 24h), + 15% (for 30m / 24h), + 20% (5m/24h), +30% (1m/24h)

Overcurrent: 1.8 x In

Peak Inrush current withstand: 250 x In

Total watt-losses: < 0.45 W / kVAr

Temperature category: -25° C to 55° C 6000 switching operations per year

IEC 60831

10.2 DETUNED FILTER

Detuned harmonic filter reactors shall be used along with power capacitors to mitigate harmonics amplification and to avoid electrical resonance in LV electrical networks.

The complete unit shall be impregnated under vacuum and over-pressure in impregnation resin. The insulation shall be Class H.

The reactors shall be made of high grade aluminum windings, having a three phase, iron core construction suitable for indoor use. The reactor shall be air cooled and the layout shall be in accordance with IEC 60289 / IS 5553.

The permitted tolerance of inductance is ± 3% of rated inductance value.

Reactor tuning factor shall be 7 % (189 Hz) and the current rating of the reactor shall include the effects of harmonics and other possible over-currents

The limit of linearity of inductance of the filter reactor is: $1.8*I_n$ with $L=0.95*L_N$.

The reactor shall be fitted with a temperature sensitive micro-switch in the center coil (normally open) for connection to trip circuits in case of high operating temperatures.

Power loss in each reactor shall be less than 5 W/kVAr

Each reactor shall have routine test certificate for the above tests.

Contactor

All contactors shall be AC6B duty 3 pole air-break, magnetic, capacitor duty type. The rating of contactor shall be suitably assigned. The contactors shall be so chosen as to withstand inrush current due to parallel switching. Contactor should be with damping resistors to limit capacitor charging current

The individual capacitor bank/step shall be switched automatically/ manually with selector switch as required using magnetic contactors suitable for switching capacitive currents. The contactor coil voltage shall be as

specified. The minimum life expectancy of the contactor shall be one million switching operations

Contactor should be with surge suppressor Operation voltage up to 690V

Insulation voltage 1 kV

Rated impulse withstand up to 8 kV

APFC Controller

The APFC controller should be microprocessor based and should correct power factor with the help of contactors by switching the required no. capacitor banks.

The controller should offer power factor correction without any need for manual intervention. The controllers should decide optimum configuration of capacitor banks in order to achieve desired power factor by taking into consideration the kVAr of each step, no of operations, total usage time, re-connection time of each step etc. Besides manual switching of capacitors should also be possible directly through the controller, The APFC controller should have the following basic features.

Backlit LCD display with multiple parameters displayed at the same time Auto step programmable

Capable of measuring VTHD and ITHD values at least up to 15th order Automatic CT reversal sensing and correction Should be 1A / 5A CT selectable.

Sensing shall be done at LT as well as HT side of the transformer Display of average weekly power factor

Keypad lock feature to prevent operation by unauthorized persons

Alarms for under/over compensation, high VTHD/ITHD, over temperature, capacitor failure, capacitor over-current, over/under voltage

Individual capacitor's ON/OFF status and capacitor failure indication Temperature sensing feature with alarm in case

of panel over heating Should have RS485 communication protocol.

10.3 ENCLOSURE

The panel shall be indoor type, free standing, and floor mounting with IP42 degree of protection. It shall be completely made of CRCA sheet steel. The enclosure shall have sturdy support structure with angle supports as necessary and shall be finished with powder coating in the approved colour shade/s to match the colour of the other panels. The thickness of powder coating should be minimum 60-80 microns.

Suitable provisions shall be made in the panel for proper heat dissipation. Air aspiration louvers for heat dissipation shall be provided as a necessary.

The front portion shall house the switchgear and the rear portion shall house capacitors

and series reactors.The enclosure is to be suitably sized to accommodate all the

components, providing necessary air clearance between live and non-live parts, providing

necessary working clearance.

10.4 SWITCHGEAR & PROTECTION

Incomer switchgear shall be TP&N breaker appropriate rating. Suitable contactor for each step shall be used and must be capable of capacitor switching duty at each step for short circuit protection.

Bus bars shall be suitably colour coded and must be mounted on appropriate insulator supports.

Power cables used shall have superior mechanical, electrical and thermal properties, and shall have the capability to continuously operate at very high temperatures up to 125 deg.C.

Internal wiring between main bus-bars, breaker, contactor and capacitors shall be made with 1100 V grade, PVC insulated, copper conductor cable of appropriate size, by using suitable copper crimping terminal ends etc.

Suitable bus links for input supply cable termination shall be provided.

10.5 CONTROL CIRCUIT & GENERAL PROTECTION

The control circuit shall be duly protected by using suitable rating MCB.

An emergency stop push button shall be provided to trip the entire system (22.5 mm dia, mushroom type, press to stop and turn to reset).

Wiring of the control circuit shall be done by using 1.5 sq.mm, 1100 V grade, PVC insulated, multi-stranded copper control wire.

Inspection terminal strip, number ferruling, labeling etc. shall be provided.

440 V caution board on the panel shall be provided.

11.0 EARTHING SYSTEM

11.1 GENERAL

11.1.1 Work Description

This section covers design, and setting of the complete earthing network for individual earthing systems, circuit protective conductors and bonding conductors and, supply, installation, testing, commissioning of earthing system.

A complete earthing network comprising cables, copper tapes, electrodes and earth bonding of all relevant necessary non-current carrying metal parts of equipments/ apparatus shall be connected as required.

The system shall have a common earthing system as described in the specification and as shown on the drawings. Individual earthing systems as per drawing shall be provided for following:

- H.T. Substation, Transformer Neutral & Body, H.T. Panels , Body Earthings, L.A. etc.
- LT Electrical Earthing
- DG Generator Neutral & body Earthing
- Earthings for Lifts.
- Earthing for Fire pumps & Domestic water pumps.
- Earthing for Lightening Protection.

- ELV Earthing
- Data Communication Earthing

Main LT / Generator Electrical Earthing shall have two earth connections to the earthing system.

Sufficient numbers of electrodes interconnected by Cooper / GI (as per requirement) to form earthing mat so that the overall earth resistance is less than 1 ohm for each individual earthing mat.

The number of earth electrodes of the earthing mat is indicated on the drawings as minimum. The Contractor shall test the resistivity of soil at site and determine the exact number of earth electrodes to achieve the required earth resistance value with approval of Engineer-in-charge. Earth plate, earth mat detail to achieve the earth resistance value shall be included in the Contract for complete earthing installation.

The Contractor shall have approval of materials from engineer-in-charge before use on work. Execution of earthing shall be carried out only in the presence of the Engineer or the representative.

11.1.2 Standards

Complete earthing system shall be designed and executed in accordance with the latest revision of the following standards and the appropriate BS/IEC:

1. IS: 3043 : Earthing
2. BS6651 : Lightning Protection System
3. IEC 61024-1-2: Lightning Protection System

The detail of the Earthing System shall also conform to the requirements of all relevant

local codes as applicable together with the additional requirements referred to in the

Specification and Drawings, whichever is the more stringent and acceptable to the Engineer-in charge.

11.1.3 Submission

All technical submissions shall be approved by the EPC contractor prior to the respective stages of construction with respect to the approved design and development documents. In case of major deviations, it shall be brought under the notice of LICI for its review and approval.

As minimum requirement the submission shall include the following:

- Shop Drawings and Sample Submission
- Builder's work requirement
- Testing procedures and report format for testing of the earth electrodes and/or earth strips
- Soil resisting test report with calculation report for the details of the earthing system detail including quantity and layout of earth electrodes and/or earth strips to achieve the required earth resistance. The report shall be endorsed by the Contractor's Installation Engineer who supervise and endorse the installation upon completion
- Proposed details of earthing system including quantity and layout of the earth electrodes and/or earth strips according to the calculation result.

11.2 PRODUCT

11.2.1 General

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 0.5 ohms in order to ensure satisfactory operation of protective devices.

The resistance to earth shall be measured at the following:-

At each electrical system ground or system neutral ground.

At one point each grounding system used to ground electrical equipment enclosures.

At one point each grounding system used to ground wiring system enclosures such as metal conduits and cable sheaths or armoured.

All earthing conductors shall be of high conductivity copper/ G.I. and able to protect against mechanical damage as per requirement. The cross-sectional

area of earth conductor shall not be smaller than half that of the largest current carrying conductor. However, the contractor shall use the sizes specified of the Tender. Common earth mats of resistivity of less than one (1) ohm shall be constructed below the lowest floor structure prior to any ground work construction. The earth mats shall comprise the complete earth electrodes, earth strips/grids, earth inspection chambers, earth leads, main earth terminals, earth test link boxes at ground level, etc. Each individual earthing system shall have earth leads connecting its main earth terminal directly to an earth electrode underground as specified.

All earthing products/accessories shall be in accordance to IS standards.

The mating surface of all tapes at joints etc shall be cleaned before clamping and riveted with proper connector or exothermic welded. All connections to electrical apparatus shall be made by bolted connection in a visible and accessible position

11.2.2 Pipe Earth Electrode

G.I. pipe shall be of medium class 100mm dia and 3m in length.

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 up to 2m of length from bottom.

The electrode shall be buried in the ground vertically with its top being 20cm minimum below ground level.

Clamping of the earth leads to the earth rod shall be made by earth clamp. The clamps shall be capable of providing high pressure contact between the earth rod and the earth leads to achieve low contact resistance.

When two or more electrodes are driven to form a group, the heads of the electrodes in the group shall be bonded to each other by means of a 25 mm x 3mm GI / Copper strip, laid at a depth of at least 600 mm in soil.

Recommended water seal insert sleeve approved by Engineer-in-charge shall be provided with all earth electrode penetrations through basement water proofing membranes and the installation shall be done under strict supervision.

11.2.3 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 4.5m below Ground level. The plate shall be filled with charcoal dust and common salt filling, extending 15cm around it's on all sides.

A watering pipe of 50mm dia of medium class G.I pipe 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.

The earthing lead from electrode onwards shall be suitably protected from mechanical injury by suitable dia medium class G.I. pipe in case of wire and size according to strip size.The overlapping of strips at joints shall done in approved manner

GI strips shall be riveted with rivets/ bolted and welded.

- Copper strips shall be riveted with rivets/ bolted brass nuts, bolts and washers and brazed.

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 the earthing lead shall be securely bolted to the plate with two bolts, nuts, check nuts 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 1.5 M 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 flower beds or water taps.

11.2.4 Earth Inspection Chamber

Earth electrode shall be fitted with a heavy-duty pre cast concrete inspection chamber / pit complete with heavy-duty cover as specified on drawings.

For earth electrodes located outside or on the apron of the building, earth inspection chambers shall extend to a depth of not less than 300 mm below finished ground level and kept free of soil. For earth electrodes located inside building, earth electrodes shall be buried not less than 100 mm below the floor slab structure. Each earth electrode shall be clearly marked 'Safety Electrical Earth Connection – Do Not Remove'.

The chamber and cover shall be heavy duty detail to consider the traffic load at the location of installation. The cover shall be recessed cover to receive the Architectural floor finish at the location of installation.

11.2.5 Earth Strip

Earth strips/grids shall be of bare GI/ Copper strips of 25 mm x 3 mm as specified.

Earth strips shall be riveted or joint with proper connector to earth electrodes underground below the floor slab structure, and shall be buried not less than 300 mm below the floor slab structure.

In order to minimize the mutual inductance between strips, earth strips shall be positioned at a distance not less than 6m apart unless otherwise specified.

11.3 EARTH BONDING

11.3.1 Circuit Protective Conductor

Circuit protective conductor (CPC) is a system of conductors joining together all exposed conductive parts and connecting them to the main earth terminal.

The purpose of circuit protective conductor is to provide a path for earth fault circuit so that the protective device will operate to remove dangerous potential differences during a fault condition.

The circuit protective conductors shall take the form of separate cable with a sheath in green/yellow color or copper tape of minimum size 25mm x 3mm.

All exposed non-current carrying metal parts of light fittings, switchgears, motors, enclosures, etc. shall be effectively earthed by circuit protective conductors for earth continuity protection.

For equipment where an earth terminal is provided, the earth continuity wire shall be firmly clamped. Where no earth terminal is provided, the exposed metal part shall be cleaned of paint and surface rust before welding the earth continuity lead.

The minimum size of the principal protective conductors shall be in accordance with to the current edition of IS: 3043/ BS7671 and BS7430.

The external earth terminal on the outside of the end panel of any switchboard shall be connected to the main earth bar provided in two independent points.

Circuit protective conductors shall be provided in electrical and mechanical rooms and along the routes for the bonding of all exposed conductive parts and extraneous conductive parts. A suitably sized earth terminal shall be provided at each zone of the building for this purpose.

All exposed conductive parts shall be effectively connected in an approved manner to the principal protective conductors. The circuit protective conductors shall be single core copper cables or high conductivity annealed copper tapes specified. Unless otherwise specified, the minimum cross-sectional area of the circuit protective conductors shall be selected in accordance with IS: 3043/ BS7671.

SECTION-12 : TRANSFORMER (OIL TYPE)

12.1 SCOPE :

This standard specification covers the general requirements for the design, manufacture, supply, installation, testing and commissioning of outdoor dry impregnated type transformer (having general requirements listed in the following paragraphs). This specification is accompanied by the transformer data sheet.

Transformer complete with and miscellaneous accessories shall be thoroughly inspected and any damage noticed shall be reported to the Engineer-in- charge. Before erection of transformer, the level of rails on foundation shall be checked and minor corrections if necessary shall be carried out. After the completion of erection, necessary stoppers shall be provided at the wheels. All loosely supplied fittings / accessories shall be cleaned and mounted on the transformer and connections made. After completely assembling, installation the transformer shall be cleaned and touch up with paint supplied by the manufacturer applied wherever necessary. All Cover bolts shall be checked for proper tightness. (The foundation of transformer and rail fixing will be made by civil Contractor). Various field tests as reckoned in the

IS shall be carried out for the transformer. Winding insulation test and polarity test shall also be carried out.

12.2 STANDARDS:

The OIL TYPE TRANSFORMER shall comply with the applicable clauses of the latest editions of the following standards. In case of any conflict, the requirements of this standards shall prevail.

1000 KVA,11/.433KV, 50HZ, outdoor type, copper wound, oil cooled type distribution transformer(ONAN) as per IS : 2026-1977, or latest version vector droup-DY11, having bushing on HV side & LV cable end box on LT side with silica gel breather& provision for thermometer. Filter valve, conservator tank and standardaccessories. Sub station work shall also includes 11KV HT switch gearof suitable breaking capacity depending on load and local electricity Authority network, including substationequipment comprising HT panel active harmonic filters, transient voltagesupression system (TVSS), surge protection device (SPD), essential panel, earthing, required interconnections, sub station safety equipments, including LT cable from substation to building fed by the substation.

IS: 1271 : Classification of Insulating Materials

IS: 3639 : Power Transformer - Fittings and Accessories

IS: 2025(Part I to IV) : Power Transformers

IS: 11171 : Specifications for dry type power transformer

IEC : 726 : Dry type Power Transformer

CBIP Specifications : Power & Distribution Part-II Transformers.

IS : 2099 : Bushing for alternating voltages above 1000 volts.

IS : 2705 : Current transformers

IEC : 76 : Power transformers.

IEEE : Std. 141 : Recommended Practice for Electrical Power Distribution for Industrial plants

IS : 3202 : Code of practice for climate proofing of electrical equipment.

12.3 CONSTRUCTIONAL DETAILS

LIQUID-FILLED DISTRIBUTION TRANSFORMERS

A. Description: Comply with IEC 61330 for liquid-filled, 2-winding transformers.

B. Insulating Liquid: Mineral oil, Type II; tested according to IS: 335.

C. Insulating Liquid: Less flammable, edible-seed-oil based, as complying with IS 335 requirements for fire point of not less than 300 deg C when tested. Liquid shall be biodegradable and non-toxic.

D. Insulation Temperature Rise: 55 deg C, based on an average ambient temperature of 35 deg C over 24 hours with a maximum ambient temperature of 48 deg C.

E. Basic Impulse Level: Comply with UL 1062.

F. Full-Capacity Voltage Taps: Four, 2.5 percent taps, 2 above and 2 below rated primary voltage; with externally operable, de-energized tap changer; position indicator; and padlock hasp.

G. Cooling System: ONAN (Oil Natural Air Natural).

H. Sound level should be as per relevant standards.

I. Impedance: 5 percent (to be specified by Vendor).

J. Accessories for each Transformer:

a) Grounding pads, lifting lugs, and provisions for jacking under base.

b) Oil conservator with Magnetic Oil level Gauge / Plain Oil gauge, filling hole with cap & Drain valve.

c) Additional 10% oil should be supplied in non returnable drums for each transformer

d) Explosion vent with double diaphragm & equalizer pipe

e) 1 set of detachable radiator with shutoff valve

f) Silica gel Dehydrating Breather for transformer.

g) Magnetic oil level gauge with low oil level alarm contact

h) Marshalling Box

i) Double float Bucchholz relay with alarm & trip contacts & two shut off valve

j) 6 inch Dial type Oil Temperature Indicator with Alarm & trip contacts.

k) 6 inch Dial type with Winding Temperature indicator with heater bulb, suitable CTs and Alarm & trip contacts.

l) Thermometer pocket for O.T.I.

m) Separate Neutral Bushing to be brought out for solid Earthing.

n) 4 # Bi-directional flat rollers

o) 2 # Thermometer pockets

p) Drain valve with plug, Filter valve with plug

q) 2 # Lifting lugs

r) Rating & Diagram plate.

s) Air Release plug

t) Sampling valve

u) Jacking pads

v) Earthing terminal

w) Pressure relief valve

x) HV Cable box with disconnecting chamber

y) LV Cable box with disconnecting chamber

12.4 IDENTIFICATION DEVICES

Name Plates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws.

12.5 CONSTRUCTION FEATURES

General:

a)Similar parts, particularly removable ones, should be interchangeable.

b)Exposed parts should not leave pockets where water can collect.

c)Internal design of transformer should ensure that air is not trapped in any location.

Material in contact with oil should be such as not to contribute to the formation of acid in oil surface in contact with oil should not be galvanized or cadmium plated.

A. Core:

a) The design of the magnetic circuit should be such as to avoid static discharge, development of short circuit paths within itself or to the earthed clamping structure and the production of flux component at right angles to the plane of the lamination which may cause local heating.

b) The magnetic circuit should be of core type construction. It should be built out of high grade, non aging, low losses, high permeability, cold rolled grain oriented silicon steel lamination.

c) The finally assembled core should be free from distortion. It should be rigidly clamped to ensure adequate mechanical strength and to prevent vibrations during operation.

d) The core should be provided with lugs suitable for lifting the complete core and coil assembly.

e) All parts of the cores should be of robust design capable of withstanding any shocks to which they may be subjected during lifting, transport, installation and service.

B. Internal Earthing

All metal parts of transformer with the exception of the individual core lamination, core bolts, and associated individual clamping plates should be earthed.

C. WINDING

Winding should be subjected to shrinking and seasoning process, so that no further shrinkage occurs during service. Adjustable devices should be provided for taking up possible shrinkage in service.

Materials used in the insulation and assembly of the winding should be insoluble, non catalytic and chemically inactive in hot transformer oil, and shell not often or be otherwise affected under the operating conditions.

Neutral of all star connected winding should be brought out in open.

The winding should be designed to reduce a minimum out of balance forces in the transformer at all voltage ratios.

D. TANK

Tank should be made from good commercial grade low carbon steel and should be of welded construction.

Tank should be designed to permit lifting, by crane of jacks, of the complete transformer assembly filled with oil. Radiators should be detachable type connected to the tank through butterfly valves.

The material used for gasket should be cork neoprene or approved equivalent.

Tank should be provided with lifting lugs a minimum of four jacking lugs and suitable haulage holes.

The tank cover should be fitted with pockets for a thermometer and for the bulbs of oil and winding temperature indicators. Protection should be provided, where necessary, for each capillary tube.

All wheels should be detachable and should be made of cast iron or steel as required.

Inspection cover on the top should be provided (for small transformer of 500 KVA and above). Tank cover should be suitably sloped to prevent accumulation of rain water.

E. Conservator:

a) A conservator complete with sump and drain valve to meet the requirement of expansion of the total cold oil volume in the transformer and cooling equipment from the minimum ambient temperature to 90°C.

b) Normally one coil gauge magnetic\ prismatic\ plain type as specified should be provided.

c) Conservator should be fitted with a silica gel breather.

Filter and Drain Valves: Each transformer should be fitted with the filter and drain valves, a sampling device and air release of any pressure.

F. Pressure Relief Device:

a) The pressure relief device should be provided of sufficient sizes for rapid releases of any pressure.

b) If a diaphragm is put at the base of pipe, an oil gauge is required on the stand pipe for indicating fracture of diaphragm.

c) If a diaphragm is used it should be of suitable design and material and situated above maximum oil level.

d) An equalizer pipes should be connected between the pressure relief device to the conservator or silica gel breather should be fitted to pressure relief device for relieving or equalizing the pressure.

e)Two earthing terminal of required size should be provided.

f)Rating and diagram plates should be provided as per IS: 2026.

G. OIL

Transformer should be supplied with first filling oil conforming to IS: 335.

Additional 10% oil should be supplied in non returnable drums for each transformer.

H. BUSHING INSULATORS AND CABLE BOXES

Transformer should be fitted either with bushing insulators or with cable boxes, as specified. Cable box should be air insulated type.

Cable box should have sufficient space to facilitate termination if more than one cable terminations are specified, and to accommodate all cable joint fittings or sealing ends including stress/cones etc. Links should be provided of suitable length for easy termination of cables. Necessary glands and cable sockets should be provided. Box should have a drain plug to enable the filling medium removal quickly. Armour earthing pads (2 nos.) should be provided along with cable termination kit support.

Non magnetic cable gland plate should be provided in the cable box, whenever single core cables are specified.

I. CABLE TERMINATION BOX WITH DISCONNECTING CHAMBER

The cable termination box with disconnecting chamber on HV side of the transformer should be capable to connect 3C x 400 sqmm HT XLPE cable x 1 nos. and on LV side of the transformer should be capable of terminating COPPER BUS-DUCT/ Cable of suitable capacity.

1. Winding shall be brought out and terminated on outdoor bushing, cable boxes or bus duct chamber which will be located as specified on data sheet.

2. Cable boxes shall be supplied with cable lugs and glands. H.T. cable box shall be suitably dimensioned to accept terminations of XLPE cable specified in data sheet.

3. The H.V./L.V. terminal boxes shall be located on the side/top respectively and at right angle or oposite to each other as specified in the data sheet . Suitable flange shall be provided for bus duct on LV side where specified in the Data sheet.

4. For L.T. PVC control cables compression glands:("Type HW") shall be supplied. Gland plate shall be removable type. For single core cables, gland plate shall be of non - magnetic material. Such cable boxes shall have arrangements for grounding the armour of cables.

5. Cable lugs shall be non-soldering crimping type.

6. LV side terminal chamber for bus duct termination shall have a gasketted cover plate bolted to it. A seperate cover plate shall be provided to facilitate the connection and inspection. Phase sequence of busbar shall be as specified in MR or data sheet. The arrengment may be from top or side entry.

7. Marshalling box shall be weather - tight. All prospective devices and neutral CTs shall be wired by means of PVC insulated armoured cable upto marshalling box .

Terminals shall be Elmex type or approved equal. Removable gland plate with compression type cable glands as stated in 4.4 shall be provided.

8. For transformers having provisions for terminating TPN bus duct on 433 V side neutral of the star connected scondary winding shall be brought out to a secondary terminal chamber. A CT shall be mounted (if specified) on the neutral terminal with C.T. Secondary wired upto marshalling box.

9. Separate neutral terminal/bushing shall be provided for grounding.

J. TEMPERATURE INDICATING DEVICES AND ALARM

Oil temperature indicator with/without electrical contacts should be provided as specified in data sheet. Winding temperature indicator should be provided, if specified with no of contact required. The tripping contact of winding temperature indicators should be adjustable to close between 60°C and 120°C and alarm contacts to close between 50°C and 100°C and both should reopen when the temperature falls by about 10°C.

Connections should be brought from the device to marshalling box.

K. GAS AND OIL ACTUATED RELAYS

A double float type Buchholz relay as per IS: 3637 should be provided. Two electrically independent alarm and trip contact should be provided. Two isolating valves should be provided an either side of the relay. Buchholz relay should be provided with a test cover

L. PAINTING

The interior of transformer tank, other oil filled chambers and internal structural steel work should be painted with heat resistant, oil insoluble insulating varnish after thorough cleaning of all scales and dust by shot blasting or other approved method.

Steel surfaces exposed to the weather should be thoroughly cleaned and applied first coat of zinc chromate, second coat of oil and weather resistant paint and final coat of glossy oil and weather resistant non fading paint of shade no 632 of IS :5 (epoxy paint)

12.6 TAPPINGS AND CONTROL

A. The tap changer shall be **ON LOAD TYPE**. These shall be provided on high voltage side to get constant voltage on LV side and connected to on load tap changing gear. Under conditions of external short circuit, the tap changing equipment must be capable of carrying the same current as the winding.

12.7 INSTALLATION

Modify first paragraph and subparagraphs below to suit project. Coordinate with Drawings and with seismic-restraint requirements if applicable.

Install and anchor transformers on concrete bases according to manufacturer's written instructions.

a) Construct concrete bases of dimensions indicated, but not less than 100 mm larger in both directions than supported unit and 100 mm high.

b) Use 20.7-MPa, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

c) Install dowel rods to connect concrete bases to concrete floor. Unless otherwise indicated, install dowel rods on 450-mm centres around full perimeter of base.

d) Anchor equipment with epoxy-embedded anchor bolts that extend through concrete base and anchor into structural concrete floor.

Maintain minimum clearances according to manufacturer's written instructions and NFPA 70.

12.8 IDENTIFICATION

Identify components and provide warning signs as specified in Division 26 Section "Identification for Electrical Systems." FIELD QUALITY CONTROL

Perform electrical test and visual and mechanical inspection stated in IS 3637. Certify compliance with test parameters.

Test and adjust controls and safeties.

12.9 FOLLOW-UP SERVICE

Voltage Monitoring and Adjusting: Perform the following voltage monitoring after Substantial Completion but not more than six months after Final Acceptance:

a) During a period of normal load cycles, perform seven days of continuous three-phase voltage recording at secondary terminals of each transformer. Voltage unbalance greater than 1 percent between phases, or deviation of any phase voltage from nominal value by more than plus or minus 5 percent during test period, is unacceptable.

b) Corrective Actions: If test results are unacceptable, perform the following corrective actions, as appropriate:

c) Adjust transformer taps as per requirement.

d) Prepare written request for voltage adjustment by electric utility.

e) Retests: After corrective actions have been performed, repeat monitoring until satisfactory results are obtained.

f) Report: Prepare written report covering monitoring and corrective actions performed.

12.10 INSPECTION, TESTING AND COMMISSIONING

A. Inspection including witnessing routine tests will be carried out by purchaser or his authorized representative.

B. Vendor should notify purchaser or his authorized representative in writing at least fifteen days prior to vendor's scheduled inspection tests.

C. Vendor will send his engineer at the time of commissioning of the transformer .He will test all pre-commissioning checks and will commission the transformer jointly with the electrical contractor at site

D. The transformer marshalling box shall be provided with anti-corrosive heaters controlled through a manually operated switch suitable for operation on 230V AC.

E. The transformer shall be designed with particular regards to suppression of harmonic voltages the K factor should be K-1 / K-13.

F. A copper plate shielding shall be provided between primary and secondary winding and lead shall be taken out.

12.11 TESTING

Client's representative shall be given free access in the works from time to time for stagewise inspection and progress reporting. The following routine and type test shall be performed on the transformers as per IS-2026 in the presence of client's representative and should have to submit the test certificates. About three week's notice shall be given to the client's to witness the tests at the vendor's works.

A. TYPE TEST

Only certificates for Type test as indicated in IS: 11171/IEC 726 (like HV impulse test, Tan-Delta, Heat run test etc,.) for similar rating and type of transformer should be submitted.

B. ROUTINE TEST

The routine tests, including but not limited to the following shall be performed on each of the transformers, as per the relevant standards.

1. Measurement of winding resistance.
2. Measurement of voltage ratio Test, Vector group test.
3. Measurement of impedance voltage/short circuit impedance and load loss.
4. Secondary injection test.
5. Insulation Resistance test.

C. ACCEPTANCE TESTS

D. FIELD TESTS

12.12 ACCESSORIES

Accessories as specified in the attached data sheet shall be included in the scope of supply.

Tapping and control gears shall be provided on the H.V. side. Tap changer shall be off- circuit or OLTC with RTCC panel as specified in data sheet. The tap changing

equipment shall be suitable for carrying the fault current under condition of external or internal faults.

12.13 PAINTING

All metal parts shall be thoroughly cleaned to remove rust, scale, grease etc. and painted with two coats of approved colour shade over one coat of rust resisting primer . The paint shall not scale-off crinkle or removed due to normal handling.

All metal surfaces not accessible for painting shall be made or corrosion resistant material.

12.14 RATING PLATE DETAILS

Each transformer shall be provided with a rating plate giving the details as per IS:2026 (Pt.I). The marking shall be indelible and the rating plate shall be located on the front the side.

Exact value pf transformer % impedance, as determined by tests shall be marked on it and also on the final submission of name plate drawing.

12.15 NOISE

Noise level shall be precribe as per NEEMA standard depending on the rating of transformers.

12.16 DRAWINGS & DOCUMENTS

1. All drawings and documents shall be submitted as per the requirements specified in vendor data requirements.

2. Complete technical particulars as per Appendix-B of IS:2026 as applicable to Oil type transformers shall be furnished with quotations.

3. Make and type of various accessories and protective devices shall be furnished with the quotation.

12.17 GUARANTEE

The transformer shall be guaranteed for trouble-free service for the period of 24 Months from the date of commissioning. Any defects discovered during this period shall be rectified free of charge.

12.18 INFORMATION TO BE FURNISH BY SUCCESSFUL TENDERER

A. Clause wise deviations to this specification. If the same are not furnished it will be assumed that the offered equipments meet the enquiry specifications in total.

DATA – SHEET GENERAL

1)	Application	:	Power Distribution

2)	Quantity	:	One
3)	Installation	:	**Indoor/Outdoor – Oil type with ONAN cooling**
4)	Type of winding	:	**Double wound**
5)	Rating	:	
6)	Cooling	:	AN

RATING

1)	No load voltages		
M.V. winding	:	11 KV	
L.V. winding	:	433 V	
2)	Frequency	:	50 Hz
3)	% age Impedance	:	Submitted by the manufacturer as per IS.
4)	Primary Fault Level	:	1000KA

WINDING

1)	Material of winding	:	Copper
2)	Winding Connection	:	
H.V. side	:	Delta	
L.V. side	:	Star	
3)	Vector group	:	DYn11
4)	Neutral	:	Earthed

TERMINAL CONNECTION

1)	M.V. winding end	:	HT cable
2)	L.V. winding end	:	LT Cable/ Copper Bus-Duct
3)	L.V. winding end	:	To be brought out separately Neutral

OFF LOAD TAP CHANGING - ON HV WINDING

1)	Total tapping range	:	+10 TO -15 %
2)	Steps	:	In step of 2.5%

SHADEOF Siemens Gray RAL7032
EENCLOUSE

LOSSES OF OIL TYPE TRANSFORMER for Transforemer:

The client have right to reject the transformer at time of inspection if the tolerances of the losses and impedance exceeds tolerances specified in relevant IS code for transformer.

3.0 PERFORMANCE (TO BE FURNISHED BY BIDDER WITH TENDER)

3.1 % Losses

No load at 100 % V : _____ KW

On load at 110 % V : _____ KW

Copper at 75 centigrade : _____ KW

Copper Losses at 25% Load : _____ KW

Copper Losses at 50% Load : _____ KW

Copper Losses at 75% Load : _____ KW

Copper Losses at 100% Load : _____ KW

3.2 Rated efficiency %

Power factor Load 4/4 ¾ 1/2

0.8

1.0

3.3 Impedance voltage

Primary :_____

Secondary :_____

3.4 Load at which maximum efficiency occurs : _____

3.5 Maximum efficiency : _____

3.6 Efficeiny at load following load

At 100% load : _____

At 75% Load : _____

At 50% Load : _____

4.0 MECHANICAL DATA (TO BE FURNISHED BY BIDDER WITH TENDER)

4.1 Weights

Core and windings : _____

Tanks and fittings : _____

4.2 Dimensions : _____

5.0 ACCESSORIES REQUIRED

5.1 Bidirectional flat/rollers : Required

5.2 Seperate neutral bushing : Required

5.3 Seperate Surge bushing : Required

5.4 On circuit tap changer : Required

5.5 Lifting lugs for active part : Required

5.6 MV and LV connectors/lugs : Not Required

5.7 Cable glands : Not Required

5.8 HV Cable box : Required

5.9 LV Side busduct arrangement : Required

5.10 Rating and Diagram Plate : Required

5.11 Earthing Terminals : Required

5.12 J.B. for winding test indicator : Required

SECTION-13 : SUBSTATION ACCESSORIES

13.0 GENERAL:

13.1 Danger Sign boards

The Danger notice labels shall be made on indestructible non deteriorating material with lettering engraved in red, black, white background except where otherwise specified. The letters shall be at least of 12 MM and shall be of radium sticker type so as to be visible in the night time also.

13.2 M. S. Chequared Plates :

The plates shall be as specified in the item and shall have 3 coats of anti corrosive paint. The plates shall not be brittle and shall take normal weights.

13.3 Rubber mats and hand gloves

Rubber insulation gmats conforming to IS 15652-2006 shall be provided in front of main switch board as well as other control equipments as specified in drawings. Rubber mats, Rubber gloves, boots shall confirm to the safety equipments standard and shall with ISI approval.

13.4 First aid kit and First aid shock treatment charts

Charts (One in English, one in hindi and one in regional language), displaying methods of giving artificial respiration to a recipient of electrical shokc shall be

prominently provided at appropriate place. Standard first aid boxes contanining materials for first aid shall be provided in sub-station.

13.5 Fire Extinguishers

Portable Co2 conforming to IS : 2878-1976 fire extinguishers shall be installed in the sub station at suitable places as per the fire safety norms.

13.6 Fire buckets

Fire buckets conforming to IS: 2546-1974 shall be installed with the suitable stand for storage of water and sand as per the fire safety norms.

13.7 Emergency Light

Emergency lights shall be with maintenance free rechargeable batteries with minimum 4 hour back up..

13.8 Safety Equipments (Rubber mats, rubber gloves, First aid kit, Sign boards, Sand Buckets, Fire Extinguishers etc.)

The Danger notice labels shall be made on indestructible non deteriorating material with lettering engraved in red, black, white background except where otherwise specified. The letters shall be atleast of 12 MM and shall be of radium sticker type so as to be visible in the night time also.

Rubber mats, Rubber gloves, boots shall confirm to the safety equipments standard and shall with ISI approval.

Sand Buckets and Fire extinguishers shall be as per the fire safety norms and shall be operated as specified in the item.

Emergency lights shall be with maintenance free rechargeable batteries.

PLEASE NOTE THAT TRANSFORMER TO BE PROVIDED SHOULD BE TPCODL,ODISHA APPROVED TRANSFORMER AND AS PER THEIR SPECIFICATION AND DETAILS GIVEN BY THE TPCODL PERMISSION LETTER . THE TRANSFORMER WILL BETESTEDBY TPCODL AUTHORITIES BEFORE INSTALLATION AT SITE. ALL CORDINATION IN THIS REGARD WITH TPCODL VEDOR REGARDING TRANSFORMER AND SUBSTATION LAYOUT AND APPROVAL HAS TO BE CARRIED OUT BY THE VENDOR AND IT IS IN ETHIR SCOPE. THE PERMISSION OF THE ELECTRICAL INSPECTOR OF GOVT OF ODISHA IS A PRIMARY REQUIREMENT BEFOREENERGISATION BY TPCODL AND THE SAME HAS TO BE CARRIED OUT BY THE VENDOR.

15.0 11 KV VCB PANEL

15.0 SCOPE

This specification covers design, engineering, manufacture, shop testing, delivery at site, erection, testing and commissioning of type tested 11 KV, 3 phase, metal clad indoor, Horizontal draw out type, Vacuum Circuit Breaker (VCB) Switchboard with all accessories and protective devices mounted and wired up. 11 KV VCB PANEL shall be allowed from OEMs only.

15.1 CODES AND STANDARDS

The design, material, construction, manufacture, inspection, testing and performance of the Switch Board offered shall comply with all currently/latest applicable standards (including amendments thereto), regulations and safety codes in the locality where the equipments will be installed. Nothing in this specification shall be construed to relieve the Supplier of his responsibility. Where no standards are available, the supply items shall be of good quality and workmanship and backed by test results. Other National Standards are acceptable if they are established to be equivalent to or superior to the listed standards.

	Standards	
•	IEC: 62271 - 1	High-voltage switchgear and control gear - Common specifications.
•	IEC: 62271 - 100	High-voltage switchgear and control gear - Alternating current circuit-breakers.
•	IEC: 62271 - 200	High-voltage switchgear and control gear - AC metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV.
4.	IEC: 600441-1	Current Transformers
5.	IEC: 600441-2	Voltage Transformers
6.	IEC: 60529	Classification of degrees of protection provided by enclosures
7.	IEC: 60038	Standard Voltages
8.	IEC: 60255	Measuring relays and protection equipment - Part 24: Common

format for transient data exchange (COMTRADE) for power systems.

9.	ANSI IEEE C 37/20	Switch gear assemblies including metal enclosed bus.

15.2 CIRCUIT BREAKER

The circuit breaker shall be mounted on a withdrawable truck which shall roll out horizontally from service position to isolated position with ease and it shall also be possible to take out the breaker truck from cubicle smoothly on to the floor without use of any separate handling equipment. It is preferable to provide three point guide for withdrawal and insertion of truck into the cubicle with ball bearing arrangement on the top of the truck. Circuit breaker shall be of vacuum only and the truck shall have distinct 'SERVICE' and 'TEST' position. Isolated position by defeating the interlock shall also be inside the cubicle so that the front door of breaker compartment can be closed even in breaker isolated position. Special more than three point hinged locking arrangement shall be provided to prevent opening of door in the event of internal arc in breaker compartment. Isolation shall be horizontal.

All the three interrupters of individual phases shall be mounted on a common phase

segregated epoxy body mounted on a truck for better insulation and avoidance of non-

simultaneity of poles. Circuit breaker shall be vacuum type only. Interrupter mounted on

the conventional individual insulators will not be accepted. No separate fiberglass sheet

barrier to be used.

It shall be operated through a common motor wound spring charged mechanism with electrical release coil for closing and shunt trip coil for tripping. Operating mechanism must have manual charging, closing and tripping facility with the provision locking facility in push to close & push to trip mechanical push button.

The mechanism shall be such that motor will automatically recharge the mechanism springs after a closing operation enabling breaker to perform OCO operation. The charging time of motor shall be less than 15 secs making it suitable for rapid auto reclosing duty. Emergency mechanical push to trip button shall be provided for emergency manual tripping with front door closed. All the 'MS' components of circuit breaker mechanism shall be treated with zinc platting with olive green passivation for longer life even in adverse climatic condition. Yellow passivation shall not be acceptable. All mechanism springs shall be powder coated. Plating on mechanism spring is not

acceptable. The normal current rating of circuit breaker shall be in panel rating without fan.

There shall be minimum 4NO and 4NC contacts in breaker auxiliary switch. In case of Additional contacts the same can be multiplied through latched type contactors. Auxiliary plug and socket shall be of minimum 24 pin plug type and shall have scrapping earth feature. Auxiliary contacts shall be suitable for continuous thermal current rating of 10A.

15.3 INTERLOCKS

Circuit breaker can be inserted only in open position. Likewise, circuit breaker in closed position cannot be withdrawn. Attempt to draw out closed breaker shall not trip the breaker.

The circuit breaker shall operate only in one of the three defined positions i.e. service, test and isolated. The breaker shall not close in any of the intermediate positions.

The circuit breaker cannot be inserted into service position till auxiliary contacts are made. Similarly interlock prevent auxiliary contacts from being disconnected, if circuit breaker is in service position.

It will not be possible to rack out the withdrawable part from Service to Test position when the switching device is switched ON. Similarly, it will not be possible to rack in the withdrawable part from Test to Service position, if the switching device is switched ON.

Any attempt to rack out withdrawable part from Service to Test position will not result in switching OFF of the Circuit Breaker instead the Service position will be locked till switching device is 'ON'.

It will not be possible to rack in or rack out withdrawable truck when the front high voltage door is open. However, a suitable defeat interlock mechanism is provided for emergency purpose.

It will not be possible to rack in the withdrawable truck from test to service position when the low voltage control plug is not in position and locked on the truck itself.

It will not be possible to close the door if the low voltage control plug is not engaged

15.4 BUSBARS

Bus bar material shall be Electrolytic Copper.

All bus bars shall be insulated with heat shrinkable PVC sleeves. Joints shall be insulated with shrouds in busbar chamber and interphase barrier shall be provided in cable chamber.

Phase identification shall be made at the end by colored tape.

Bus bars shall be mounted on integral seal off bushings while passing from one compartment to another except busbar compartment.

Busbar shall run throughout the switchgear without interruption so in case of any arc, arc shall travel and cause minimum damage to the switchgear.

Temperature Rise of busbar along with other parts of switchgear shall be governed by IEC 60694, Table III.

15.5 CUBICLE CONSTRUCTION

The switchgear panel shall be of sheet steel construction with ALUZINC not less than 2.5mm thickness for load bearing section and not less than 2 mm thickness for non-load bearing and shall totally dust and vermin proof. The panels shall be rigid without using any external bracings. The switchboard panels should comply with relevant IS/IEC and revision thereof and shall be designed for easy operation maintenance and further extension. Bus bar, metering circuit breaker chamber, cables and cable box chamber should have proper access for maintenance, proper interlocks should be provided. All instruments shall be non-draw out type and safe guard in every respect from damages and provided with mechanical indicator of connection and disconnection position. The switchgear shall be completed with all necessary wiring fuses, auxiliary contacts terminal boards etc.

Width of cubicle is 600mm up to 1250A and 800 mm above 1250A.

Joints for All front door shall be provided with neoprene or cross-linked poly ethylene gaskets self-adhesive type

All the high voltage compartments must have pressure discharge flap for the exit of gas due to internal arc to insure operator safety. All the HV compartment design i.e. Busbar compartment, VCB compartment and Cable compartment should ensure conformity to IEC 62271-200 and must be type tested individually for Internal Arc Test for AFLR 26.3 kA for 1s at rated

voltage. The switchgear panels shall be suitable for loss of service continuity LSC 2B. Safety shutters complying with IEC-62271-200 shall be provided to cover up the fixed high voltage contacts on busbar and cable sides when the truck is moved to ISOLATED position.

Safety shutters shall be metallic and shall be provided to cover up the fixed High voltage contacts on bus bar and cable sides when the truck is moved to Test / isolated position. The shutters shall move automatically, through a Linkage with the movement of the truck and shall be of gravity fall type only. It shall be possible to padlock shutters individually.

Switch gear cubicle shall have seal off bushing arrangement between the circuit breaker compartment and bus bar / C.T. cum cable compartment, i.e. the fixed isolating contacts shall be embedded in epoxy cast bushing so these act as seal off bushing to prevent transfer of arc from one compartment to the other in the event of internal arc within the cubicle & must be tested for internal arc in all three HV compartments as per new IEC 62271-200.

Louvers can be provided for higher normal current rating however, same shall be backed

up by fine wire mesh.

Joints for All front door shall be provided with neoprene or cross-linked poly ethylene gaskets self-adhesive type. For Compressibility step type channel base shall be provided for easy compressibility. It shall be preferable to provide cross linked poly ethylene type. It shall be preferable to supply cubicle with gaskets between all metal to metal proper vermin proof. Minimum degree of protection shall be IP4X.

15.6 LOW VOLTAGE COMPARTMENT

Low voltage compartment shall be mounted at the front on the top of breaker compartment and shall also have hinged type of door.

All wiring shall be routed through PVC ducts and shall be terminated on to stud type terminal with plastic cover.

For current transformer terminal shall be disconnecting link type only.

The wire shall be of 1.1KV grade and suitable for 2KVrms for I minute power frequency high voltage.

15.7 CABLE COMPARTMENT

It shall be at the rear side with rear bolted box type back covers. There shall be an inspection window at the rear back cover enabling operator to have visual inspection without opening back cover in live condition. Viewing

window at the rear side shall be of poly carbonate only and shall be tested for internal arc.

The gland plate of cable chamber shall be of minimum 3mm thickness MS sheet in two halves section with built in adjustable cable holding clamp. In case of single core cable it shall be supplied with non-magnetic gland plate. Cable box shall accommodate 2-3Core 630 sq. mm. Cables or 6- 1C cables. Addition rear extension box of minimum 500 mm depth shall be provided for cables more than the quantity mentioned above.

Sufficient headroom shall be provided for cable termination. The distance between gland plate and terminal shall be minimum 600mm.

Control cable entry shall be from front and there should be a possibility of terminating to LV chamber from both right hand and left hand side. Power cable entry shall be from rear bottom. Provision shall be available for entry of power cable or bus duct from rear bottom or rear top.

15.8 EARTHING

There shall be a continuous copper earth bus of size 30x6 sq. mm running at the bottom of the panel. Earth bus shall be robust and shall be capable of carrying full short circuit current for 1 second. Doors, covers and all non-current carrying metallic parts shall be earthed through flexible copper wires. This also includes instrument casing and cable armor which are also connected to the earth bus. Earth bus must be tested for 26.3 KA for 1 sec

Separate earthing truck shall be provided for bus earthing and cable earthing. The earthing truck shall be so designed that it is impossible to earth a live. It shall be provided with capacitive voltage divider and complete with audio visual annunciation.

In addition to scrapping earth in auxiliary plug and socket proper arrangement should be made so that during engagement of the breaker in service condition earthing contacts is made first before isolating power contacts are engaged.

15.9 CURRENT AND POTENTIAL TRANSFORMER

Current transformers shall be double core window/bar primary for higher rating or wound primary for lower rating. Maximum VA burden shall be of 15 VA and shall be rated for full short circuit current for 1 second. Differential /REF CTs can be in one mould. In case of numerical relays 10VA burden

shall be sufficient. CT shall be of a minimum accuracy of class 0.5/5P10 and CT Secondary rating shall be 1A unless otherwise specified.

Potential transformer shall be 3phase 3 limb type with 50VA per phase of class 0.5/3P accuracy and shall be mounted on incomer breaker truck. For bus connected P.T the same shall be mounted in a separate withdrawable truck in a separate vertical panel.

15.10 PROTECTION RELAYS

The Protective IDMT O/C, E/F relays should be of numerical type with the same Technical specification. The relay should have feature for storing fault data, should have site selectable CT secondary relay currents i.e -/5 Amps or -/1 Amps. Should have LED/LCD for each function element of a relay to enable to identify the type of fault condition.

All the switchgears shall be provided with microprocessor based numerical protective relays designed to disconnect faulty circuit with speed and discrimination and shall confirm to latest revision of relevant standards regarding accuracy and other feature. Relay unit having O/C (50/51), E/F(50/51N), O/V (59), U/V (27) etc. shall be provided. The numerical relays shall be SCADA Compatible communicable type and shall communicate on MODBUS protocol.

15.11 METERING

- Ammeter & voltmeter selector switches shall be four position type. Ammeter selector switches shall have make before break feature to prevent open circuiting of CT secondary. Selector switch shall be suitable for semi flush mounting with only switch front plate and operating handle projecting out.

- Multifunction meter: Digital type (Displaying A, V, PF, Hz, KVA, KW, KVAR, KWh, KVARhe.t.c.) Class 0.5 with communication in Modbus protocol.

15.12 AUXILIARY/CONTROL WIRING

Control supply for closing and tripping shall be 220 or 110Volts D.C. through external battery source. 230 Volts single phase A.C. supply shall also be available for the operation of spring charging motor and cubicle space heater. Wattage of closing and tripping coils shall be within 250 watts. Aux supply shall be suitably distributed along with switchgear in loop in loop out fashion.

All Switchgear panels shall be supplied completely wired internally upto the terminal block ready to receive external cabling.

All the secondary wiring in the panel shall have high quality PVC insulation and the same shall have conductor size of not less than 1.5 mm2 of copper.

Colors of the secondary/auxiliary wiring should confirm to IS 375/1963 and latest amendment thereof if any. All wiring shall be neatly run and group of wiring shall be securely fixed by clips so that wiring can be checked without necessity of removing the clamps. Wiring between fixed and moving portion of the panel shall be run in flexible tubes and the same shall be so mounted to avoid any damage to them due to mechanical movements. Ferrules with number shall be provided on both end of the wiring.

All wires directly connected to trip the circuit breaker shall be distinguished by the addition

of a red coloured unlettered ferrule

15.13 SELF-HEALING FUNCTIONALITY AND SCADA COMPATIBILITY.

Necessary controllers / FRTU and protection relays shall be considered for operation of complete 11KV network with self-healing functionality and the same shall be communicated to Electrical Distribution SCADA.

15.14 PRE- TREATMENT AND PAINTING

Switchgear front and rear covers shall be painted for aesthetic purposes and Paint shade shall be RAL 7032.

15.15 NAME PLATE AND DIAGRAM PLATES

All equipment shall have weather proof and non- corrosive metal plates fixed in suitable position with full particulars engraved thereon with white letters against black background. The firm shall affix a name plate on each Switchgear panel having following information:

- Manufacturer's name
- Type of Panel.
- CT Ratio.
- Rated Voltage.
- Rated Insulation Level
- Rated Frequency
- Rated Normal Current

- Rated Short Circuit Breaking Current.
- Order No. and Date
- Year of supply.

15.16 TESTS

The design of circuit breaker shall be proven through all the routine and type tests in accordance with IS IEC 62271-200 and any amendment thereof. Photocopy of all the test reports must be enclosed with the tender. Type test report earlier than 5 years from the date of tender opening shall not be acceptable.

The Bidder shall submit the type test reports of following type tests for approval of the Purchaser

- Short circuit duty test on circuit breaker, mounted inside the panel offered.
- Short time withstand test – on circuit breaker, mount inside panel offered.
- Power frequency withstand test on breaker and panel.
- Lightning impulse withstand test on breaker and panel.

- Temperature rise test on breaker and panel together.
- Measurement of resistance of main circuit.
- Mechanical endurance test on breaker.
- Mechanical operation test.

16.0 DIESEL GENERATING SYSTEM

GENERAL

16.1 WORK DESCRIPTION

The specification covers supply, installation, testing and commissioning of D.G. Sets and associated equipment/ materials, panels, cables etc. The DG sets shall be suitable for continuous duty applicable after considering duration in capacity due to ambient temperature at site.

16.2 SCOPE OF WORK

The scope of work shall include design, manufacturing, pre delivery inspection, supply, loading/ unloading, storage, installation, testing and commissioning of water cooled with acoustic enclosures D.G. Sets with alternators and associated equipment/ materials, panels, cables etc. including labor, tools, tackles and plants, hardware and consumables, steel fabrication and items as described below:

- Water cooled with acoustic enclosure Diesel engine & alternator set complete with base frame and accessories.

Integrated control panel duly wired up to terminal box for engine safeties, Electronic Fuel injection system Governor with solid state potentiometers, sensors and protection for inter facing with PLC Engine mounted or separately mounted.

Fuel oil system with piping, valves filters etc. from engine to service day oil tank. Return fuel line with fuel cooler and piping with accessories up to day service tank or collecting point as called for.

Lube oil system with piping etc. (Pre-lube oil pump with controllers as required).

Exhaust emission meeting pollution norms (CPCB norm-II & SPCB) with catalytic converter and residential silencer, exhaust piping with mineral wool insulation and aluminum cladding as called for.

Acoustic lining shall be provided on walls and ceiling of DG room in order to minimize disturbance to occupants as per CPCB norms and any other local authority requirement

Bulk high speed underground diesel oil storage tanks shall be provided outdoor for DG Sets.

Engine cooling will be achieved through heat exchanger mounted along with each engine connected to a cooling tower.

Steel fabricated independent structure/support/hanger including fixing, grouting and bolting etc.

Painting of steel work.

L.T./ Control cabling.

D. G. Auxiliary control panel.

The bidder shall indicate in his offer schedule for routine maintenance, overhauling and operating instructions for smooth and satisfactory continuous operation of D.G. Set.

- All equipment shall be of the class most suitable for working under the conditions specified and shall withstand the atmospheric conditions without deterioration.

- The contractor shall be responsible of coordination with civil and other contracting agencies to ensure completion of work in the required manner. Minor civil works required to execute the work shall be in the scope of contractor at no extra cost.

- D.G. supplier shall furnish back up combined guarantee minimum for 2 years from the date of successful commissioning from Engine and alternator supplier for their smooth operation. In case any defect is noticed during operation or for any other reason, the same shall be attended promptly and replacement of any component in part or in whole will be made immediately at no extra cost to the owner.

- EPC bidder may consider the Grooved Fittings (UL Listed) for 65mm Dia and above pipe sizes only in plant room. However Pipes upto 50 mm dia shall be joined with threaded joints.

16.3 DESIGN

The design and workmanship shall be in accordance with the best engineering practices, to ensure satisfactory performance and service life. The equipment offered by the contractor shall be as per IS standards and complete in all respects. Any materials or accessories, which may not have been specifically mentioned, but required and necessary for the completion of the system, shall be provided without any extra cost to owner. This shall also include the cost of spares for commissioning of the equipment.

The specification defines the basic guidelines to develop a suitable electrical system as necessary for the Complex. All data required in this regard shall be taken in to consideration to develop a detailed engineering for 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 to be made be as a part of contract shall require specific approval/review of Engineer-in-charge or his authorized representative

The engineering activities shall comprise the submission for approval of the following from LICI s/Engineer-in-charge

Bidder shall be responsible for:

- Submission of shop drawings for installation of DG set like foundation, fuel piping, DG Exhaust structural and frame, cable connection from PLC panel to DG set, etc. required to complete the work prior to start of work for approval.
- Detailed co-ordination with other services, submission of shop drawings for various electrical layouts, such as equipment, cabling, and earthing, equipment installation and cable termination etc. prior to start of work.
- Preparation of bill of materials for cabling, earthing and miscellaneous items etc.
- Cable schedules.
- 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.

Bidder shall also be responsible for:

Any other work/ activity which is not listed above, however is necessary for completing of electrical system and installation of equipments.

Bidder shall clearly understand and quote accordingly. All clauses given in this part of the specifications shall also apply to all other electrical works of other segments. The bidder shall bring to the notice of the Engineer-in-charge the differences, if any, and get the same clarified failing which the Engineer-

in-charge may impose the more stringent of the specification/ clauses at the sole risk and costs of the contractor.

16.4 DATE OF COMMENCEMENT AND COMPLETION PERIOD

The contractor shall be allowed admission to the site from the date of commencement as described in the General Conditions. He shall there upon and forthwith begin the works and shall regularly proceed with and complete the same on or before the date of completion subject, nevertheless to the provisions for the extension of time. The time being the essence of the contract, the Contractor will adhere to the time, progress chart and project schedule and will give proportional output/progress in proportional time

16.5 SCHEDULE AND MANNER OF OPERATIONS

Time being the essence of this Contract, the Contractor is expected to mobilize all labour and materials in sufficient quantities before the start of work. He shall expedite and schedule the work as required and manage the operation as such that the work will be completed within the time stated in the Contract.

16.6 COORDINATION OF WORK

Contract documents establish scope, materials and quality but are not detailed installation instruction.

Coordinate work with related trades and furnish, in writing, any information necessary to permit the work of related trades to be installed satisfactorily and with the least possible conflict or delay.

The drawings show the general arrangement of equipment and appurtenances. Follow these drawings as closely as the actual construction and the work of other divisions will permit. Provide off-sets, fittings, and accessories which may be required but not shown on the drawings. Investigate the site, and review drawings of other divisions to determine conditions affecting the work, and provide such work and accessories as may be required to accommodate such conditions.

The locations of thermostats, switches, panels and other equipment indicated on the drawings are approximately correct. Exercise particular caution with reference to the location of panels, thermostats, switches, etc., and have the

precise and definite locations accepted by the Engineer-in charge before proceeding with the installation.

The drawings show only the general run of services and approximate location of equipment, outlets, panels, etc. Any change in location of equipment, outlets, panels, etc. necessary to meet field conditions shall be brought to the attention ofthe Engineer-in-charge for review. The alterations may be made only with approval of Engineer-in-charge at no extra cost.

Space requirements with other division works may be checked carefully to ensure that equipment can be installed in the space allotted.

Proper co-ordination with other trades shall be maintained to ensure interconnection with other services or equipment. It may be ensured that all such items which are to be installed/ suspended in ceiling are identified and marked on drawing and hand over copy to the concern Contractor.

Wherever motor controls and distribution equipment are of the same manufacturer the installation may be done after consultation.

For passage of risers through structural masonry, concrete walls, floors and elsewhere proper sleeve as required shall be provided for proper protection of each riser passing through building surfaces.

Provide fire stopping around all pipes, conduits, ducts, sleeves, etc. which pass through fire compartments.

Provide required strength supports and hangers for equipment to avoid excessive loading of structures.

Wherever the work is of complexity adequate care be taken by examining the site or preparing detail drawings to scale for coordination between different trades.

Detailed work shall be clearly identified on the drawings indicating the area to which it applies and for attention of concern Contractor through Engineer-in-charge. On completion a set of these drawings shall be included in with final drawings for record.

Coordinate with the local utility companies/authorities for their requirements for service connections and provide all necessary provisions, grounding, materials, equipment, labor, testing, and appurtenances.

Proper site inspection shall be carried out and coordinated among working agencies to avoid hindrances and progress of the work.

The Contractor shall be responsible for all modifications required due to failure on their part for not coordinating the services among different agencies.

16.7 EXAMINATION OF SITE

The tenderer is advised to visit the site and understand himself about the nature of work prior to the submission of bids as no allowance whatsoever will be made for the same.

The Contract Documents do not make representations regarding the character or extent of the sub-soils, water levels, existing structural, mechanical and electrical installations, above or below ground, or other sub-surface conditions which may be encountered during the work, based on examination of the site or other information. Failure to examine the drawings or other information does not relieve the Contractor of responsibility for satisfactorily completion of the work.

16.8 EXCAVATION AND BACKFILL

Where ever required provide trenches details, duly approved by the Engineer-in- charge with all relevant section etc. as per IS codes to the Civil contractor minimum one month prior of laying the pipes etc. Co-ordinate with the civil contractor during the excavation, and ensure that the excavation and backfilling is done properly as per requirement.

Where provisions of trenches are in the scope of work in contractor's scope, it is deemed that the quoted prices are inclusive of cost of the pipe, laying, trench digging and backfilling.

The following points need to be taken care of while making the trenches:

The trench shall be of required width as per specification for proper execution of the work.

The trench bottom shall be graded accurately to provide uniform bearing and support the work on undisturbed soil at every point along its entire length.

Except where rock is encountered, do not excavate below the depths indicated.

Where rock excavations are required, excavate rock to a minimum over depth of four inches below the trench depth as indicated in the specification or indicated on the drawings.

Backfill over depths of the rock excavation and unauthorized over depths with loose, granular, moist earth, thoroughly machine tamped to a compaction level of at least 95% to standard proctor density or 75% relative density or as specified by the Engineer-in-charge.

Wherever unstable soil that is incapable of supporting the work is encountered in the bottom of the trench, remove soil to a depth required and backfill the trench to the proper grade with coarse sand, fine gravel or other suitable material.

Excavate the trenches for utilities to provide the following minimum depths of cover from existing grade or from indicated finished grade as required by local authorities:

Trenches should not be placed within 3 meters of foundation or soil surfaces which may resist horizontal forces.

do not backfill until all required tests are performed and installation checked by the Engineer-in-charge.

Backfill shall be done with non-expansive soil of limited porosity. 15 cm layers shall be laid throughout and carefully tamp until the work has a cover of not less than 30 cm. Backfill and tamp remainder of trench at 30 cm intervals until complete.

Grade the finished surface uniformly.

16.9 CUTTING AND PATCHING

All kind of cutting and repairing of brick walls or partitions etc are in scope of work of the contractor for proper laying and routing of pipe. However cutting and repairing of RCC wall or ceiling shall be in the scope of civil contractor.

The details of cutting of wall, drilling in floors, walls and partitions etc required to anchor conduits or equipment, shall be planned in advance. Any

damage to the structure shall be made good to match the surface at no extra cost.

16.10 SEALING OF PENETRATIONS

Air Tight Seals

All penetrations through the building fabric subject to suction or pressurization shall be sealed airtight.

Holes in Roof

Roof penetrations for passage of conduits or circular PVC and PVC Cables shall be sealed watertight using a flexible polypropylene conical sleeve manufacturer to seal the cable to the roof structure, regardless of the roof profile.

All sharp metal edges which may come in contact with the cable shall be suitably bushed.

Fire Rated Penetrations

Where services penetrate any fire rated barrier the Contractor shall seal the penetration with the use of an appropriate material to ensure the integrity of the fire barrier.

The Contractor shall seal the cable enclosures through fire rated barriers to ensure the integrity and rating of the fire barrier.

Acoustic Penetrations

Where services penetrate acoustic barriers sealant shall be supplied and provided to maintain the acoustic separation at least equal to the barrier penetration.

16.11 MOUNTING HEIGHTS

Verify exact locations and mounting heights with the Engineer-in-charge before installation.

16.12 SUPPORTS

Provide proper supports, hangers, auxiliary structural members and supplemental hardware in accordance with the best industry practice required for support of the work.

Provide supporting frames or racks extending from floor level to ceiling slab for work indicated as being supported from walls where the walls are incapable of supporting the weight. In particular, provide such frames or racks in electric closets and equipment room.

Provide supporting frames or racks for equipment which is installed in a free standing position.

Supporting frames or racks shall be of standard angle, channel or specialty support system steel members rigidly bolted or welded together and adequately braced to form substantial structure. Racks shall be of ample size to assure a workmanlike arrangement of all equipment mounted on them.

Adequate support of equipment (including outlet, pull and junction boxes and fittings) shall not depend on ducts, pipe, electric conduits, raceways, or cables for support.

Equipment shall not rest on or depend for support on suspended ceiling media (tiles, lath, plaster, as well as splinters, runners, bars and the like in the plane of the ceiling). Provide independent support of equipment. Do not attach to supports provided for ductwork, piping or work of other trades.

Provide required supports and hangers for equipment so that loading will not exceed allowable loading of structure. Equipment and supports shall not come in contact with work of other trades.

16.13 FASTENINGS

Fasten equipment to building in accordance with the best industry practice.

Where weight applied to the attachment points is 45 kg or less, conform to the following as a minimum:

1. Wood : Wood screws

2. Concrete and solid masonry :Dash Fastener of appropriate ratings-

HILTI/FISHER

3. Solid metal: Machine screws in tapped holes or with welded studs

Where weight applied to the building attachment points exceeds is equal to 135 kg and exceeds 45 kg the following shall conform as minimum:

- For concrete slabs provide 60 cm x 60 cm x 13 cm steel fishplates on top with through bolts. Fishplate assemblies shall be chased in and grouted flush with the top slabs screed line, where no fill is to be applied.
- At steel decking or sub-floor for all fastenings, provide through bolts and threaded rods. The top of bolts and rods shall be set at least one inch below**the top fill** screed line and grouted in. Suitable washers shall be used under bolt heads or nuts. In cases where the decking or sub-floor manufacturer produces special hangers to work with his decking or sub-floor such hangers shall be provided.

Where weight applied to building attachment points exceeds 135 kg, coordinate with and obtain the approval of Engineer-in-charge and conform to the following as minimum

Provide suitable auxiliary channel or angle iron bridging between building structural steel elements to establish fastening points. Bridging members shall be suitably welded or clamped to building steel. Provide Threaded rods or bolts for bridging members shall be provided.

For items which are shown as ceiling mounted at locations where fastening to the building construction element above is not possible. All such areas shall be provided with suitable auxiliary channel or angle iron bridging tying to the building structural elements.

Wall mounted equipment may be directly secured to wall by means of steel bolts. Groups or arrays of equipment may be mounted on adequately sized steel angles, channels, or bars.

16.14 IDENTIFICATION

Black phenol name plates with 13 mm high white engraved lettering shall be used for equipment identification. Identification details shall include equipment name or load served as appropriate. Nameplates shall be fixed with cadmium plated screws. Peel and stick tape or glue on type nameplates is not acceptable.

Service runs shall be properly identified as per the requirements in the Contract.

See individual section for additional identification requirements.

16.15 PROHIBITED LABELS AND IDENTIFICATIONS

In all public, tenant areas and similar locations within the project the inclusion or installation of any equipment or assembly, which bears on any surface any name, trademark, or other insignia intended to identify manufacturer, vendor, or other source(s) from which such object has been obtained, is prohibited.

Neither test lab certification labels nor identification specifically provided under various technical sections of the Specifications shall be removed.

16.16 EQUIPMENT PADS AND ANCHOR BOLTS

Provide all details with proper sections for the equipment pads and anchor. The equipment pads casting and making provision for anchor fastening as per the final unaltered drawing duly approved by the Engineer-in-charge shall be in the scope of Civil contractor. However the contractor shall ensure proper coordination with civil contractor.

All equipment pads for all vibrating equipments shall have cork vibration pads

sandwiched between the finish surface and the bottom surface of required thickness to

ensure minimum vibration travel below.

Provide galvanized anchor bolts for all equipment placed on concrete equipment pads, inertia blocks, or on concrete slabs. Provide number and size of recommended bolts by the manufacturer of the equipment and locate by means of suitable templates. Equipment installed on vibration isolators shall be secured to the isolator. Secure the isolator to the floor, pad, or support as recommended by the vibration isolation manufacturer.

Where equipment is mounted on gypsum board partitions the mounting screws shall pass through the gypsum board and securely attached to the partition studs.

16.17 MISCELLANEOUS:

A site order book will be maintained at site, which will be in the custody of the Engineer-in-charge, or his representative and all instructions given to the

contractor will berecorded in the site order book and the same has to be signed by the contractor to comply with the instructions given therein.

Contractor's Superintendence:

- The contractor shall be responsible to depute manpower required and authorized by Engineer-in-charge for supervision of the work during execution. The contractor authorized representatives approved by Engineer-in-charge shall be available all time at site of work for continuous monitoring the progress and Supervision. He shall receive and follow are directions and instructions issued by the Engineer-in-charge or his representative. Engineer-in-charge reserve the right to remove the staff from site of work if found undisciplined or involved in mal practice or criminal activity.

- The contractor shall provide details of the execution and supervisory team deployed for the works with names and CV's, of all key staff before the commencement of work and get it approved of in writing by the Engineer-in-charge/ LICI . Contact telephone or pager numbers for emergency and/or twenty-four (24) hour call shall also be included.

- if in any case of withdrawal of any worker/ technician/Engineer from the execution team, the replacement of the same shall be done with equivalent qualification, and shall be approved in writing by the Engineer-in-charge/ LICI .

After completion of the work the whole installation shall be tested by the contractor in the presence of the LICI /Engineer -in-Charge. The tests shall comply the following I.E.E. Regulations and shall be submitted along with the final bill:

- The result of the insulation test shall comply with the I.E.E. Regulations 1101 to 1108A and 1008B as may be applicable.
- Test shall be carried out to ascertain that all the non-linked SP switches have been connected to the phase conductor.
- The continuity test of the earthing system shall comply with I.E.E. Regulations 1108 to 1109 to the latest addition.

The contractor shall be responsible to provide all necessary testing instruments, such as megger insulation tester, earth tester multi-meter, AVO meter etc for carrying out the above tests.

If the result of the above tests do not comply with the I.E.E. Regulations, the contractor shall rectify the defects or replace the materials to achieve the desired results.

The work will not be considered as complete and taken over by the Engineer-in-charge till all the components of the work after completion at site in all respects are inspected/ tested by the LICI / Engineer-in-charge to his entire satisfaction and completion certificate is issued by the Engineer-in-charge / LICI to this effect.

At the completion of the work and before issuance of certificate of virtual completion, the contractor shall submit 6 sets of drawing and two tracing of each drawing to Engineer-in-charge of each layout drawings drawn at approved.

- **PRODUCT,TESTING & COMMISIONING**

- LT Power Distribution System:

  Voltage: 433V

  Frequency: 50 Hz

  Neutral: Grounded

  Short Circuit Fault withstand capacity: as pr calculations and specifications

Painting of Panels:

Powder coating of approved shade as per Specification. (Refer clause of painting)

Painting of Cable Trays and Structural steel:

Powder coating of approved shade as per Specification. (Refer clause of painting)

Cable Details:

- LT Control/power Cables: Copper conductor armored PVC insulated 1.1 KV grade.
- Grounding Conductors: Copper/ G.I. as specifications

Accuracy Class of Meters:

- Revenue Meters: Class-I or as approved by SEB
- Ammeters, Voltmeters & Other Instruments: Digital Type

16.18 DRAWINGS:

The list of drawings is enclosed along with the specification. These drawings are meant to give general idea to bidder regarding the nature of work covered under specifications.

Any information or data missing in the drawings shall not relieve the contractor of his responsibility to carry out the work as per the specifications. Additional information if required by the bidder can be obtained from Engineer-in-charge for completing the work successfully.

16.19 SHOP DRAWINGS:

The contractor shall prepare detailed coordinated electrical shop drawing indicating D.G. set layout, control panel and cable schedule with other relevant services and submit for Engineer-in-Charge approval 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. control and relay panel, diesel generating sets, cable schedule and routes, manhole trap and fixing details for the above mentioned work. All work shall be carried out only after approval of the drawings. However, approval of these drawings do not relieve the contractor of his responsibility for providing maintenance free and full proof system including any missing component / accessories to meet with the intent of the specifications. Contractor will submit 2 (two) prints for preliminary approval and finally 6 (six) prints for distribution.

16.20 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, manufacturer's instructions should be followed.

16.21 COMPLETION DOCUMENTS AND DRAWINGS

Three copies of operation manuals/catalogues of all standard equipment are to be furnished by the contractor immediately after commissioning of plant.

Three copies of write up on preventive maintenance, trouble shooting and operating instructions of the system along with as-built drawings are to be supplied by the Contractor at the time of commissioning.

On completion of the work in all respects, the Contractor shall supply five portfolios (300x450 mm), each containing complete set of drawings on approved scale, clearly indicating complete layouts, location; wiring and sequencing of automatic controls, location of all concealed wiring and other services. Each portfolio shall contain consolidated control diagrams and technical literature on all controls. The Contractor shall frame under glass one set of these consolidated control diagrams for display in the panel room.

16.22 MATERIALS AND EQUIPMENT:

All the materials and equipments shall be of the approved make and design unless otherwise called for any approval by Engineer-in-charge. Only the best quality materials and equipment shall be used.

Space Heaters:

Suitable number of adequately rated heaters thermostatically controlled with On-Off switch and fuse shall be provided to prevent condensation in 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.

Fungi static Varnish:

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

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.

Degree of Protection:

The degree of protection in the enclosures of the control cabinet, junction and marshalling boxes, panels, etc shall be as detailed here under:

1. Installed indoor : IP – 55
2. Installed indoor in air-conditioned area : IP – 31
3. Installed in covered area : IP – 42
4. Installed indoor in non air-conditioned area

   Where possibility of entry of water is limited : IP-41
5. For LT Switchgear (AC and DC distribution boards) : IP-42

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

Rating plates, Name plates and Labels:

D.G. Sets, control panel and auxiliary items installed in the building are to be permanently attached to it in conspicuous position. A rating plate of non-corrosive material with engraved manufacturer's name, year of manufacture, equipment details type or serial number together with details of designed loading conditions of operation. Equipment rating plate shall be in accordance to IEC requirement.

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

First fill of consumables, Oil & Lubricants:

All the first fill of consumables such as oils, lubricants, filing 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 scope of the specifications, into successful operation, shall be furnished by the contractor unless specifically excluded under the exclusions in the specifications / documents.

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 site are in accordance with the specifications. The Contractor shall adopt suitable quality assurance program to control such activities at all points necessary.

The programme shall be outlined by the contractor and approved by the Engineer-in-charge. 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 is inspection status.
- System for authorizing release of manufactured product to the Engineer-in-charge.
- System for maintenance of records.
- System for handling storage and delivery

The Engineer-in- charge or his duly authorized representative reserves the right to carry out quality audit, surveillance of the system and procedure of the Contractor / Vendor's quality management and control activities.

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 welder's and 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 satisfactory.

16.23 INSPECTION, TESTING AND INSPECTION CERTIFICATES

The Engineer-in-charge and the LICI 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 Engineer-in-charge 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 Engineer-in-charge the detailed programme about the tests at least three (3) weeks in advance in case of domestic supplies. If for any item type test were pending payment would be made on successful completion of type/routine test(s) actually carried out as per Engineer-in-charge instructions.

The Contractor shall give the LICI/Engineer-in-charge thirty (30) days written notice of any material being ready for testing. Such tests shall be to the

Contractor's account. The LICI/Engineer-in-charge 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 Engineer-in-charge and shall forward duly certified copies of tests in triplicate.

The Engineer-in-charge within fifteen (15) days from the date of inspection as defined shall inform in writing to the Contractor of defects noticed during inspection and any objection to drawings or 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 Engineer-in-charge shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Engineer-in-charge, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the Engineer-in-charge. 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 Engineer- in-charge 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 MICC by the Engineer-in-charge.

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 labor, materials, electricity, fuel, water, stores,

apparatus and instruments as may be required by Engineer-in- charge/LICI or this authorized representative to carry out effectively such tests of the equipment in accordance with the Specification.

The inspection by Engineer-in-charge/LICI 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 LICI/Engineer-in-charge 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 Engineer-in-charge/LICI 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.

16.24 TESTS

Charging (Pre-commissioning tests):

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Engineer-in-charge 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./ vendor/ bidder submittal and as included in the Contractor's quality assurance programme.

Commissioning Tests:

- The available instrument 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, immeasurable 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 reimburse by Engineer-in-charge on production of requisite documents.

16.25 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. Engineer-in-charge takes no responsibility of the availability of any special packaging/transporting arrangement.

16.26 PROTECTION:

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

16.27 FINISHING OF METAL SURFACES:

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 galvanize. All steel conductors used for earthing/ grounding (above ground level) shall be galvanized according to IS: 2629.

Painting:

All sheet steel work shall be degreased and phosphated in accordance with the IS-6005 "Code of practice for Phosphate iron and sheet". All surfaces which are not easily accessible after shop assembly, shall before hand 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 swab 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, stove type zinc chromate primer. The first coat may be "flashing dried" while the second coat shall be stove.

Powder coating/electrostatic painting of approved shade shall be applied.

The exterior color of the paint shall be as per IS-5 or as approved by LICI . 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 Bid for Engineer-in-charge attention and consideration.

16.28 HANDLING, STORAGE AND INSTALLATION

In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Engineer -in-charge 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, and square and properly aligned / oriented.

Instruction of manufacturer or Engineer–in-charge shall be followed for unloading, transporting, toring, testing and commissioning of various equipments supplied by contractor.

In case of any doubt/misunderstanding and for correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained form the Engineer-in-charge/LICI . 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 Engineer-in-charge every week, a report detailing all the receipts during the week. 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 Engineer-in- charge in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material after erection until expiry of guarantee period and protection against theft, corrosion, damages etc.

The Contractor shall be responsible for making suitable 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.

16.29 PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel from all exposed rotating and/ or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.

The Contractor shall conform to the general regulations governing personnel on the site and must keep to the working space allocated for their use.

The contractor shall be responsible for any kind of mishap etc to working personnel. All safety precautions shall be provided to the staff. The Engineer-in-charge shall in no way be held responsible for the treatment or any facility.

16.30 TOOLS AND TACKLES

The Contractor shall supply one complete set of all special tools and tackles for the erection, assembly, dismantling and maintenance of the equipments.

16.31 PERFORMANCE REQUIREMENTS

The equipment shall be capable of delivering power continuously at the generator terminals. Net output shall not be less than the specified value at 0.8-p.f. excluding auxiliary power (shall be included over and above), when operating under the site ambient conditions described in the specification. Generating set should have minimum 50% single step loading capacity and it should be able to take full load in less than 25 seconds from the time of start (The set shall be suitable for prime duty) . The bidder shall furnish detailed de rating calculations due to temperature and other parameters with supporting document.

The design parameters of the generator and excitation system shall be so chosen that the set is stable while running at any load between no-load and full load and also during starting of motors as specified in Annexure-I. It should also have iso-synchronous speed control with load sensing governing system suitable for parallel running of D.G. sets.

Engine should be heavy-duty four strokes, turbo charged after cooler 'V' construction, electric start. Engine should have minimum lube oil change period of 300 hrs.

The total harmonics contents should be less than 3% as per IS 4722/1969. The graph & calculation for harmonic distortion shall be submitted.

Contractor to specify guarantee maintenance contract cost and to give an undertaking to take a comprehensive maintenance contract after expiry of warranty period for which price may be quoted.

The successful bidder will submit shop drawing of the equipments/accessories selected for this work for the approval of LICI / Employer.

16.32 DIESEL ENGINE – CONSTRUCTION

Material of construction of major parts shall be as under or as per manufacturer's standard design.

- M.S. base frame with anti-vibration mountings.
- Crankcase – Aluminium alloys.
- Crank shaft, connecting rods – Forged Alloy Steel.
- Piston – Al. alloy casting
- Piston rings – Alloy steel
- Engine block – Cast iron.
- Cylinder liner – Cast
- All other materials of construction shall be as per relevant standard/code and the copies of same shall be supplied free of cost to LICI/Engineer-in-charge.

The Diesel Engine shall be multi-cylinder, 4-stroke, air cooled with engine mounted heat exchanger (not motor driven), totally enclosed, continuous duty, direct fuel injection,turbo charged, compression ignition, inter cooled oil engine or with individual cylinder head with provision to measure exhaust temperature.

One common base frame shall be provided for mounting the engine and alternator complete with electric suspension between DG set and foundation bolts, leveling lines etc. as required.

All externally mounted hardware shall be high tensile steel only.

The engine shall be fitted with an exhaust gas driven turbo charger of air/water cooled type complete with its own self contained lubricating system. The turbocharger shall be positioned at the free end of the engine preferably. The turbocharger will be provided with a provision to check lube oil level.

The engine shall be fitted with a charge air inter cooled of the air/water type. Air from the turbo-charger compressor passes through the inter cooler and then to the engine manifold. The inter cooler shall be of tubular construction or as per manufacturer design with aluminium bronze tubes, mild sheet steel and cast iron water headers.

Contractor shall indicate the maximum time for which the Diesel Engine can be operated.

16.33 GOVERNING SYSTEM

The Governor shall be electronic fuel control type for coupled Generating set along with speed control switch (solid state potentiometer) at the end of start on over speed.

16.34 ENGINE STARTING SYSTEM

Starting of the Diesel Engine shall be done by electric starting system.

The electric starting system shall comprise starter motor, batteries and battery charger including with all required instruments and accessories. The engine mounted alternator shall charge the batteries while engine is running and floor panel mounted solid state battery charger while engine is stationery. The battery charger shall be rated for boost and trickle charge with all metering and control instruments and protections for A/C and D/C circuit.

The total system shall be suitable for auto and manual operation including their wiring etc. Calculation for the battery and battery charger capacity as

well as complete descriptive circuit diagram based on six consecutive start commands shall be submitted for approval of Engineer-in-charge / LICI .

16.35 FUEL OIL SYSTEM

The manufacturer shall furnish a mild steel day tank of required capacity for individual engine. The day tank shall be suitably located to avoid gravity feed to the engine, shaft driven fuel oil pumps and shall be complete with gauges, glasses, filling, draining and vent connection with valves and level switch for auto filling of tank and for alarm in case oil level goes beyond specified limit.

The fuel system shall be provided with full flow duplex oil cartridge filter preferably changeable during running of the set. The fuel oil system shall be equipped with a crankshaft driven fuel oil transfer pump which will draw the fuel oil from the day tank via filters and shall be as per the engine manufacturer design.

Multi point (electronically controlled) fuel injection system or direct injection/through ISO synchronous fuel Governing system shall be designed taking into account the type of fuel used, engine speed etc. so as to achieve safe knock free performance with low emission smoke.

EPC bidder to consider the DG Set Fuel & Energy Monitoring System.

16.36 LUBRICATING OIL SYSTEM

All lubricating parts of the engine shall be connected to a pressurized lubricating oil distribution piping system being continuously charged by gear type lube oil pump mounted at the free end of the engine and driven from the engine crank shaft. The pumps shall take suction from a sump tank integral with the engine through a foot valve, suction filter through oil cooler and deliver oil to main supply header. High-pressure oil shall be supplied to the main and big end bearings, crankshaft bearings, governor, auxiliary drive gear etc. Suitable lubricating arrangement for engine cylinder valve gear, cams and pistons at the required level shall be arranged. A pressure relief valve shall be mounted on the main supply header for safety against too high-pressure while starting with cold oil. A timer based, auto running (auto priming pump) shall be provided to keep engine primed all the time complete with control system (if required).

The lube oil system shall be provided with full flow duplex lube oil cartridge filters. The minimum lube oil change shall be after 300 hrs of operation.

Arrangement shall be provided to bypass the lube oil pressure switches and safety at the starting till the pressure is built up.

The lube oil sump shall be provided to sense the low level of lube oil in the sump and fill it up automatically from the main lube oil tank/sump and stop the transfer pump, once the lube oil is filled in the sump without stopping the engine. Pressure switches to give alarm under extreme low pressure of lube oil and subsequently to trip the unit, when the minimum safe pressure has reached, shall be provided.

All necessary accessories such as pressure gauges, temperature indicators, pressure relief valves, bypass valves, pressure switches shall be provided and the safeties shall be wired up to junction box.

16.37 EXHAUST SYSTEM

Engine emission exhaust system shall be residential type. Silencer ducting, bends, hood/canopy, thermally insulated aluminium clad exhaust piping etc. shall be provided along with structural support with stays for each engine. Heat resistant paint shall be provided on exhaust pipe for the portion, which is outside of the building including canopy. Exhaust system pollution level shall be indicated and got approved by authorities. (Exhaust smoke quality & quantity should be within the norms of central & state pollution control board).

16.38 ENGINE ALTERNATOR CONTROL PANEL

Engine alternator (D.G.) control panel shall be provided with speedometer, lubricating oil pressure gauge, jacket water temp, battery charging, for local indication panel mounted on the engine itself.

Engine shall be supplied with engine control module (ECM) for diesel generating set monitoring control system, which should be equipped with (digital) electronic Governor along with solid-state AVR to facilitate discreet control of speed and voltage in synchronous mode..

The system shall be equipped with starting control including integrated fuel ramping to limit the black smoke frequency overshoot with optimized cold weather starting. The engine instrument panel shall be equipped with digital

alarm and status to monitor and display the following parameters. The scanner, inter face modules, converter, probe and their wiring up to terminal block in panel with 485 ports etc. making compatibility with PLC. The necessary CT/PT shall be included and wired accordingly to meet the requirements.

Engine Indicators:

Digital tachometer with running hour meter

Lubricating oil pressure low

Lube oil temp high

Over speed

Bearing temperature.

Engine fail to start

Lack of fuel due to low level.

Volts RY-YB-BR.

Amps R-Y-B.

16.39 AMF CONTROL PANELS

Control Philosophy:

1. Automatic Starting and Stopping of Engines:

The system should come in operation after sensing of Grid Failure and / or the voltage drops below preset value. For this purpose the NB- 2 or equivalent "Engine Control & Automatic Mains Failure Stand by System" shall be provided to perform the following functions.

Sensing the healthiness of supply from Supply Company, the engine shall be at rest.

On sensing the supply healthiness (the supply fails or drop below the preset value) the command shall be given to start the D.G. Set.

In case the D.G. Set does not start in the 1st command than two more commands shall be given to start the D.G. Set at an equal interval of time (5 Sec). Even then if the engine does not start the indication shall appear on window / screen "Set fail to start" and alarm shall be generated.

On starting of D.G. Set & monitoring the healthiness of supply, the load shall automatically be transferred on D.G.

on restoration of the supply & monitoring the healthiness of the system, the load shall be transferred to Mains automatically & vice versa.

2. Manual Mode:

Select manual mode on the relay unit. The Set shall only be started by pushing the "start button" on the relay.On attaining the requisite voltage & frequency, the D.G. breaker / Contactor will be closed or tripped manually without shutting down the engine. The Engine shall be shut down manually by pressing the push button.

3. Test Mode:

The test mode operation is independent of the conditions of the mains supply & thereby enables routine testing or exercising of the D.G. Set without closing the D.G. breaker / contactor. (Select the switch on selector mode & is similar to the auto mode except closing of the breaker).

The relay shall have following features such as:

Modeselector switch (Auto/Manual/Test/Off) Engine Control switch (On/Off push button) Reset/Acknowledge push button.

Breaker close/open

push button. Test push button.

Set of visual indication Load on Mains.

Load on D.G. Set.

Set fails to start.

Low-pressure alarm & Trip.

High temperature alarm & Trip.

Engine over speed.

Alternator overload & short circuit.

Voltages, phase to phase & phase to neutral.

Ammeter Line / Phase current.

Power factor meter.

Kilowatt-hour meter.

Frequency meter.

Tachometer.

16.40 ALTERNATOR (433V – 3 PHASE, 3 WIRE SYSTEM)

The alternator shall be brushless synchronous and suitable for 3 phase 433V, 3 wire, 50 Hz, 0.8 p.f., 1500 RPM.

The alternator shall besuitable for coupling directly to the diesel engines described earlier in clause no. 1.0 It shall be Drip proof, screen protected as per IP 21. It shall include one set of suitable rated foot mounted anti - condensation heaters. The alternator shall be double bearing type and self ventilating. The Alternators shall be provided with fully interconnected damper windings to facilitate parallel running. The alternators shall be continuously rated and shall have class 'F' insulation designed and built to withstand tropical conditions. It shall generally conform to BS : 5000 (part - 99). Each DG set shall be suitable for sustaining a 10% overload for 1 hour in any 12 hour period without injury. Additional adopter box to be provided for accommodating outgoing Al. Conductor cables including G.I. nut bolts for termination.

The alternator shall also have a solid state static type automatic voltage regulator (A.V.R.) suitable for single and parallel running with control limits of 1% from no load to full load under normal load changes when running single.

The Engine and Alternator shall be direct coupled and mounted on a common rigid fabricated steel base frame with suitable vibration isolation system.

The Alternator shall withstand an over speed of 20% for a period of 3 minutes without mechanical damage.

The generator/alternator shall with stand over load of 10% for 1 hour every 12 hourly. The terminal voltage shall be adjustable and the range of adjustment shall be + 5% of nominal voltage.

The Alternator shall be capable to withstand 3-phase short circuit at its terminals for 3 seconds when operated at rated KVA and power factor at 5% over voltage with fixed excitation (3 times the line current for 10 Sec) without damage / injury.

The alternator shall be capable of withstanding 50 % excess of rated current for 30 seconds at maintained rated voltage, consistent with max capacity of the prime mover.

Six Nos. embedded (RTD) resistant temperature detector platinum (100-ohm resistance at 0 Degree) to measure the winding temperature and 2 Nos. (BTDS) bearing temperature detector shall be provided.

The leads of embedded RTD shall be wired up to the terminal block in a separate auxiliary terminal box. Manufacturer shall indicate the setting values for each RTD/BTD for alarm and trip. All external nuts and bolts shall be of high tensile steel only.

Alternator shall be provided with anti-condensation space heater of adequate rating suitable for 240V, 50 Hz. single ph A.C. supply and shall be wired up to a separate terminal box and thermostatically controlled when machine is in idle condition. (Wiring and equipment shall be provided by D.G. supplier).

Two independent earth terminals on the frame complete with nuts, spring washer and plain washer shall be provided.

Alternator shall be provided with suitable terminal box for terminating TP bus-duct / cables drop and protection. CTS within the terminal box duly wired up to the panel shall be provided.

The alternator shall be capable to sustain the unbalanced current between the phases minimum 40% of rated current provide that the KVA rating and

maximum current does not exceed 11% of rated current in any phase as per BS-4999 Part-101.

The alternator shall be fitted with radio interference suppressors in accordance with BS-613-1977 and shall be within the limit of CISPR standard.

The alternator shall be dynamically balanced complete with rotor and shaft.

Alternator should have bearings at both shaft ends. Damper winding shall be provided in the pole to damp the oscillations and ensure satisfactory performance during parallel operation.

Winding of 3 phase alternator shall be of star connected and neutral point shall be brought out to the terminal box through protection and earthed with independent earth or through contactor as per scheme.

Protection CT's/PT's shall be mounted above the terminal box with enclosure. Bus duct / cable shall be terminated on terminals through this.

Diesel generating set shall be able to start motor of 30% capacity of D.G. set with a 20% base load.

16.41 AUTOMATIC VOLTAGE REGULATOR

An automatic high speed dead band channel voltage regulator shall be provided with all accessories. The regulation system shall be with equipment accessories for automatic as well as for manual switchover control.

The voltage regulator shall be dual control type i.e. the voltage regulation shall be through compound transformer or magnetic amplifier and the electronic regulation through solid state devices and secured from all three phases. The combined voltage regulation shall be ± 1% from full load to no-load, from hot to cold at unity power factor and from 0.8 to 0.99 power factor with 4% speed regulation of the engine.

Voltage regulation and steady state modulation shall be within ± 1% of the line voltage and with manual voltage adjustment capability within ± 5%. The maximum permissible wave from distortion should not exceed 5% at any load.

Necessary equipment for field suppression and surge protection shall be provided.

The response time of the exciter and the generator shall be matched to avoid hunting.

AVR system shall be provided with equipment for auto-manual operation from remote (PLC – joystick or push buttons)

In the event of AVR failure the generator excitation control is transferred automatically without any change in the excitation current.

Necessary equipment shall be furnished for the following:

- To prevent rise of field voltage in case of failure of potential supply.
- To initiate from automatic to manual control of excitation on fuse failure in the generator potential signal.
- Reactive load sharing of parallel operating generator shall be in proposition to their ratings. The quartrative drop current transfer compensation feature should be provided on exciter regulation and drop voltage shall be within 1% variation.

D.G. Set Vendor shall inspect the existing system and include all necessary hardware, input/ output modules and junction box with terminal block and its wiring complete as required to make the system operational in PLC / Manual mode and to be included in price bid.

16.42 PLC SYSTEM

Note:

D.G. Vendor shall include all necessary hardware, input/output modules and junction box with terminal block complete as required to make the system operational in PLC/Manual mode and to be included in price bid.

Control Philosophy (Only for Information)

- **Automatic Starting & Stopping of Engines:**

The system should come in operation after sensing of grid failure or the voltage drops below preset values. The 'PLC' shall issue the command to 'Master' D.G. set. In case the D. G. set fails to start in the 1st cranking, two more cranking attempts shall be made with proper intervals. Even then if engine fails to start, indication must appear on MMI / Monitor 'Set Fails to Start' & alarm shall be generated. The PLC shall give the command to the next DG set selected in sequence.

DG set on load operation system shall start monitoring voltage, frequency and load. If the load exceeds settable limit the next D.G. shall be started to prevent D.G. over loading. The process shall continue till all the D.G. sets have been started.

At any point of time the engines are under loaded and the load is capable of being catered by less than the numbers of running DG sets. Stop command shall be given to DG running for shortest duration at that moment.

On restoration of mains and sensing the healthiness of the same, the load shall be transferred to mains. The DG sets shall be given stop command after settable time delay ensuring adequate cooling down of the engine.

- **Auto Synchronization:**

  Synchronization facility shall be available both for 'Auto & manual' mode. In auto mode, the synchronization will be achieved by 'PLC' (PLC will control voltage, frequency and phase angle and issue command to breaker), However if due to any reason auto synchronization fails repeatedly the 'PLC' system should initiate start command to next DG for operation as well as synchronize the system automatically.

  In manual mode the system shall be manually operated backed by relays. In auto mode facility the closing of breaker shall be automatic, whereas in manual mode breaker will be closed by panel switch through synchronizing relay.

  In any case if the auto synchronization is failed to achieve in a settable time an alarm shall be generated and displayed that the 'DG Failed to Synchronize' and the same shall be aborted.

- **Automatic Load Sharing:**

  'PLC' shall monitor active & reactive power generated by the various sets continuously and shall issue command to achieve proper load sharing.

- **Back up Protection:**

  The system shall have built in protection as listed below and shall continuously monitor the parameters and on sensing of any electrical fault PLC shall trigger 'Trip command'. Through Trip relay of the corresponding

breaker similarly in case of semi auto mode and in case of manual mode it shall be through master trip relay.

Over voltage/ Under voltage

Over frequency/ Under frequency Over Current

Reverse power active Active Power

Reactive Synchronizing check (MMI)

Earth fault relay unbalance

Differential protection through relay interface with PLC/PC

Engine Protection as listed under DG sub-head shall also be interfaced with PC/PLC for generating trip command/alarm and generating report etc.

16.43 CATALYTIC CONVERTER

The technical specifications for catalytic converter shall be as follows:

The Diesel Oxidation Catalytic Converter shall include one number catalyst element contained in a stainless steel high pressure rated housing designed to withstand 0.5 bar peak pressure, equipped with a provision for future upgrade, 0.5" mild steel custom sized plate flanges drilled per DIN / ANSI or customer specifications , standard monitoring ports and cover plate allowing easy access for service, inspection, maintenance and / or replacement of the catalyst elements.

The catalyst material is coated on a metal honeycomb substrate conatining a series of alternatively flat and corrugated foils made of stainless steel wound together and contained inside a stainless steel 'C' Channel outer shell. Stiffening bars are used in order to provide additional rigidity. Ultra-thin foils increase the interior void space and give a low back pressure. Catalyst elements are equipped with handles for easy installation and maintenance.

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16.44 COMMISSIONING CHECKS

In addition to the checks and test recommended by the manufacturer, the Contractor shall supervise the following commissioning checks to be carried out at site.

Load Test (site and factory):

The engine shall be given test run for a period of at least 6 hours. The set shall be

subjected to the maximum achievable load as directed by Engineer-in-charge without

exceeding the specified D.G. Set rating:

During the load test, half hourly records of the following shall be taken:

Ambient temperature

Lubricating oil temperature where oil cooler fitted.

Lubricating oil pressure.

Color of exhaust gas. Speed.

Voltage, wattage and current output.

Oil tank level.

The necessary load to carry out the test shall be provided by the Engineer-in-charge.

Insulation Resistance Test for Alternator:

Insulation resistance in mega-ohms between the coils and the frame of the alternator when tested with a 1000V megger shall not be less than

IR = 2 x (rated voltage in KV) + 1

Fuel consumption Check:

A check of the fuel consumption shall be made during the load run test. This test shall be conducted for the purpose of proper tuning of the engine.

Insulation Resistance of Wiring:

Insulation resistance of control panel wiring shall be checked by 500V megger. The IR shall not be less than one mega ohm.

Functional Tests:

Functional tests on control panel.

Functional test on starting provision on the engine. Functional tests on all Field devices.

Functional tests on AVR and speed governor.

Vibration Measurement:

The vibration shall be measured at Load as close to maximum achievable load and shall not exceed 130 microns.

Test Certificates and Reports:

Test Certificate shall be submitted in four (4) copies.

The test certificates shall be furnished to the Engineer-in-charge for prior approval before dispatch of any equipment from works and the approval in writing from Engineer-in-charge shall be essential to effect dispatch of the equipment.

The test reports shall furnish complete data for equipment identification.

16.45 EARTHING:

All electrical equipment is to be earthed by connecting two earth tapes/strips 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: 3043 – 1987.

The following shall be earthed:

D.G. Set

neutrals.

D.G.
Housing.

Non-current carrying metallic parts of electrical equipment such as switchgear, bus ducts, D.G. Control panel/ distribution boards, cable trays (electrical wiring accessories).

For earthing of electrode shall consist of copper/G.I. plate (size as per item) which shall be provided with holes. The place electrode shall be buried in the ground vertically with its top not less than 3.5M below ground level. The earth plate shall be buried in the ground below the permanent moisture level but not less than 3.5 meter below ground. The plate shall be filled with charcoal dust and common salt filling extending 15 cm around it on all sides up to the ground level for water pipe. The top of the pipe shall be provided with a funnel and a GI mesh screen for watering the earth. This will be used in a masonry sump with cement plastering not less than 40 cm square and 30 cm deep. M.S. frame heavy duty CI cover with hinged and locking arrangement shall be suitably provided over the sump. The earthing lead from electrode onwards shall be suitably protected from mechanical injury by GI pipe. The portion of this protection pipe within ground shall be buried at least 30 cm deep (to be increased to building shall recessed in walls and floors to adequate depth). In the case of plate earth electrode the earthing load shall be securely bolted to the plate with two bolts, nuts, check nuts and washers. In case of pipe earth electrode, it shall be connected by means of through bolt, nuts and washers and cable socket. All materials used for connecting the earth lead with electrode shall be of tinned brass in case of tinned copper plate electrode.

16.46 TESTING AND COMMISSIONING:

Testing and commissioning shall be done as per the programme/instructions to be given by Engineer-in-charge/LICI 's authorized 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 Engineer-in-charge/LICI that all equipment wiring and connections have been correctly done and are in good working condition and will operate as intended.

17.0 LIGHTNING PROTECTION SYSTEM

17.1 WORK DESCRIPTION

This section comprises the engineering, supply and installation, testing necessary for the Lightning Protection System for all buildings and of open areas (storage, leisure, office areas etc) It includes the protection against the electrical consequences due to the lightning current flow through the lightning protection system.

Notes:

- This standard does not cover the protection of electrical equipments or system against voltage surges of atmospheric origin which are transmitted by networks entering the structure.
- Other standards describe lightning protection systems using simple rod lightning conductor, stretched wires and meshed conductors.

The Lightning Protection System shall be installed generally in accordance with IS / IEC 62305- 3 & IS 3043 and additional requirements of this specification. The system shall consist of air terminations, down conductors, joints and bonds, testing joints, earth terminations and earth electrodes. The general arrangement shall be as indicated on the drawings.

The lightning protection system shall comprise:-

- Air terminal (as per rolling sphere or mesh or protective angle method or any combination thereof.)
- Down Conductors
- Joints and Bonds
- Test Links
- Maintenance free earthing system based on chemical earth compound

Lightning protection system employing steel structural and reinforcement system as part of the down conductors shall be adopted as per Drawing specified. All requirements in the specification included cast-in re-bar down conductors shall be applied unless otherwise specified.

17.2 STANDARDS

Complete supply and installation of the lightning protection system shall be followed for engineering, construction and installation in accordance of the following standards and with the latest revision with update amendments:

IS / IEC 62305-3 & IS 3043 IS/ IEC 62561

The detail of the lightning protection system shall also conform to the requirements of all relevant local codes, as applicable, together with the additional requirements referred to in this Specification and Drawings, whichever is the more stringent and acceptable to the Engineer.

In the adoption of standards and requirements, the Contractor shall take the following precedence:

- Engineer's decision
- Local codes of practice
- Drawings
- Specification
- International standards and requirements.
    - Lightning arrestor air terminals Lightning and Earthing Material

17.3 SUBMISSION

All technical submissions shall be got approved by the EPC contractor prior to the respective stages of construction with respect to the approved design and development documents. In case of major deviations, it shall be brought under the notice of LICI for its review and approval.

A prior survey may be conducted to determine the protection level to be considered, the ESE lightning conductor location(s), the down –conductor path(s), the earth termination system location(s) and type(s). All technical submissions shall be approved by the Engineer prior to the respective stages of construction.

Architectural constrains may be taken into account in the lightning protection system design and the design shall be based in a manner so that there is no reduction in the lightning protection system effectiveness.

As a minimum requirement, the submission shall include the following:

- Equipment submission with manufacturer's data;
- Sample submission;
- Shop Drawings showing the co-ordinate routing of air terminations, down conductors bonding to re-bar and foundation earth terminations, methods of fixing etc.
- Builder's works requirement.
- Proposal on testing procedures and report format for testing of the Lightning Protection System.
- Detail of the Contractor's installation Professional Engineer who supervise and endorse the installation for occupation permit application.

17.4 AIR TERMINAL

1.0 General

Lightning Protection System shall be in accordance with IS / IEC 62305-3 & IS 3043 2.0 Zone of Protection

The zone of protection of a lightning conductor defines the space within which Air Terminal provides protection against a direct lightning strike with probability of protection as per LPL.

2.0 LPL (Lightning Protection Level)

LPL is a number associated with a set of lightning current parameters relevant to the probability that the associated minimum & maximum values do not exceed the normally occurring lightning. LPL can be determined by Risk analysis as explained in IS / IEC 62305-2.

LPL levels and probability of protection:

Lightning	Lightning current	Lightning current	Interception
protection	peak value	peak value	probability
Class	MINIMUM	MAXIMUM	
LPL 1:	3 kA	200 kA	98%

LPL 2:	5 kA	150 kA	95%
LPL 3:	10 kA	100 kA	88%
LPL 4:	16 kA	100 kA	81%

Components of External LPS

1.) Air terminal (as per rolling sphere or mesh or protective angle method or any combination thereof.)

2.) Down conductor

3.) Earthing

2.1 Air termination system:

No drilling is allowed in the terrace for fixing the air terminal, if the roof is made of concrete. Parapet wall is exception to this.

Values of Rolling sphere radius, Mesh size and protection angle as per Class of LPL/LPS.

Class of LPL/LPS	Rolling sphere radius(m)	Mesh size (m)	Protection angle
1	20	5*5	Refer figure 1
2	30	10*10	Refer figure 1

3	45	15*15	Refer figure 1
4	60	20*20	Refer figure 1

2.1.1 Material and Dimensions

Material of air terminal, down conductor, earth termination etc. shall be as below:

Material	May be destroyed by galvanic coupling	
	with	
Copper(Solid)	GI and Aluminium	
Hot galvanized steel(Solid)	Copper	
Stainless steel(Solid)	.....	
Aluminium (Solid)	Copper	

Dissimilar metals (eg. Copper with Aluminium) must be connected only by using bimetal

connectors.

Minimum thickness of metal in air termination system for LPL /LPS

Material	Thickness (a) in mm	Thickness (b) in mm

Galvanized steel	4	0.5
Stainless steel	4	0.5
Copper	5	0.5
Aluminium	7	0.65

Material, Configuration and Minimum cross sectional area of air terminal & down conductors

Material	Type	Minimum cross section area	Remarks
Copper	Solid tape	50 sq mm	2mm min thickness
Copper	Solid round	50 sq mm	8mm dia
Aluminum	Solid tape	70 sq mm	3 mm min thickness
Aluminium	Solid round	50 sq mm	8 mm dia
GI	Solid tape	50 sq mm	2.5 mm min thickness
Stainless steel	Solid tape	50 sq mm	2 mm min thickness

2.1.2 Air terminal holder:

Concrete Roof structure: Conductors shall be securely fixed on the terrace by means of air terminal holder which is fixed on the roof by adhesive of good quality taking care of varying weather conditions. Air conductor holder is an insulator & should be of minimum 50 mm height so that even small amount of water logging on terrace is below the level of conductor holder.

Metal Roof structure: Conductors shall be securely fixed on the terrace by means of air terminal holder which is fixed on the roof by metal conductor holder of good quality which is tested for lightning current as per IEC standard. Vendor need to give proof. As metal roof structures are normally tapered at an angle, there is no min. height criteria for metal conductor holder.

2.1.3 Recommended distance between air terminal holders:

Arrangement	Recommended distance for SOLID TAPE	Recommended distance For ROUND conductors
Horizontal conductor on horizontal surface	500 mm	1000 mm
Horizontal conductor on vertical surface	500 mm	1000 mm
Vertical conductor from Ground to 20m height	1000 mm	1000 mm
Vertical conductor above 20m height	500 mm	1000 mm

If antenna, air cooler or any other electrical equipment is present above terrace level, the same have to be protected by using vertical air terminal after calculating the safety or separation distance. The vertical air terminal has to have suitable supports to hold it

Wind speed need to be taken into account. Vertical air terminal must be connected to horizontal air terminal by using suitable connectors.

t the crossings of the horizontal air terminals, suitable Cross connector has to be used for secure connection which is tested for lightning current as per IEC standard. Vendor has to provide proof.

2.1.4 Safety or Separation distance:

It is must to calculate safety or separation distance in order to avoid flash over to the electrical equipment when the lightning current is passing through the vertical air terminal.

2.1.5 Safety/Separation distance (S) in m = (ki * kc*L) / km

Coefficient ki depends on class of LPL/LPS

ki = 0.08 for LPL1,

ki = 0.06 for LPL 2,

ki = 0.04 for LPL3 and 4.

Coefficient kc depends on no of down conductors:

kc = 0.66 for 2 down conductors

kc = 0.44 for 3 or more down conductors

Value of coefficient km = 1

Value of L is the total distance between the equipment to be protected (for e.g. Antenna) to the equi-potential bonding bar situated just above the ground.

2.1.6 Expansion piece

In order to take care the expansion of the metal in summer and contraction of the metal in winter, expansion piece with suitable connectors have to be used at every 20m distance of horizontal air terminal.

2.1.7 Joints and Bonds

The lightning protective system shall have few joints as far as possible & air terminal & down conductor have to be straight. Where it is not possible, it should NOT be bent at 90 degree (right angles) & should have a curved path of 45 degree bend.

2.1.8 Down conductor system

In order to reduce the probability of damage to electronic/electrical equipment, the down conductors shall be arranged in equal distance in such a way that from the point of strike to earth, several parallel current paths should exist & length of the current path should be minimum. Down conductors can be installed separately or more wisely it can be part of natural components of the building. Examples are steel reinforcement in RCC columns, metal facades, profile rails, metal doors & windows. Down conductors should be installed at each exposed corner of the structure as a minimum.

Value of distance between down conductors as per Class of LPL / LPS

Class of LPL/LPS	Typical distance (m)
1	10
2	10
3	15
4	20

2.2.1 Test joints:

At the connection of the earth terminal, a test joint should be fitted on each down conductor at a height of 1 m from the ground, except in the case of natural down conductors combined with foundation earth electrode. The purpose of test joint is to measure the earth resistance value. The remaining portion of down conductor (i.e., after the test joint should be mounted inside a plastic pipe of minimum 3 mm thickness.)

2.2.2 Earth Terminations

Earth mat is most preferable. Where earth mat is not possible, ring earthing is the next best method. Ring earthing must be 1 meter away from the

building and 0.5m below the ground level. The resistance of earthing system shall not exceed 10 ohm as per IEC 62305. Lower earth resistance is more preferable For earth termination system, 2 basic types of earth electrode arrangements are applicable.

Type A & Type B arrangement.

Type A arrangement: Comprises of horizontal or vertical earth electrode installed outside the structure to be protected connected to each down conductor.

In type A arrangement, the total number of earth electrodes shall not be less than two.

Type A arrangement is suitable in places where electronic equipment are not located.

Type B arrangement: This type of arrangement comprises either a ring conductor external to the structure to be protected, in contact with the soil for at least 80% of its total length or a foundation earth electrode. Such earth electrodes can also be meshed. For structures with extensive electronic systems or with high risk of fire, type B earthing is most preferable method. Corrosion proofing band has to be used wherever down conductor is connected to earth termination system. Bitumen has to be applied at the point of inter-connection.

In potentially corrosive areas, Stainless steel must be used.

LIGHTNING PROTECTION

- The lightning protection system shall not be in direct contact with underground metallic service ducts and cab.
- Conductors of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.
- Down conductors shall be cleated on the structures at 600 mm interval.
- Connection between each down conductor and rod electrodes shall be made via test joint (pad type compression clamp) located approximately 1500 mm above ground level. The rod electrode shall be further joined with the main earth mat.

Lightning conductors shall not pass through or run inside G.I. conduits

2.2.3 References:

IS / IEC62305 – PROTECTION AGAINST LIGHTNING:

Part 1: General Principles

Part 2: Risk Management

Part 3: Protection of structures

Part 4: Protection of Electrical & Electronic equipment within structure

IS3043: 1987: Code of practice for Earthing.

TESTING & COMMISSIONING

The contractor shall conduct his own inspection and test reports certified by their engineer shall be submitted to the Engineer-in-charge for his approval and submit a request for joint inspection.

Joint inspection shall be carried out by the engineer-in charge or his authorized representative. Test results shall be checked and compared with the report submitted. All equipment, transportation, manpower and other necessary costs for the joint inspection shall be borne by contractor.

The system shall be tested once in every month intervals for earth resistivity, resistance to earth of the electrodes and electrical continuity of the system. The record of readings / results of these tests shall be maintained by contactor during defect liability period by the contractor and after that by Engineer-in charge.

The contractor shall supply one set of potable Air terminal test meter suitable for operation on batteries for maintenance and check of system. The meter should be suitable:

To test the individual charge sensor

To test the individual triggering terminal To identify the faulty air terminal

To give alarm in case test meter is defective.

The Contractor shall submit a detailed layout drawing showing the positions of testing carry out on site.

18.0 EXTERNAL LIGHTING

a. GENERAL

18.1 WORK DESCRIPTION

The scope of work includes as per drawing for the external lighting indicates approximate position of all lighting fittings. The actual position of all fittings, the wiring details and cable routes shall be co-ordinated with other trades at site and submitted for the approval of the Engineer-in-charge. All time and cost required for adjusting the layout or complete installation to suit site requirement is included.

To determine the exact positioning of External lighting points due consideration shall be given, for selection of the most accessible routes for wiring, convenience of switching and operational requirement of the installation.

No extra cost will be paid should the final positions be relocated.

For the purpose of specification and related drawing, each lighting circuit shall be coded with a prefix to indicate the corresponding distribution board number.

The electrical equipment/system may develop sudden changes due to low frequency/or direct electric current components such as fluorescent lamps, contactors, etc. shall be fitted with radio and television interference suppression components suitable to meet the levels specified in BS 800 “Limits of Radio Interference”.

18.2 STANDARDS

The complete wiring installation shall be engineered according to manufacturer data and constructed in accordance with the latest revision of the IS and the appropriate BS/IEC In the adoption of standards and requirements, the Contractor shall take the following precedence:

Engineer’s decision

Local codes of
practice Drawings

Specification

International standards and requirements

18.3 SUBMISSION

All technical submissions shall be approved by the EPC contractor prior to the respective stages of construction with respect to the approved design and development documents. In case of major deviations, it shall be brought under the notice of LICI for its review and approval.

The submission shall include the following as a minimum requirement, Equipment catalogues submission with manufacturer's data Sample submission include all wiring accessories Shop Drawings of the lighting, circuit numbers, cable routings, switching arrangement, mounting height, etc. The positions and mounting heights shall be coordinated with other services. Fixing details of all wiring accessories shall also be included. Drawings showing the installation details Labeling system Builder's works requirement.

b. PRODUCT

18.4 EXTERNAL LIGHTING:

- **STEEL TUBULAR SWAGED TYPE POLE**

Steel tubular swaged type street lighting poles of the following standard shall be used on work

- The steel tubular swaged type welded poles in stepped from shall be with single/double curved bracket arm suitable for mounting luminaries .
- The poles shall be manufactured from electric resistance welded tubes as per IS: 2713-1980 with latest amendment.
- The pole shall be erected in plumb, buried 1/6th of the pole size under ground in cement concrete foundation as per details given in the the drawing.
- The excavation shall be made in hard and dense soil as per site. A MS plate of size 450x450x10mm thick shall be welded at the bottom of the pole and 300x300x6mm thick MS plate for GI pipes poles.
- The base plates of pole shall be grouted over a 150mm thick 1:2:4 cement concrete bed. The pole shall have a brick / concrete collar as per drawing duly plastered around it at the ground level.
- A MS junction box of size 250x200x115mm depth for looping incoming and outgoing cables as per drawings. MS whether proof junction box

shall be fabricated out of 16SWG sheet steel having hinged cover on the front with neoprene gasket and locking arrangement. The box shall incorporate glands and one 63A, 10way ELMAX connector for looping incoming and outgoing 2Nos. cables and 10/20A DP, MCB, 40mm GI pipe for incoming and outgoing cables shall be fixed to the pole so that PVCA aluminium cable shall be protected from mechanical damages.

- An earthing stud with copper lugs for connecting 8SWG GI wires for earthing shall be provided on the pole at the position outside the MS box. The incoming and outgoing cables shall be marked with ferrules as required.
- The poles shall be given a coat of rust preventive bituminous paint on the inside and red oxide primer on the outside at the factory premises. After the erection of the pole, two coats of enamel/aluminium paint of approved colour shall be applied.
- Touch up paint shall be given at the time of handing over the work. Marking of circuit and pole number shall also undergo same painting treatment as given above for the pole. GI pole shall be supplied in 3M length as per B.O.Q., no jointed / welded pole shall be accepted.
- **DECORATIVE STREET LIGHTING POLES:**

Decorative street lighting pole of the following standard shall be used on work

Design & Construction:

Ornamental cast aluminum pole BCIP- 01 made out of cast aluminum as per requirements of IS: 202-1993 or equivalent. Casting of all pole sections should be accurately done from permanent moulds and cores of the design submitted to achieve uniformity in all design aspects in internal and external shape of the unit. All sections should be free from defects like blow holes, porosity, hard spots, cracks, hot tears, cold shuts, distortion, sand and slag inclusion and other harmful defects. All the casted sections used in the pole should be free from welding of any kind used to repair it. The casted sections should be machined from all the locations used to insert the pieces into one another using either threading or socket method accuracy of all machined parts should be maintained through out a lot for random replacements of sections if

and when required. All the threaded joints should be mechanically tightened and sealed using industrial tools to make the entire unit vandal resistant.

Aesthetic Appearance:

All the grooves and carvings of the pole unit should be free from any kind of distortion for a pleasing aesthetic appearance

Material:

Cast aluminum material used for casting pole unit should be of grade FG- 220 type, as described in IS: 202 and should have minimum tensile strength of the order of 200 N/sq. mm.

Pre treatment:

Each and every casted piece should be subject to sand blasting at a pressure of 10-15 Kgf to remove all external dirt and sand remains etc

Painting & Finishing:

Entire unit should be given an extensive three stage treatment with PU based two pack Zn-Ph primer and paint prescribed for CI surfaces to make it absolutely rust and corrosion proof, as well as giving it a pleasing appearance. PU based paint should be MRF make or equivalent.

Thickness of the coating:

A minimum of 80 microns of coating thickness should be achieved on the final piece.

Installation:

Pole unit should be grouted using 4nos. anchor bolts of size M-16x450mm confirming to 6.8 Gr. As per IS: 2062. Pole unit should be grouted in a Foundation made out of 1:3:6 cement concrete after excavating the earth with proper cable sleeves etc. laid in the foundation itself.

Manufacturer standard installation drawing shall be follower for installation of poles.

- **OCTAGONAL STREET LIGHTING POLES:**

Octagonal G.I. street lighting poles of the following specification shall be used for work.

- The Octagonal Poles shall be designed to withstand the maximum wind speed as per IS 875. The top loading i.e. area and the weight of fixtures are to be considered to calculate maximum deflection of the pole and the same shall meet the requirement of BS: 5649 Part VI1982.
- The pole shaft shall have octagonal cross section and shall be continuously tapered with single longitudinal welding. There shall not be any circumferential welding. The welding of pole shaft shall be done by Submerged Arc Welding (SAW) process.
- All octagonal pole shafts shall be provided with the rigid flange plate of suitable thickness with provision for fixing 4 foundation bolts. This base plate shall be fillet welded to the pole shaft at two locations i.e. from inside and outside. The welding shall be done as per qualified MWAW process approved by third party inspection Contractor.
- The octagonal Poles shall have door of approximate 500 mm length at the elevation of 500 mm from the Base plate. The door shall be vandal resistance and shall be weather proof to ensure safety of inside connections. The door shall be flush with the exterior surface and shall have suitable locking arrangement. There shall also be suitable arrangement for the purpose of earthing.
- The pole shall be adequately strengthened at the location of the door to compensate for the loss In section.
- Hie welding shall be carried out confirming to approved procedures duly qualified by third party Inspection Contractor. The welders shall also be qualified for welding the octagonal shafts.
- The Octagonal Poles shall be in single section (upto 11 mtr). There shall not be any circumferential weld joint
- The poles shall be hot dip galvanized as per IS-2629/IS-2633/IS-4759 standards with average coating thickness of 70 micron. The galvanizing shall be done in single dipping.
- The Octagonal Poles shall be bolted on a pre-cast foundation with a set of four foundation bolts for greater rigidity.
- Top Mounting; the galvanized mounting bracket shall be part of supply along with the Octagonal Poles for Installation of the luminaries.

- Installation of poles shall be carried out as per manufacturer's standards.
- The Lux level for lighting shall be considered as per IS standards and on the following area requirement.

Parking	40-50
Internal Roads (10mtrs)	18-20
Main Approach Roads (12mtrs)	20-25
Security lights	20

- **Aviation Lighting**

Aviator warning lights shall be provided as per the recommendations of ICAO and Director General of Civil Aviation, India. The arrangement of light should be marked such that the object is indicated from every angle in azimuth. The aviation warning lighting system shall also confirm to the latest IS 4998.

19.0 FINAL DISTRIBUTION BOARDS & DEVICES:

19.1 GENERAL

This section covers specification of DBs.

19.2 STANDARDS AND CODES

The latest and amended upto date Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

19.3 MINIATURE CIRCUIT BREAKERS & RESIDUAL CONTROL DEVICES

Miniature circuit breakers shall be of approved design and make and must be tested and validated as per IS/IEC 60898 and IEC 60947-2 standards.

MCBs shall be suitable for operation at 240V/415V, 50Hz supply. The MCB ratings shall be available from 1--125A in 1P/2P/3P/4P versions. The rated short circuit capacity shall be 10KA as per IS/IEC 60898 and electrical life shall be 10,000 operations. MCBs shall be offered with B, C or D tripping

characteristics as per the requirements. The MCBs shall be suitable for mounting on a 35mm DIN rail.

MCBs shall carry ISI and CE marking. The MCB manufacturer (through the bidder) has to submit the valid BIS license certificate at the time of offer submission.

MCBs shall ensure complete electrical Isolation of downstream circuit or equipment, when the MCB is switched OFF (to be marked on the MCB in symbolic form)

IP 20 Degree of Protection shall be ensured to prevent electrical shocks by accidental touch to any live parts, by providing finger touch proof terminals.

Energy Limitation Class-3 shall be to ensure minimum let through energy in the event of a fault, for safety & longevity of downstream circuit equipment. (to be mentioned on the as per standards) MCBs shall be line-load reversible with no derating @ 35 deg C.

MCBs shall have bi-connect facility to terminate fork type busbar and wires, simultaneously. Terminal capacity shall be minimum 25 sq.mm. for ratings up to 25A, and 35 sq.mm. for ratings 32A & above to ensure perfect termination of wires and cables. Terminals of MCBs shall have captive screws.

Basic technical parameters, rating, operating voltage, energy limiting class 3 etc. shall be printed on front face of MCB for ease of identification. MCB should have clear indication on front facia for tripping on Short circuit faults for differentiation between O/L & S/C faults

The devices must be capable of heavy-duty operation and to that end, the manufacturer shall guarantee the following performance levels, defined by IEC / EN 60947-2 standards:

- suitability for isolation (section 7.2.7)
- rated insulation voltage (section 4.3.1.2): 500 V
- pollution degree (Part 1, section 6.1.3.2): 3
- rated impulse-withstand voltage (section 4.3.1.3): 6 kV
- Discrimination for power continuity
- Validated Cascading tables as per standard IEC 60947-2

Operating knob shall have provision to lock in ON / OFF condition without affecting any automatic tripping

Circuit- breakers shall be capable of operation under ambient temperature up to 35 °C, without derating of their overload tripping threshold with respect to their rated operating current. The same must be tested and validated as per IEC 60947-2 standard.

MCBs shall be suitable for field-fittable Protection auxiliaries (viz. Over-voltage release, Under -voltage release, Shunt trip) and Indication Auxiliaries (like Auxiliary Contact, Trip alarm contact).

For critical application feeders wherever specified in for remote monitoring of circuit breakers status is required, MCB shall be communication ready to indicate the status of the device (On/Off/Trip), Number of On/Off cycles and Number of Tripping over universally open Modbus protocol so as to have seamless connectivity with any Energy and Building Management System.

19.4 RCCB WITH OVER CURRENT PROTECTION (RCBOS): 2 MODULE VERSION

RCBOs must confirm to IEC/EN 61009 standards.

RCBOs shall be suitable for operation at 240V/415V, 50Hz supply. The RCBO ratings shall be available from 6A-40A in SPN version with the sensitivity of 30mA (for personal protection) and 300mA (for Fire protection), as per the requirements. Rated short circuit breaking capacity shall be 10KA RMS

RCBO shall have clear separate indication of tripping on Short circuit and earth leakage faults on front facia. RCBO shall have Electrical life of 10,000 operations for all ratings.

19.5 DB (DISTRIBUTION BOARD)

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

Recess/ Surface type with integral loose wire box.

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

Din Channel for mounting MCBs.

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

Copper Bus bar

Earthing bolts- 2 nos.

Wiring from MCBs to phase terminal block.

Terminal blocks should be suitable for termination of conductor/ cable of required size but minimum rated cross section of the terminal blocks should be 6 sq. mm.

Terminal block shall be made of flame retardant polyamide material.

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

Prewired DB shall be provided with a detachable PAN assembly for safe removal of MCBs, RCCBs.

The prewired DB shall have have cement spill protector /masking sheet for protection from cement, plaster, paints etc. during the construction period.

Detachable plate with Knock out holes shall be provided at the top/ bottom of board. Complete board shall be factory fabricated and pre-wired in factory ready for installation at site. The box and cover shall be fabricated from 1.6mm sheet steel, properly pre-treated with 7 tank process and duly powder coated, phosphatized with powder coated finish.

DB shall have neutral & earth terminal block on the side, not on top or bottom to provide better wiring space and hear dissipation inside the DB.

DBs shall be provided with rotary knob and shall have flexibility to change to Key lock on field.

The Ingress Protection for entire range of DBs must be certified by any neutral testing authority (viz. ERDA / CPRI/ any govt certified lab) as per standard IS/IEC 60529 for the degree of;

IP43 for DBs for indoor application and IP 54 for outdoor application.

The Impact Protection for entire range of DBs must be certified by any neutral testing authority (viz. ERDA, CPRI, any govt certified lab) as per standard IEC 62262 for the degree of : IK09 for DBs with Double Door

Environmental regulations for Green Buildings : DB shall comply with RoHS and REACH standard and shall have high Strength-to-Weight ratio to avoid burden on building structure.

Where specified it shall be of double door construction provided with hinged cover in the front.

Horizontal TPN DBs shall have Separate Insulated Neutral bar for each phase to achieve per

20.0 SPECIFICATIONS FOR LED LIGHT FIXTURES / LUMINAIRES

1.0 SCOPE

The scope of work includes design, development, manufacturing, testing, supply and commissioning of energy efficient luminaries complete with all accessories, LED lamps with suitable current control driver circuit including mounting arrangement for recessed type and ceiling / wall mounting arrangements.

2.0 STANDARDS

The LED light fixtures / luminaries their associated accessories such as lamps / tubes, reflector, housings, glass, diffusers, energy efficient ballasts/drives etc. shall comply with the latest applicable standards.

IS: 16102-2 : Ballast type LED lamp performance requirement, lamp and accessories

IS: 16107-2-1 : Luminaries performance LED luminaries

IS: 16103-2 : LED modules performance requirements electric lamps and accessories

IEC 62031 : LED modules for general lighting safety requirements

EN 61547 : Equipment for general lighting purpose EMC immunity requirement

IEC 60598-2-1 : Fixed general purpose luminaries

IEC 60598-1 : Luminaries General requirement and tests

IEC 61000-3-2 : Electro Magnetic compatibility (EMC) Limits for Harmonic current emission (equipment input current less than or equal to 16 amps per phase)

IEC 61347-2-13 : Lamp control gear particular requirement or DC and AC supplied electronic control gear for LED modules

IS: 10322 : Specification or the luminaries

IS: 4905 : Method for random sampling

LM 79 : LED luminaire photometry measurement

LM 80 : Lumen maintenance

IEC 62384 : DC or AC supplied electronic control gear for LED modules-performance requirement

IEC / PAS 62612 : Self ballasted LED lamps for general lighting services performance requirement

3.0 GENERAL REQUIREMENTS

The LED light fixtures / luminaries shall be designed for continuous trouble-free operation under hot humid atmospheric conditions, at the specified ambient temperature, without reduction in lamp life or without deterioration of materials and internal wiring.

The LED light fixtures / luminaries shall be designed so as to facilitate easy maintenance, including cleaning, replacement of lamps / drives, starters etc.

Connections between different components shall be made in such a way that they will not work loose by small vibration.

For each type of light fixture the Contractor shall supply the utilisation factor to indicate the proportion of the light emitted by the bare lamp which falls on the working plane.

The LED light fixtures / luminaries shall be supplied complete with lamps.

The LED light fixtures / luminaries and accessories shall be designed to have low temperature rise. The temperature rise above the ambient temperature shall be as indicated in the relevant standards.

4.0 EARTHING

Each light fixture / luminaire shall be provided with an earthing terminal suitable for connection to the earthing conductor. All metal or metal enclosed parts of the housing shall be bonded to the earthing terminal so as to ensure satisfactory earth continuity throughout the fixture.

5.0 PAINTING / FINISH

All surfaces of the fittings shall be thoroughly cleaned and degreased. The fittings shall be free from scale, rust, sharp edges and burrs. The housing shall be stove-enamelled / epoxy stove-enamelled / vitreous enamelled or anodised as indicated under various types of fitting.

6.0 ACCESSORIES FOR LIGHT FIXTURES

LED LAMPS:

Technical specification of LED Lighting Fixtures

Sr.No.	**Parameters**	**Value**
A	**Site Parameter**	
	Ambient Temperature	**Upto 50 Deg C.**
B	Electricity Efficiency Management/Electronic Driver	
	Input Operating Voltage	180 to 270Volts, AC 50Hz±3

	AC Power Factor	Not Less than 0.95
	Efficiency of driver	More than 85%
	THD (AC current 180V to 270V)	Less than 10%
	LED Drive Current	Not more than 300mA / W
	LED Efficacy	As specified in individual schedule of items
	Optical Management	
	LED Make	Osram /Cree /Nichia /SEOUL/EDISON /Phillips Lumileds /Avago
	Colour Temperature	As specified in individual schedule of items
	LED life	Lumen maintenance of the lamp shall not be less than 80% of the initial lumen after 20000 burning hours and 70% of the initial lumen after 50,000 burning hours. The initial lumen will be taken after 100 hours aging.
	E Avg, 9 point method	As per BIS Standards / Latest updated
	CRI	More than 80 or as specified in individual schedule of items whichever is better
	Illumination Uniformity	As per BIS Standards. The illumination should be uniform without Dark Bands or abrupt variations and have Proper glass for soothing to the eyes.
	Average lighting angle	160° or more / as per schedule of items
	Thermal Management	
	Frame of fixture, Heat Sink	Wherever applicable Single Piece die cast High grade Aluminium grade >6000,
	Jn. Temperature of LED at 25 Deg. C	$\leq$ 65 Deg. C.

	Heat Sink temperature rise above ambient	≤30 Deg. C
	General parameters	
	Surge Protection	Yes to be provided separately or to be inbuilt not less than 3kV or as specified in individual schedule of items whichever is suitable
	Cover	Non-inflammable toughened glass 4mm thick with silicon gaskets
	Overall system efficiency	Not less than 95%
	IP Clause & Environment Protection	IP 20 and above / as per Schedule of Item and requirements
	Starting time	Instant on
	Fire protection	Connecting wires used inside the luminaries Smoke halogen free, fire retardant e-beam cable and fuse protection shall be provided in input side. All the material used in the luminaries shall be halogen free and fire retardant confirming to UL94.

REFLECTORS

The reflectors shall be made of CRCA sheet steel / aluminium / silvered glass as indicated for above mentioned fittings. The thickness of steel / aluminium shall comply with relevant standards. Reflectors made of steel shall have stove enamelled / vitreous enamelled / epoxy coating finish. Aluminium used for reflectors shall be anodized / epoxy stove enamelled / mirror polished. Reflectors shall be free from scratches or blisters and shall have a smooth and glossy surface having an optimum light reflecting co-efficient such as to ensure the overall light output specified by the Manufacturer. Reflectors shall be easily removable from the housing for cleaning and

maintenance without disturbing the lamps and without the use of tools. They shall be securely fixed to the housing by means of positive fastening device of captive type.

BALLASTS/ DRIVES

The ballasts/drives shall be designed, manufactured and supplied in accordance with the relevant standards. The ballast/drives shall be designed to have a long service life and low power loss. Ballasts/drives shall be mounted using self locking, anti-vibration fixings and shall be easy to remove without de-mounting the fittings. They shall be in dust-tight, non combustible enclosures.

The Ballast/Drive shall be low loss electronic type and suitable to operate at 180V 270V. End connections shall be brought out in a suitable terminal block, rigidly fixed to the ballast enclosure. Separate ballast/drive for each lamp shall be provided in case of Multi Lamp Fittings.

LAMP HOLDERS

Lamp holders, if any shall comply with relevant standards. They shall have low contact resistance, shall be resistant to wear and shall be suitable for operation at the specified temperature without deterioration in insulation value. They shall hold the lamps in position under normal condition of shock and vibration met with in normal installation and use.

Lamp holders for the LED tubular lamps shall be of the spring loaded bi-pin rotor type, Live parts of the lamp holder shall not be exposed during insertion or removal of the lamp or after lamp has been taken out. The lamp holder contacts shall provide adequate pressure on the lamp cap pins when in working position.

CAPACITORS

The capacitors shall have a constant value of capacitance and shall be connected across the supply of individual lamp circuits. The capacitors shall be suitable for operation at supply voltage as specified and shall have a value of capacitance so as to correct the power factor of its corresponding lamp circuit to the extent of 0.95 lag. The capacitors shall be hermetically sealed preferably in a metal enclosure to prevent seepage of impregnate and ingress of moisture. The lamps shall be capable of withstanding small vibrations and the connections at lead in wires shall not break under such circumstances. Lamps shall conform to relevant standards and shall be suitable for supply voltage and frequency specified.

21.0TECHNICAL SPECIFICATION FOR LIFT

Supplying, Installing and Commissioning of machine room Lift of approved make

Although we have analyzed the quantity of Lifts, which are as under:-

Supplying, Installing and Commissioning of lift of approved make

1. 02 Nos, 13 Passenger, 1.00mps. (884 Kgs or more)

But contractor have to re-design and submit the quantity of lifts according to traffic analysis and available shaft sizes.

Travel: Rise to be verified as per Architectural Drawing building height

Stops/Openings: As per approved architectural drawing

Floor Marking: On each floor

Direction: All at Same Side as per location

Power Supply: 415 Volts, 3 Phase, 50 Hertz, AC+5%-10%

Light supply: 230 Volts, Single phase, 50 Hertz, A.C. +5%-10%

Machine: Machine room less variable frequency drive, Gearless M/C

Control: AC VVVF – Microprocessor-Based Controller with variable frequency drive

Operation: Simplex for each lift

Size of lift & Shaft: as per approval authorities.

Car Enclosure: SS Hairline/ Honeycomb finish

Flooring: 25 mm recess for granite

False Ceiling: Stainless Steel Standard

Car Door Type: 2 Panel Centre opening, sliding steel power operated in SS hairline Finish.

Clear door opening/ Entrance Size: As per IS code/NBC/as per approval authorities.

Landing Doors: 2 Panel Centre opening, sliding steel power operated in SS hairline Finish.

Jambs on all Floors: SS hairline/ Honey comb Finish

Door Operation: Automatic, High-performance contact-free, infrared curtain - 2 dimensional

Car operating Board: Half Height –Surface Mounted

Std. Fixtures / Features:

1) Hall button- Destination Control System (6 Nos. at ground floor & 4 Nos. at all other floors)

2) Handrail: On the rear wall

3) Kick Plate at bottom: SS-Hairline / Honey Comb finish

4) Lighting: Standard LED

5) Emergency light with Alarm bell:

6) Fan/Blower:

7) Press & speak intercom:

8) Car position Indicators: Standard Dot Matrix indicators

As and above the scope also includes supplying and installing safety features like guaranteed governor tripping, Oil buffer, motor overheat protection, full load bypass, Multibeam door sensor, Automatic rescue device, Fireman operation, Interphone system, Car Emergency Lighting, Nearest Landing operation, Door time adjustment, overload indicator inside car, over voltage detection device, Automatic turn off Elevator light & fan, Fire emergency operation by fire switch, voice synthesizer, Auto micro levelling, Inspection panel with trouble code, One No. Coaxial cable for CC TV (device by others), Abnormal speed protection system, lift machine gearless, motor, controller, governor, rail guides, car frame, car safety, counterweight, buffer support, ropes, retiring cam, hoist way interlocks, travelling cables and wiring hoisting

beams, machine beams, bearing plates , sill angle, Facia plates, ladder in pit, safety railing in car etc. complete as per manufacturer's specifications.

The scope **includes** all civil & structural works associated with erection & operation of the lift, hoisting hook or beam in shaft top slab for lifting lift equipments, scaffolding, lighting arrangements for execution & maintenance in future to be provided. It also includes electric installation required for installation.

The scope **includes** obtaining statutory approval including permission from lift inspector for its commissioning. The scope includes free comprehensive maintenance for 24 months incl. supply of tools, plants, consumables, for the purpose of the efficient and smooth operation of lifts.

Before placing the order, the lift with the approved manufacturer, the contractor shall get the approval of the model/make of the manufacturer and lifts technical specification/ parameters and also its aesthetic specification from consultant / EIC.

In general, the work shall be carried out as per the standard specifications of C.P.W.D./relevant drawings and as per the instructions of Engineer in Charge. The work shall be carried out as per item description & as per manufacturer's specifications.

Lifts Constructions & Installation shall also comply Fire Protection Requirements of Lifts in High Rise Buildings as per National Building Code. 2016.

GENENRAL TECHNICAL REQUIREMENTS:

GENERAL STANDARDS

These standards are intended to describe the elevator system for the project using all new equipment, parts, materials, component installation and service technicians. For any discrepancy between the General Conditions and these special requirements, the more stringent shall apply.

Standards and Design Criteria

The following elevator standards and design criteria are intended to assist the contractor in understanding features and facilities, and the quality of after-sales services required for the project.

The contractor shall regard these standards as outline specifications describing an energy-efficient complete, functioning state-of-the-art system with necessary intelligence, flexibility and riding comfort provided herein. Nothing in the specification shall be taken to state or imply "work by others" except where specifically so mentioned.

A 24 -month period of system guarantee shall begin upon completion and acceptance of the entire elevator system. Such guarantee shall cover the entire system and all required expertise to ensure a safety operating system entirely without cost to the owner. Repairs and adjustments shall be timely carried out. The Contractor warrants that all parts replaced shall be new and of equal or better quality then the original.

GOVERNING CODES AND PERMITS

Codes

Elevator equipment shall be furnished and installed in accordance with the specification or local codes requirements whichever is more stringent. The Contractor shall inform the owner of any intended or required departures from the code requirements described above.

Elevator equipment shall comply with the following codes:

a)	Code of Practice for installation, operation and maintenance of electric passenger and good lifts.	:	IS-1860:1980
b)	Outline dimension of electric lifts.	:	IS-3534:1977
c)	Specification for electric passenger and goods lift.	:	IS-4566:1980

Permits and Inspections

Contractor shall secure, at his cost, all licenses and permits, inspections, tests, etc. required by governing codes to operate the elevator system and called for in these specifications.

Contractor shall submit in writing a listing of features and facilities modification to meet local authorities/code requirement.

Contractor shall have to obtain necessary clearance from the lift inspector and Fire Brigade Authorities before and after the complete installation.

It will be the responsibility of the Contractor to get the installation inspected and passed by the Government Inspector for lifts. Any modification as suggested by Inspector for Lifts shall be attended by him at no extra costs to the owner. Inspection fees, if any, for such input will be reimbursed by owner on the production of documentary evidence.

GUARANTEE, MAINTENANCE, INSTALLATION SCHEMATICS

Guarantee

The Contractor shall guarantee all equipment parts, material, and workmanship furnished for the installation. Contractor shall warrant replacing any failed part for a period of 24 months from the date of acceptance of the elevator system under the terms and conditions. All failed parts or parts exhibiting unusual wear and tear shall be replaced without cost to the owner, and such replacement shall be factory approved, new, equal or better than original. All labour, tools, materials, transportation, insurance, etc. required in the performance of guarantee work shall be at the contractor's expense.

Maintenance

The Contractor shall maintain the elevator system in a first-class and safe working manner during this period. Such maintenance shall be for the entire elevator system except when the failure occurs due to work performed by others. Responsibility entails daily inspection and unlimited callback service including nights, weekends and holidays. This maintenance shall include:

Call back service shall be provided for emergencies, in response to emergency calls.

Call back service shall be responded on the same day, and service involving more than one stalled or erratic elevator shall be provided within an hour regardless of the time of day or night. There shall be no compensation for call back service regardless of the hour/day, etc.

The Contractor shall anticipate demand on supplies and parts and keep an inventory of a reasonable number of spare parts, at his own cost onsite in a self-provided lockable metal cabinet which shall be provided and maintained by the Contractor.

A comprehensive full-service maintenance agreement consisting of regular examinations, adjustments, cleaning and lubrication of the elevator equipment shall be provided by the contractor. This service shall not be subcontracted, but shall be performed by the trained elevator technicians employed by the elevator contractor. All work performed shall be during regular working hours and shall include emergency 24 hours call back service and all other conditions cited in various documents appended hereto.

Drawings

Prior to commencing work, the contractor shall prepare all shop drawings necessary to show all details of the installation of the elevator and its equipment. Drawings and other data, which are submitted by the contractor to the Department for his comments shall, if necessary, be marked up and returned to the contractor.

Painting

All exposed metalwork furnished under these specifications, unless otherwise specified, shall be shop primed and properly painted after installation by the elevator contractor. If the baked-on finish is called for, painting shall be completed in a paint shop using seven tank paint process.

IMPORT LICENCE

Should any import license be required for import of any component, the contractor shall make his own arrangement for the same. The Department shall not undertake any responsibility for import of components, and all payments shall be made in Indian rupees only.

DEVIATIONS

Contractor shall stipulate the deviations, if any, from these Technical Specifications, and the reason thereof.

STRUCTURAL REQUIREMENTS

The shaft and pit shall be provided by the contractor. Lift Shaft Shall be Two Hours Fire rated.

TOOLS AND TACKLES

All tools, tackles, supports, scaffolding and staging etc. required for erection and assembly of the equipment and installation covered by the contract shall be provided by the Contractor himself. In additions, all other materials such as foundation bolts, nuts etc. required for the installation of the equipment shall also be provided by the Contractor and should be included in the cost.

TESTING AND HANDING OVER

The Contractor shall carry out the test run of the installation in the presence of representatives of EIC to establish satisfactory functioning of the installation.

The installations shall be handed over after satisfactory testing along with six sets of completion documents each consisting of:

Detailed equipment data and catalogues.

Manufacturer's maintenance chart including check chart and lubrication chart.

Set of "AS INSTALLED DRAWINGS" showing layouts, equipment details, electrical power and control wiring diagrams, etc.

Test Certificates for major equipments.

Certificates of approval from statutory and/or Local Authorities for the operation and maintenance of the installation and equipment, wherever such approval of certification is required (Lift Inspector's

List of two year recommended spares.

Certificate from the EIC that the Contractor has cleared the site of all debris and litter caused by them during the construction.

Submission of the above documents shall form a precondition for the final acceptance of the installation and final payment.

SAFETY PRECAUTIONS

A competent and authorized supervisor/erector shall be on the site whenever the Contractor's men are at work. The supervisor/erector should ensure that all plant and machinery used on the site are rendered safe for working and met with the Indian or International safety standards applicable for the use and operation of such

machinery. The supervisor/erector should also ensure that the workmen at the site are made to use safety appliances such as safety belts/lifelines, helmets etc.

Any hot job such as welding, soldering, gas cutting shall not be carried out without the permission of the EIC. Such jobs shall not be carried out where inflammable materials are stored or lying above. All electric connections shall be through adequately sized mechanically protected cables without any joint and with proper and adequate terminal boxes. All power supplies shall be through properly rated fuses with isolating devices.

MAINTENANCE DURING DEFECTS LIABILITY PERIOD

Complaints

The Contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 24 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

Repairs

All equipments that require repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs for two year concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of-charge to the Departments.

The Contractor shall provide log in the form of diskettes or bound, printed comprehensive logbook containing Tables for the daily record, services rendered for the systems alarms, maintenance and record of unusual observations etc. The Contractor shall also submit a preventive maintenance schedule.

During DLP Period the Preventive maintenance shall be carried out once in a Three Months

OTHER ASSOCIATED WORKS

The following associated civil and electrical work shall also be done by the contractor:

Machine Room: The elevator shall be with machine room.

Hoistway: Hoistway shall be made properly framed and enclosed, including a pit of proper depth with drainage provision and waterproofing. The hoistway and pit walls shall be duly treated and painted.

Hoistway Guard: Provision shall be made during construction for proper guarding and protection of hoistway and temporary barricading of hoistway entrances.

Power and Light: Power/light shall be provided with the following considerations:

Lighting Conductor: Lighting conductor on the top with an independent earth pit shall be provided.

All items/materials/equipments required for completion and functioning of the installation in all respect are deemed to be included in the scope of this work, whether specifically mentioned or not.

QUALITY ASSURANCE PROGRAMME & TEST PROCEDURE FOR ACCEPTANCE

Following test procedures shall be carried out prior to acceptance of the elevator system.

a) Test to determine insulation resistance between power and control lines and earth is as per specified IS codes.
b) Test to determine earthing of all conduit, switch, casing and similar metal works is continuous and has low resistance.
c) Test to determine the proper working of the motor, brake, control equipment and door locking devices and limit switches.
d) Brake load test to check whether it can sustain a car at rest with 25% of the contract load.
e) Test to determine that the lift car raises and lowers rated load.
f) Test to determine that the car achieves the contract speed.
g) Test to determine that the safety gear stops the lift with the rated load.
h) Test for rated power against actual power consumption under full load.
i) Check for current drawn by each elevator during starting and full load operation.
j) Sound level check for motors.
k) Visual inspection for all components.

Besides the above, the contractor shall submit their standard quality assurance programme and test acceptance procedures for reference of the EIC.

TECHNICAL SPECIFICATIONS

PASSENGER ELEVATORS

Passenger elevators shall include all elements conforming to specifications or as amended herein. Elevators covered by this specification shall be provided, installed, tested, commissioned, certified, approved by all agencies having jurisdiction including insurance carriers. Each Contractor having jurisdiction shall certify each elevator fit for public use.

HOIST GEAR

Hoisting machines for passenger (guest) elevators will normally be of the geared type operating at 1.0/1.5 m/s as specified os as per NBC-2016.

EMERGENCY CRANKING

The hoisting machines shall be provided with the means of manual cranking and to allow the release of hoist brake and provide for manual movement of the car in case of emergency.

BRAKE

Brake with non-asbestos lining shall be spring-loaded closed and shall open electrically. Braking shall be using variable voltage variable frequency input to bring the elevator to electrical stop.

AUTOMATIC SELF-LEVELLING

The elevator shall be provided with an automatic self-levelling feature that shall bring the elevator car level to within ± 3mm of the landing floor regardless of load or direction of travel. The automatic self-leveling feature shall correct for over travel and rope stretch.

HOISTWAY MATERIALS

All hoist way materials shall be non-flammable except travel cable cladding which shall be flame resistant. All other electrical cables shall be flame resistant and housed in metal conduit or other metal enclosures.

HOISTWAY ENTRANCES

For each landing served, furnish and install a complete elevator hoistway entrance with stainless steel panels. Each entrance shall have power-operated centre opening doors suitable for a clear opening as per IS codes, and shall exposed surfaces of doors and frames shall be finished as directed by EIC. Corrosion-resistant coating shall be applied, where required, prior to completion of the installation.

HOISTWAY DOORS

Sheave type two-point suspension ball bearing door hangers and tracks complete shall be furnished for hoist way opening, and adjustable ball bearing rollers shall take the up thrust of the doors. Car and hoist way door leaf shall be fitted with two Teflon or nylon gibs as bottom door stabilizers.

CAR AND HOISTWAY DOOR OPERATOR

For each elevator door, a D.C. door operator shall be furnished to simultaneously open the car and hoist way doors when the car is at a landing. The doors shall be closed simultaneously by motor power. Emergency key provision shall be made to open doors at top and bottom landing from outside of the hoist way. The door speeds shall be controlled independent of hydraulic cushioning.

In the event of interruption of electric power or failure of the door operator, it shall be possible to open the car door manually from within the car.

An electric contact for each car door leaf shall be provided which shall prevent elevator movement away from the landing unless the door is in the closed position. Each hoist way door shall be equipped with a positive electromechanical interlock and auxiliary door closing device so that the elevator can be operated only after the interlock circuit is established.

The doors shall open automatically while the car is levelling at the respective landing. The doors shall automatically close after a predetermined time interval has lapsed, but the momentary pressure of the “door open” button provided in the car shall reverse the motion and reopen the doors and reset the time interval unless overridden by the infrared beams monitoring the open door.

INFRA-RED BEAM MONITOR

An infra-red beam device with emitters and receivers shall be installed on each passenger elevator. This device shall monitor traffic across the threshold of the door

and shall initiate door closing 2 seconds after last beam interruption, overriding door open period. There should be minimum of 50 beams crisscrossing across door height.

ARCHITRAVES AND DOORS

Doors, threshold, door hangers and electro-mechanical locks shall be, as a system, fire-rated for not less than 1 hour.

DOOR OPEN CLEARANCE

Clear door opening on passenger elevator shall be as per IS codes. Any other dimension shall require departments approval. Finishes shall be as directed by OWNER.

CAR TOP STATION

A car top operating station comprised of key operated switch and constant pressure up/down buttons shall be provided on each elevator. The car shall respond to up/down command at inspection speed. Contractor shall provide electrical LED lamp switched from car top station.

SHEAVES

Sheaves shall be machined, balanced and shall maintain cable/sheave ratio well within code requirements. Lubrication points shall be extended to a location that is easily accessible.

CAR FRAME AND SAFETY

A car frame fabricated from formed or structural steel members shall be provided with adequate bracing to support the platform and car enclosures. The car safety shall be integral with the car frame, or shall be mounted on the bottom members of the car frame and shall be of the flexible guide clamp-type designed to stop and hold a fully-loaded car, which exceeds descending speed. Safeties shall conform to local codes.

WIRING

All wiring and electrical interconnections shall comply with governing codes and manufacturer standards. Insulated wiring shall have flame retardant and moisture

proof outer covering, and shall be run in metal conduit, tubing or approved electrical raceways. Travelling cables shall be flexible and suspended to relieve strain on individual conductors. A minimum of 10% spare conductors shall be provided in travelling cable.

HOISTWAY OPERATING DEVICES

Redundant series wired terminal stopping devices shall be provided to slow down and stop the car automatically at the terminal landings. Resetting a tripped device shall be done manually only.

PIT SWITCH

An emergency stop switch shall be located in the pit accessible from the pit access door which when operated shall stop the car regardless of position in the hoist way.

BUFFERS

Buffers shall be installed in the pit as means for slowing and stopping the car and counterweight at the bottom limits of travel, in compliance with local codes. Clearance from the underside of the car resting on a fully compressed buffer shall be not less than 1.20m. Buffer shall be designed for design speed +15%. These shall conform to IS 4666-1980 and IS 9803-1981. Spring or oil buffers only shall be used, spring buffers shall be capable of supporting, without being compressed solid, a total load equivalent to two times the weight of car and its rated load for the car buffers and two times the weight of counterweight for counter weight buffers. The oil buffers shall be self resetting type. They will also be provided with means for determining the oil level.

GUIDE RAILS

Steel elevator guide rails shall be installed to guide the car and counterweight, erected plumb and securely fastened to the building structure file and filed to ensure smooth joints.

CABLE ANCHOR

Cable shall conform to relevant codes and shall anchor to the frame by means of an equalizing device to ensure uniform cable loading.

TRAVELLING CABLE

Travelling cable shall be secured to the cars underside. Cable shall be clear of all obstructions while the car is in motion. Cable jacket shall be rated for immersion in water, saltwater and oil. Jacket restraint shall minimize the strain on the conductor.

INTERLOCKS

All hoist way openings shall be provided with electromechanical locks.

COUNTERWEIGHT

A structural steel frame with cast iron or steel plate filled weights shall be furnished to provide the proper counterbalance for smooth and economical operation. The counter-balance shall be 50% of the rated carload.

COUNTERWEIGHT GUARD

A metal counterweight guard shall be furnished and installed at the bottom of the hoist way, and shall wrap around counterweight rails for a height of no less than 1.80m in order to protect accidental contact.

ROPES

All ropes shall conform to governing codes and regulations. It shall be of flat polyurethane-coated belts.

PLATFORM

The car platform shall be formed of cold-rolled steel construction. It shall be equipped with slop resistant aluminum threshold. The entire platform shall rest on rubber pads, so designed to form an isolating cushion between the car and car frame. Platform deflection shall be limited to the maximum 3 mm under maximum normal operating condition. The platform shall conform to local codes.

SILL TO SILL CLEARANCE

Sill to sill clearance shall not exceed 30mm for all elevators.

OVERLOAD FEATURE

Elevators shall be fitted with the load weighting feature to illuminate and sound a buzzer to indicate “Over Load” and subsequently defeat the car’s operating circuits when carload reaches 110% or more of rated load. Car platform may require

stiffening to minimize the margin of error resulting from an excessive deflection. Overload fixture and/or circuit defeat for passenger elevators shall conform to governing code.

CAR SPEED

Car speed shall be as mentioned in table below in meters per second.

ACCELERATION/DECLARATION

Acceleration/declaration shall be linear and smooth. Stops shall be without cable oscillations.

NOISE LEVELS

Noise from all stationary equipment shall not intrude into adjoining public areas by more than 15 dB. Noise from moving equipment including door operation, car motion, fan, wind, etc. shall not intrude into adjoining corridors by more than 20 dB and adjoining occupied areas by not more than 10 dB (all octave bands).

CAR LEVELLING

The car shall reduce travelling speed, stop and open doors. Car leveling shall be within +3mm of landing threshold with a load range of 0 – 100%.

CAR PHONE

Provision for interphone shall be made in the car operation station. Necessary wires shall be included in the car traveling cable. Communications equipment and connections to the building service system shall be furnished and installed by others. Cable for interphone handset shall be provided in the Car Operating Panel.

PROVISION FOR SPEAKERS

Contractor shall provide emergency speakers and travelling cable. Speaker shall have two voice coils and shall be supplied and connected to the background music system and to the emergency paging system. Elevator contractor shall provide all cables and conduits and terminate the same at head-end equipment.

CAR POSITION INDICATOR

A digital car position indicator should be provided in the Car-operating panel. The position of the car in the hoist way should be shown by the corresponding Digital indication. The numerals should be clearly displayed in a large digital readout. The display should be covered with a non-glare lens and should be easily visible by passengers from any position in the car.

LIGHTING

"The lighting fixtures of approved type and quality shall be provided in the car by lift vendor to provide adequate lighting in the car. Suitable outlet shall be provided on the top and bottom of the lift car to install a hand lamp during maintenance".

HALL BUTTONS

At all floors.

CALL BUTTON

Call button and faceplate for passenger car shall be stainless steel hairline finish.

FIXTURE FINISHES

The metal face plates of the signal and operating fixtures in the cars and at the landings, and the metal accessories in the cars, shall be stainless steel.

CAB CLADDING AND FINISHES

Walls shall be of embossed stainless steel to full height.

AUTOMATIC ELEVATOR RETRIEVAL SYSTEM (FIRE PHASE)

All elevators described in these standards must be equipped with an automatic elevator retrieval system which will operate by manually operated key switch or a fire detecting device to be provided by the fire alarm, the supplier which will cause all elevators to be dispatched automatically to the ground floor. Elevator shall, after discharging passengers, open their doors and remain at the ground floor. All floor and car buttons shall be rendered ineffective until the system is manually reset.

A key-operated switch shall be provided at the ground floor to activate and reset the retrieval system manually.

a) Emergency operation shall return the elevators to a designated floor, most commonly, the lobby.

b) On initiation from the fire alarm system, all elevators travelling away from the lobby floors shall stop and reverse with opening their doors indicating fire mode operation to passengers, ignore all car and hall calls and express to the lobby or alternate landing floor.

c) Cars travelling towards lobby shall express to lobby ignoring all car and hall calls. The car parked on intermediate floors shall close their doors and express to lobby. Cars parked at lobby shall open their doors, ignoring car and hall calls. All hall and car buttons shall extinguish and shall accept no further hall or car registration.

d) Elevators shall, in addition, and where allowed by code, be provided with a key-operated switch where designated by the Department, for use by the in-house fire brigade.

e)

Actuation of fire mode shall put all car function as described hereunder fireman control.

a) Close Door – When the car is static in the shaft, applying constant pressure to door close button will cause the doors to close.

b) Applying constant pressure to the up or down shall cause the car to travel in a selected direction.

c) Applying constant pressure to the door open button shall cause door to open. Releasing the button before door is fully, open shall cause the door to close. Allowing the door to open fully, doors will remain open until the door close button is pressed or after a predetermined interval.

d) Hall buttons shall be rendered inoperative.

e) Car position indicator shall indicate the floor when the car is within door operating range, and if in motion it shall indicate nearest floor by flashing. When a car is within the operating zone, the position indicator shall light uninterrupted.

f) All electrical door safety locks shall remain effective.

g) Car position, the direction of travel and floor conditions shall be displayed on the car position monitor in the lobby, and at elevator system monitor at the front desk.

h) Returning the car to the designated landing floor, deactivating the lobby switch will render the car to original pre-fire mode condition.

i) Resetting the Fire Alarm contacts in the car monitoring panel will restore the system to normal condition.

INSPECTION OPERATION

A switch shall be provided in the control panel to permit operation of the elevator from the top of the car for inspection purposes, with car and hall buttons inoperative.

INDEPENDENT SERVICE

A key-operated switch shall be provided in the car operating station which, when actuated, shall disconnect the elevator from the hall buttons and permit operation from the car buttons only.

HOIST GEAR

Hoisting Machine: Machine room, variable voltage variable frequency drive, Gearless M/C

CAR OPERATING PANEL: Destination Control Standard COP

One number full-length Car Operating Panel shall be provided in each passenger car. The car operating panel shall contain a bank of mechanical micro stroke ring illuminated buttons with a maximum movement of 1.5mm marked to correspond to the landings Serviced. It shall include a series of pushbuttons corresponding to the floors served, along with an emergency stop and switches required. Operating panel shall incorporate the following:

Floor buttons, door open/close, emergency stop/alarm, up/down in manual mode, man/auto key switch and fire operation.

A locked compartment integral with operating panel shall contain:

a) Auto / manual / inspection key-operated switch.
b) Up/down button.
c) Fan switches.
d) Interphone Module

On sounding of general fire alarm, the elevator shall respond as stated. Interphone shall be provided, installed in the car-operating panel and connected to the PABX by the low-tension contractor.

HALL LANTERNS*

Recessed surface mounted directional lanterns with stainless steel face plates shall be provided at all hoist way entrances, with up and down indications at intermediate landings and single indications at terminal landings. When a car is stopping at a landing, the lantern shall indicate the direction in which the car is travelling and shall become illuminated prior to the arrival of the car. A soft chime shall sound for the "UP" direction and twice for the "DOWN" direction to announce the impending arrival of the associated elevator.

MISCELLANEOUS FEATURES

The following features shall also be provided as per manufactured design:

a) Anti – Nuisance

If the load in the car is less than three persons and the controller detects too many pressed floor buttons for the number of passengers in the car, it cancels all the car calls. This feature helps avoid unwanted elevator operation caused by mischievously or mistakenly registered car calls.

b) Automatic Fan Switch Off

The fan in the car is automatically switched off if there is no hall or car calls for a fixed period of time, that can be specified by you.

c) Car Failure Operation (Safe Landing)

In case a car stops between floors, the controller will automatically investigate the cause of failure. And if found safe to operate, the car will be controlled to travel to the nearest landing at a slow speed. Upon arrival, the doors will automatically open.

d) Door Failure Operation

When the doors are prevented from being closed by a foreign substance caught in the threshold groove or in a door edge, the doors automatically try to remove the substance by repeated opening and closing.

It may happen that an object is caught between the opening door and the door receptacle, preventing the doors from opening fully. In that case, after a fixed period of time, the car will travel to the next floor and the doors will automatically open.

e) Double Door Operation

If both, up and down hall calls at a certain floor are registered, and they are the last call in the car direction, the car proceeds to the floor and opens/closes the doors. After that, the car reverses, its travel and opens/closes the doors again unless no car calls are registered at that floor.

f) Emergency Alarm

At the gentle press of the button located in the car operating panel, the emergency alarm is activated.

g) Hall Call Detection

If the elevator car arrives at a floor to answer hall call and the hall button is kept activated for longer than a predetermined period of time, the car will not be held up at the floor, but will close its doors and proceed to respond to another call.

h) Independent Service

When the independent key switch is turned on, all registered hall calls are cancelled, and the elevator responds only to car calls. No hall calls can be registered during this service.

i) Load Nonstop

When the carload exceeds 80% of the rated duty load, the elevator does not answer hall calls. When the car load becomes less than 80% of the rated load, the elevator returns to normal operation.

j) Motor Overheat Protection

If an abnormal temperature in the elevator motor is detected, the car is forced to stop at the nearest floor and open the doors. It automatically reverts to normal operation as soon as the motor has cooled.

k) Nudging Door Operation

When the door remain open for more than the fixed door open time (approximately 20 seconds), a buzzer sounds and the doors will be closed automatically. The door sensing device is rendered inoperative, but the door open button and the safety shoe remain operative.

l) Separate Door Times

When the car responds to only a car call, the doors are controlled to open and close in a shorter time, say 20 seconds. On the other hand, when a car stops to respond to a hall call, a longer time can be set, say 40 seconds. If the door open button is

pressed when the doors are closing, the doors will remain open for a shorter time than normal, say 12-15 seconds.

m) Overload Warning

When an overload is detected, the car does not start and the doors open. A buzzer is activated, and the sign on the car operating panel is lit. The elevator operation resumes only upon removal of the overload.

n)Emergency Power Operation

In case of a power failure, standby power equipment (provided by contractor) enables the elevator to return to a predetermined floor for passenger evacuation and to subsequently continue operating depending on the standby power capacity.

Fire Alarm Home Landing

When a fire detecting device installed in the building is activated, the elevator rushes to a predetermined emergency purpose landing for passenger evacuation. After which the elevator parks at the landing with doors open and remains inoperative.

Fireman's Service

Upon switching on the fireman's switch in the hall of a predetermined floor, the elevator rushes to that floor for passenger evacuation. After which the elevator is ready to be used for fire fighting.

Home landing

The elevator automatically returns to the predetermined home landing after the last call has been answered.

Parking Shutoff

When the parking switch is turned on, the elevator proceeds to the parking floor responding to calls on the way. On arriving at the park floor, the car fan is automatically turned, off and the hall position indicator displays "PARK". Only one parking floor can be assigned.

TECHNICAL DATA

1.	Load carrying capacity and speed	:	**884 Kg @ 1.00 mps – 02 No**
2.	No. of passenger	:	**02 no with 13 persons**
3.	Travel	:	As per approved architectural drawing
4.	Serving	:	All openings are located at the front of hoistway
5.	Car size (clear inside)	:	As per standard (or as per Mfg. Specifications)
6.	Type of drive	:	Microprocessor Based Controller with variable frequency drive.
7.	Operation	:	Destination Control System- Fibre
8.	Hoistway Clear Dimension (W * D)		As per approved drawing
9.	Passenger Lift		As per Mfg.'s drawing (To be assembled by the contractor)
10.	Machine		Variable voltage variable frequency drive, Gearless M/C
11.	Car Features Panels False Ceiling Lighting Ventilation Intercom Flooring Jambs on all Floors	: : : : :	 SS Hairline/ Honey Comb Finish Stainless Steel Standard Standard LED Concealed pressure fan with decorative aluminum grill Two-way intercommunication system 25 recess for granite (Granite by others) SS hairline Finish
12.	Car Entrance/Door	:	Clear opening as per IS code/NBC

	Door Operation		2 panel Centre opening sliding steel power operated in SS Hairline Finish. Automatic, High-performance contact-free, Infrared curtain - 2 dimensional Or as per Mfg. Drawings/specifications
13.	Landing entrance (at all landings)	:	2 panel Centre opening sliding steel power operated in SS hairline Finish.
14.	Control	:	AC VVVF - Microprocessor Based Controller with variable frequency drive
15.	Noise Level	:	55 db
16.	Ropes	:	Flat Polyurethane coated belts
17.	Over head	:	**As per Architectural Drawing with Machine room**
18.	Floor marking	:	On each floor
19.	Direction	:	All at same side
20.	Car operating Board	:	Destination Control Standard COP
21	Fireman switch		Fireman switches are to be provided for each lift as mentioned in the Technical specifications. Lifts should be brought down to the Ground Floor by operating this switch to ON position. In this position all landing call buttons must become inoperative and lift must be on fireman's control only. The lift must return to normal position when the switch is in off position. The location of Fireman's switches shall be as per relevant specifications and shall be marked as desired, and if necessary the same shall be got approved from the Chief Engineer.
22	Automatic Rescue Device (ARD)		ARD to be provided for each Lift

All the above installation shall be to suit the power supply of 415 Volts, 3 Phase, 50 Hertz AC +5%-10%

Light supply: 230 Volts, Single phase, 50 Hertz, A.C. +5%-10%

Standard Fixtures / Features:

1.) Hall button – At Every Floor .

2.) Full height car operating with micro stroke call push button (Located on side panel)

3.) Door open and door close button on the car operating panel

4.) Two-way intercommunication system

5.) Destination Control Standard car operating panel

6.) Battery operated alarm bell and emergency light

7.) Fireman's switch at main lobby

8.) Automatic rescue operation

9.) Voice synthesizer and car chime

10. Alarm button in car operating panel with battery back-up

11. Automatic operation for car fan

12. Adjustable door open time

13. Anti-nuisance (empty car)

14. Anti-nuisance (car call cancellation at direction reversal)

15. Blower fan in car for ventilation

16. Braille Script on push buttons

17. Car call cancellation by double pressing floor button in car operation panel

18. Door open and door close buttons in car operating panel

19. Door closing retries

20. Door nudging

21. Emergency light

22. Full load by-pass

23. Home landing

24. Infra-red screen for car door

25. Intercom

26. Motor overheat protection

27. Overload function with audio-visual indication in car operating panel

28. Phase failure and phase reversal protection

29. Automatic rescue device in case of power failure

30. Attendant control

30. Scrolling display in car operating panel

31. Scrolling display in landing operating panel on All Floors

32. Fireman control

33. Fireman emergency return

33. Provision of additional cores in travelling cable for CCTV camera signals/music system wiring

34. Voice announcement unit in English language in car

35. Metal stands for car and counter weight buffers

36. Natural mirror of half car height and full car width provided on rear wall of car.

37. Round handrail in Stainless steel finish provided on rear wall of car

38. Supply & fixing of Stainless Steel plate of thickness of thickness 1.6mm & size 150mm x150mm indicating floor level like B, G, 1, 2.
.

39. Faceplate Finish: Stainless Steel In hairline.

40. Faceplate Shape: Rectangular for COP and Hall Button

41. Jammed landing operating panel call button by-pass

As and above the scope also includes supplying and installing safety features like guaranteed governor tripping, Oil buffer, motor overheat protection, full load bypass,

Multibeam door sensor, Automatic rescue device, Fireman operation, Interphone system, Fireman operation, Interphone system, Car Emergency Lighting, Nearest Landing operation, Door time adjustment, overload indicator inside car, over-voltage detection device, Automatic turn off Elevator light & fan, Fire emergency operation by fire switch, voice synthesizer, Auto micro levelling, Inspection panel with trouble code, One No. Coaxial cable for CC TV (device by others), Abnormal speed protection system, lift machine gearless, motor, controller, governor, rail guides, car frame, car safety, counter weight, buffer support, ropes, retiring cam, hoist way interlocks, travelling cables and wiring hoisting beams, machine beams, bearing plates , sill angle, Facia plates, ladder in pit, safety railing in car etc. complete as per manufacturer's specifications.

The scope excludes all civil & structural works associated with erection & operation of the lift, hoisting hook or beam in shaft top slab for lifting lift equipments, scaffolding, lighting arrangements for execution & maintenance in future to be provided. It also includes electric installation required for installation.

The scope excludes obtaining statutory approval including permission from lift inspector for its commissioning. The scope includes free comprehensive maintenance for 24 months incl. supply of tools, plants, consumables, for the purpose of the efficient and smooth operation of lifts.

Before placing the order, the lift with the approved manufacturer, the contractor shall get the approval of the model/make of the manufacturer and lifts technical specification/ parameters and also its aesthetic specification from consultant/EIC.

APPENDIX 'C'

SAFETY ASPECTS & PROCEDURES

General

1. Since lift installation consists of a number of electrical and mechanical components having linear/rotary motions, utmost caution should be exercised while working and all safety precaution should be rigorously followed.
2. Only authorized persons should be allowed to work on lift installations and officer (s) empowered for such authorization shall keep a proper record thereof during the tests, inspection and maintenance except where necessary.

3. If during erection any safety or protection device is inoperative, special care must be taken to avoid accidents on this account.
4. Supply of main incoming iron-clad switch or circuit breaker should be switched off before examining any part of the equipment. Whether during periodical inspection, or while carrying out any work on the equipments (including using the winding handle at times of main failures) unless power is particularly required for the particular operation or tests on the lifts. The fuse grips of the main switch should be removed and kept under the safe custody.
5. Whenever the car needs to be moved by the use of winding handle in the machine room:
   a) Power at incoming should be switched off before applying the handle.
   b) Power should be restored only after this handle is removed from the winding shaft and brakes are applied.
6. The landing and car buttons should be kept out of circuit by switching on the "Maintenance switch" located on the top of the lift car during maintenance stop switch inside car and or attendant control switch should be used.
7. Before carrying out any repair work it should be ensured that none of the electromechanical door-locks are short circuited either from the controller or at the landings.
8. As a general precaution, facia plate between the door header and the corresponding upper landing sill on each floor must be provided.

TECHNICAL QUESTIONERY TO BE SUBMITTED FOR EACH TYPE OF LIFT

Name of Work: Supplying, Installing and Commissioning of machine room lift of approved make

- 02 Nos, 13 Passenger, 1.00mps.

(This Technical Questionnaire should be filled in by the Tenderer for all items covered under Schedule "B" and must be submitted along with Tender Documents).

Sr.No	Items	Compliance of Bidder
1	2	3
[A] Machine FOR 1.0 MPS ONLY		
1	Drive Sheave Diameter	

2	Grooving Angle.	
3	Roping Arrangement	
4	Rope Diameter	
5	No. of Ropes	
[B] LIFT A. C. MOTOR:		
1	Make & Type	
2	Rated K.W.	
3	Rated H.P.	
4	Rated R.P.M.	
5	Full Load Running Current	
6	Insulation Class.	
[C] CONTROLLER		
1	Type of Contacts.	
2	Operating Voltage	
3	Make of Main Relays	
4	Type of Rectifier.	
5	The Capacity of Main Contactor	
6	Make &Type of Over load	
7	Method of Reversal Relay Employed	
8	Capacity & Type of Selection Contactor	
9	Capacity & Type of Accel and	

	Rated. Contactor	
[D] HOISTWAY ENTRANCE		
1	Material	
2	Gauge	
3	Size of Vision Panels	
4	Class Specification	
5	Type of Roller used for Hangers	
6	Materials of Rollers	
[E] RAILS		
1	Rail size: A. Car rails	
	B. Counter Weight	
2	Maximum Car Rail Deflection, under Normal Operation.	
3	Modules of Section.	
4	Moment of Inertia found Flanges.	
5	Radius of Gyration Around Flanges.	
[F] HOISTWAY ROPES		
1	Name of Manufacture.	
2	No. of Performed Strand.	
3	Wires per Strand.	
4	Lay	
5	Tensile Strength of Rope	

6	Safety Factor of Rope	
[G] BUFFERS		
1	Type of Car Buffers	
2	No. of Car Buffers	
3	Type of Counter Weight Buffers	
4	No. of Counter Weight Buffers	
5	Stroke of Car Buffers	
6	Stroke of Counter Weight Buffers.	
7	Average Retardation Speed Buffer at Rated Load	
8	Peak Retardation for all Buffers at Rated Load	
9	Duration of Peak Retardation at Rated Load	
[H] GEAR BOX		
1	Type	
2	Input Speed	
3	Out Put Speed	
4	Gear Ratio: 40 :	
5	Cyclic Duration Factor	
6	Capacity (i) Input H.P.	
7	Capacity (ii) Out Put Torque	
8	Type of Bearings	
9	Un – Balance Torque (Lp – in)	

[I] BRAKE		
1	Type	
2	Duty	
3	Size	
4	Brake Shoe	
5	Lining	
6	Torque T	
7	Type of winding	
8	Shape & Size of Shaft	
9	Operating Mechanism	
[J] SAFETIES		
1	Furnish the List of Safeties Included.	
2	The Equipment Offered Must Confirm to ISI Bombay	

22.0 FIRE FIGHTING AND SPRINKLER WORKS SPECIFICATIONS

SECTION-A : FIRE PROTECTION SYSTEM

1. SCOPE

The scope of this section consists of but is not necessarily limited to supply, installation, testing and commissioning of the fire protection system. The philosophy of the system is as follows:

a. The Fire Suppression System shall comprise the Fire Hydrants System, Portable Fire Extinguishers etc.

b. Water from the Utility underground RCC Fire Water Storage Tanks, shall be supplied for the uses listed below.Fire Hydrant System (Pressurised) both for the external hydrants, the internal landing valves and the hose reels at landings.

c. The Hydrant System and the Sprinkler System, under normal conditions, shall be lowest pressurized by means of the electric motor driven Jockey Pump.

d. The Hydrant System shall be provided with two pump sets, one of which will be diesel engine driven and the other electric motor driven.

e. The Sprinkler System shall be provided with an electric motor driven pump set.

f. The piping and valve connections shall be done so that the water from the discharge of the Hydrant Pump sets is able to supply water, automatically to the Sprinkler System whenever, the Sprinkler Pump is unable to maintain the pressure or fails and not vice versa.

g. The starting and stopping of the Jockey pump shall be automatic based on the pressure switches at preset low and high pressure.

h. The electric motor driven Hydrant Pump and Sprinkler System starts automatically at a preset pressure by means of a pressure switch. As soon as the Hydrant Pump starts, the Jockey Pump Stops. If for any reason the electric motor driven Hydrant Pump does not start at the preset pressure or is unable to maintain the pressure, the diesel engine driven Hydrant Pump and Sprinkler system starts at the preset pressure.

i. The Hydrant Pump, whether electric motor driven or the diesel engine driven shall be stopped only manually.

j. The Sprinkler Pump shall be started automatically at a preset pressure but shall be stopped only manually.

k. Contractor shall ensure that all false ceiling voids greater than 800 mm are provided with upright and pendant sprinklers.

l. Contractor shall ensure Hydro Testing for the complete system.

m The Contractor shall obtain the necessary approval of the drawings and the schemes from the local Fire authority / TAC as called for. The contractor shall also take care of any other requirement so that insurance cover can be obtained, if required at minimum premium at a later date.

The contractor shall design and after approval of Engineer-in-Charge display near each staircase landing at floor levels, a glass covered framed floor plan clearly showing the locations of all landing valves, hose reels, hand appliances, as well as the DO's and DON'T's for the personnel and the exit direction in case of an emergency. The dimensions of the floor plan, its scale, lettering size, colour scheme etc shall be as directed by the Engineer-in-Charge.

2. PIPE WORK

2.1 GENERAL REQUIREMENTS

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

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.

Pipes shall be securely fixed to walls and ceilings by suitable clamps and supports (galvanized after fabrication) at intervals specified. Only approved type of anchor fasteners shall be used for RCC slabs and walls / floors etc.

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

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

Pipe accessories such as gauges, meters, control devices, etc. shall have the same working pressure rating as the associated pipe work. All pipe work shall be free from burrs, rust and scale and shall be cleaned before installation. All personnel engaged

on welding operations must possess a certificate of competence issued by an acceptable / recognized authority.

2.2 PIPING

Pipes of following types are to be used:

GI heavy class pipes as per IS:1239 heavy grade(for pipes of sizes 150 mm N.B. and below) suitably lagged on the outside to prevent soil corrosion. GI heavy class pipes buried below ground shall also be suitably be lagged with 2 layers of 400 micron polythene sheet over 2 coats of bitumen.

Steel pipelines upto 150 mm dia shall be as per IS: 1239, Part-II (heavy grade) while pipelines above 150 mm dia shall be as per I.S.:3589.

All pipe clamps and supports shall be fabricated from MS steel sections and shall be factory galvanised before use at site. Welding of galvanised clamps and supports shall not be permitted.

Pipes shall be hung by means of expandable anchor fastener of approved make and design. The hangers and clamps shall be fastened by means of galvanised nuts and bolts. The size/diameter of the anchor fastener and the clamps shall be suitable to carry the weight of water filled pipe and dead load normally encountered.

Hangers and supports shall be thoroughly galvanised after fabrication. The selection and design of the hanger & support shall be capable of carrying the sum of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipeline movements as necessary. All guides, anchor braces, dampener, expansion joint and structural steel to be attached to the building/structure trenches etc. shall be provided.

Hangers and components for all piping shall be approved by the LICIs.

The piping system shall be tested for leakages at 2 times the operating pressure or 1.5 time shut-off pressure, whichever is highest including testing for water hammer effects.

Flanged joints shall be used for connections for vessels, equipment, flanged valves and also on two straight lengths of pipelines of strategic points to facilitate erection and subsequent maintenance work.

For pipes under ground installation the pipes shall be buried at least one meter below ground level and shall have 230 mm x 230 mm masonry or concrete supports

at least 300 mm high at 3m intervals. Masonry work to have plain cement concrete foundation (1 cement: 4 coarse sand : 8 stone aggregate) of size 380x380x75 thick resting on firm soil. Mains below ground level shall be supported at regular intervals not exceeding 3.0 metres and shall be laid at least 2.0 metre away from the building.

2.3 PIPING INSTALLATION & SUPPORT

Tender drawings indicate schematically the size and location of pipes. The Contractor, on the award of the work, shall prepare detailed working drawings, showing the cross-sections, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves, and all pipe supports. He must keep in view the specific openings in buildings and other structure through which pipes are designed to pass.

Piping shall be properly supported on , or suspended from , on stands, clamps, hangers as specified and as required.

The Contractor shall adequately design all the brackets, saddles, anchor, clamps and hangers, and be responsible for their structural stability.

Pipe work and fittings shall be supported by hangers or brackets so as to permit free expansion and contraction. Risers shall be supported at each floor with Galvanized steel clamps. To permit free movement of common piping support shall be from a common hanger bar fabricated from Galvanised steel sections.

Pipe hangers shall be provided at the following maximum spacings:

Pipe Dia mm)	Hanger Rod Dia (mm)	Spacing between Supports (m)
Up to 25	6	2
32 to 50	6	2.5
65 to 80	8	2.5
80 to 100	10	2.5
125 to 150	10	3.0
200 to 300	12	3.5

The end of the steel rods shall be threaded and not welded to the threaded bolt.

All pipe work shall be carried out in a proper workman like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The

entire piping work shall be organized in consultation with other agencies work, so that area can be carried out in one stretch.

Cut-outs in the floor slab for installing the various pipes area are indicated in the drawings. Contractor shall carefully examine the cut-outs provided and clearly point out wherever the cut-outs shown in the drawings, do not meet with the requirements.

Pipe sleeves, larger diameter than pipes, shall be provided wherever pipes pass through walls and slab and annular space filled with fibreglass and finished with retainer rings.

The contractor shall make sure that the clamps, brackets, saddles and hangers provided for pipe supports are adequate or as specified / approved by LICIs. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required.

All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reduces shall be used for the piping to drain freely. In other locations, concentric reduces may be used.

Automatic air valves shall be provided at all high points in the piping system for venting. All valves shall be of 15mm pipe size and shall be associated with an equal size gate valves. Automatic air valves shall be provided on hot water risers.

Discharge from the air valves shall be piped through a pipe to the nearest drain or sump. All pipes shall be pitched towards drain points.

Pressure gauges shall be provided as shown on the approved drawings. Care shall be taken to protect pressure gauges during pressure testing.

2.4 PIPE FITTINGS

Pipe fittings mean tees, elbows, couplings, unions, flanges, reducers etc and all such connecting devices that are needed to complete the piping work in its totality.

Ductile Iron / Cast Iron / Forged steel screwed type fitting shall be used for pipes of 50 mm dia& below.

Fabricated fittings shall not be permitted for pipes diameters 50mm and below.

Fabricated fittings used on pipe size 65 mm & above shall be fabricated, welded in workshops. They shall be inspected by Engineer-in-Charge before dispatch from the workshop. The welding procedures of the workshop should have been approved by the rules for sprinkler system and applicable to hydrant and sprinkler system. For "connection, pipes shall be drilled and reamed. Cutting by gas or electrical welding shall not be permitted.

a. PROCEDURE FOR PYPKOTE / COATEK APPLICATION

A) Surface Preparation - The pipe surface shall be cleaned by a wire brush.

B) Application of Primer - Pypkote / Coatek primer is to be applied on pipes immediately after cleaning. This is to prevent any further accumulation of rust on the pipe. This is a cold applied primer and is applied by brush.

C) Application of Pypkote / Coatek 4 mm Tape - After the primer is applied on the pipe, it is allowed to dry for about 30 min. till it becomes touch dry. Before adhering the tape to the pipe, it is advisable to gently heat the primer coated pipe by a run of LPG torch. Remove the bottom polyethylene from the tape & then heat bottom surface of the tape by LPG torch or any heat source & start wrapping the tape to the pipe by heating the primer coated pipe & by removing the bottom polyethylene from the tape before wrapping better adhesion between the tape & pipe is obtained. Overlaps are maintained with a minimum of 12.5 mm.

D) Tape coating of weld joints - The tape is applied over the weld joints after the necessary welding & testing methods of the joints is completed. The procedure for application of tape shall be the same as bare pipe procedure. Overlaps on each side of the weld joints shall be 50 mm.

E) A final coat of White wash with water based cement paint is done immediately over the entire coated pipe.

b. JOINTING

2.6.1 Welded Joints :

Joints between GI heavy class pipes and fittings shall be made with the pipes and fittings having "V" groove and welded with electrical resistance welding in an approved manner. But welding without "V" groove shall not be permitted.

All joints in the pipe line with screwed fittings shall be seal welded after testing and the weld plus the adjoining portion shall be given two coats of zinc rich primer.

2.6.2 Flanged joints (65 mm dia and above)Flanged joints with flanges conforming to IS: 6392 shall be provided on

a. Straight runs at intervals not exceeding 25-30m on pipe lines of 50 mm dia and above and as directed by the Engineer-in-Charge.

b. For jointing all types of valves, appurtenances, pumps, connections with other type of pipes, to water tanks and other places necessary and as required for good engineering practice and as shown/noted on the drawings.

c. Flanges shall be with GI bolts and nuts and 3mm insertion gasket of natural rubber conforming to IS: 11149.

2.6.3 Unions (upto 50 mm dia)

Approved type of dismountable unions shall be provided on pipe lines of 40 mm dia and smaller dia, in locations similar to those specified for flanges.

3. AIR VESSEL

The air vessel shall be provided to compensate for slight loss of pressure in the system and to provide an air cushion for counter-acting pressure, surges, whenever the pumping sets come into operation. Air vessel shall conform to IS:3844. It shall be normally half full of water, when the system is in normal operation. Air vessel shall be fabricated with 8 mm thick M.S. plate with dished ends and suitable supporting legs. It shall be provided with one 100 mm diaflanged connection from pump, one 25 mm drain with valve, one water level gauge and 25 mm sockets for pressure switches. The air vessel shall be tested to pressure for 12 hours at 2 times the operating pressure or 1.5 times the shut-off.

4. AIR CUSHION TANK

Every wet riser shall be provided with an air cushion tank at its top most point. The air cushion shall be provided with an automatic air release cock, 20 mm dia drain pipe, drain valve and shut off valve.

5. FIRE BRIGADE CONNECTION

The storage tank shall be provided with a 150 mm fire brigade pumping connection to discharge at least 2275 litres / minute into it. This connection shall not be taken directly into the side of the storage tank, but arranged to discharge not less than 150 mm above the top edge of the tank such that the water flow can be seen. The connection shall be fitted with stop valve in a position approved by the Engineer-in-

Charge. An overflow connection discharging to a drain point shall be provided from the storage tank.

The fire brigade connection shall be fitted with four numbers of 63mm instantaneous inlets in a glass fronted wall box at a suitable position at street level, so located as to make the inlets accessible from the outside of the building. The size of the wall box shall be adequate to allow hose to be connected to the inlets, even if the door cannot be opened and the glass has to be broken. Each box shall have fall of 25mm towards the front at its base and shall be glassed

with wired glass with "FIRE BRIGADE INLET" painted on the inner face of the glass in 50 mm size block letter. Each such box shall be provided with a steel hammer with chain for breaking the glass.

In addition to the emergency fire brigade connection to the storage tank, a 150mm common connection shall be taken from the four 63mm instantaneous inlets direct to hydrant main so that the fire brigade may pump to the hydrants in the event of the hydrant pumps being out of commission. The connection shall be fitted with a sluice valve and reflux valve. Location of these valve shall be as per the approval of the Engineer-in-Charge.

Two way collecting head with two numbers 63 mm instantaneous type inlets shall be connected to the sprinkler header. All other details shall be as described above.

6. SYSTEM DRAINAGE

The system shall be provided with suitable drainage arrangement with drain valves complete with all accessories.

7. VALVE CHAMBERS

Provision of 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 20 mm nominal size) with 15 mm thick cement plaster inside and outside finished with a plaster inside and outside finished with a floated coat of neat cement inside with cast iron surface box approved by fire brigade including excavation,back-filling complete shall be made.

8. VALVES

8.1 SLUICE VALVES

Sluice valves shall be double flanged valves with cast iron body. The spindle, wall seat and wedge nuts shall be of bronze. They shall generally have non-rising spindle and shall be of the particular duty and design called for.

The valves shall be supplied with suitable flanges, non- corrosive bolts and asbestos fibre gaskets. Sluice valves shall conform to Indian Standard IS : 780-1969 and IS : 2906 .

8.2 BUTTERFLY VALVE

The butterfly valve shall be suitable for waterworks and rated for 300 P.S.I

The body shall be of cast iron to IS:210 in circular shape and of high strength to take the water pressure . The disc shall be heavy duty cast iron with anti corrosive epoxy or nickel coating.

The valve seat shall be of high grade elastomer or nitrile rubber. The valve is closed position shall have complete contact between the seat and the disc throughout the perimeter. The elastomer rubber shall have a long life and shall not give away on continuous applied water pressure . The shaft shall be EN 8 grade carbon steel.The valve shall be fitted between two flanges on either side of pipe flanges. The valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakages.

8.3 BALL VALVE

The ball valve shall be made forged brass and suitable for test pressure of pipe line. The valve shall be internally threaded to receive pipe connections.

The ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body-bonnet gasket and gland packing shall be of Teflon.

The handle shall be provided with PVC jacket. The handle shall also indicate the direction of ‘open’ and ‘closed’ situations. The gap between the ball and the Teflon packing shall be sealed to prevent water seeping.

The handle shall also be provided with a lug to keep the movement of the ball valve within 90°. The lever shall be operated smoothly and without application of any unnecessary force.

8.4 GUN METAL VALVES

Gun metal Valves shall be used for smaller dia pipes, and for threaded connections. The Valves shall bear certification as per IS:778

The body and bonnet shall be of gun metal to IS:318. The stem gland and gland nut shall be of forged brass to IS:6912. The hand wheel shall be of cast iron to IS:210.

The Hand wheel shall be of high quality finish to avoid hand abrasions. Movement shall also be easy. The spindle shall be non rising type.

8.5 NON-RETURN VALVE

Non-Return valves shall be cast iron double flanged with cast iron body and gunmetal internal parts conforming to IS:5312.

8.6 PRESSURE RELIEF VALVE

Each System shall be provided with a Pressure Relief Valves. The Valve shall be spring actuated and set to operate as per field requirement. The Valve shall be constructed of bronze and provided with an open discharge orificefor releasing the water. The Valve shall be open lift type.

9. PRESSURE SWITCH

The pressure switches shall be employed for starting and shutting down operation of pumps automatically, dictated by line pressure. The Pressure Switch shall be diaphragm type. The housing shall be die cast aluminium, with SS 316 movement, pressure element and socket. The set pressure shall be adjustable.

The Switch shall be suitable for consistent and repeated operations without change in values. It shall be provided with IP:55 water and environment protection.

10. PRESSURE GAUGE

Pressure gauge shall be provided near all individual connections of the hydrant system with isolation valves and near each flow switch assembly of the sprinkler system. Pressure gauge shall be 50 mm dia gunmetal bourdon type with gunmetal isolation ball valve, tapping and connecting pipe and nipple. The gauge shall be installed at appropriate height for easy readability.

11. PAINTING

All Hydrant and Sprinkler pipes shall be painted with post office red colour paint. All GI heavy class pipes shall first be cleaned thoroughly before application of primer coat. After application of primer coat two coats of enamel paint shall be applied.

Each coat shall be given minimum 24 hours drying time. No thinners shall be used. Wherever required all pipe headers shall be worded indicating the direction of the pipe and its purpose such as "TO RISER NO.1" etc.

Painting shall be expertly applied, the paint shall not over run on surfaces not requiring painting such as walls, surfaces etc. Nuts and bolts shall be painted black, while valves shall be painted blue.

12. EXCAVATION

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 burried with a minimum cover of 1 meter or as shown on drawings.

Wherever required Contractor shall support all trenches or adjoining structures with adequate timber supports,shoring and strutting.

On completion of testing in the presence of the Engineer-in-Charge and pipe protection, trenches shall be backfilled in 150 mm layers and consolidated.

Contractor shall dispose off all surplus earth as directed by the Engineer-in-Charge.

13. ANCHOR / THRUST BLOCK

Contractor shall provide suitably designed anchor blocks in cement concrete/steel support to cater to the excess thrust due to work hammer and high pressure.

Thrust blocks shall be provided at all bends, tees and such other location as determined by the Engineer-in-Charge.

Exact location, design, size and mix of the concrete blocks/steel support shall be as shown on the drawings or as directed by the Engineer-in-Charge prior to execution of work.

14. FIRE HYDRANTS

14.1 EXTERNAL HYDRANTS

a. Contractor shall provide external hydrants. The hydrants shall be controlled by a cast iron sluice valve. Hydrants shall have instantaneous type 63mm dia outlets. The hydrants shall be single / double outlet comprising of 80mm dia.Stand pipe, 80mm dia.bend and 63mm dia.G.M.landing valve conforming to IS: 5290 with instantaneous female coupling on the outlet with S.S orifice flange 6mm thick as

required to maintain 3.5kg/sq.cm gun metal blank cap and chain, necessary companion flanges (as per table 'E' nuts,bolts, washers and gasket complete.

b. Contractor shall provide for each external fire hydrant two numbers of 63mm dia. 15 m long

controlled percolation hose pipe with gunmetal male and female instantaneous type couplings machine wound with GI wire (hose to IS:636 type certification) , gunmetal branch pipe with nozzle to IS:903. This shall be measured and paid for separately.

c. Each external hydrant hose cabinet shall be provided with a drain in the bottom plate.

d. Each external hydrant hose cabinet containing items as above shall also be provided with a nozzle spanner and a Fireman's Axe. This shall be measured and paid for separately.

e. Each hose cabinet shall be conspicuously painted with the letters "FIRE HOSE".

14.2 INTERNAL HYDRANTS

a. Contractor shall provide on each landing and other locations as shown on the drawings single/double headed gunmetal landing valve with 100 mm dia inlet as per IS:5290, with instataneous female coupling on the outlet with S.S orifice flange 6mm thick as required to maintain 3.5kg/sq.cm gun metal blank cap and chain, necessary companion flanges (as per table 'E' nuts,bolts, washers and gasket complete.

b. Instantaneous outlets for fire hydrants shall be standard pattern and suitable for fire hoses.

c. Contractor shall provide for each internal fire hydrant station two numbers of 63 mm dia. 15 m long rubberized fabric lined hose pipes with gunmetal male and female instantaneous type coupling machine would with GI wire (hose to IS:636 type 2 and couplings to IS:903 with IS certification), fire hose reel, gun metal branch pipe with nozzle to IS:903. This shall be measured and paid for separately.

d. Contractor shall provide standard fire hose reels of 20mm dia high pressure dunlop rubber hose 36 m long with gunmetal nozzle, all mounted on a circular hose reel of heavy duty mild steel construction having cast iron brackets. Hose reel shall be connected directly to the wet riser with an isolating valve. Hose reel shall conform

to IS:884 and shall be mounted vertically . This shall be measured and paid for separately.

e. Each internal hydrant hose cabinet shall be provided with a drain in the bottom plate. The drain point shall be lead away to the nearest general drain.

f. Each internal hydrant hose cabinet containing items as above shall also be provided with a nozzle spanner and a Fireman's Axe. The cabinet shall be recessed in the wall as directed. This shall be measured and paid for separately.

g. Each hose cabinet shall be conspicuously painted with the letters "FIRE HOSE".

14.3 Hose Reel

Hose reel shall conform to IS : 884, heavy duty, 20 mm dia length shall be 36 metre long fitted with gun metal chromium plated nozzle, mild steel pressed reel drum which can swing upto 170 degree with wall brackets of cast iron finished with red and black enamel complete.

14.4 Fire Hose

All hose pipes shall be of 63 mm diameter RRL/ CP as required, conforming to IS : 636 or IS : 8423. The hose shall be provided with copper alloy delivery coupling. The hose shall be capable of withstanding a bursting pressure of 35.7 Kg/Sq.cm without undue leakage or sweating. Hose shall be provided with instantaneous spring-lock,

type couplings.

14.5 Branch Pipe, Nozzle

Branch pipes shall be of gun metal with loaded tin bronze ring at the discharge and to receive the nozzle and provided at the other with a leaded tin bronze ring to fit into the instantaneous coupling. Nozzle shall be of spray type of diameter of not less than 16 mm and not more than 25 mm. Nozzle shall be of loaded tin bronze branch pipe and nozzle shall be of instantaneous pattern conforming to Indian Standard - 903.

14.6 Hose Cabinet

Hose cabinet shall be provided for all internal and external fire hydrants. Hose cabinets shall be fabricated from 16 gauge MS powder coated sheet of fully welded construction with hinged double front door partially glazed (3 mm glass panel) with locking arrangement, stove enamelled fire red paint (shade No. 536 of IS:5) with "FIRE HOSE" written on it prominently . Cabinet surfaces in contact with the walls

shall not be powder coated but instead given two coats of anti-corrosive bitumastic paint.

14.7 Internal Hose Cabinet

Hose cabinet shall be of glass fronted with hinged door & lock. The cabinet shall be made of 16 gauge thick MS sheet and spray painted to shade No. 536 of IS:5. The hose cabinet shall be of size to accommodate the following:

i. Landing Valves (Single/double headed)

ii. Hose pipe

iii. Hose reel (36.5 mtr.)

iv Branch pipes, nozzles (2 sets)

v. Fire man's axe and hand appliances

14.8 External Hose Cabinet

The hose cabinet shall be of size to accommodate the following:

i. Single/Double headed yard hydrant valve

ii. Hose pipe (2 length of 15 m)

iii. Branch pipes, nozzles (2 sets)

iv. Fire man's axe

15. SPRINKLER SYSTEM, WET RISER & FIRE ALARM SYSTEM

15.1. GENERAL SPECIFICATION

The scope of work shall include supply, commissioning, testing of the system as a whole. The sprinkler heads are to be fixed into heavy quality GI heavy class pipes, conforming to IS 1239 or any other approved specification. The size of pipe will vary from 25 mm to 150mm to suit the hydraulics of the system. The System shall conform to CFO Rules/ NBC for the installation of sprinkler systems in general for 'Ordinary Hazard' category-in respect of design, density and spacing of sprinkler heads.

Sprinkter system in all the floors including stilt & podium as per latest NBC shall be provided .

Provision of exit signage board and portable fire extinguishers (6kg ABC and CO2 shall be provided.

Provision of addressable fire detection system equipment with optical smole detecter, heat detecter, MCP, with talk back, hooter response indicator,, addressable fire panel with auto dialing system along with PA ststem for fire safety and protection system as per NBC and local fire authority norms and regulations

Reduction in pipe sizes shall not be made by use of bushings. All piping shall be done by means of welding, screwed & flanged jointing as per codes.

Due care shall be taken that sprinklers are not applied with paint at the time of applying paint to piping and fittings.

All control, drain, test and alarm valves shall be provided with signs to identify their purposes, functions, direction of flow the satisfaction of the LICIs.

15.2. QUARTZOID BULB AUTOMATIC SPRINKLER

Sprinkler heads shall be made of brass/quartzoid bulb sufficiently strong, in compression to withstand any pressure, surge or hammer likely to occur in the system. The yoke & body shall be made of high quality gun metal brass with arms streamlined to ensure minimum interference with the spread of water. The deflector of suitable design shall be fitted to give even distribution of water over the area commanded by the sprinkler.

The bulb shall contain a liquid having a freezing point below any natural climatic figure and a high coefficient of expansion. The temperature rating of the sprinkler shall be stamped on the deflector & the colour of the liquid filled in the bulb shall be according to the temperature rating as per NFPA standard. The sprinkler heads shall be of type & quality approved by the local fire brigade authority. The inlet shall be screwed.

The sprinklers shall have 15mm nominal size of the orifice for ordinary hazard.

The orifice size shall be marked on the body or the deflector of the sprinkler.

Metal guards for protection of sprinkler against accidental or mechanical damage shall be provided as desired by the Engineer-in-Charge.

Contractor shall submit detailed submittal and discharge spray pattern for the Sprinkler for the approval of LICI.

15.2.1 **Operating Temperature**

The Operating temperature at which the quartzoid bulb of the sprinkler head shall actuate, shall be 68 degree C or as specifically mentioned.

15.2.2 Sprinkler Installation

Sprinkler heads shall be located in positions shown on the drawings. While slight relocation may result from building construction features or interference from other services, the maximum spacing between sprinkler heads and coverage area shall not exceed those stipulated in the TAC regulations and the NFPA 13-1994 Rules and IS 15105.

Allowance shall be made for such relocations within a radius of 1500 mm of the indicated positions without additional cost.

The Fire Protection Services Trade shall co-ordinate with the ceiling Trade to set out the sprinkler locations to suit the site location of the unit grid. In general, all sprinklers shall be located at the centre of the ceiling unit and a provision of about 10% more sprinklers and pipe work than required in TAC and NFPA Rules shall be included in this sub-contract. Chrome

plated wire mesh guards shall be used to protect the sprinkler heads which are liable to accidental or mechanical (at no extra cost) damage.

FLOW REQUIREMENTS

The flow requirement for sprinkler heads shall be specifically approved for the designated area of installation.

15.4. ORIFICE PLATES

For restricting pressure at lower levels in the sprinkler system, orifice plates of appropriate sizes shall be fitted at different floor levels, at the branching points from Riser Main.

The Diameter of such orifice shall not be less than 50% of the dia of pipe into which it is to be fitted, which shall not be less than 50mm dia. These orifice plates must be of stainless steel with plain central hole without burrs, and the thickness shall be 3mm for pipe size upto 80 mm, 6 mm for pipes from 80 to 125 mm dia and 9 mm for pipes greater than 125 mm dia. Such orifice plate must have a projecting identification tag.

The orifice plate shall fitted not less than two pipe internal diameters down stream of the outlet from any elbow or brand.Contractor shall submit the design and identify location on drawing before installation.

15.5 INSTALLATION CONTROL VALVES

Each installation shall be provided with a set of installation control valves comprising:-

a. An Alarm Valve.

b. A Water Motor Alarm & Gong.

c. Installation valves shall be installed on the sprinkler circuits as shown on the drawings.

d. Contractor shall submit detailed shop drawings showing the exact location, details of installation of the valves/alarm in all respects.

e. Installation valve shall comprise of a cast iron body with gunmetal trim, and double seated clapper check valves, pressure gauges, test valve and orifice assembly and drain valve with pressure gauges, turbine water gong including all accessories necessary and required and as supplied by original equipment manufacturer and required for full and satisfactory performance of the system. A cast iron isolation valve with lock and chain at the inlet of the installation valve shall be provided.

15.6 INSPECTION AND TEST VALVE ASSEMBLY

Inspection and testing of the automatic starting of the sprinkler system shall be done by providing an assembly consisting of gunmetal valves, gunmetal sight glass, bye-pass valve and orifice assembly as per approved drawing.

15.7 FLOW SWITCH

Flow switch shall have a paddle made of flexible and sturdy material of the width to fit within the pipe bore. The terminal box shall be mounted over the paddle/ pipe through a connecting socket. The Switch shall be potential free in either N O or N C position as required. The switch shall be able to trip and make / break contact on the operation of a single sprinkler head. The terminal box shall have connections for wiring to the Annunciation Panel. The flow switch shall have connections for wiring the seat shall be of S.S to the Annunciation Panel. The flow switch shall have IP: 55 protections.

The flows switch work at a triggering threshold bandwidth (flow rate) of 4 to 10 GPM. Further, it shall have a 'Retard' to compensate for line leakage or intermitted flows.

15.8 THE MAIN STOP VALVE

These shall be of cast iron body of requisite size. When closed, these will shut off supply of water to the installation. A location plate must be fixed on the outside or

an external wall, as near to the main stop valve as possible, bearing the following words on raised letters or other approved type letter.

i Sprinkler Stop Valve Inside : The word `sprinkler stop valve' shall be in letters of at least 35mm and the word "INSIDE" at least25mm in height. The words shall be painted white on black back ground.

ii All stop valves shall be right handed i.e. they shall be so constructed that in order to shut the valve the spindle shall turn from left to right. There shall be an indicator which will show whether the valve is open or shut.

15.9 PIPES FOR DRAINAGE:

Sprinkler pipes shall be so installed that the system can be thoroughly drained. As far as possible all pipes shall be arranged to drain to the installation drain valve as shown in the drawing for ordinary hazard system.In the case of basement & other areas where sprinkler pipe-work is below the installation drain valve & in other trapped points in the system, auxiliary valves of the following sizes shall be provided.

-25 mm valves for 80mm dia pipe.

-50 mm valves for pipes larger than 80mm dia.

15.10 SYSTEM DESIGN

The entire sprinkler installation shall be designed to make it a hydraulically balanced system. The pressure requirement at typical floors shall be designed between 2.5 bar and 3.5 bar.

16. HAND HELD FIRE EXTINGUISHERS

16.1 HAND APPLIANCES

16.1.1 Scope

Work under this section shall consist of furnishing all labour, materials, appliances and equipment necessary and required to install fire extinguishing hand appliances as per relevant specification of various authorities.

Without restricting to the generality of the foregoing, the work shall consists of the following:

Installation of fully charged and tested fire extinguishing hand appliances of A B C powder type as required and specified in the drawings and schedule of rates.

16.2 GENERAL REQUIREMENTS

Hand appliances shall be installed in easily accessible locations with the brackets fixed to the wall by suitable anchor fasteners.

Each appliance shall be provided with an inspection card indicating the date of inspection, testing, change of charge and other relevant data.

All appliances shall be fixed in a true workmanlike manner truly vertical and at correct locations.

Distribution / installation of fire extinguisher to be in accordance to IS:2190.

16.3 MEASUREMENT

Fire extinguishers shall be counted in numbers and include installation of all necessary items required as given in the specifications.

16.4. ABC TYPE DRY POWDER EXTINGUISHER

The Extinguisher shall be filled with ABC grade 40, Mono Ammonium Phosphate 40% from any approved manufacturer.

The capacity of the extinguisher when filled with Dry Chemical Powder (First filling) as per IS 4308, Part II, shall be 5 Kg +/-2% or 10 Kg +/- 3%.

The distribution of fire extinguishers to be as per IS 2190 – 1992.

It shall be operated upright, with a squeeze grip valve to control discharge. The plunger neck shall have a safety clip, fitted with a pin, to prevent accidental discharge. It shall be pressurised with Dry Nitrogen, as expellant. The Nitrogen to be charged at a pressure of 15 Kg/cm2

Body shall be of mild steel conforming to relevant IS Standards. The neck ring shall be also mild steel and welded to the body. The discharge valve body, shall be forged brass or leaded bronze, while the spindle, spring and siphon tube shall be of brass. The nozzle shall be of brass, while the hose shall be braided nylon. The body shall be cylindrical in shape, with the dish and dome welded to it. Sufficient space for Nitrogen gas shall be provided inside the body, above the powder filling.

The Neck Ring shall be externally threaded - the threading portion being 1.6 cm. The filler opening in the neck ring shall not less than 50 mm. Discharge nozzle shall be screwed to the hose. The design of the nozzle shall meet the performance requirement, so as to discharge at least 85% of contents upto a throw of 4 mtrs, continuously, at least for 15 seconds. The hose, forming part of discharge nozzle, shall be 500 mm long, with 10 mm dia internally for 5 Kg capacity and 12 mm for 10

Kg capacity. It shall have a pressure gauge fitted to the valve assembly or the cylinder to indicate pressure available inside. The extinguisher shall be treated with anti-corrosive paint, and it shall be labelled with words ABC 2.5 cm long, within a triangle of 5 cm on each face. The extinguisher body and valve assembly shall withstand internal pressure of 30 Kg/cm2 for a minimum period of 2 minutes. The pressure gauge shall be imported and suited for the purpose.

16.5 WATER TYPE EXTINGUISHER (Gas Pressure Type)

The Extinguishing medium shall be primarily water stored under normal pressure, the discharge being affected by release of Carbon Dioxide Gas from a 120 gms cylinder.

The capacity of Extinguisher, when filled upto the indicated level, shall be 9 ltr +/- 5%

The skin thickness of the Cylinder shall be minimum 4.0 mm, fabricated from Mild Steel sheet, welded as required,with dish and dome, being of same thickness, and of size not exceeding the diameter of body. The diameter of body to be not less than 150 mm and not exceeding200 mm. The neck shall be externally threaded upto a minimum depth of 16 mm, and leaded tin bronze.

The cap shall be of leaded tin bronze, and screwed on the body upto a minimum of 1.6 cm depth, with parallel screw thread to match the neck ring. The siphon tube to be of brass or G.I. and the strainer of Brass. The cartridge holder, knob, discharge fittings and plunger to be of Brass/Leaded tin bronze, and plunger of stainless steel, spring of stainless steel. The cap to have handle fixed to it. The discharge hose shall be braided nylon, of 10 mm dia and 600 mm long, with a nozzle of brass fitted at end.

The extinguisher shall be treated for anti-corrosion internally and externally, and externally painted with Fire Red paint. The paint shall be stove enamelled/powder coated. The cartridge shall be as per IS, and have 60 gm net carbon dioxide gas for expelling. The extinguisher, body and cap shall be treated to an internal hydraulic pressure of 25 Kg/cm2. It shall have external marking with letter A, of 2.5 cm height, in block letters within a triangle of 5 cm each side. The extinguisher shall be upright in operation, with the body placed on ground and discharge tube with nozzle held in one hand to give a throw of not less than 6 mtr, and continue so for atleast 60 secs. The extinguisher body shall be clearly marked with ISI stamp (IS 940).

16.6 CARBON DIOXIDE EXTINGUISHER

The Carbon Dioxide Extinguisher shall be as per IS: 2878

The body shall be constructed of seamless tube conforming to IS:7285 and having a convex dome and flat base. Itsdia shall be maximum 140 mm, and the overall height shall not exceed 720 mm.

The discharge mechanism shall be through a control valve conforming to IS:3224. The internal syphon tube shall be of copper aluminium conforming to relevant specifications.

Hose Pipe shall be high pressure braided Rubber hose with a minimum burst pressure of 140 Kg/cm2 and shall be approximately 1.0 meter in length having internal dia of 10 mm. The discharge horn shall be of high quality unbreakable plastic with gradually expanding shape, to convert liquid carbon dioxide into gas form. The hand grip of Discharge horn shall be insulated with Rubber of appropriate thickness.

The gas shall be conforming to IS:307 and shall be stored at about 85 Kg/cm2. The expansion ratio between stored liquid carbon dioxide to expanded gas shall be 1:9 times and the total discharge time (effective) shall be minimum 10 secs and maximum 25 secs.

The extinguisher shall fulfill the following test pressures:

Cylinder: 236 Kg/cm2

Control Valve: 125 Kg/cm2

Burst Pressure of Hose: 140 Kg/cm2 minimum

It shall be an Upright type. The cylinder, including the control valve and high pressure Discharge Hose must comply with relevant Statutory Regulations, and be approved by Chief Controller of Explosives, Nagpur and also bear IS marking.

The Extinguisher including components shall be IS marked.

17. FIRE PUMPS AND ALLIED EQUIPMENTS

17.1 SCOPE

Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install electrically operated and

diesel driven pumps and as required by drawings and specified hereinafter or given in the schedule of rates.

a. Electrically operated pumps with motors and diesel engine driven pumps with diesel engine, common base plates, coupling, coupling guard and accessories.

b. Automatic starting system with all accessories, wiring and connections and pressure switches.

c. Motor control centre.

d. Annunciation system with all accessories wiring and connections.

e. Pressure gauges with isolation valves and piping, bleed and block valves.

f. Suction strainers and accessories.

g. Vibration eliminator pads and foundation bolts.

h. Leak-off drain shall be led to the nearest floor drain.

17.2. GENERAL REQUIREMENTS

Pumps shall be installed true to levels on suitable concrete foundations. Base plate shall be firmly fixed by properly grouted foundation bolts.

Pumps and motors shall be truly aligned by suitably instruments. Record of such alignment shall be furnished to the Engineer-in-Charge.

All pump connections shall be standard flanged type with number of bolts as per relevant standard requirement for the working pressure. Companion flanges shall be provided with the pumps.

Manufacturers' instructions regarding installation, connections and commissioning shall be strictly followed.

Contractor shall provide necessary test certificates, type test certificates, performance curves and NPSH curves of the pumps from the manufacturer when called for. The contractor shall provide facilities to the Engineer-in-Charge& LICI for inspection of equipment during manufacturing and also to witness various tests at the manufacturer's works without any cost to the Engineer-in-Charge or LICI.

Seismic isolation and clamping for each pump and flexible connection on the suction as well as the discharge side shall be provided.

The contractor shall submit with this tender a list of recommended spare parts for three years of normal operation and quote the prices for the same as a separate submittal / annexure.

17.3. ELECTRIC FIRE PUMP

General

The electric fire pump shall be suitable for automatic operation complete with necessary electric motor and automatic starting gear, suitable for operation on 415 volts, 3 phase, 50 Hz. A.C. system. Both the motor and the pump shall be assembled on a common base plate, fabricated M.S. channel type or cast iron type.

Drive

The pump shall be direct driven by means of a flexible coupling. Coupling guard shall also be provided.

17.4. FIRE PUMP

The fire pump shall be horizontally mounted, split case, single stage centrifugal type. It shall have a capacity to deliver 1620 lpm / as per NBC, as specified, and developing adequate head so as toensure a minimum pressure of 3.5 Kg/Sq.cm at the highest and the farthest outlet.

The pump shall be capable of giving a discharge of not less than 150 per cent of the rated discharge, at a head of not less than 65 per cent of the rated head. The shut off head shall be within 120 per cent of the rated head.

The pump casing shall be of cast iron to grade FG 200 to IS: 210 and parts like impeller, shaft sleeve, wearing ring etc. shall be of non-corrosive metal like bronze/brass/gun metal. The shaft shall be of stainless steel. Provision of mechanical seal shall also be made.

Bearings of the pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water. The pump shall be provided with a plate indicating the suction lift, delivery head, discharge, speed and number of stages. The pump casing shall be designed to withstand 1.5 times the working pressure.

Provision of Jockey Pump for low and high zone shall be made. The pump shall be vertical SS type and of detail as in schedule of quantity. Contractor shall verify that the capacity of the Jockey pump shall not be less than 3%

(Minimum 180 LPM) and not more than 10% of the installed pump capacity.

Motor

The motor shall be squirrel cage A.C. induction type suitable for operation on 415 volts 3 phase 50 Hz. system.

The motor shall be totally enclosed fan cooled type conforming to protection clause IP 55. The class of insulation shall be F. The synchronous speed shall be 1500 RPM as specified. The motor shall be rated for continuous duty and shall have a horse power rating necessary to drive the pump at 150 per cent of its rated discharge with at least 65 per cent rated head. The motor shall conform to I.S.325-1978.

Motor Starter

The motor starter shall be as per detail in MCC. The unit shall include suitable current transformer and ammeter of suitable range on one line to indicate the current. The starter shall not incorporate under voltage, no voltage trip overload or SPP.

The starter assembly shall be suitably integrated in the power and control panel for the wet riser system & sprinkler system.

17.5. DIESEL FIRE PUMP

General

The diesel pump set shall be suitable for automatic operation complete with necessary automatic starting gear for starting on wet battery system and shall be complete with all accessories. Both engine and pump shall be assembled on a common base plate.

DRIVE

The pump shall be only direct driven by means of a flexible coupling. Coupling guard shall also be provided. The speed shall be 1500 RPM as specified.

Fire Pump

The fire pump shall be horizontally mounted, split case, centrifugal multi stage. It shall have a capacity to deliver as specified equal to main electric Fire Pump, and developing adequate head so as to ensure a minimum pressure of 3.5 Kg/Sq.cm at the highest and the farthest outlet. The pump shall be multi stage as specified. The pump shall be capable of giving a discharge of not less than 150% of the rated discharge at a head of not less than 65% of the rated head. The shut off head shall be within 120% of the rated head.

The pump casing shall be of cast iron to grade FG 200 to IS 210 and parts like impeller, shaft sleeves, wearing-ring etc. shall be of non-corrosive metal like bronze/brass/gun metal. The shaft shall be stainless steel. Provision of mechanical seal shall also be made.

Jockey & Terrace pump shall be provide as per latest NBC requirement.

The pump casing shall be designed to withstand 1.5 times the working pressure.

Bearing of pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.

Diesel Engine

Engine Rating - The engine shall be cold starting type without the necessity of preliminary heating of the engine cylinders or combustion chamber (for example, by wicks, cartridge, heater, plugs etc.). The engine shall be multi cylinder/vertical 4 stroke cycle, air-cooled, diesel engine, developing suitable HP at the operating speed specified to drive the fire pump. Continuous capacity available for the load shall be exclusive of the power requirement of auxiliaries of the diesel engine, and the after correction for altitude, ambient temperature and humidity for the specified environmental conditions. This shall be at least 20% greater than the maximum HP required to drive the pump at its duty point. It shall also be capable of driving the pump at 150% of the rated discharge at 65% of rated head.

The engine shall be capable of continuous non-stop operation for 8 hours and major overhaul shall not be required before 3000 hours of operation. The engine shall have 10% overload capacity for one hour in any period of 12 hours continuous run. The engine shall accept full load within 15 seconds from the receipt of signal to start. The diesel engine shall conform to BS 649/IS 1601/IS 10002, all amended up to date.

a. Engine Accessories - The engine shall be complete with the following accessories:-

Fly wheel dynamically balanced.

Direct coupling for pump and coupling guard.

Corrosion Resistor.

Air cleaner.

Fuel service tank support, and fuel oil filter with necessary pipe work.

Elect. starting battery (2X24 v).

Exhaust silencer with necessary pipe work.

Governor.

Instrument panel housing all the gauges, including Tachometer, hour meter and starting switch with key (for manual starting).

Necessary safety controls.

b. Fuel System - The fuel shall be gravity fed from the engine fuel tank to the engine driven fuel pump. The engine fuel tank shall be mounted either over or adjacent to the engine itself or suitably wall mounted on bracket. The fuel filter shall be suitably located to permit easy servicing.

All fuel tubing to the engine shall be with copper, with flexible hose connections where required. Plastic tubing shall not be permitted.

The fuel tank shall be of welded steel construction (3 mm. thick) and of capacity sufficient to allow the engine to run on full load for at least 8 hours. The tank shall be complete with necessary wall mounted supports, level indicator (protected against mechanical injury) inlet, outlet, overflow connections and drain plug and piping to the engine fuel tank. The outlet shall be so located as to avoid entry of any sediments into the fuel line to the engine.

As semi rotary hand pump for filling the daily service tank together with hose pipe 5 mtr. long with a foot valve etc. shall also form part of the scope of supply.

c. Lubricating Oil System- Forced feed Lub. Oil system shall be employed for positive lubrication. Necessary Lub. oil filters shall be provided, located suitably for convenient servicing.

d Starting System- The starting system shall comprise necessary batteries (2x24v), 24 volts starter motor of adequate capacity and axle type gear to match with the toothed ring on the fly wheel. Bi metallic relay protection to protect starting motor from excessively long cranking runs suitably integrated with engine protection system shall be included within the scope of the work.

The capacity of the battery shall be suitable for meeting the needs of the starting system.

The battery capacity shall be adequate for 10 consecutive starts without recharging with cold engine under full compression.

The scope shall cover all cabling, terminals, initial charging etc.

e. Exhaust System - The exhaust system shall be complete with silencer suitable for outdoor installation and silencer piping including bends and accessories needed for a run of 15 metre from the engine manifold.(Adjustment rates for extra lengths shall also be given). The total back pressure shall not exceed the engine manufacture's recommendation. The exhaust piping shall be suitably supported.

f. Engine shut down mechanism- This shall be auto/ manually operated and shall return automatically to the starting position after use.

g. Governing System- The engine shall be provided with an adjustable governor to control the engine speed within 5% of its rated speed under all conditions of load up to full load. The governor shall be set to maintain rated pump speed at maximum pump load.

h. Engine Instrumentation- Engine instrumentation shall include the following:-

i) Lub. oil pressure gauge.

ii) Lub. oil temperature gauge.

iii) Water pressure gauge.

iv) Water temperature gauge.

v) Tachometer.

vi) Hour meter.

The instrumentation panel shall be suitably resident mounted on the engine.

Engine Protection Devices- Following engine protection and automatic shut down facilities shall be provided:-

i) Low lub.oil pressure.

ii) High cooling water temp.

iii) High lub.oil temperature.

iv) Over speed shut down.

i. Pipe Work - All pipe lines with fittings and accessories required shall be provided for fuel oil, lub.oil and exhaust systems, copper piping of adequate sizes, shall be used for Lub.oil and fuel oil. M.S. piping will be permitted for exhaust.

j. Anti Vibration Mounting- Suitable vibration mounting duly approved by Engineer-in-Charge shall be employed for mounting the unit so as to minimise transmission of

vibration to the structure. The isolation efficiency achievable shall be clearly indicated.

k. Battery Charger-Necessary float and boost charger shall be incorporated in the control section of the power and control panel, to keep the battery in trim condition. Voltmeter to indicate the state of charge of the batteries shall be provided.

17.6. PUMP SETS ASSEMBLY

On the main fire sprinkler and hydrant headers near pump sets a 150 mm dia by-pass valve located in an accessible location shall be provided along with a rate of flow rota meter calibrated in 1 pm and able to read 200% of the rated pump capacity. The delivery shall be connected to the fire tank. Each and every pump set assembly shall be provided with suction valve (only for positive suction head), discharge valve, non-return valve and 150 mm dia Bourdon type pressure gauge with isolation valve.

17.7. FLEXIBLE CONNECTORS

On all suction and delivery lines double flanged reinforced neoprene flexible pipe connectors shall be provided. Connectors should be suitable for maximum working pressure of each pipe line on which it is mounted and tested to a test pressure of 1:5 time the operating pressure. Length of the connector shall be as per manufacturers standard.

17.8 INTERLOCKING

The following inter-locking between the two main fire pumps (i.e. wet riser pump & sprinkler pump), the jockey pump and the diesel engine driven pump. Only one category of pumps will work at a time i.e. either jockey pump or main fire pumps (wet riser and sprinkler,

both the wet riser and sprinkler can come up at a time) or diesel driven pump.

JOCKEY PUMP	WET RISER PUMP	SPRINKLER PUMP	DIESELDRIVEN PUMP
i. ON	OFF	OFF	OFF
ii. OFF	ON	OFF	OFF
iii. OFF	OFF	ON	OFF
iv. OFF	ON	ON	OFF

v. OFF OFF ON ON

vi. OFF OFFOFF ON

vii OFF ON OFF ON

17.9. ANNUNCIATION PANEL

One solid state electronic annunciation panel, fully wired with visual display and audible alarm unit shall be provided to indicate:

a. Flow condition in any flow switch indicating the area of distress and fire alarm.

b. Starting and stopping of each hydrant pump.

c. Starting and stopping of each jockey pump.

d. Starting and stopping of each sprinkler pump.

e. Failure of Hydrant / Sprinkler pump to start.

f. High level in fire water storage tank compartment.

g. Low level in fire water storage tank compartment.

h. Low level in HSD day tank of the fire pump.

The panel shall be factory fabricated, wired and tested. All details shall be submitted with the tender.

The annunciation panel shall be located in the security office / reception on the ground floor or as instructed by the Engineer-in-Charge.

17.10. VIBRATION ISOLATION

The pumpset shall be mounted on rolled steel channels and 150 mm thick inertia block spring and ribbed neoprene vibration isolation mounting shall support the inertia block onto a 100 mm thick concrete plinths. The spring mountings shall have a maximum deflection of15 mm. Reference shall be made to the section on “Nose and Vibration” for further technical requirements.

SECTION-B :: COMMISSIONING & GUARANTEE

1. SCOPE OF WORK

Work under this section shall be executed without any additional cost. The rates quoted in this tender shall be inclusive of the works given in this section.

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

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.

All tests shall be made in the presence of the LICI or his representative or any inspecting authority. At least five working days notice in writing shall be given to the inspecting parties before performing any test.

Water flow rates of all equipment and in pipe lines through valves shall be adjusted to design conditions. Complete results of adjustments shall be recorded and submitted.

Contractor shall ensure proper balancing of the hydraulic system and for the pipes / valves installed in his scope of work by regulating the flow rates in the pipe line by valve operation. The contractor shall also provide permanent Tee connection (with plug) in water supply lines for ease of installing pressure gauge, temperature gauge & meters.

Contractor shall also supply all required pressure gauge, temperature gauge & rotameter for system commissioning and balancing. The balancing shall be to the satisfaction of LICI / Engineer-in-Charge.

Three copies of all test results shall be submitted to the Engineer in A4 size sheet paper within two weeks after completion of the tests.

2. PRECOMMISSIONNIG

On completion of the installation of all pumps, piping, valves, pipe connections, insulation etc. the Contractor shall proceed as follows:

a. Prior to start-up and hydraulic testing, the Contractor shall clean the entire installation including all fitments and pipe work and the like after installation and keep them in a new condition. All pumping systems shall be flushed and drained at least once through to get rid of contaminating materials. All pipes shall be rodded to ensure clearance of debris, cleaning and flushing shall be carried out in sections as the installation becomes completed.

b. All strainers shall be inspected and cleaned out or replaced.

c. When the entire systems are reasonably clean, a pre-treatment chemical shall be introduced and circulated for at least 8 hours. Warning signs shall be provided at all outlets during pre-treatment. The pre-treatment chemical shall:

· Remove oil, grease and foreign residue from the pipe work and fittings;

· Pre-condition the metal surfaces to resist reaction with water or air.

. Establish an initial protective film;

· After pre-treatment, the system shall be drained and refilled with fresh water and left until the system is put into operation.

· Details and procedures of the pre-treatment shall be submitted to the LICI for approval.

d. Check all clamps, supports and hangers provided for the pipes.

e. Check all the equipment, piping and valves coming under hot water system and operate each and every valve on the system to see if the valves are functioning properly. Thereafter conduct & hydro test of the system as for (b) above.

f. Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specification. If any leakage is found, rectify the same and retest the pipes.

Fire Protection System

a. Check all hydrant valves by opening and closing : any valve found to be open shall be closed.

b. Check all the piping under hydro test.

c. Check that all suction and delivery connections are properly made for all pump sets.

d. Check rotation of each motor after decoupling and correct the same if required.

e. Test run each pump set.

f. All pump sets shall be run continuously for 8 hours (if required with temporary piping back to the tank).

Commissioning and Testing

a. Pressurise the fire hydrant system by running the jockey pump and after it attains the shutoff pressure of the pump , then

b. Open bypass valve and allow the pressure to drop in the system. Check that the jockey pump cuts-in and cuts-out at the preset pressure. If necessary adjust the pressure switch for the jockey pump. Close by-pass valve.

c. Open hydrant valve and allow the water to below into the fire water tank in order to avoid wastage of water.

The main fire pump shall cut-in at the preset pressure and shall not cutout automatically on reaching the normal line pressure. The main fire pump shall stop only by manual push button. However the jockey pump shall cut-out as soon as the main pump starts,

d. Switch off the main fire pump and test check the diesel engine driven pump in the same manner as the electrically driven pump,

e. When the fire pumps have been checked for satisfactory working on automatic controls, open fire hydrant valves simultaneously and allow the hose pipes to discharge water into the fire tank to avoid wastage.

f. 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 do not fit into the other properly shall be replace by the Contractor. Each landing valve shall also be checked by opening and closing under pressure.

g. Check all annunciations by simulating the alarm conditions at site.

SPRINKLER SYSTEM

The System shall conform to CFO Rules/ NBC for the installation of sprinkler systems in general for 'Ordinary Hazard' category-in respect of design, density and spacing of sprinkler heads. As per NBC sprinkter system shall be provided in all the floors.

a. Start the sprinkler pump and develop the required pressure in the sprinkler pipes.

b. Open the test valve to test the automatic starting of the pump. If necessary , make necessary adjustments in the setting of pressure switch. The sprinkler water gong alarm shall also operate when the test valve is open.

This operation is to be done for each and every section of the sprinkler system and the alarm for each section (via flow switch) shall be checked for operation.

c. After satisfactory operation of the pump the Contractor shall set up mock fire and test the system.

d. Check all annunciations by simulating the alarm conditions at site.

3. STATUTORY AUTHORITIES' TESTS AND INSPECTIONS

As and when notified in writing or instructed by the LICI, the Contractor shall submit shop drawing and attend all tests and inspections carried out by Local Fire Authorities, Water Authority and other Statutory Authorities, and shall forthwith execute free of charge any rectification work ordered by the LICI as a result of such tests and inspections where these indicate non-compliance with Statutory Regulations. Some of these tests may take place after the issue of Practical Completion of the Main Contract and the Contractor shall make all allowances in this respect.

The Contractor shall be responsible for the submission of all necessary forms and shop drawings to the Statutory Authorities which shall conform in layout to the latest plans submitted to and kept by these Authorities.

The submission shall comply with the requirements set forth in the current Codes of Practice and circular letters of the Statutory Authorities. The shop drawings to be submitted shall be forwarded to the LICI for checking before submission.

The Contractor shall allow for at least two submissions of complete sets of shop drawings to the Authorities, one to be made within six months after the award of the Contract but not less than six weeks before the inspection. The LICI may at his discretion instruct the Contractor for additional submissions to the Local Authorities whenever necessary.

The Contractor shall notify the LICI at least seven days in advance of his application for local Authority tests and inspections. On receipt of a confirmed date for test and inspection the Contractor shall inform the LICI without delay.

4. FINAL ACCEPTANCE TESTS

Following commissioning and inspection of the entire installation, and prior to issue of the Completion Certificate, the Contractor shall carry out final acceptance tests in accordance with a programme to be agreed with the LICI.

Should the results of the acceptance tests show that plant, systems and/or equipment fail to perform to the efficiencies or other performance figures as given in

this Specification, the Contractor shall adjust, modify and if necessary replace the equipment without further payment in order that the required performance is obtained.

Where acceptance tests are required by the relevant Authorities having jurisdiction, these tests shall be carried out by the Contractor prior to the issue of Completion Certificate to the acceptance of the Authorities.

5. REJECTION OF INSTALLATION / PLANT

Any item of plant or system or component which fails to comply with the requirements of this Specification in any respect whatsoever at any stage of manufacture, test, erection or on completion at site may be rejected by the LICI either in whole or in part as he considers necessary/appropriate. Adjustment and/or modification work as

required by the LICI so as to comply with the Authority's requirements and the intent of the Specification shall be carried out by the Contractor at his own expense and to the satisfaction of the Authority/LICI.

After works have been accepted, the Contractor may be required to carry out assist in carrying out additional performance tests as reasonably required by the LICI/Employer.

6. WARRANTY AND HANDOVER

The Contractor shall warrant that all plant, materials and equipment supplied and all workmanship performed by him to be free from defects of whatsoever nature before handover to the Owner.

7. HANDING OVER OF DOCUMENTS

All testing and commissioning shall be done by the Contractor to the entire satisfaction of the Owner's site representative and all 3 sets testing and commissioning documents shall be handed over to the Owner's site representative.

The Contractor shall also hand over 3 sets of As built drawings, maintenance and operation manuals, warranty and guaranty certificates along with the list of recommended spare parts. Also, the contractor has to submit the test certificates of equipments and contact details of service center.

8. PIPE COLOUR CODE:

S.No. Pipe Lines Ground / Base Colour Band First Colour Band Second

1	Cooling Water	Sea Green	French Blue
2	Boiler feed	Sea Green	Gulf Red
3	Condensate	Sea Green	Light Brown
4	Drinking Water (All cold water lines after filter)	Sea Green	French Blue Single Red
5	Treated Water (Soft Water)	Sea Green	Light Orange
6	Domestic Hot Water	Sea Green	Light Grey
7	Compressed air upto 15/Kg/Sqcm	Sky Blue	
8	Steam	Silver Grey	
9	Drainage (Storm Water)	Black	
10	Drainage (Sewage Water)	Brown	
11	Gas	Canary Yellow	
12	Fire System	Post Office Red	

9. CHECK LIST FOR COMMISSIONING

Fire Protection System

1)Check all hydrant & other valves by opening and closing. Any valve found to be open shall be closed.

2) Check all clamps, supports and hangers provided for the pipes.

3) All the pump sets shall be run continuously for 30 minutes (with temporary piping back to tank from the nearest hydrant, using canvas hose pipes).

4) Fire Hydrant System - Pressurise the fire hydrant system by running the jockey pump and after it attains the shutoff pressure of the pump, then Open bypass valve and allow the pressure to drop in the system. Check that the jockey pump cuts-in and cuts-out at the preset pressure. If necessary adjust the pressure switch for the jockey pump. Close by-pass valve.

Open hydrant valve and allow the water to flow into the fire water tank in order to avoid wastage of water. The main fire pump shall cut-in at the preset pressure and shall not cutout automatically on reaching the normal line pressure. The main fire pump shall stop only by manual push button. However the jockey pump shall cut-out as soon as the main pump starts.

Operate booster pump continuously for 30 minutes with piping back to underground tanks from the hydrant nearest to plant room.

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 do not fit into the other properly shall be replaced by the Contractor. Each landing valve shall also be checked by opening and closing under pressure.

Check air cushion tanks on the terrace for proper functioning.

AS BUILT DRAWINGS / SHOP DRAWINGS

Contractor shall make all necessary shop drawings indicating conduit / cable tray routes / qtys / sizes; cable schedule, circuiting details etc complete before starting the works and get approval of LICI.

At the completion of the works and before issue of the certificate of virtual completion, the contractor shall submit to the LICI 5 sets (HARD AND SOFT FORMAT) of layout drawings drawn at approved scale indicating the complete wiring system as installed.

Above indicates the general requirement. However, contractor must include all information desired by the LICIs in the final as built documents. Guidance for the preparation of as built document shall be had from the LICI.

MANUFACTURER'S INSTRUCTIONS

Where manufacturer's have furnished specific instructions, relating to the materials used in this job for covering, paints etc which are not specifically mentioned in this documents, manufacturer's instructions shall be followed

GUARANTEE / WARRANTY

Contractor Warranty: The Contractor shall unconditionally warrant all equipment, systems, and components provided under the work of this Section of the Specifications, to be free from all defects in material and workmanship for a period of at least 12 months from the date of final acceptance of the work of this Section. The

warranty shall cover all materials, components, labour and equipment necessary for complete replacement and installation of the covered items by the Contractor.

Manufacturer's Warranty: Manufacturer shall unconditionally warrant all equipment and components provided under this Section of the Specifications, to be free from all defects in materials and workmanship for a period of not less than 12 months from the date of final acceptance of the work of this Section. The warranty shall cover all materials, components, labour and equipment necessary for complete replacement of the covered items by the Manufacturer.

Contractor should submit Copy of Guarantee /Warranty certificates to client at the time of hand over.

Contractor Should submit make list for executed item with contact details of supplier, service centre, head office for the same.

At the close of the work and before issue of the final certificate of virtual completion. The contractor shall furnish written guarantee indemnifying the LICI/LICI against defective materials and workmanship for a period as mentioned in the schedule of fiscal aspects. The contractor shall hold himself fully responsible for reinstallation or replacement, free of cost to client the following:

A.Any defective work or material supplied by the Contractor.

B.Any material or equipment damage or destroyed as a result of defective workmanship by the Contractor.

PLEASE NOTE THAT THE AGENCY HAS TO CARRYOUT ALL FIRE HYDRANT AND SUPRESION WORK AS PER THE FIRE DRAWING APPROVED BY FIRE AUTHORITY OF ODISHA WHICH INCLUDES FIRE ALARM,SUPRESSSION,VENTILATION SYSTEM OF THE BASEMENT AND LIFT AS PER THEIR NOC LETTER (BEFORE EXECUTION) AND AFTER COMPLETION OF THE WORK,THE SAME HAS TO BE GOT APPROVED FROM FIRE AUTHORITY OF ODISHA .THE NOC FROM FIRE AUTHORITY IS A PART OF FINAL OC .

23.0 EXTRA LOW VOLTAGE WORKS SPECIFICATIONS

ELV SYSTEM

SECTION-1 : TELEPHONE POINT WIRING

1.0 Scope :

1.1 The scope of work shall cover supply, installation, commissioning and testing of :

i) Telephone cables

ii) Telephone Tag Blocks

iii) Telephone wiring in conduits

iv) Telephone Outlet points

2.0 Telephone cables

All multi core cables and wires shall be of tinned copper conductor of not less than 0.5 mm dia and shall be colour coded twisted pairs with rip cord.

The conductor resistance shall be less than 150 ohms per KM and the insulation resistance between the conductors not less than 50 mega ohms and the nominal capacitance of about 0.1 micro farad per kilometer.

Cables laid underground or locations subject to dampness and flooding shall be filled with polyethylene compound and shall have sufficient protection against moisture and water ingress.

All armoring shall be of galvanized steel wires and protected against corrosion by an outer sheath of PVC in the case of indoor cables and polyethylene in the case of outdoor cables. Outer sheathing must be fire retarding and anti-termite.

All unarmoured single core cables and inner sheath of armored cables shall be provided with rip cord.

All single pair cables for final extension to the telephone outlet box shall be unarmoured tinned copper conductors of not less than 0.6 mm. diameter and shall be drawn in conduits. All telephone outlets shall consist of 2 A 2 pair polythene connector in G.I box with 6 mm per spex cover with beveled edges and chromium plated brass hardware.

3.0 Tag blocks :

3.1 The telephone tag blocks shall be suitable for the multi core telephone cables and shall have two terminal blocks, cross connect type. All incoming and outgoing cables shall be terminated on separate terminal blocks and termination shall be silver soldered. The cross connecting jumpers shall be insulated wires of same diameter and screw connected.

3.2 The tag blocks shall be mounted inside fabricated sheet steel boxes with removable hinged covers and shall be fully accessible. The enclosure shall be painted with 2 coats of red oxide and stove enameled.

SECTION-2 : TELEVISION WIRING

1.0 Scope :

1.1 The scope of work shall cover supply, installation, commissioning and testing of :

i) Television cables

ii) Television Splitters

iii) Television wiring in conduits

2.0 Installation :

2.1 The installation of conduits shall generally be as specified under section `CONDUIT WIRING'.

2.2 All cables shall be on cable racks and neatly stitched together.

2.3 The connection at the spiller/junction boxes shall be made with end sockets as to achieve minimum contact resistance.

2.4 The final branch connections with single cables in conduits and the maximum number of cables in each conduit shall be as follows :

Conduit diameter (MM)	Max. No. of cables mm.
20	1 no RG 6 / 11
25	2/3 nos. RG 6 /11
32	6 Nos. RG 6 /11

SECTION-3 : CCTV WIRING

1.0 GENERAL:

1.1 SUMMARY

A. The work under this system shall consist of design, supply, installation, testing, training & handing over of all materials, equipment's and appliances and labour necessary to commission the said system. The IP Based NVR for CCTV System shall comprise of fixed dome Cameras and varifocal vandal proof dome Cameras with

Video encoder and power supply units, monitoring stations. All recording shall be done in Network video recorder through network switch available in control room. It shall also include laying of cabling, necessary for installation of the system as indicated in the specification . Any openings/chasing in the wall/ceiling required for the installation shall be made good in appropriate manner.

B. Video surveillance system shall be integrated with monitoring and control system specified - Access Control System, Intrusion Detection & Perimeter Security Systems which specifies systems integration..

1.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Video surveillance system shall withstand the effects of earthquake motions in general.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For video surveillance. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.

3. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.

4. UPS: Sizing calculations.

5. Retain subparagraph below if equipment includes wiring.

6. Wiring Diagrams: For power, signal, and control wiring.

C. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation.

D. Field quality-control reports.

E. Operation and maintenance data.

1.4 QUALITY ASSURANCE

CCTV system should be designed such as to cover the strategic locations and sensitive areas of High end cameras with Day/Night features to be installed for outdoor and perimeter security application, these cameras shall be IR Compatible so that IR Lamps can be introduced at a later stage to enhance night vision. All Speed domes shall be rugged and shall be weather proof as per specifications. The fixed dome cameras shall necessarily be of Varifocal / fixed lens as per detailed specifications. Day/Night Cameras with built in varifocal lenses shall be provided for select indoor/outdoor locations as per the detailes. Also the systems should utilize only industry standard protocol.

System should be programmed such that operator's intervention if required shall be minimal and the system should provide features like guard tours, preset positions and the preset positions will be linked to perimeter protection system/intrusion system in future. The NVR's should allow for recording of events both continuous and motion triggered as per requirement and recordings should be able to create evidences and support post event analysis.

1.5 PROJECT CONDITIONS

A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Control Station: Rated for continuous operation in ambient temperatures of 16 to 29 deg C and a relative humidity of 20 to 80 percent, non condensing.

2. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 15 to 40 deg C dry bulb and 20 to 90 percent relative humidity, non-condensing. Use required enclosures.

3. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 10 to plus 45 deg C dry bulb and 20 to 90 percent relative humidity, non-condensing. Use proper enclosures to ensure better and required performance.

4. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of 0 to plus

50 deg C dry bulb and 20 to 90 percent relative humidity, condensing. Use proper enclosure to ensure better and required performance.

5. Security Environment: Camera housing for use in high-risk areas where surveillance equipment may be subject to physical violence.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cameras, equipment related to camera operation, and control-station equipment that fail in materials or workmanship within specified warranty period.

B. All component, system software, parts and assemblies supplied by the contractor shall be guaranteed against defects in materials and workmanship for one year from the acceptance date.

C. Labour to troubleshoot, repair, reprogram, or replace system components shall be furnished by the contractor at no charge to the owner during the warranty period. All corrective software modifications made during warranty service periods shall be updated on all user documentation and on user and manufacturer archived software disks.

D. Warranty Period: One year from date of Substantial Completion and should be extended with suitable Annual Maintenance Contract

2.0 PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. Video-signal format shall comply with PAL standard, composite interlaced video. Composite video-signal termination shall be 75 ohms.

B. Surge Protection: Protect components from voltage surges entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor's entry connection to components.

1. Minimum Protection for Power Connections 230 V and More: Auxiliary panel suppressors complying with requirements in Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits."

2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Division 26 Section "Transient-Voltage

Suppression for Low-Voltage Electrical Power Circuits." as recommended by manufacturer for type of line being protected.

C. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

2.2 STANDARD CAMERAS

A. Manufacturers: Subject to compliance with requirements, provide products as mentioned in approved makes.

B. Basis-of-Design Product: Subject to compliance with requirements.

C. Colour Camera:

1. Preferably comply with UL Listing. Vendor to mention certification of each product in the offer.

2. Pickup Device: 1/3" CCD interline transfer pixels.

3. Horizontal Resolution: 480 lines.

4. Signal-to-Noise Ratio: Not less than 50 dB, with camera AGC off.

5. With AGC, manually selectable on or off.

6. Sensitivity: Camera shall provide usable images in low-light conditions, delivering an image at a scene illumination of 0.1lux.

7. Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. Illumination for the test shall be with lamps rated at approximately 2200-K colour temperature, and with camera AGC off.

8. Manually selectable modes for backlight compensation or normal lighting.

9. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.

10. White Balance: Auto-tracing white balance, with manually settable fixed balance option.

11. Motion Detector is preferable and vendor to highlight in technical offer.

D. Automatic Colour Dome Camera: Assembled and tested as a manufactured unit, containing dome assembly, colour camera, motorized pan and tilt, zoom lens, and receiver/driver.

1. Preferably comply with UL Listing. Vendor to mention certification of each product in the offer.

2. Pickup Device: 1/3" CCD interline transfer.

3. Horizontal Resolution: 480 lines.

4. Signal-to-Noise Ratio: Not less than 50 dB, with camera AGC off.

5. With AGC, manually selectable on or off.

6. Sensitivity: Camera shall provide usable images in low-light conditions, delivering an image at a scene illumination of 0.1 lux.

7. Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. Illumination for the test shall be with lamps rated at approximately 2200-K colour temperature, and with camera AGC off.

8. Manually selectable modes for backlight compensation or normal lighting.

9. Pan and Tilt: Direct-drive motor, 360-degree rotation angle, and 180-degree tilt angle. Pan-and-tilt speed shall be controlled by operator. Movement from preset positions shall be not less than 300 degrees per second.

10. Preset Positioning: Eight user-definable scenes, each allowing 16-character titles. Controls shall include the following:

i) In "sequence mode," camera shall continuously sequence through preset positions, with dwell time and sequencing under operator control.

ii) Motion detection shall be available at each camera position.

iii) Up to four preset positions may be selected to be activated by an alarm. Each of the alarm positions may be programmed to output a response signal.

1) Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.

2) White Balance: Auto-tracing white balance, with manually settable fixed balance option.

3) Motion Detector is preferable.

4) Dome shall support multiplexed control communications using coaxial cable recommended by manufacturer.

2.3 LENSES

A. Manufacturers: Subject to compliance with requirements, provide products as mentioned in approved makes.

B. Basis-of-Design Product: Subject to compliance with requirements.

C. Description: Optical-quality coated lens, designed specifically for video-surveillance applications and matched to specified camera. Provide colour-corrected lenses.

1. Auto-Iris Lens: Electrically controlled iris with circuit set to maintain a constant video level in varying lighting conditions.

2. Fixed Lens: With calibrated focus ring.

3. Zoom Lens: Motorized, remote-controlled unit, rated as "quiet operating." Features include the following:

i) Electrical Leads: Filtered to minimize video signal interference.

ii) Motor Speed: Variable.

iii) Lens shall be available with preset positioning capability to recall the position of specific scenes.

2.4 POWER SUPPLIES

A. Low-voltage power supplies matched for voltage and current requirements of cameras and accessories, and of type as recommended by manufacturer of camera and lens.

2.5 CAMERA-SUPPORTING EQUIPMENT

A. Manufacturers: Subject to compliance with requirements, provide products as mentioned in approved makes.

B. Basis-of-Design Product: Subject to compliance with requirements.

C. Minimum Load Rating: Rated for load in excess of the total weight supported times a minimum safety factor of two.

D. Pan-and-Tilt Units: Motorized units arranged to provide remote-controlled aiming of cameras with smooth and silent operation, and equipped with matching mounting brackets.

1. Panning Rotation: 0 to 355 degrees, with adjustable stops.

2. Tilt Movement: 90 degrees, plus or minus 5 degrees, with adjustable stops.

3. Speed: 12 degrees per second in both horizontal and vertical planes.

4. Wiring: Factory prewired for camera and zoom lens functions and pan-and-tilt power and control.

5. Built-in encoders or potentiometers for position feedback

6. Pan-and-tilt unit shall be available with preset positioning capability to recall the position of a specific scene.

E. Mounting Brackets for Fixed Cameras: Type matched to items supported and mounting conditions. Include manual pan-and-tilt adjustment. F. Protective Housings for Fixed and Movable Cameras: Suitable enclosures with internal camera mounting and connecting provisions that are matched to camera/lens combination and mounting and installing arrangement of camera to be housed.

1. Tamper switch on access cover sounds an alarm signal when unit is opened or partially disassembled. Central-control unit shall identify tamper alarms and indicate location in alarm display. Tamper switches and central-control unit are specified in Division 28 Section "Intrusion Detection."

2. Camera Viewing Window: Polycarbonate window, aligned with camera lens.

3. Duplex Receptacle: Internally mounted.

4. Alignment Provisions: Camera mounting shall provide for field aiming of camera and permit removal and reinstallation of camera lens without disturbing camera alignment.

5. Sun shield shall not interfere with normal airflow around the housing.

6. Mounting bracket and hardware for wall or ceiling mounting of the housing. Bracket shall be of same material as the housing; mounting hardware shall be stainless steel.

7. Finish: Housing and mounting bracket shall be factory finished using manufacturer's standard finishing process suitable for the environment.

8. Enclosure Rating: IP 66

2.6 COLOR MONITORS

A. Manufacturers: Subject to compliance with requirements, provide products as mentioned in approved makes.

B. Basis-of-Design Product: Subject to compliance with requirements.

C. Screen Size (Diagonal Dimension): 21 inch.

D. Resolution: 1280 x 1024 pixels or higher

E. Minimum Front Panel Devices and Controls: Power switch; power-on indicator; and brightness, contrast, colour, and tint controls.

F. Degaussing: Automatic.

G. Mounting: Single.

H. Electrical: 230-V ac, 50 Hz.

2.7 VIDEO RECORDERS

A. Manufacturers: Subject to compliance with requirements, provide products as mentioned in approved makes.

B. Basis-of-Design Product: Subject to compliance with requirements.

C. **Video Recorder recording at 4CIF real-time, H.264 compression:**

The Video recorder will have 16 video inputs and have the following features:

 at genuine D1 resolution image in live view and playback mode at real time frame rate

 Records / Captures the images in D1 resolution out of front end cameras in full frame

 Advanced H.264 video compression technology should be used for vivid image recording

 Resolution and frame rate of each channel can be set individually

 Support dual stream and multicast for each individual channel

 Support variable bit rate and constant bit rate to provide high video quality under various situations

 16 channel audio should be available to be recorded and playback synchronized with video image.

 Embedded system design should protect NVR from network attack

 IP address filter protect system from unauthorized IP address access

 Various detections should be available like Camera covered, video loss and relative actions can be taken like alarm notice, environment checking

 Password encryption should be available to avoid password be sniffed on network

 System should have passed the strictest CE, FCC and QAP test

 Tamperproof recording should be available to ensures no record be spitefully modified

 Four hot-swappable internal hard drivers should be available to ensure no video loss even when hard disks as changed

 There should be no system down time even when hard disks are changed

 Hard disk status should be monitored to guarantee continuous recording

 NVR status should be monitored to ensure system continuous operation

 Control centre application software should be available and allow:

o Easy configuration and user management

o Live view

o Record and search

o Alarm handling

o PTZ controlling

o System status monitoring

 Mouse operation, plug and play.

 IE browser should be supported and Web configuration should have easy and quick access

 Motion detection should be area selectable and sensitivity adjustable. Relative actions should be taken after motion is detected to enable quick response.

 System log should be available

 NVR auto searching mechanism should ease system configuration

 It should fully support scheduled recording, triggered (alarm in, motion detection, video loss) recording, pre-alarm record and post-alarm record to cater to different needs in recording settings

 Users should be able to search recordings by date, record type (regular, triggered) to quickly find records needed

 Up to 8TB internal storage should be available, which should support at least 22 days continuous recording for 16 channels at D1 resolution and real time

 eSATA port should be available for storage extension if needed

 16 channel alarm inputs and 4 channel relay outputs should be available for easy connection to 3rd party devices

 The NVR should support various PTZ protocols from different vendors

 1080P HDMI and VGA high definition display outputs should be available as video outputs in the NVR

 Operation should be easy and intuitive with menu driven and auto prompted tips

 Maximum utilization of storage and network infrastructure should be available with H.264 compression

 The NVR should display high reliability and usability

 Flexible recording mechanism and high efficient searching dramatically improve your video surveillance system's efficiency

Type of NVR	Embedded
Number of Channels	As per Requirements.
Mode	Pentaplex (record, view/playback, network (view remotely), administrate and backup)
Compression Method	H.264
Display Frame Rate	Real Time
Recording Frame Rate and Resolution (Maximum)	400fps at D1
Recording Mode	Continuous / Scheduled / Sensor Based / Motion Detection Based /

	Manual
Video Motion Detection & Recording Configuration	Independent Channel configuration
Video Out	Composite, 1080P HDMI and VGA high definition
Audio Input	As per requirements & Nos of Channel
Audio Output	1
Alarm Input	As per requirements. & Nos of Channel
Alarm Output	4
Max Internal HDD supported (TB)	As per requirements & Nos of Channel
Internal HDD Interface	Hot Swappable
External HDD Interface	eSATA port
PTZ Connectivity	Yes
Remote Access Software	Yes
Web Browsing	Yes
Certifications	CE, FCC and QAP test

D. PTZ Controls: Arranged for multiple-camera control, with switches to select camera to be controlled.

1. Pan-and-Tilt Control: Joystick type.

2. Zoom Control: Momentary-contact, "in-out" push button.

3. Automatic-Scan Control: A push button for each camera with pan capability that places camera in automatic-scanning mode.

2.8 IP VIDEO SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products as mentioned in approved makes.

B. Basis-of-Design Product: Subject to compliance with requirements.

C. Description:

1. The Video Encoder shall be a dual channel, high-performance IP video encoder to encode video and control data for transmission over an IP network to remote CCTV monitors and PCs.

2. The encoder shall be capable of producing MPEG-4 video at 25 images per second (PAL Mode) per channel at ½ DI resolution and shall also support 25 images per second if one channel is used giving DVD-quality 4CIF resolution.

3. The encoder shall accept analog video input from fixed cameras and then provides MPEG-4 IP video to the network.

4. The encoder shall support NTSC, PAL, EIA, and CCIR camera sources.

5. The video encoder specified shall be capable of functioning on data networks, such as Ethernet LANs and the Internet, using a standard web browser (such as Microsoft Internet Explorer Version 5.5) as the receiver, the encoder shall function as a server to provide MPEG-4 or JPEG video via the network to a PC workstation. The web browser may also be used to configure the settings of the encoder using the local network or via the Internet.

6. The video encoder shall be capable of transmitting video that can be viewed over an IP network using the software running on a network workstation.

7. The video encoder shall provide dual streaming capability that simultaneously creates two data streams at different rates and resolution where one stream may be used for local recording and the second stream may be transmitted over the network for live viewing.

8. The MPEG-4 encoder shall allow selection of the following resolutions per channel:

Resolution	Frame-rate
QCIF	30fields/sec
CIF	30fields/sec
2CIF	25fields/sec
½ D	25 frames/sec

4CIF / D1 12frames/sec

9. An RS-232 bidirectional serial communications port shall be provided to allow configuration of the encoder settings for network

10. Individual snapshots from a video sequence of the encoder currently being displayed on the browser may be saved as JPEG images and stored on the PC hard drive.

11. Video clips from the video sequence of the encoder currently being displayed on the browser may be saved on the PC hard drive.

12. The video encoder shall provide three levels of password protection to prevent unauthorized connection or configuration changes to the unit.

13. The video encoder shall provide a standard BNC connector for connection of the video input source.

14. The video encoder shall be compatible with NTSC, PAL, EIA, and CCIR video sources.

15. The video encoder shall be capable of sending images to a network video recorder for long term archiving.

16. The video encoder shall provide time synchronization capability ensuring that simultaneously occurring events will display the correct time and date when multiple specified devices are connected to the same network.

17. The Video encoder shall support up to 5 unicast streams with a maximum of 3 Mbits

18. The video encoder shall provide four alarm inputs for external sensors such as door contacts or PIRs. These alarm inputs can trigger an automatic connection between the encoder and a remote workstation. A relay shall be provided that may be automatically or manually activated.

19. The video encoder shall trigger an alarm upon video loss.

20. The video encoder shall be capable of establishing a connection to a predefined IP address upon an alarm. Up to ten IP addresses may be programmed where each location is contacted until a connection is established. Automatic reconnection to one of the specified IP addresses shall be established after each restart caused by a connection or network failure.

21. The encoder shall provide a normally open or normally closed relay output function. The relay may be configured to turn on and stay on until manually reset, or, the relay may be activated for a specific period of time. Alarm conditions such as video loss or an external contact input may activate the relay output.

a) The relay output may be activated remotely via a standard web browser or an optionally available video management software program. The relay may be programmed to remain in its active state when switched, or, revert to the inactive state after a specific time interval. The relay may be configured to activate if a connection is established to the unit, there is a loss of video signal, or an via an external alarm sensor.

b) System shall provide high-quality delivery and processing of IP-based video, audio, and control data using standard Ethernet-based networks.

c) System shall have seamless integration of all video surveillance and control functions.

d) Graphical user interface software shall manage all IP-based video matrix switching and camera control functions, two-way audio communication, alarm monitoring and control, and recording and archive/retrieval management. IP system shall also be capable of integrating into larger system environments.

e) All camera signals shall be compressed, encoded, and delivered onto the network for processing and control by the IP video-management software. f) Encoder/decoder combinations shall place video, audio, and data network stream that can be managed from multiple workstations on the user's LAN or WAN.

g) All system interconnect cables, workstation PCs, PTZ joysticks, and network intermediate devices shall be provided for full performance of specified system.

2.9 CONTROL STATIONS

A. Manufacturers: Subject to compliance with requirements, provide products as mentioned in approved makes.

B. Basis-of-Design Product: Subject to compliance with requirements.

C. Description: Heavy-duty, freestanding, modular, metal furniture units arranged to house electronic equipment. Coordinate component arrangement and wiring with components and wiring of other systems.

D. Equipment Mounting: Standard 483-mm rack.

E. Normal System Power Supply: 230 V, 50 Hz, through a locked disconnect device and an isolation transformer in central-station control unit. Central-station control unit shall supply power to all components connected to it unless otherwise indicated.

F. Power Continuity for Control Station: Batteries in power supplies of central-station control units and individual system components shall maintain continuous system operation during outages of both normal and backup ac system supply.

1. Batteries: Rechargeable, valve-regulated, recombinant, sealed, lead-acid type with nominal 4-5-years life expectancy. Capacity adequate to operate portions of system served including audible trouble signal devices for up to four hours and audible and visual alarm devices under alarm conditions for an additional 10 minutes.

2. Battery Charger: Solid-state, fully automatic, variable-charging-rate type. Charger shall recharge fully discharged battery within 24 hours. CPU	Intel I3 Processor @ 3.2 GHz, 800FSB, 4 MB Cache or better
Mother Board	Intel Original Mother board
Memory	4 GB RAM
Hard Drives	2 TB or more
Keyboards	Cordless 104 keys window 98 keyboard,PS/2 Compatible
Mouse	Optical Mouse with scroll
Video Card	In Built 2 No.s for connecting 2 monitors
Network Adapter (NIC)	Integrated 10/100/1000 Base -T
Sound Card	In- Built
DVD writer	DVD+16x –16x, RW +8x -6x, CDW 48x,
Monitor	22" LED monitor
USB 2.0 or fire wire card	2 nos. at front panel

Operating system	Support Windows XP sp2

VIDEO Management Module:

GENERAL REQUIRMENTS:

1. The Integrated Video Management software shall leverage a powerful Client Server LICIure with interactive Graphical User Interface to provide exceptional Operator management and Alarm handling capabilities.

2. The system shall be able to support redundancy server module and redundancy communication gateways to ensure that the devices are online in case of failure of the primary server or gateway modules.

3. The software components (Application server, Database and Gateways) shall be capable of running together on a single PC for small systems or on separate PCs and servers for large systems. Multiple NVRs and client workstations shall be used as needed to suit application of any size

4. Live video from a camera shall be viewed in an independent floating window. It shall support multi-viewer feature to allow monitoring multiple cameras simultaneously. Selecting the cameras for multi-view shall be made easy using the Drag and Drop from the Device browser or Site Explorer. PTZ operation shall also be performed from the multi viewer.

5. It shall have the capability to directly transmit the video to the desktop / browser based client upon authentication of the Client from the server for various streaming parameters and upon fetching the Username/password if enabled.

6. The software shall allow the floating windows to be dragged to another monitor in the case of a PC supporting multiple monitors to facilitate graphics views on one monitor and list views or video on another. The software shall also support tabs to view multiple camera videos page by page.

7. The software shall be able to support configuration of parameters such as Preset Name, Target Data Rate, I-frame and P-frame quality, I-frame distance, Video Resolution, Password, Relay Switch, Alarm Inputs, Audio and status of the device, subject to the acceptance of the same by IP Camera devices.

8. The software shall allow the Camera to be selected in the site explorer or the camera list view or from the Graphics page which allows a video window to pop up

with video stream. Any number of such video windows shall be opened subject to resource availability / limitations on individual devices and PC.

9. The software shall be user friendly. Video capture, video record, maximize/minimize, video stop are all shall be activated by a click of a button.

10. The application shall have a PAN speed track bar to allow PTZ function, Preset functions and video sequencing. Presets on PTZ devices shall be definable. Operator shall be able to select a pre-defined preset and move the PTZ to that preset. Video clip search and playback shall also be available in the tool bar.

11. Video Management system shall allow the following

* Record Video streams, and audio continuously

* Trigger recording based on alarm input, motion detection

* Set Record time interval for each day of a week

* Recorded information on the entire network

* Password protected access to recorded video based on the authorization level

* Simple integration of cameras and storage media

* Simple integration to various systems in the application platform

* Pre and post event recording based on events

* Support playing back video directly from event list

* User friendly graphics

* Supports multiple NVR's

* Quick search functions with time filters to access desired video sequence

* Status of the NVR hard disk size, HDD space available, data transfer rate, retention time, type of video stream etc

* Creation of snapshots in JPEG format and video segments in MPEG format to be stored in a separate location for third party application

12. The Video management system shall be able to support cross module functionality. The application software shall provide easily definable cause and effects across disciplines by simply referencing the respective object, its state and its attribute directly from the integrated database.

* Video recording shall be enabled based on access events (valid or invalid). These recording shall be played back directly from the access event listing. * Client stations shall be defined to automatically pop up live video stream on receipt of alarms and events from other systems.

SYSTEM FUNCTIONS:

DEPLOYMENT – SHALL BE CAPABLE OF THE FOLLOWING

* Updates of operator client and configuration client shall be automatically deployed from the central server.

CONFIGURATION – FOLLOWING SHALL BE SUPPORTED

* Configurable Logical Tree

* Predefined camera sequences

* "Automatic Sequences" created by multiple selection and drag and drop to Image panes

USER INTERFACE – SHALL BE CAPABLE TO DO THE FOLLOWING

* Sitemaps with Links, Devices, Sequences, and Command Scripts

* Up to 4 monitors supported per workstation

* Flexible Image panes allow any combination of video window sizes and layouts

* Device states shall be shown by icons, including network connection loss, video loss

* Camera selection by double-click or drag and drop from site maps, logical tree, or favourites tree

* Control of analog monitors connected to decoders via drag and drop

* Shall have Sophisticated multi-camera timeline to allow easy, graphical searching of stored video

* Flexible search shall work across all NVRs connected to the system

* Analog monitor wall support

EVENT HANDLING

* Event list with device events (e.g. video loss), system events (e.g. disk full), network events (e.g., heavy network traffic), subsystem events (e.g. allegiant alarm), user events (e.g. logon failure), schedule events (e.g. every Tuesday at 10:15), etc.

* Event allocation to user groups

* Schedule dependent alarm generation

* Schedule dependent event logging

ALARM HANDLING – SHALL HAVE THE FOLLOWING CAPABILITIES

* Alarms can trigger alarm-mode recording for any cameras

* 100 alarm priorities

* Selective auto-popup on alarm

* Alarms displayed in separate alarm window

* Wave file per alarm priority

* Workflow with user instructions and user comments, optionally forced before clearing

* Email or SMS notification on alarm

* Alarm display on analog monitor walls

USER MANAGEMENT – SHALL HAVE THE FOLLOWING CAPABILITIES

* Logical tree customized per user group – users shall only see devices for which they have access

* User group rights for protecting, deleting, exporting, and printing video

* User group rights for Logbook access

* User group priority assignment for PTZ control

SYSTEM MONITORING – SHALL SUPPORT THE FOLLOWING

* System-wide health monitoring, including cameras, computers, software, and network equipment

2.10 SIGNAL TRANSMISSION COMPONENTS

A. Cable: Coaxial cable elements have 75-ohm nominal impedance. Comply with requirements as per Indian standards.

B. Video Surveillance Coaxial Cable Connectors: BNC type, 75 ohms. Comply with requirements as per Indian standards.

3.0 EXECUTION

3.1 WIRING : Wiring Method: Install cables in raceways unless otherwise indicated.

1. Except raceways are not required in accessible indoor ceiling spaces and attics.

2. Except raceways are not required in hollow gypsum board partitions.

3. Conceal raceways and wiring except in unfinished spaces.

A. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

B. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

C. For LAN connection and fiber-optic and copper communication wiring, comply with Indian Standards.

D. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

3.2 VIDEO SURVEILLANCE SYSTEM INSTALLATION

A. Install cameras with 2134-mm minimum clear space below cameras and their mountings. Change type of mounting to achieve required clearance.

B. Set pan-and-tilt unit stops to suit final camera position and to obtain the field of view required for camera. Connect all controls and alarms, and adjust.

C. Avoid ground loops by making ground connections only at the control station.

1. For 12- and 24-V dc cameras, connect the coaxial cable shields only at the monitor end.

D. Identify system components, wiring, cabling, and terminals as per standard.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Inspection: Verify that units and controls are properly installed, connected, and labelled, and that interconnecting wires and terminals are identified.

2. Pretesting: Align and adjust system and pre-test components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:

a) Verify operation of auto-iris lenses.

b) Set back-focus of fixed focal length lenses. At focus set to infinity, simulate night time lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.

c) Set back-focus of zoom lenses. At focus set to infinity, simulate night time lighting conditions by using a dark glass filter of a density that produces a clear image. Additionally, set zoom to full wide angle and aim camera at an object 17 to 23 m away. Adjust until image is in focus from full wide angle to full telephoto, with the filter in place.

d) Set and name all preset positions; consult Owner's personnel.

e) Set sensitivity of motion detection.

f) Connect and verify responses to alarms.

g) Verify operation of control-station equipment.

* Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.

* Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation.

C. Video surveillance system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. All training shall be by the contractor and shall utilize specified manuals and As-Built Documentation

B. Operator training shall include total seven sessions each of six-hour encompassing:

1. - Modifying text and graphics

2. - Sequence of operation review

3. - Selection of all displays and reports

4. - Use of all specified OS functions

5. - Use of portable operator's terminals

6. - Trouble shooting

7. - Password assignment and modification

C. The training shall be under taken in two phases. One training session shall be conducted at system completion, and the other shall be conducted within forty-five days of system completion

4.0 METHOD OF PAYMENT

4.1 Include in Item Rates below, distributed costs of all General Conditions, Special Conditions, and Division One requirements.

4.2 ITEM RATES FOR COORDINATION DRAWINGS

A. All work as specified for Coordination Drawings for clamping / saddling and routing of cables , conduits and components coordinated with Cast-in-place Reinforced Concrete Structure including location, size and configuration of sleeves, hangers, inserts, brackets in or supported by concrete beams, slabs, columns, walls or foundation structures.

B. All work as specified for Coordination Drawings for clamping / saddling and routing of cables, conduits and components coordinated with duct work, mechanical systems piping and components, plumbing piping and components, electrical power distribution components, and electrical lighting system components.

C. All work as specified for Coordination Drawings for clamping / saddling and routing of cables, conduits, and components coordinated with general construction and finish systems including, but not limited to, suspended ceiling systems, wall cladding and finishes, glazing systems, and non-structural fire-rated assemblies.

4.3 ITEM RATES FOR SHOP DRAWINGS AND OTHER SUBMITTALS

A. All work for Shop Drawings as indicated above.

B. All work for Product Data as indicated above.

C. All work for Samples as indicated above.

4.4 ITEM RATES FOR EMPLOYER INSTRUCTION AND SYSTEMS COMMISSIONING

A. All work to provide instruction to Employer's Personnel as indicated above.

B. All work to complete Testing and Commissioning as indicated in Division 01 Section.

SECTION-6: CONVENTIONAL FIRE DETECTION & ALARM SYSTEM

1.0 GENERAL:

1.1 SUMMARY

Section Includes:

a) Fire-alarm control unit.

b) Manual fire-alarm boxes.

c) System smoke detectors.

d) Nonsystem smoke detectors.

e) Heat detectors.

f) Notification appliances.

g) Magnetic door holders.

h) Remote annunciator.

i) Addressable interface device.

j) Digital alarm communicator transmitter.

1.2 SYSTEM DESCRIPTION

Noncoded, addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

1.3 PERFORMANCE REQUIREMENTS

Insert other Project-specific system requirements, such as Owner's insurance company standards.

Retain paragraph below with "Seismic Qualification Certificates" Paragraph in "Submittals" Article for projects requiring seismic design. Model building codes and SEI/ASCE 7 establish criteria for buildings subject to earthquake motions. Verify requirements of authorities having jurisdiction.

Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions in general.

a) The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces. Good installation practice should be followed.

1.4 SUBMITTALS

General Submittal Requirements:

a) Submittals shall be approved by authorities having jurisdiction prior to submitting them to LICI. EPC Contractor to take care of approval from authorities.

b) Shop Drawings shall be prepared by persons with the following qualifications:

1. Trained and qualified engineer/technician by manufacturer in fire-alarm system design.

A. Product Data: For each type of product indicated.

B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

a) Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.

b) Include voltage drop calculations for notification appliance circuits.

c) Include battery-size calculations.

d) Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.

e) Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations. f) Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

C. Delegated-Design Submittal: For smoke and heat detectors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

a) Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.

b) Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.

D. Qualification Data: For qualified Installer.

E. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer or a certified testing Contractor when tested in accordance with SEI/ASCE 7 requirements.

F. Field quality-control reports.

G. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

a) Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

b) Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.

c) Record copy of site-specific software if printable version.

d) Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:

1. Frequency of testing of installed components.

2. Frequency of inspection of installed components.

3. Requirements and recommendations related to results of maintenance.

4. Manufacturer's user training manuals.

e) Manufacturer's required maintenance related to system warranty requirements.

f) Abbreviated operating instructions for mounting at fire-alarm control unit.

g) Copy of NFPA 25 (client-owner to arrange for same).

H. Software and Firmware Operational Documentation:

a) Software operating and upgrade manuals.

b) Program Software Backup: On magnetic media or compact disk, complete with data files.

c) Device address list.

d) Printout of software application and graphic screens.

1.5 QUALITY ASSURANCE

Retain one or both of first two paragraphs below. See Editing Instruction No. 2 in the Evaluations for discussion about installer qualifications. Coordinate with "Submittals" Article.

Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

Installer Qualifications: Installation shall be by personnel identified by manufacturer.

Retain first paragraph below for fire-alarm projects that are renovations of or additions to existing facilities.

Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing Contractor, and marked for intended location and application.

1.6 SOFTWARE SERVICE AGREEMENT

Services in this article may not be allowed for publicly funded projects.

Comply with UL 864.

Technical Support: Beginning with Substantial Completion, provide software support for one year during warranty and after that based on annual maintenance contract.

Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within one year from date of Substantial Completion within warranty and should be extended with annual maintenance program. Upgrade shall include new or revised licenses for use of software.

Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

2.0 PRODUCTS

2.1 MANUFACTURERS

See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers. Retain one of two paragraphs and list of manufacturers below. See Division 01 Section "Product Requirements."

Basis-of-Design Product: Subject to compliance with requirements.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

Fire-alarm signal initiation shall be by one or more of the following devices and systems:

a) Manual stations.

b) Heat detectors.

c) Retain one or both of first two subparagraphs below. Coordinate with Drawings if retaining both.

d) Smoke detectors.

e) Duct smoke detectors.

f) Automatic sprinkler system water flow (in case of fire - potential free contact to panel)

g) Fire-extinguishing system operation.

h) Fire standpipe system.

Fire-alarm signal shall initiate the following actions:

a) Continuously operate alarm-notification appliances.

b) Identify alarm at the fire-alarm control unit and remote annunciators.

c) Transmit an alarm signal to the remote alarm receiving station.

d) Unlock electric door locks in designated egress paths.

e) Release fire and smoke doors held open by magnetic door holders.

f) Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.

g) Recall elevators to primary or alternate recall floors.

i) Activate emergency lighting control.

j) Activate emergency shutoffs for gas and fuel supplies.

k) Record events in the system memory.

Supervisory signal initiation shall be by one or more of the following devices and actions:

a) Valve supervisory switch.

b) Low-air-pressure switch of a dry-pipe sprinkler system.

c) Elevator shunt-trip supervision.

System trouble signal initiation shall be by one or more of the following devices and actions: a) Open circuits, shorts, and grounds in designated circuits.

b) Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.

c) Loss of primary power at fire-alarm control unit.

d) Ground or a single break in fire-alarm control unit internal circuits.

e) Abnormal ac voltage at fire-alarm control unit.

f) Break in standby battery circuitry.

g) Failure of battery charging.

h) Abnormal position of any switch at fire-alarm control unit or annunciator.

System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators.

2.3 FIRE-ALARM CONTROL UNIT

General Requirements for Fire-Alarm Control Unit:

Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.

a) System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.

b) Include a real-time clock for time annotation of events on the event recorder and printer.

c) The fire alarm control panel shall be microprocessor based using the multiple microprocessors throughout the system providing rapid processing of smoke detector and other initiation device information to control system output functions. There shall be a watchdog circuit, which shall verify the system processors and the software program. Problems with either the processors or the system program shall activate a trouble signal, and reset the panel. The system modules shall communicate with an RS 485 network communications protocol. All module wiring shall be to terminal blocks, which will plug into the system card cage. The blocks shall be color coded to prevent accidental crossing of wiring.

d) The basic system shall have capabilities for 252 intelligent initiation devices and can be expanded up to 2500 intelligent initiation devices. The system shall employ a flexible number of detection input loops to reach maximum system capacity. Systems which, have a fixed number of device addresses per node based on a fixed number of device circuits (loops) shall provide 25% of loop maximum spare capacity on all loops to meet this requirement.

e) The Device Loop Card shall be capable of minimum 252 intelligent devices distributed between two SLC circuits. Any trouble on one circuit shall not affect the

other circuit. This module shall control the signaling from the initiation devices reporting alarms and troubles to the control panel. This module shall also provide the signaling to the field devices for controlling the output of specific initiation devices. The circuit shall be capable of being connected with polarity insensitive intelligent initiation devices. The circuits shall have the ability to be wired, Style 4, Style 6. Any of all of the 252 devices on the loop card shall be capable of activating up to two devices (relay base, audible base or remote lamps). These accessories shall not take away from the 252 addresses available per loop. The on board microprocessor provides the loop card with the ability to function even if the main microprocessor fails. LED's on the board shall provide annunciation for the following; Power, Card Failure, Network Failure, Ground. Fault, Alarm, Trouble, Short Zone 1, Short Zone 2, Style 6 Open Zone 1, Style 6 Open Zone 2. This card shall plug into the system card cage.

f) The Signal Line Circuits shall be tested for opens, shorts, ground faults, device status and multiple device response (2 devices at same address) and communications with all addressable devices installed before connection to the control panel. Systems without this capability shall have a test panel installed for initial testing to eliminate any possible damage short term or long term to the control panel. After initial testing replace the test panel and proceed with complete testing.

g) The Person Machine Interface (Display) or the Remote Person Machine Interface (Repeater) shall provide the system information on six inch ¼ VGA monochrome LCD, with Touch Screen and LED display. The DISPLAY shall provide floor plans with alarm type and "you are here" indication. The DISPLAY shall be navigable by device/module custom message in the system LICIure with no need for device address knowledge. The DISPLAY shall provide a physical as well as a system geographic view. Graphic user interface shall be menu driven with 4 tabs showing the level and the total events for each tab. The tabs shall be; Alarm, Supervisory, Trouble and Security. Each level shall show 5 events simultaneously. The LED displays shall indicate Power, Audibles On or Silenced, and Partial system disabled. Systems not having the above LED's shall provide separate LED's within the control panel enclosure with appropriate labels. Selection buttons shall be backlit to aid the operator in the selection process. There shall be controls for scrolling throughout the event list. A button shall provide zoom in zoom out for the amount of information desired for a specific entry. The DISPLAY shall be capable of monitoring the power supply loading and show available capacity for future expansion planning. The

DISPLAY LCD shall provide standard NFPA symbols showing Fire Service Equipment, Hazards, compliant with NFPA 170 and People in the area of alarm. Systems without this type of display shall supply a "UL" listed Graphics package with their system. The LCD shall have a keyboard screen to allow the technician ability to enter test and numbers for passwords or text changes

h) The Zone Indicating Card shall contain 8 NAC circuits rated at 2 amps each with power-limited outputs. The four zone inputs for the card shall be isolated and independently supervised. There shall be unique codes/signals for each circuit based on system logic. These signals shall be Temporal Code 3 (Evacuation), Steady (Such as "Recall"), and Alert (such as "Tornado Alert"),MT 30 PPM, MT 60 PPM and MT 120PPMThe card shall be listed for notification appliances, horns, bells, strobes, and speakers. The card shall also be listed for NFPA 13 Pre-Action Release, Halon 1301 NFPA 12A, FM200 NFPA 2001. The card shall have the ability to wire the circuits Style Y or Style Z with outputs synchronized. The card shall have the following LED's to provide trouble shooting and annunciation; Reset, Power, Card Failure, Network Failure, Ground. Fault, Zone Activation or Trouble. This card shall plug into the system card cage.

i) The Zone Indicating Card shall contain 4 NAC circuits rated at 4 amps each with power-limited outputs. All zone inputs for the card shall be isolated and independently supervised. There shall be at least 3 unique codes/signals for each circuit based on system logic. These signals shall be Temporal Code 3 (Evacuation), Steady (Such as "Recall"), and Alert (such as "Tornado Alert"). The card shall be listed for notification appliances, horns, bells, strobes, and speakers. The card shall also be listed for NFPA 13 Pre-Action Release, Halon 1301 NFPA 12A, FM200 NFPA 2001, Lease Line, and Municipal Tie. The card shall have the ability to wire the circuits Style Y or Style Z with outputs synchronized. The card shall have the following LED's to provide trouble shooting and annunciation; Reset, Power, Card Failure, Network Failure, Ground. Fault, Zone Activation or Trouble. This card shall plug into the system card cage.

j) The Conventional Detector Card shall have 4 circuits of conventional initiation circuits. Each zone shall be capable of supporting 30 smoke detectors and an unlimited number of contact devices. This card shall also have the ability to power and monitor Linear Beam detectors and Flame detectors. The card shall have the

ability to wire the circuits Style D or Style B. This card shall plug into the system card cage.

k) Where needed a Conventional Zone Module shall connect to the Signal Line Circuit, which will allow the use of conventional initiation devices. This module shall have the ability to support up to 15 convention smoke detectors and an unlimited number of contact devices. The module shall have the ability to wire the circuits Style D or Style B. This module shall also be capable of monitoring Linear Beam detectors as well as Flame detectors.

l) The Network Interface Card shall provide communication between enclosures. The network card supervises the network to insure proper operation. Any faults that are detected shall be reported to the DISPLAY for annunciation. The network card shall isolate short circuits to each individual segment of the network. If a short occurs only the segment between the network cards will be affected. The card shall have the ability to provide Style 4 or 7 network wiring configurations. The card shall have as the minimum the following diagnostic LED; Reset, Power, Card Fail, CAN Fail, HNET Fail, ZNET Fail, GND Fault, Loop A Fail, Loop B fail, Networks - Style 7, Style 4, GND Fault Enabled, GND Fault Disabled. m) The Controllable Relay Card shall provide 6 programmable relays. Each relay shall have SPDT contacts rated at 4 amps at 30VDC/120VAC resistive and 3.5 amps, 120VAC inductive. The card shall have as a minimum the following diagnostic LED's; Reset, Power, Card Fail, 24V Fail, Relay 1, Relay2, Relay3, Relay 4, Relay5, Relay6.

n) Where required to monitor a large amount of relays, such as monitoring subsystems or normally open contact devices, provide a Supervised Input Module, which will monitor up to 16 inputs. Each input shall be individually programmed for supervised or non-supervised circuits. This module shall be connected to a system network. The module shall contain 2 programmable form "C" relays for control of the monitored subsystem.

o) Where required for control of relays or LED's the Output control Module shall provide 16 open collector outputs to operate LED's, incandescent lamps or relays as needed. The module shall contain a local audible output, Lamp Test and local audible silence. All circuits shall be power limited.

p) The system card cage shall provide the mounting of all system cards, field wiring, and panel's inter-card wiring. The terminal strips for the cards shall be color-coded to eliminate the possibility of making the wrong connection. The terminal blocks

maybe disconnected and reconnected while the system is powered up without causing any difficulties. All power limited field wiring shall connect to the top of the card cage. All non-power limited internal wiring shall be connected to the bottom of the card cage. The card cage shall hold the systems cards and have capability of connecting multiple card cages to meet system demands.

q) System response time from alarm to output shall not exceed four (4) seconds.

r) To expedite system troubleshooting, the system cards shall have ground fault detection, and diagnostic LED's by card.

s) All system cards and modules shall have Flash memory for downloading the latest module firmware.

t) Addressable control circuits for operation of mechanical equipment.

A. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

a) Annunciator and Display: Liquid-crystal type – 6 inch with more than 3000 event history log.

b) Keypad: Arranged to permit entry and execution of programming, display, and control commands.

B. Circuits:

a) Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.

1. Initiating Device Circuits: Style D or Style E depending on wiring.

2. Notification Appliance Circuits: Style Z.

3. Signaling Line Circuits: Style 6.

4. Install no more than 300 addressable devices on each signaling line circuit with minimum capability of 240 detectors per line.

b) Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.

1. Initiating Device Circuits: Style A or Style B or Style C depending on wiring.

2. Notification Appliance Circuits: Style W or Style X or Style Y depending on wiring.

3. Signaling Line Circuits: Style 4.

4. Install no more than 300 addressable devices on each signaling line circuit.

C. Notification Appliance Circuit: Operation shall sound in a standard fire alarm pattern.

D. Elevator Recall:

a) Smoke detectors at the following locations shall initiate automatic elevator recall.

1. Elevator lobby detectors except the lobby detector on the designated floor.

2. Smoke detector in elevator machine room.

b) Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor. c) Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.

1. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

E. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.

F. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

G. Primary Power: The system Power Supply/Charger shall be a 12-amp supply with battery charger. The power supply shall be filtered and regulated. The power supply shall have a minimum of 1 power limited output rated at 4 amps, and a minimum of 1 output rated at 12 amps. The system power supply can be expanded up to 48 amps. The auxiliary power supply module shall share common batteries with the primary power supply. The system power supply shall have 4 relays, one for common alarm, one for common trouble and two programmable relays. The power supply shall be rated for 240 VAC 50 Hz.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

H. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: The battery charger shall be able to charge the system Lead Acid batteries up to 100 AH batteries. Battery charging shall be microprocessor controlled and programmed with a special software package to select charging rates and battery sizes. An optional Thermostat for monitoring battery temperature to control charging rate shall be available.

2. The power supply shall have a plug for an AC adapter cable, which allows a technician to plug in a laptop computer for up or down loading program information or test equipment.

I. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

J. System Enclosures: Provide the enclosure needed to hold all the cards and modules as specified with at least spare capacity for two cards. The enclosures shall be either black or red. The outer doors shall be capable of being a left hand open or a right hand open. The inner door shall have a left hand opening. System enclosure doors shall provide where required ventilation for the modules or cards in the enclosure.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type. With integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.

2. Provide single action addressable manual stations where shown on the drawings, to be flush or surface mounted as required. Manual stations shall contain the intelligence for reporting address, identity, alarm and trouble to the fire alarm control panel. The manual station communications shall allow the station to provide alarm input to the system and alarm output from the system within less than four (4) seconds. The manual station shall be equipped with terminal strip and pressure

style screw terminals for the connection of field wiring. Surface mounted stations where indicated on the drawings shall be mounted using a manufacturer's prescribed matching red enamel outlet box.

3. Double-action mechanism requiring two actions to initiate an alarm pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.

4. Station Reset: Key- or wrench-operated switch. 5. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.

6. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 SYSTEM SMOKE DETECTORS

A. The smoke detector shall be an intelligent digital photoelectric detector with a programmable heat detector. Detectors shall be listed for use as open area protective coverage, in duct installation and duct sampling assembly installation and shall be insensitive to air velocity changes. The detector communications shall allow the detector to provide alarm input to the system and alarm output from the system within four (4) seconds. Detectors shall be programmable as application specific, selected in software for a minimum of eleven environmental fire profiles unique to the installed location. These fire profiles shall eliminate the possibility of false indications caused by dust, moisture, RFI/EMI, chemical fumes and air movement while factoring in conditions of ambient temperature rise, obscuration rate changes and hot/cold smoke phenomenon into the alarm decision to give the earliest possible real alarm condition report. The intelligent smoke detector shall be capable of providing three distinct outputs from the control panel. The system controlled output functions shall be from an individual or unique input of smoke obscuration, a thermal condition or a combination of obscuration and thermal conditions. The detector shall be designed to eliminate calibration errors associated with field cleaning of the chamber. The detector shall support the use of a relay and LED remote indicator at the same time. Low profile, white case shall not exceed 2.5 inches of extension below the finish ceiling. Detector wiring shall not require any special shielded cable.

B. The smoke detector shall be an intelligent digital photoelectric detector with a programmable heat detector. Detectors shall be listed for use as open area protective coverage, in duct installation and sampling assembly installation and shall be insensitive to air velocity changes. The detector communications shall allow the detector to provide alarm input to the system and alarm output from the system within four (4) seconds. The detector shall be mounted in a duct detector housing listed for that purpose. The duct detector shall support the use of a remote test switch, relay or LED remote indicator. The duct detector shall be supplied with the appropriate sampling tubes to fit the installation. Where duct detectors are exposed to the weather provide a weatherproof enclosure.

C. Detector bases shall be low profile twist lock type with screw clamp terminals and self-wiping contacts. Bases shall be installed on an industry standard, 4" square or octagonal electrical outlet box.

1. Where selective localized control of electrical devices is required for system operation, furnish and install detector base with software programmed addressable relay integral to the base. The relay shall switch electrical loads within relay ratings, as indicated on the drawings. Operation of the addressable control circuit shall be independent of the number of detectors and relays on the circuit or the number in an alarm state. Relay bases shall be rated for resistive or inductive load (120VAC or 30VDC) 3 amps.

2. Where indicated on the drawings, furnish detector base with integral approved audible evacuation alarm signal having an output of 85db. The audible signal shall be individually addressable and software programmed for operation.

D. Duct Smoke Detectors: Photoelectric type complying with standards.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a) Primary status.

b) Device type.

c) Sensor range (normal, dirty, etc.).

3. Each sensor shall have preferably multiple levels of detection sensitivity.

4. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

2.6 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

1. The Horn or horn/strobe appliance as indicated on the drawings shall be a synchronized temporal horn with a synchronized strobe light with multiple candela taps to meet the intended application. The appliance shall be red or white as indicated on the drawings. The strobe light taps shall be adjustable for 15/75, 30/75, 75, and 110 candela. The appliance shall be red for wall mounted and white for ceiling mounted. Ceiling mounted appliances shall be rated for that application.

2. The electronic chime or chime/strobe as indicated on the drawings shall be a speaker with a tone card and have and adjustable range of 700 to 1300 Hz. The chime or chime/strobe shall be adjustable for either single stroke or continuous operation. The chime/strobe shall be available with adjustable strobe intensities of 15, 30, 75, and 110 candela. The appliance shall be red for wall mounted and white for ceiling mounted. Ceiling mounted appliances shall be rated for that application.

3. The strobe only appliance as indicated on the drawings shall be a synchronized strobe light with multiple candela taps to meet the intended application. The strobe light taps shall be adjustable for 15, 30, 75, and 110 candela. The appliance shall be red for wall mounting and white for ceiling mounted. Ceiling mounted appliances shall be rated for that application.

4. Where required provide a 10” bell where indicated on drawings to be connected to a non-silenceable circuit for activation of the sprinkler system.

5. An alarm extender panel shall be provided where needed. The power supply shall be a minimum of 6 amps. The power supply shall contain four supervised notification circuits maximum of 3 amps each circuit. The power supply shall contain built-in synchronizing modules for strobes and audible. There shall be a 3 amp filtered auxiliary power limited output. There shall be a minimum of 8 options as to the operations of the inputs and outputs.

6. Mounting: Wall mounted unless otherwise indicated. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.

7. Flashing shall be in a temporal pattern, synchronized with other units. Strobe Leads: Factory connected to screw terminals. Mounting Faceplate: Factory finished, red colored.

2.7 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.

1. Electromagnet: Requires no more than 3 W to develop 111-N holding force.

2. Wall-Mounted Units: Flush mounted unless otherwise indicated.

3. Rating: 24-V ac or dc.

4. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.8 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Surface cabinet

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

C. The remote annunciator shall be either a system display or a graphic display as indicated on the drawings.

D. The System Status Display shall be a 4-line 40-character display with backlit screen for easy viewing. The module shall be connected to the network allowing it to be placed any where on the system. The system display shall have local sounder with silence control, local acknowledgement, local scrolling. E. The graphic annunciator design and layout shall be submittal to the user for approved prior to

construction. The graphics annunciator shall be a Brushed Stainless Steel cover with hinged door. The LED's shall be driven from a module with a minimum of 16 outputs, and connected to a system network.

2.9 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, UL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall, to circuit-breaker shunt trip for power shutdown.

2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture one telephone line and dial a preset number for a remote central station. When contact is made with central station, signals shall be transmitted.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Programming device.

2. LED display.

3. Manual test report function and manual transmission clear indication.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.

2. Address of the supervisory signal.

3. Address of the trouble-initiating device.

4. Loss of ac supply or loss of power.

5. Low battery.

6. Abnormal test signal.

7. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: System should preferably conduct automatically every 24 hours. Manufacturer to give confirmation while technical offer.

3.0 EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Equipment Mounting: Install fire-alarm control unit on concrete base with tops of cabinets not more than 1830 mm above the finished floor.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 450-mm centers around the full perimeter of concrete base.

2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 1830 mm above the finished floor.

D. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.

3. Expand, modify, and supplement existing control and/or monitoring equipment as necessary to extend existing control and/or monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

E. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.

2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.

3. Smooth ceiling spacing shall not exceed 9 m.

4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A or Appendix B in NFPA 72.

5. HVAC: Locate detectors not closer than 1.5 m from air-supply diffuser or return-air opening.

6. Lighting Fixtures: Locate detectors not closer than 300 mm from any part of a lighting fixture.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

G. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

H. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

I. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

J. Audible Alarm-Indicating Devices: Install not less than 150 mm below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

K. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 150 mm below the ceiling.

L. Device Location-Indicating Lights: Locate in public space near the device they monitor.

M. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 1830 mm above the finished floor.

N. Annunciator: Install with top of panel not more than 1830 mm above the finished floor.

3.2 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are standardized for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 1 m from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.

2. Alarm-initiating connection to elevator recall system and components.

3. Alarm-initiating connection to activate emergency lighting control.

4. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.

5. Supervisory connections at valve supervisory switches.

6. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.

7. Supervisory connections at elevator shunt trip breaker. 8. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.

9. Supervisory connections at fire-pump engine control panel.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified.

B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE or equivalent standard. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

A. All Alarm Initiating Devices shall be observed and logged for correct zone and sensitivity. These devices and their bases shall be tagged with adhesive tags located in an area not visible when installed, showing the initials of the installing technician and date.

B. Wiring runs shall be tested for continuity, short circuits and grounds before system is energized. Resistance, current and voltage readings shall be made as work progresses.

C. A systematic record shall be maintained of all readings using schedules or charts of tests and measurements. Areas shall be provided on the logging form for readings, dates and witnesses.

D. The acceptance inspector shall be notified before the start of the required tests. All items found at variance with the drawings or this specification during testing or inspection by the acceptance inspector shall be corrected.

E. Test reports shall be delivered to the acceptance inspector as completed.

F. The installing contractor shall make instruments, tools and labor required to conduct the system tests available.

G. The following equipment shall be a minimum for conducting the tests:

1. Ladders and scaffolds as required to access all installed equipment.

2. Multimeter for reading voltage, current and resistance.

3. Two way radios, and flashlights.

4. Decibel meter.

H. In addition to the testing specified to be performed by the installing contractor, the installation shall be subject to test by the Engineer of Record.

3.6 ACCEPTANCE TESTING:

A. A written acceptance test procedure (ATP) for testing the fire alarm system components and installation will be prepared by the engineer in accordance with NFPA 72 and this specification. The contractor shall be responsible for the

performance of the ATP, demonstrating the function of the system and verifying the correct operation of all system components, circuits, and programming.

B. A program matrix shall be prepared by the installing contractor referencing each alarm input to every output function affected as a result of an alarm condition on that input.

C. The installing contractor prior to the ATP shall prepare a complete listing of all device labels for alphanumeric annunciator displays.

D. The acceptance inspector shall use the system record drawings in combination with the documents specified under paragraph 3.01 during the testing procedure to verify operation as programmed. conducting the ATP, the acceptance inspector shall request demonstration of any or all input and output functions.

E. The items tested shall include but not be limited to the following:

1. System wiring shall be tested to show the following results and the system subsequence operation:

Open, Shorted or Grounded Circuits.

Primary and Battery power disconnected.

2. System notification circuits and appliances operate as programmed. Audibility and Visual levels meet required standards.

3. System shall demonstrate the correct messages at the FACP and Remote Annunciator.

4. System off site reporting shall be verified for alarm, supervisory and trouble.

5. System shall be tested for stand-by battery backup as outline in this specification.

F. Field tests shall be witnessed by client, owner, LICI and relevant authorities.

G. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

a) Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.

b) Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

2. Test audible appliances for the public operating mode according to manufacturer's written instructions.

3. Test audible appliances for the private operating mode according to manufacturer's written instructions.

4. Test visible appliances for the public operating mode according to manufacturer's written instructions.

5. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

H. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

I. Fire-alarm system will be considered defective if it does not pass tests and inspections.

J. Prepare test and inspection reports.

K. Maintenance Test and Inspection: Perform tests and inspections listed for monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

L. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

24.0 TECHNICAL SPECIFICATIONS FOR SIGNAGE

BOQ SPECIFIED:

ACP Background Board

Scope of work:

This work includes supply, installation, testing and commissioning ACP Background board on building top of specified size, to be installed in the same on the locations as specified in detailed drawings and as per Architect/ Engineer-in-Charge.

Material & Workmanship:

ACP Background board shall be of required thickness, smooth matt finish, illuminated with yellow and blue led and face glow letters above it. The frame shall be offset from the glazing and shall be supported by the floor beams on Terrace and Terrace Floor. The peripheral gap space between front side and the backing shall also be covered with acrylic sheets, having a width of 500 to 700 mm. Aluminium framework and inclusive of two coats of primer and anti-corrosive paint. Complete for all height, levels, floors in all shapes as per the Architectural drawings and directions of engineer-in-charge. The Work shall be carried out as per manufacturer's instructions, detailed drawings and Architect/EIC instructions.

Mode of Measurement & Payment:

The rate shall include all materials, tools, plants and labour involved in satisfactory completion of work as prescribed above. Rate to include cost of steel framework, Aluminium framework and inclusive of two coats of primer and anti-corrosive paint. The Measurement of the item shall be per Sqm. basis.

Box Type Metal Letter

Scope of work:

This work includes supply, installation, testing and commissioning Box type metal letter on Entrance of the building of specified size, to be installed in the same on the locations as specified in detailed drawings and as per Architect/ Engineer-in-Charge.

Material & Workmanship:

Box type metal letters forming composite box made from 1mm thick stainless steel plate of grade 304 shall be of colour finish of approved colour by consultant /client. The frame shall be offset from the glazing and shall be supported by the floor beams on Terrace and Terrace Floor. The peripheral gap space between front side and the backing shall also be covered with acrylic sheets, having a width of 500 to 700 mm. Aluminium framework and inclusive of two coats of primer and anti-corrosive paint. Complete for all height, levels, floors in all shapes as per the Architectural drawings and directions of engineer-in-charge. The Work shall be carried out as per manufacturer's instructions, detailed drawings and Architect/EIC instructions.

Mode of Measurement & Payment:

The rate shall include all materials, tools, plants and labour involved in satisfactory completion of work as prescribed above. Rate to include cost of steel framework, Aluminium framework and inclusive of two coats of primer and anti-corrosive paint. The Measurement of the item shall be per Sqm. basis.

Back Painted Toughen Glass of 8mm thickness, chrome finished in Signage Board

Scope of work:

This work includes supply, installation, testing and commissioning Back Painted toughen glass of 8mm thickness, chrome finished in Signage Board on Entrance of the building of specified size, to be installed in the same on the locations as specified in detailed drawings and as per Architect/ Engineer-in-Charge.

Material & Workmanship:

Back Painted toughen glass of 8mm thickness, chrome finished in Signage Board. Glazing clips, S.S Struds of approved shade etc. Size & Height of glass shall be 600 mm X 450 mm & 50 mm respectively. Complete for all height, levels, floors in all shapes as per the Architectural drawings and directions of engineer-in-charge. The Work shall be carried out as per manufacturer's instructions, detailed drawings and Architect/EIC instructions.

Mode of Measurement & Payment:

The rate shall include all materials, tools, plants and labour involved in satisfactory completion of work as prescribed above. The Measurement of the item shall be per Sqm. basis.

Lift Signage- Stainless Steel Plate

Scope of work:

This work includes supply, installation, testing and commissioning Stainless steel plate for Lift Signage of the building of specified size, to be installed in the same on the locations as specified in detailed drawings and as per Architect/ Engineer-in-Charge.

Material & Workmanship:

Stainless steel plate of grade 304 having 2.5 mm thick (brush finish) shall be used with back side LED light of approved colour by Architect/EIC. Size of plate shall be 600 mm X 450 mm. The size of Laser cut fonts arrows or logo shall be as per drawing. Complete for all height, levels, floors in all shapes as per the Architectural drawings and directions of engineer-in-charge. The Work shall be carried out as per manufacturer's instructions, detailed drawings and Architect/EIC instructions.

Mode of Measurement & Payment:

The rate shall include all materials, tools, plants and labour involved in satisfactory completion of work as prescribed above. The Measurement of the item shall be per Sqm. basis.

Toilet Signage- Stainless Steel Plate

Scope of work:

This work includes supply, installation, testing and commissioning Stainless steel plate for Toilet Signage of the building of specified size, to be installed in the same on the locations as specified in detailed drawings and as per Architect/ Engineer-in-Charge.

Material & Workmanship:

Stainless steel plate of grade 304 having 2.5 mm thick (brush finish) shall be used. Size of plate shall be 250 mm X 60 mm. The height of the laser cut fonts arrows or logo shall be as per Drawing. Complete for all height, levels, floors in all shapes as per the Architectural drawings and directions of engineer-in-charge. The Work shall be carried out as per manufacturer's instructions, detailed drawings and Architect/EIC instructions.

Mode of Measurement & Payment:

The rate shall include all materials, tools, plants and labour involved in satisfactory completion of work as prescribed above. The Measurement of the item shall be per Sqm. basis.

Toilet Signage- Stainless Steel Plate

Scope of work:

This work includes supply, installation, testing and commissioning Stainless steel plate for Toilet Signage of the building of specified size, to be installed in the same on the locations as specified in detailed drawings and as per Architect/ Engineer-in-Charge.

Material & Workmanship:

Stainless steel plate of grade 304 having 2.5 mm thick (brush finish) shall be used. Size of plate shall be 180 mm X 180 mm. The height of the laser cut fonts arrows or logo shall be as per Drawing. Complete for all height, levels, floors in all shapes as per the Architectural drawings and directions of engineer-in-charge. The Work shall be carried out as per manufacturer's instructions, detailed drawings and Architect/EIC instructions.

Mode of Measurement & Payment:

The rate shall include all materials, tools, plants and labour involved in satisfactory completion of work as prescribed above. The Measurement of the item shall be per Sqm. basis.

All Rooms Signage- Stainless Steel Plate

Scope of work:

This work includes supply, installation, testing and commissioning Stainless steel plate for all Rooms & Water tank Signage of the building of specified size, to be installed in the same on the locations as specified in detailed drawings and as per Architect/ Engineer-in-Charge.

Material & Workmanship:

Stainless steel plate of grade 304 having 2.5 mm thick (brush finish) shall be used. Size of plate shall be as per detailed drawings and Architect/EIC instructions. The height of the laser cut fonts arrows or logo shall be as per Drawing. Complete for all height, levels, floors in all shapes as per the Architectural drawings and directions of engineer-in-charge. The Work shall be carried out as per manufacturer's instructions, detailed drawings and Architect/EIC instructions.

Mode of Measurement & Payment:

The rate shall include all materials, tools, plants and labour involved in satisfactory completion of work as prescribed above. The Measurement of the item shall be per Sqm. basis.

25.0 Technical Specification For Automatic Boom Barrier

Scope of work:

The scope of work includes providing & laying Automatic Boom Barrier, inclusive of all labours and materials. The work shall be carried out as per manufacturer's instructions, detailed drawings and Architect/EIC instructions.

Material & Workmanship:

Automatic Boom Barrier, Waterproof& protection- IP54 Barrier Body and IP65 for controller, Maximum Boom Length - upto 6000 mm, Max Power Consumption 120 W at peak, Power Supply - 230 VAC, 24 VDC, 50/60 Hz, Opening & Closing Time - 1.5 Secs for Up to 3 meters & 4 to 6 Sec. for up to 6 meters, 100% Duty cycle, Weight (without boom) - 64 Kg, Opening Temperature range is -20 to 50 centigrade. Housing - Mild Steel with Zinc coating (inside out) plus Anti-corrosion treatment, Housing Dimensions- 350mm*250mm*1070mm, Housing Base Frame-Mild Steel. The barrier should be UL Listed with 1 Year Warranty should have capability to integrate with Above Access Control reader and Card Refer Specs for further details. Certificates Required -TUV certificate for Opening & Closing time ISO Certificate of the Company, Certification for Ingress Protection, EMC Test report according to manufacturer instructions, detailed drawing and Architect/EIC instructions.

Technical Specification of Automatic Boom Barrier

Sr. No.	Description	Specifications
1.	Duty Cycle	100%
2.	Mechanism	Electro-mechanical
3.	Maximum Boom Length	Up to 6000 mm
4.	Opening/Closing Time	≤ 1.5 Sec. for Up to 3 meters & up to 4 to 6 Sec. for up to 6 meters
5.	Power Supply	230 VAC,24 VDC 50/60 Hz
6.	Power Consumption	120 W
7.	Housing	Mild Steel with Zinc coating (inside out) plus Anti-corrosion treatment
8.	Housing Dimensions	350mm*250mm*1070mm
9.	Housing Base Frame	Mild Steel
10.	Operative Options	Push Button & Remote Control
11.	In case of Power Failure	Open/Close options with mechanical handle
12.	Water Proof & Protection	IP54 for Barrier Body and IP65 for controller (Inside barrier Body)
13.	Safety Features	Warning Lights/ Traffic Lights (Optional)
14.	Life Cycle	One Year Warranty
15.	Weight (without Boom)	64 kg
16.	Opening temp. range	-20 to 50 degree centigrade
17.	Drive	Torque Motor
Controller Unit		

18.	Voltage (+/- 10%)	100-240v
19.	Frequency	50-60Hz
20.	Maximum Power Consumption	20watts
21.	Fuse	2Ah
22.	Control Voltage	12v
23.	No. of input Channels	06
24.	No. of Open collector output	02

Rate:

The contractor unit rate for Automatic Boom Barrier shall be payment in full compensation of furnishing all labour, materials, tools, equipment, including all incidental costs necessary for carrying out the work at the site confirming to these specifications complete as per the approved drawing(s) or as directed by the engineer and other incidental cost necessary to complete the work to these specifications.

26.0 Technical Specifications for Solar Water Heating System

Scope Of work

Minimum capacity of solar water heating system should be met the Green Building Criteria. So EPC contractor will design the same as per requirements in the scope of work. The FPC based systems will be from BIS approved manufacturers and ETC/ Heat pipe based systems from MNRE approved manufacturers/suppliers. The Systems will have the following minimum requirements for installation

General Requirements

i) System will be well grouted/ clamped with collectors installed so as to enable it to sustain the highest wind pressure of that area.

ii) All the collectors will be south facing inclined at suitable angle to give best performance in winter

iii) There will not be any shadow falling on the collectors from nearby structures or of other collectors in front or back row

iv) Hot water pipe lines of any kind in colder regions will be fully insulated from the point of drawl of water from tank to delivery points. In other regions also care will be taken to avoid heat losses from pipelines.

v) System will be installed nearest to the point of hot water usage to avoid longer pipeline & higher heat losses.

vi) Where water quality is bad either FPC based systems with Heat Exchanger or ETC based systems will be installed.

vii) The workmanship & aesthetics of the system will be good and it should be visible to anybody viii) Air vent pipe, make up water and cold water tanks will be installed as required for smooth functioning of the system

ix) There won't be any leakage observed in the system from tanks/ collectors/ pipelines

x) No electric back up will be provided in hot water storage tank at places where electric geysers are already installed. At places where electric geysers are not

installed, electric back up could be provided in upper portion of storage tank, if necessary.

Technical Requirements

Flat Plate Collectors : ISI mark (2 sq. m. absorber area for 100 liter tank capacity system in colder region and 125 liter for other regions)

Evacuated Tube Collectors/ Heat pipes

Type of tubes 3 layer solar selective (Inner layer of copper coating should be visible). Detailed specifications of tubes will be as per the guidelines laid down by MNRE for empanelment of manufacturers of ETC based systems & made available at MNRE website

No. of tubes in a system To have minimum 1 ½ sq. m. of absorber area for 100 liter tank capacity system. Absorber area will be calculated as follows:

Area in Meter = Number of tubes X Radius in Meter X Length in Meter.

Accordingly, 14 tubes of Dia : 47 mm & length : 1500 mm and

10 tubes of Dia 58 mm & length : 1800 mm will be required for each 100 lpd system.

For higher capacity systems, the no. of tubes calculated as per above could be slightly less.

For details, please refer to MNRE Circular no. 25/5/2009-10/ST dated 2nd March, 2010. Procurement : From reputed supplier (Details of supplier to be provided)

Storage Tanks, Piping, Support structure etc (To be all indigenous & not imported)

Inner tank material : SS 304 or 316 grade min/ MS or any other material with anticorrosive coating for hard water with chlorine contents.

Inner tank thickness : For SS minimum thickness will be 0.5 mm when using argon arc or metal inert gas for welding and 0.8 mm when using other type of welding. For MS minimum thickness will be 1.5 mm. No leakage under any kind of negative or positive pressure of water will be ensured.

Inner tank welding : TIG / Seam/ pressurized weld (Open arc weld not permitted)

Storage tank capacity : Not less than system capacity. In case of ETC based system, volume of tubes & manifold not to be included in tank capacity.

Thermal insulation : Minimum 50mm thick with CFC free PUF having density tanks & hot water piping of 28-32 kg per Cu.mtr. For regions with sub zero temperatures, it will be doubled.

Outer cladding & Frames : Al/SS/FRP or GI powder coated. MS may also be used with special anti-corrosive protective coatings

Valves, cold water tank : ISI mark or standard make vent pipe, heat exchanger, make up tank & measuring instruments

Support structure for pipng, tanks etc. : Of non corrosive material or have corrosion resistant Collectors, protective coating. They will be strong enough to sustain their pressure during the lifetime of system.

Scope will include if any latest amendment has come and it should be comply to BIS / MNRE / Green Building standard.

STANDARDS & CODES

ELECTRICAL CODE OF PRACTICE

The following ISI code of practice for providing and installation of the electrical items shall be deemed. Any deviation from the code should be approved from the Electrical Inspector.

- ISI 694: PVC insulated cables for working voltages upto and including 1100 Volts.
- ISI 1554: PCV insulated (heavy duty) (part-I) electric cables for working voltages upto and including 1100 V.
- ISI 1554: PVC insulated (Heavy duty) electric (PART-I) cables for working voltages from 3.3 KV upto and including 11 Kv.
- ISI 2551 : Danger notice plates.
- ISI 3043 : Earthing
- ISI 5578 : Guide for marking of insulated conductors.
- ISI 5216 : Guide for safety procedures and practices in electrical works.
- ISI 3072 : Installation and maintenance of switch gears.
- ISI 1886 : Installation & maintenance of transformers.
- ISI 1944 : Lighting of Public thoroughfares.
- ISI 2309 : Protection of building and allied structures against lighting.
- ISI 3106 : Selection, installation and maintenance of fuses (Voltages no exceeding 650 volts).
- ISI 8923 : Warning symbol for dangerous voltages. HRC cartridge fuse links upto 650 V.
- ISI 8724 : Re-wireable fuses upto 650 V.
- ISI 10118: Switchgear and control gear, selection
- IS : 325 : Three Phase Induction Motors
- IS : 694 : PVC insulated cables for working voltages upto& including 1100 V

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- IS : 779 : Specification for water meters (domestic type).

- IS : 782 : Specification for caulking load
- IS : 800 : Code of practice for general construction in steel

- IS : 1068 : Electroplated coatings of nickel plus chromium and copper plus nickel plus chromium.
- IS : 1367 (Part 1) : Technical supply conditions for threaded steel fasteners: Part 1 introduction and general information.
- IS : 1367 (Part 2) : Technical supply conditions for threaded steel fasteners: Part 2 product grades and tolerances.
- IS : 1554 (Part 1) : PVC insulated (heavy duty) electric cables: Part 1 for working voltages upto and including 1100 V.
- IS : 1554 (Part 2) : PVC insulated (heavy duty) electric cables: Part 2 for working voltages from 3.3 KV upto and including 11 KV.

TRANSFORMERS & HT INSTALLATION

The OIL TYPE TRANSFORMER shall comply with the applicable clauses of the latest editions of the following standards. In case of any conflict, the requirements of this standards shall prevail.

- IS: 1271 : Classification of Insulating Materials
- IS: 3639 : Power Transformer - Fittings and Accessories
- IS: 2025(Part I to IV) : Power Transformers
- IS: 11171 : Specifications for dry type power transformer
- IEC : 726 : Dry type Power Transformer
- CBIP Specifications : Power & Distribution Part-II Transformers.
- IS : 2099 : Bushing for alternating voltages above 1000 volts.
- IS : 2705 : Current transformers
- IEC : 76 : Power transformers.
- IEEE : Std. 141 : Recommended Practice for Electrical Power Distribution for Industrial plants
- IS : 3202 : Code of practice for climate proofing of electrical equipment.

IS No.	**Description**
IS: 2026-1977-1981 -1994	Distributing transformers & fittings
IS 3639-1966	Fittings and acc. For P.T
IS10028-Part III - 1981	Installation of Transformer
IS: 13118-1991	Specification for AC circuit breakers
IS: 335-1993	Insulating oil for Transformers & switch gear
IS: 2705-1992	CT for measuring and protection

IS: 3155-1992	Voltage (Potential) Transformers.
IS: 3155-1992	Voltage Transformer
IS:8623 -Part II, 1993	Bus-bar arrangement and marking
IS:2099 -1986	Bushing
IS:5621 -1980	Large Hollow Porcelains Insulator
IS:2544-1973	Insulators
IS:2629-1985 IS:2633-1986	Hot Dip Galvanizing
IS: 3842-1967	Relays
IS: 1248-2003	Meters (measuring)
IS: 10118-1982	Installation of Switch gears.
IS: 692-1994	HV cable
IS: 1255 -1983	Installation of HV cables and jointing
IS: 3043-1987	Code of practice for earthing
IS:13947-Part III-1993	HD Air breaker, Switch gears and fuses voltage not exceeding 1000 Volts
IS:13703-Part IV-1993	Selection, installation and maintenance of fuses up to 650 Volts
IS:13947-Part I-1993	General requirements for switch gear and control gear for voltage not exceeding 1000 volts
IS: 13947-Part III, -1993	Air-break isolators for Voltage not exceeding 1000 Volts
IS:8623-1993	Factory built assemblies of switch gears and control gears for voltage up to and including 1000 Volts A.C. and 1200 Volts D.C
IS:11353-1985	Marking and arrangement of switch gear bus bars main connectors and auxiliary wiring
IS: 2147-1962	Cubical Boards.
IS: 8084-1976	Insulated conductor rating
IS: 2675-1983	Enclosed distribution fuse boards and cutouts

	for Voltage not exceeding 1000 Volts.
IS: 8828-1995	Miniature Circuit Breaker
IS: 9926-1981	Fuse wire used in rewirable type electric fuses up to 650 Volts
IS: 1554-Part I, 1998	PVC insulated electric cables Heavy duty
IS: 3961-Part II, 1967	Recommended current rating for cables
IS: 8130-1984	Copper conductor in insulated cables and cores
IS: 8130-1984	Conductor for insulated electric cables and flexible cords
IS: 3975-1999	Mild steel wires, strips and tapes for armoring cables
IS: 5831-1984	PVC insulation and sheath of electric cables
IS: 8130-1984	Aluminum conductor for insulated cables
IS: 11955-1987	Recommended current rating for Cable.
IS: 732-1989	Code of practice for electrical wiring installation system Voltage not exceeding 650 Volts.
IS: 1646-1997	Code of practice for fire safety of Buildings (general) electrical installation
IS: 9537-1981	Rigid steel conduits for electrical wiring
IS: 2667-1988	Fittings for rigid steel conduits for electrical wiring
IS: 3480-1966	Flexible steel conduit for electrical wiring
IS: 3837-1976	Accessories for rigid steel conduits for electrical wiring
IS: 694-1990	PVC insulated cables (wires).
IS: 9537-Part III, 1983	Rigid non-metallic conduits for electrical wiring
IS: 6946-1973	Flexible (playable) nonmetallic conduits for electrical installation

IS: 1293-2005	Three pin plugs and sockets
IS: 8130-1984	Conductors for insulated electrical cables and flexible codes
IS: 9537-1980	Specification for conduit for electrical installation
IS: 3419-1988	Accessories for non-metallic conduits for electrical wiring
IS: 3854-1997	Switches
IS: 6538-1971	Plugs
IS: 13925-Part I, 1998	Shunt Capacitors for power systems
IS: 9385-1979	HRC cartridge fuse and links up to 660 volts
IS: 1913-1978	General and safety requirement for lighting fittings
IS: 1944-1981	Code of practice for lighting public thorough fares
IS: 3528-1966	Waterproof electric lighting fittings
IS: 3553-1966	Water tight electric lighting fitting
IS: 1239-Part I, 2004	Mild Steel tubular and other wrought steel pipe fitting
IS: 10322-Part V, 1987	Luminaries for street light
IS: 93703-Part III, 1993	HRC fuses having rupturing capacity of 90 KA
IS: 2312-1967	Exhaust Fan
IS: 374-1979	Class I Ceiling Fan
IS: 7098 (Part I, II, III), -1985&86	XLPE armoured Cables
IS:7098 (Part I&II)	XLPE armoured Cables

SWITCH GEAR SYTEMS

- IS-2516: Circuit Breakers
- IS-2705: Current Transformer

- IS-3156: Potential Transformer
- IS-9385: High voltage fuses
- IS-6875: Control switches
- IS-1248: Electrical Direct acting indicating instruments
- IS-722: AC electricity Meter of Induction type
- IS-3231: Electrical Relays
- IS-2147: Degree of protection provided by enclosures for low voltage switch gear and control gears.
- IS-375: Marking and arrangement for switchgear, bus bars, main connection and auxiliary wiring.
- IS-9224 : Low voltage fuses.
- IEC 62271-1 Common Specifications for Switchgear & Control gear
- IEC 62271-100 Circuit Breakers
- IEC 62271-200 A.C. metal-enclosed switchgear and control gear for rated voltages above 1kV and up to and including 72kV
- IEC Code herein referred
- IEC 60129 Alternating current disconnectors (isolators)
- IS 2705 Current transformers IS 3156 Voltage transformers
- IEC 60255 Electrical relays
- IEC 60529 Classification of degrees of protection provided by enclosures
- Any other codes recognized in the country of origin of equipment might be considered provided that they fully comply with Indian Electricity code.

NOMINAL VOLTAGE HT TR - XLPE POWER CABLES

IS:8130 – 1984	Conductors for insulated electric cables and flexible cords.
IS:7098 (Part 2)/ 1985	Cross linked Polyethylene (XLPE) Insulated PVC sheathed cabl for working voltages from 3.3 kV up to and including33kV
IS:5831 – 1984	PVC insulation and sheath of electric cables.
IS:3975 – 1988	Mild steel wires, Formed wires and Tapes for armoring of cable
IS:0462 (Part I)/1983	Fictitious calculation method for determination of dimensions protective coverings of cables
IEC 60502-2	Cables for rated voltages from 6 kV (Um = 7,2 kV) up to 30 kV (Um = 36 kV)
ANSI/ICEA S-94 649:2004	Standard for concentric neutral cables rated 5 through 46KV

- IS-8130-1984 - Conductors of Insulated Cables.
- IEC-230 - Impulse Tests on cables and their accessories.
- IEC-502 - Extruded Solid Dielectric-Insulated Power Cables for rated voltage from 1 KV up to 30 KV.
- IEC-540 - Test Methods for Insulation and Sheaths of Electric cables and chords.
- IEC-229 - Test on Cable over sheaths which have a special protective functions and are applied by extrusion.
- IEC-287 - Calculation of continuous current rating of cables (100% load factor).
- IS-708(part-II) - Cross linked polyethylene insulated PVC sheathed cable for voltage from 3.3 KV upto 33 KV.
- IS-5831-1984 - PVC insulation & sheath for electrical cables.
- IS-3975 - Mild steel wires / strips and tapes for armouring of cables.
- IEC-885(2)-1987 - Electrical test methods for electric cables part-II partial discharge test.
- IS-10810 - Methods of test for cables.
- IEC-811 - Common test methods for insulating and sheathing materials of electric cables. IEC-230 - Impulse test on cables & other accessories.
- IEC-859 - Cable termination for gas insulated switchgear.

LT SIDE INSTALLATION

MV SWITCHGEAR & POWER PANELS

- IS : 4237 :General requirements for switch gear and control gear for voltage not exceeding 1000 v.
- IS : 375 :Switchgear bus-bars, main connection and auxiliary wiring, marking and arrangement.
- IS : 2147 :Degree of protection provided by enclosures for low voltage switch gear and control gear.
- IS : 8197 :Terminal marking for electrical measuring instrument and their accessories.
- IS : 2557 :Danger notice plates.
- IS : 2516 :Specification for AC circuit breaker.
- IS : 1818 :Specification for AC isolator and earthing switch.
- IS : 3072 :Code of practice for installation and maintenance of switchgear.
- IS : 8623 :Specification for factory built as symbolize of switch gear and control gear for voltage up to and including 1000v. A.C.& 1200 v. D.C.
- IS : 8828 :Miniature Circuit Breaker.
- IS : 4064 :Fuse switch and switch fuse unit.
- IS : 9224 :HRC fuse unit.
- IS : 2705 :Current transformer.
- IS : 3155 :Voltage transformer.
- IS : 3231 :Electrical relay for protection.
- IS : 1248 :indicating instrument.
- IS : 722 : Integrating instrument.
- IS : 6875 :Control switches & push buttons.
- IS : 2959 :Auxiliary contactor.
- IS : 1822 :AC motor starters of voltage not exceeding 1000V.
- IS : 13947 :Switch Board General Requirement

WIRING SYSTEMS

- IS : 732 Code of practice for electrical wiring installation (System voltage not Exceeding 1100 V).
- IS : 1646 Code of practice for fire safety of buildings (General) Electrical installation.
- IS : 9537 Conduits for Electrical installations (Part 1-4)
- IS : 2667 Fittings for rigid steel conduits for electrical wiring.
- IS : 3480 Flexible steel conduits for electrical wiring.
- IS : 3837 Accessories for rigid steel conduit for electrical wiring.
- IS : 694 PVC insulated cables.
- IS : 6946 Flexible (Pliable) non-metallic conduits for electrical installation.
- IS : 1293 Plugs and sockets outlets of rated voltage upto and including 250V.
- IS : 8130 Specifications for conduits for electrical installation.
- IS : 3854 Switches for domestic and similar purposes.
- IS : 3419 Fittings for rigid non-metallic conduits.
- IS : 4648 Guide for electrical layout in residential building.
- IS : 4649 Adopters for flexible steel conduits.
- IS : 5133 Boxes for enclosures of the Electrical.
- IS : 4615 Switch socket outlets.
- IS : 8884 Code of practice for installation of Electric bells and call system.
- IS : 2551 Electric Danger notice plates.
- IS : 3646 Code of practice for interior illumination.
- IS : 371 Ceiling Roses.
- IS : 302 General and safety requirements for household and similar electrical appliances.
- IS : 3043 Code of practice for earthing.
- IS : 5216 Guide for safety procedures and practices in electrical work. Indian Electricity Act and Rules. Regulations for the electrical equipment in buildings issued by the concerned Electrical Authorities.

PANELS

- IS 13947 L.V. switchgear and control gear Part-I - 1993 General rules
- IS 5578-85 Guide for marking of insulated conductors.
- IS 11353-85 Guide for uniform system of marking and identification of conductors and apparatus terminals.
- IS 2147-62 Degree of protection provided by enclosures for low voltage switch gear and control gears.
- IS 2675-83 Enclosed distribution fuse boards and cutouts for Voltages not Exceeding 1000 V.
- IS 2551-82 Danger notice plates.
- IS 13947-1993 Circuit breakers. (Part-II)
- IS 13947-1993 Switches, Disconnectors, switch disconnector (Part - III) and fuse combination units.
- IS 1818-72 Alternating current isolators (disconnectors) and earthing switches.
- IEC 61439 Low Voltage Switchgear and Control Gear Assemblies
- IS 8828 Miniature air break circuit breakers for voltages not exceeding 1000V.

- IS 9926 Fuse wires used in rewritable type Electric fuses up to 1100 Volts.
- IS 2208 HRC fuse links
- IS 2705 Current Transformers (Part- I, II & III)
- IS 3156 Voltage Transformers (Part- I, II & III)
- IS 1248 Indicating Instruments
- IS 722 Integrating Instruments
- IEC 60947 Control devices and switching elements. (Part - 5) Section-1
- IEC 60947 Contactors and motor starter section 1 (Part4) Electromechanical.Section- 1
- IS 3231 Relays
- IS 375 Marking and arrangement of bus bars Indian Electricity Act and Rules.

CONDUIT SYSTEM, CABLE TRAY, CABLE LADDER AND TRUNKING

IS-9537/1983 (Part-III)/BS6099 & BS4607	PVC Conduit and Fitting Accessories
BS729	Cable Tray
BS729	Cable Ladder
IS:458	Precast Concrete Pipe (with & without reinforcement)- Specification
IS:513	Cold rolled low carbon steel sheets and strips – Specification.
IS:802 Part II	Code of practice for use of structural steel in overhead transmission line towers
IS:808	Dimension for hot rolled steel beam, channel and angle sections
IS:1079	Hot rolled carbon steel sheets and strips - Specification
IS:1367 (Part-1)	Technical supply conditions for threaded steel fasteners. :General requirements for bolts, screws and studs
IS:1367 (Part-13)	Technical supply conditions for threaded steel fastners :Hot dip galvanised coatings on threaded fasteners.
IS:2062	Steel for general structural purposes - Specification
IS:2629	Recommended practice for hot dip galvanizing of iron and steel.
IS:2633	Method for testing uniformity of coating on zinc coated articles
IS 4759	Hot-Dip Zinc Coatings on Structural Steel and other Allied Products -

	Specification
IS:6745	Methods for determination of mass of zinc coating on zinc coated iron and steel articles.
IS:3063	Fasteners - single coil rectangular section spring lock washers - Specification.
IS 7318 part-I	Approval test for welders when welding procedure approval is not required.: Fusion welding of steel
IS 7318 part-II	Approval tests for welders when welding procedure approval is not required: TIG or MIG welding of aluminum and its alloys
IS 10748	Hot rolled steel strip for welded tubes and pipes – specification.
ASME (section-IX)	Welding and brazing qualification

WIRES AND CABLES

- IS-3961: Current rating for cables.
- IS-5831: PVC insulation and sheath of electric cables.
- IS-694: PVC insulated cables for working voltage up to and including 1100 volts.
- IEC-54 (I): PVC insulated cable.
- IS: 8130: Conductors for insulated electric cables and flexible cords.
- IS: 5831: HRPVC / HR PVC insulation and LSZH sheath of electric cables.
- IS: 3975: Mild steel wires, strips and tapes for armoring cables.
- IS: 3961: Current rating of cables.

LOW VOLTAGE SWITCHGEAR AND TESTED ASSEMBLY

- IEC61 439-1 & 2: Low Voltage Switchgear Assemblies
- IEC 60 947 /IS 13947: 1993 Low Voltage switchgear & control gear
- IEC 61641: Internal arc

AUTOMATIC TRANSFER SWITCH

- EN 60947-6-1 / IEC60947-6-1: transfer switching
- EN60947 -3 / IEC60947-3: Suitable for Isolation
- EN55022: Radiated and Conducted Emission,Class A
- EN61000-3-2: Harmonic Current Emission, Class A

- EN61000-3-3: Limits of Voltage fluctuation and Flicker
- EN 61000-4-5: Immunity to Surge
- EN 61000-4-4: Immunity to Electrical Fast Transient:
- EN61000-4-2: Immunity to Electrostatic Discharge
- EN61000-4-3: Immunity to Radiated Electric Fields
- EN 61000-4-6: Immunity to Continuous Conducted Interference

LIGHTNING PROTECTION SYSTEM

- IS / IEC 62305-3 & IS 3043 IS/ IEC 62561

SPECIFICATIONS FOR LED LIGHT FIXTURES / LUMINAIRES

- IS: 16102-2 : Ballast type LED lamp performance requirement, lamp and accessories
- IS: 16107-2-1 : Luminaries performance LED luminaries
- IS: 16103-2 : LED modules performance requirements electric lamps and accessories
- IEC 62031 : LED modules for general lighting safety requirements
- EN 61547 : Equipment for general lighting purpose EMC immunity requirement
- IEC 60598-2-1 : Fixed general purpose luminaries
- IEC 60598-1 : Luminaries General requirement and tests
- IEC 61000-3-2 : Electro Magnetic compatibility (EMC) Limits for Harmonic current emission (equipment input current less than or equal to 16 amps per phase)
- IEC 61347-2-13 : Lamp control gear particular requirement or DC and AC supplied electronic control gear for LED modules
- IS: 10322 : Specification or the luminaries
- IS: 4905 : Method for random sampling
- LM 79 : LED luminaire photometry measurement
- LM 80 : Lumen maintenance
- IEC 62384 : DC or AC supplied electronic control gear for LED modules-performance requirement
- IEC / PAS 62612 : Self ballasted LED lamps for general lighting services performance requirement

DG SETS

- IS 1601 : Performance and testing of 1C engines for General purpose.
- BS-649 : Performance and testing of diesel engines for General Purpose.
- IS-4722 : Rotating electrical machines.
- IS-4889 : Method of determination of efficiency of Rotating Electrical machinery.
- IS-6491 : Degree of protection provided by enclosures for Rotating Electrical machinery.
- IS-4729 : Measurement and evaluation of vibration of Rotating Electrical machines.
- AIEE-606 : Recommended specification for speed governing of internal (1959) combustion engine generator units.
- IS-2705 : Current transformers.
- IS-1248 : Electrical indicating instruments.
- ISO-8528 : Reciprocating IC engine driven AC Gensets Section (Part II)

LIFT INSTALLATIONS

List of Indian Standards connected with Lift installations:

IS: 1860 – 1980	:	Code of Practice for installation, operation and maintenance of electric passenger & goods lift.
IS: 6620 – 1972	:	Code of Practice for installation, operation and maintenance of electric service lift.
IS: 4666 – 1968	:	Specification of electric passenger & goods lifts
IS: 6383 – 1971	:	Electric Service lift
IS: 3534 – 1977	:	Outline dimensions for electric lifts
IS: 4591 – 1968	:	Code of Practice for installation, operation and maintenance of escalators.
IS: 2365 – 1977	:	Specification for steel wire suspension ropes for lifts and hoists.
IS: 2363	:	Glossary of terms relating to wire ropes.
IS: 4289 – 1967	:	Specification for lifts cables.
IS: 1591 – 1960	:	Glossary of terms for electrical cables & conduits
IS: 434/1 – 1964	:	Specification for rubber insulated cable.
IS: 3352 – 1965	:	Specification for varnished, cotton cloth & tape for electrical purpose.
IS: 7759 – 1975	:	Specification for lift door locking devices and contacts.
IS: 1173 – 1967	:	Specification for hot rolled and slit steel bars.

(R)		
IS: 7443 – 1974	:	Method of loading rating of worm gear.
IS: 7403 – 1974	:	Code of Practice for selection of standard work & helical gear box.
IS: 4218/ii – 1967	:	Isometrics screw threads.
IS: 2147 – 1962	:	Degree of protection provided by enclosure for low voltage switch gear & control gear.
IS: 2208 – 1962	:	Specification for HRC cartridge fuse links upto 650 volts.
IS: 732 – 1963	:	Code of Practice for electrical wiring installation (system voltage not exceeding 650 volts.)
IS: 585 – 1962	:	Voltage & frequency for AC transmission & distribution system.
IS: 2959 – 1969	:	Specification for AC contractors voltage not exceeding 1000V.
IS: 4047 – 1967	:	Heavy duty air break switches & composite units of air break switches & fuses for voltage not exceeding 1000V.
IS: 4237 – 1967	:	General requirements for switchgears and controller for voltage not exceeding 1000V.
IS: 1822 – 1961	:	Specification for motor starter of voltage upto 650V.
IS: 2332 – 1962	:	Nomenclature of floors &storey.
IS: 1950 – 1962	:	Code of Practice for sound insulation of non-industrial building.
IS: 906 – 1965	:	Code of Practice for installing & maintenance of induction motors.
IS: 325 – 1970	:	Specification of three phase induction motors (R).
IS: 4029 – 1967	:	Guide for testing of three phase induction motors.
IS: 4691 – 1968	:	Specification for degree of protection provided by enclosure for rotating electrical machinery.
IS: 6362 – 1971	:	Designation of method of cooling for rotating electrical machines.
IS: 1271 – 1958	:	Classification of insulating materials for electrical machinery and apparatus in relation to their thermal stability in service.
4566:1980 6335: 1971	:	Safety rules for passenger and Goods Lifts Electric Passenger & Goods Lift. Electric Service Lifts

IS 2315: 1978	:	Thimbles for Wire ropes
IS 2361: 1994	:	Bulldog grips ropes
IS 2485: 1979	:	Prop. Purged Sockets for wire ropes for General Engineering purposes.
IS 3734: 1983	:	Dimensions for Warm gearing.
IS 3937: 1974	:	Recommendations for Socketing of wire ropes.
IS 4190: 1984	:	Eyebolts with Collars
9803: 1981	:	Buffers for Electric Passenger and Goods Lifts.
10191: 1982	:	Car and Counter weight guide rails, guide rail supports and fastenings for lifts
11615: 1986	:	Car and counter weight guide shoes for electric passenger and goods lifts.
11706: 1986	:	General requirements for Car frame for electric passenger and goods lift.
9878: 1981	:	safety gears and Governors for electric passenger and goods lifts.
10448: 1983	:	Retiring Cam for Passenger and Goods Lifts
IS 14665 (Part.2 / Sec 1) 2000	:	Electric traction Lifts. a) Code of practice for installation, operation and maintenance
IS 14665 (Part 3 / Sec. 1 & 2) 2000	:	b) Electric traction safety rules
IS 14665 (Part.4/Sec.3) 2000	:	c) Components of lifts car frame, car counter weight and suspension
IS 14665 (Part.4/Sec.5) 2000	:	d) Lift doors and locking devices and contacts.

The lift installation shall also be governed by the following Acts/Byelaws/Rules/Codes as amended upto date in addition to standards and codes specified in the tender:

1. National Building Code of India – 1983
2. Indian Electricity Act – 2003
3. Indian Electricity Rule – 1956

4. Bombay Lift Act – 1939
5. Patna Govt. Development Control Regulation for Structural Safety against Natural Hazards.

HVAC

LIST OF BUREAU OF INDIAN STANDARDS AND OTHER CODES

- IS : 277 - 1992 Galvanized steel sheet (Plain & Corrugated) wire for fencing.
- IS : 554 - 1985 (Reaffirmed 1996) Dimensions for pipe threads where pressure tight joints are required on the threads.
- IS : 655 - 1963 (Reaffirmed 1991) Metal air ducts.
- IS : 659 – 1964 (Reaffirmed 1991) Air conditioning (Safety Code)
- IS : 660 – 1963 (Reaffirmed 1991) Mechanical Refrigeration (Safety Code)
- IS : 694 - 1990 (Reaffirmed 1994) PVC insulated (HD) electric cables for working voltage upto
- and including 1100 volts.
- IS : 732 - 1989 Code of practice for electrical wiring.
- IS : 780 - 1984 Sluice valves for water works purposes.
- IS : 822-1970 (Reaffirmed 1991) Code of procedure for inspection of welds.
- IS : 1239 (Part - I) - 1990 Mild steel tube
- IS : 1239 (Part - II) - 1992 Mild steel Tubulars and other wrought steel pipe fittings.
- IS : 1255 - 1983 Code of Practice for installation and maintenance of Power Cables upto and including 33 KV rating (Second Revision)
- IS : 1554 - 1988 (Part – I) PVC insulated (Heay Duty) electric cables for working voltages pto and including 1100 volts.
- IS : 1897 - 1983 (Reaffirmed 1991) Copper bus bar / strip for electrical purposes
- IS : 2379 - 1990 Colour code for the identification of pipelines.
- IS : 2551 - 1982 Danger notice plate
- IS : 3043 - 1987 Code of practice for earthing.
- IS : 3103 – 1975 (Reaffirmed 1999) Code of practice for Industrial Ventilation.
- IS : 3837 - 1976 (Reaffirmed 1990) Accessories for rigid steel conduit for electrical wiring.
- IS : 4736 – 1986 (Reaffirmed 1998) Hot-dip zinc coatings on steel tubes
- : 4894 - 1987 Centrifugal Fan.
- IS : 5133 - 1969 (Part-I) (Reaffirmed 1990) Boxes for the enclosure of electrical accessories.
- IS : 5216 - 1982 (Part-I) (Reaffirmed 1990) Guide for safety procedure and practices
- in electrical work.
- IS : 5312 (Part-I) - 1984 (Reaffirmed 1990) Swing - check type reflux Non return valves for water works
- IS : 5424 – 1989 (Reaffirmed 1994) Rubber mats for electrical purposes.
- IS : 5578 & 11353-1985 Marking and identification of conductors
- IS : 6392 - 1971 (Reaffirmed 1988) Steel pipe flanges.
- IS : 8623 - 1993 Low voltage switchgear and control gear Assemblies (Requirement for type partly type tested assemblies)
- IS : 8623 - 1993 Bus Bar trunking system (Part - II)
- IS : 8828 - 1996 Circuit Breakers for over current protection For house hold and similar nstallation.

- IS : 9537 - 1981 (Part II) Rigid Steel Conduits for electrical wiring
- IS : 10810 - 1988 Methods of test for cables.
- IS : 13947-1993 (Part-I) General rules for low voltage swtich gears and control gears.
- IS : 13947-1993 (Part-II) Circuit Breakers
- IEC 947 - 2
- IS : 13947 - 1993 (Part-III) Swiches, disconnectors and fuse for low voltage switch gear and control gear.
- IS : 13947 - 1993 (Part-IV) Low voltage switch gear and control gear for contactors and motor starters
- IS : 13947 – 1993 (Part-V) Control Circuit Devices.
- BS : EN:779 – 1993 Filters
- ASHRAE Hand Books American Society of Heating Refrigeration & Airconditioning . application 2007.
- Fundamentals 2005.
- Refrigeration 2006.
- Systems & Equipment 2008.
- ASHRAE Indoor air quality Standard 62.1-2007.
- ASHRAE 90.1-2007
- ASHRAE 55-2004
- ASHRAE 52.1 and 52.2
- IEC Relevant Sections.
- Energy Conservation Building code of India -2008 (BEE)

FIRE FIGHTING SYSTEM

Standards, specifications, associations, and regulatory bodies are generally referred to throughout the specifications by their abbreviated designations. The materials workmanship shall be in accordance with the requirement of the appropriate CP, I.S code wherever applicable together with any building regulations or bye-laws governing the works.

The following list is included for guidance only and the omission of any CP, I.S. codes from the list does not relieve the contractor from compliance therewith:

The more important Codes, Standards and Publications applicable to this section are listed hereinafter:

SP : 6 (1)	Structural Steel Sections
IS : 1726	Specification for cast iron manhole covers and frames.
IS : 1742	Code of practice for building drainage.

IS : 2064	Selection, installation and maintenance of sanitary appliance code of practice.
IS : 2065	Code of practice for water supply in buildings.
IS : 2104	Specification for water meter for boxes (domestic type)
IS : 2373	Specification for eater meter (bulk type)
IS : 2379	Colour code for identification of pipe lines.
IS : 2629	Recommended practice for hot dip galvanizing on iron and Steel.
IS : 3114	Code of practice for laying of cast iron pipes
IS : 4111 (Part 1)	Code of practice for ancillary structures in sewerage system : Part 1 manholes.
IS : 4127	Code of practice for laying glazed stoneware pipes.
IS : 4853	Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes.
IS : 5329	Code of practice for sanitary pipe work above ground for buildings.
IS : 5455	Cast iron steps for manholes.
IS : 6159	Recommended practice for design and fabrication of material, prior to galvanizing.
IS : 7558	Code of practice for domestic hot water installations.
IS : 8321	Glossary of terms applicable to plumbing work.
IS : 8419 (Part 1)	Requirements for water filtration equipment: Part 1 Filtration medium sand and gravel.
IS : 8419 (Part 2)	Requirements for water filtration equipment: Part 2 under drainage system.
IS : 9668	Code of practice for provision and maintenance of water supplies and fire fighting.
IS : 9842	Preformed fibrous pipe insulation.
IS : 9912	Coal tar based coating materials and suitable primers for protecting iron and steel pipe lines.

	IS : 10221	Code of practice for coating and wrapping of underground mild steel pipelines.
	IS : 10446	Glossary of terms relating to water supply and sanitation.
	IS : 11149	Rubber Gaskets
	IS : 11790	Code of practice for preparation of butt-welding ends for pipes, valves, flanges and fittings.
	IS : 12183 (Part 1)	Code of practice for plumbing in multistoried buildings : Part 1 water supply.
	IS : 12251	Code of practice for drainage of building basements.
	IS : 5572	Code of practice for sanitary pipe work.
	BS : 6700	Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their cartilages.
	BS : 8301	Code of practice for building drainage.
	BSEN : 274	Sanitary tap were, waste fittings for basins, bidets and baths. General technical specifications.
2.	**Pipes and Fittings**	
	IS : 458	Specification for precast concrete pipes (with and without reinforcement)
	IS : 651	Salt glazed stone ware pipes and fittings.
	IS : 1239 (Part 1)	Mild steel, tubes, tubular and other wrought steel fittings : Part 1 Mild Steel tubes.
	IS : 1239 (Part 2)	Mild Steel tubes, tubular and other wrought steel fittings: Part 2 Mild Steel tubular and other wrought steel pipe fittings.
	IS : 1536	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage.
	IS : 1537	Vertically cast iron pressure pipes for water, gas and sewage.
	IS : 1538	Cast Iron fittings for pressure pipes for water, gas and sewage.

	IS : 1729	Sand Cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
	IS : 1879	Malleable cast iron pipe fittings.
	IS : 1978	Line pipe
	IS : 1979	High test line pipe.
	IS : 2501	Copper tubes for general engineering purposes
	IS : 2643 (Part 1)	Dimensions for pipe threads for fastening purposes: Part 1 Basic profile and dimensions.
	IS : 2643 (Part 2)	Dimensions for pipe threads for fastening purposes: Part 2 Tolerances.
	IS : 2643 (Part 3)	Dimensions for pipe threads for fastening purposes: Part 3 Limits of sizes.
	IS : 3468	Pipe nuts.
	IS : 3589	Seamless or electrically welded steel pipes for water, gas and sewage (168.3 mm to 2032 mm outside diameter).
	IS : 3989	Centrifugally cast (sun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
	IS : 4346	Specifications for washers for use with fittings for water services.
	IS : 4711	Methods for sampling steel pipes, tubes and fittings.
	IS : 6392	Steel pipe flanges
	IS : 6418	Cast iron and malleable cast iron flanges for general engineering purposes.
	IS : 7181	Specification for horizontally cast iron double flanged pipe for water, gas and sewage
3.	**Valves**	
	IS : 778	Specification for copper alloy gage, globe and check valves for water works purposes.
	IS : 780	Specification for sluice valves for water works purposes (50 mm to 300 mm size).
	IS : 1703	Specification copper alloy float valves (horizontal plunger type) for water supply fittings.

	IS : 2906	Specification for sluice valves for water works purposes (350 mm to 1200 mm size)
	IS : 3950	Specification for surface boxes for sluice valves.
	IS : 5312 (Part 1)	Specification for swing check type reflux (non return) valves : part 2 Multi door pattern.
	IS : 5312 (Part 2)	Specification for swing check type reflux (non return) valves : part 2 Multi door pattern.
	IS : 12992 (Part 1)	Safety relief valves, spring loaded : Design
	IS : 13095	Butterfly valves for general purposes.
4.	**Pumps & Vessels**	
	IS : 1520	Specification for horizontal centrifugal pumps for clear cold fresh water.
	IS : 2002	Steel plates for pressure vessels for intermediate and high temperature service including boilers.
	IS : 2825	Code for unfired pressure vessels.
	IS : 4648 (Part 1)	Code of practice for lining of vessels and equipment for chemical processes Part 1 : Rubber lining.
	IS : 5600	Specification for sewage and drainage pumps
	IS : 8034	Specification for submersible pump sets for clear, cold, fresh water.
	IS : 8418	Specification for horizontal centrifugal self priming pumps.
	Fire Fighting Equipment	
5	SP:7	Amendment No. III to NBC Part-IV Fire Protection Jan 1997
	TAC	Tariff Advisory Committee fire protection manual Part-I.
	TAC	Rules of Tariff Advisory Committee for automatic sprinkler system.

NFPA : 12 , 1993	Standards on Carbon Dioxide Extinguishing System
IS : 636	Non-percolating flexible fire fighting delivery hose.
IS : 884	Specification for first aid hose reel for fire fighting.
IS : 901	Specification for couplings, double male and double female, instantaneous pattern for fire fighting.
IS : 902	Suction hose couplings for fire fighting purposes.
IS : 903	Specification for fire hose delivery couplings, branch pipe, nozzles and nozzle spanner.
IS : 904	Specification for 2-way and 3-way suction collecting heads for fire fighting purposes.
IS : 907	Specification for suction strainers, cylindrical type for fire fighting purposes.
IS : 908	Specification for fire hydrant, stand post type.
IS : 909	Specification for underground fire hydrant, sluice valve type.
IS : 910	Specification for portable chemical foam fire extinguisher.
IS : 933	Specification for portable chemical foam fire extinguisher.
IS : 1648	Code of practice for fire safety of building (general) : Fire fighting equipment and its maintenance
IS : 2171	Specification for portable fire extinguishers dry powder (cartridge type)
IS : 2190	Selection, installation and maintenance of first aid fire extinguishers – Code of practice.
IS : 2871	Specification for branch pipe, universal, for fire fighting purposes.
IS : 2878	Specification for fire extinguishers, carbon dioxide type (portable and trolley mounted).
IS : 3844	Code of practice for installation and maintenance of internal fire hydrants and hose reel on premises.
IS : 5290	Specification for landing valves.

IS 5714	Specification for coupling, branch pipe, nozzle, used in hose reel tubing for fire fighting.
IS : 8423	Specification for controlled percolation type hose for fire fighting.
IS : 10658	Specification for higher capacity dry powder fire extinguisher (trolley mounted).
IS : 11460	Code of practice for fire safety of libraries and archives buildings.
IS : 1309	External hydrant systems – Provision and maintenance – Code of practice.
IS : 5514 (Parts 1 to 7)	Reciprocating internal combustion engines : Performance
IS : 3589	Seamless or electrically welded steel pipes for water, gas and sewage (168.3 mm to 2032 mm outside diameter).
IS : 3989	Centrifugally cast (sun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 4346	Specifications for washers for use with fittings for water services.
IS : 4711	Methods for sampling steel pipes, tubes and fittings.
IS : 6392	Steel pipe flanges
IS : 6418	Cast iron and malleable cast iron flanges for general engineering purposes.
IS : 7181	Specification for horizontally cast iron double flanged pipe for water, gas and sewage.
IS : 10221	Code of practice for coating and wrapping of underground mild steel pipelines.
IS : 11149	Rubber Gaskets

CONVENTIONAL FIRE ALARM SYSTEM

- IS 732-1963 Code of Practice for electrical wiring installation (system voltage not exceeding 650 Volts).
- UL "UNDERWRITERS" laboratory/NFPA/ FM for listed detector, fire panel.
- IS 1584 (Part-I) for PVC insulated copper conductor armoured cable.
- IS 694 PVC insulated copper fkexible wire.
- IS 1653 for M.S Conduits.
- All items and installation shall be according to the Indian Standards. Where these standards do not exist, they shall conform to the American Standards or other internationally accepted standard.

SOLAR PV MODULES AND ARRAY

- IEC 61215/IS14286: Crystalline Silicon Terrestrial PV Modules
- IEC 61730 1: requirements for construction & Part 2 – requirements for testing, for safety qualification or Equivalent IS (Under Dev.)
- IEC 61701/IS61701: PV modules must also qualify Salt Mist CorrosionTesting

TEST REPORTS /FACTORY TESTING /O LABORTORY TESTING / SITE TESTING OF ELECTRICAL & MEP INSTALLATION/ MATERIALS

For following test, contractor has to arrange the manufacturers' certificate, where as available / test to be carried out at factory in presence of LIC Engineer if desires to attain and preparation of reports thereof / test to be carried out at site and preparation of reports etc.

MATERIAL TESTING

The project in charge engineer shall have full power to get any material of work to be tested by an independent agency at contractor's expense in order to prove the soundness and adequacy.

WIRING

After completion of wiring, installation of switches etc., testing shall be done for insulation resistance as specified in the tender

The following tests shall form a part of the routine tests.

i) Power frequency voltage dry test on each transport unit
ii) Insulation test with 1 kV/1sec on all auxiliary circuits
iii) Resistance measurement of the main circuits of each transport unit
iv) Mechanical testing of the switching devices
v) Timing test of the circuit breaker
vi) Tightness test

Copies of all routine test certificates shall be made available to the purchaser if required.

All ELMCB / RCCB should be tested for overloading, short circuit, earth leakage tripping and MCBs should be tested for overloading and short circuit tripping.

CABLE

Insulation Resistance:

a) The insulation resistance shall be measured by applying between earth and the whole system of conductors or any section thereof with all fuses in place and all switches closed and except in earthed concentric wiring all lamps in position or both poles of the installation otherwise electrically connected together. A direct current pressure of not less than twice the working pressure provided that it need not exceed 500 volts for medium voltage circuits. Where the supply is derived from the three wire (AC or DC) or a poly phase system, the neutral pole of which is connected to earth either direct or through added resistance, the working pressure shall be deemed to be that which is maintained between the outer or phase conductor and the neutral.

b) The insulation resistance measured as above shall not be less than 50, divided by the number of points on the circuits provided that the whole installation shall be required to have an insulation resistance greater than one mega ohm.

c) Control rheostats, heating and power appliances and electrical signs may, if required, be disconnected from the circuit during the test, but in that event the insulation resistance between the case of frame work and all live parts or each rheostat appliance and sign shall not be less than that specified in the relevant IS specifications shall not be less than half a megohm.

d) The insulation resistance shall also be measured between all conductors connected to one or phase conductor of the supply and all the conductors connected to the middle wire or the neutral or to the other pole or phase conductors of the supply and its value shall not be less than that specified in sub clause(b).

e) On completion of an electric installation (or an extension to an installation) a certificate shall be furnished by the contractor countersigned by the qualified supervisor where the installation was carried out.

Testing of earth continuity path: The earth continuity conductor including metal conduits and metallic envelopes of cables in all cases shall be tested for electric continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit-breaker measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

Testing of polarity of non-linked single pole switches:

a) In a two wire installation a test shall be made to verify that all non-linked single pole switches have been fitted in the same conductor throughout and such conductor shall be labeled or marked for connection to an outer of phase conductor or to the non-earthed conductor of the supply.

b) In a three wire or a four wire installation, a test shall be made to verify that every non-linked single pole switch is fitted in a conductor which is labeled or marked for connection to one of the outer or phase conductor of the supply.

Testing :

Before energizing , the megger test shall be carried out for insulation resistance between phase to phase and phase to earth.

For cable up to 1.1KV grade 1000 KV megger shall be used.

D.C. High Voltage test shall be conducted after installation on the following and test results are recorded as per format furnished by the Engineer-in-charge.

a) All 1000 Volts grade cables in which straight through joints have been made.

b) All cables above 1100 V grade.

For record purposes test data shall include the measure values of leakage current verses time.

Cables shall be installed in final position with all the straight through joints complete. Termination shall be kept on unfinished so that the motors, switchgears, t transformers, etc.. are not subjected to test Voltages.

The Test Voltage shall be as under:

i) for cable 1.1 KV Grade	2.0	KV DC
ii) for cable 3.3 KV Grade	5.4	KV DC
iii) for cable 6.6 KV Grade	10.8	KV DC
iv) for cable 11 KV Grade	18	KV DC

1.1 KV XLPE (CROSS - LINKED POLYETHYLENE) INSULATED POWER CABLES

Should the Engineer require it, the Contractor shall submit reports issued by a approved testing authority on type test that have been successfully performed on the cable for his approval. The type test shall include the following test:

Partial discharge test;

- Bending test, plus partial discharge test;
- Tan measurement as a function of the voltage and capacitance measurement;
- Tan measurement as a function of the temperature;
- Heating cycle test plus partial discharge test ;

- Impulse withstand test, followed by a power frequency voltage test;
- Medium-voltage alternating current test;
- Type test (non-electrical) as stipulated in IEC 502, Table VI.
- Cable routine test shall be conducted at factory in accordance with IEC 502 for the following tests:
- Measurement of the electrical resistance of conductors
- Partial discharge test,
- 4-hour HT test

Site Acceptance Test

The Contractor shall supply all necessary testing equipments for site testing. When required, these testing equipments shall be calibrated at the expense of the Contractor at a recognized national laboratory.

The Contractor shall engage an Authorised Medium Voltage Testing Engineer who is recognized by SEB to perform all site tests.In addition to SEB's requirements and those recommended by the manufacturer, the following tests shall be carried out:

- Continuity test
- Earth test
- Polarity test
- Insulation resistance test
- DC high voltage test. The test voltage shall be in accordance with SEB's requirements and Engineer's approval.

Test for conductors.

- Annealing test (For copper).
- Tensile test (For Aluminum).
- Wrapping test (For Aluminum).
- Resistance test.
- Test of armoring / strips

Test for insulation and sheath.

Physical Test for insulation.

- Tensile strength and elongation at break.
- Aging in air oven.
- Hot set test.
- Shrinkage test.
- Water absorption test. (Gravimetric).

Physical test for outer sheath.

- Tensile strength and elongation at break.
- Aging in air oven.
- Loss of mass in air oven.
- Shrinkage test.
- Hot deformation.
- Heat shock test.
- Thermal stability.

Insulation Resistance (Volume resistively test).

- High voltage test.
- Flammability test

Acceptance test.

The following shall constitute Acceptance test.

- Annealing test (For copper).
- Tensile test (For Aluminum).
- Wrapping test (For Aluminum).
- Conductor Resistance tests.
- Test for thickness of insulation and sheath.
- Hot set test for insulation.
- Tensile strength and elongation at break for insulation and sheath.
- High voltage Test and insulation (Volume resistively)
- Cold bend test for outer sheath.
- Cold impact test for outer sheath.
- Resistance test for armor

Sampling plan for acceptance test shall be as per IS 7098 Part 1 with latest revisions

Routine test.

The following shall constitute the routine test.

- Conductor resistance test.
- High voltage test.

Once the cable is laid, following tests shall be conducted in presence of the departmental representatives authorized by Engineer – In – Charge, before energizing the cable.

1. Insulation resistance test (Sectional and Overall).
2. Sheathing continuity test.
3. Continuity and conductor resistance test.
4. Earth test.
5. High voltage test.

6. Teat conducted shall be as per Indian standard and National Electrical code.

LED LIGHTS

TEST REPORTS

The Supplier has to produce test report of similar LED light for following parameters from NABL Government Test House i.e. NTH etc. along with the bid. However, test certificates of the lot to be supplied are required to be produced before supply of material at site.

i) For LED

a) LM 80 report of the LED chip being used shall be produced

ii) For Fixtures

a) Endurance Test

b) Thermal Test

d) Power factor, efficiency

e) Harmonic test

f) Surge test

g) Mechanical strength test

h) Dielectric test

LT PANEL

TESTS AND INSPECTION

The distribution boards shall be subjected to routine test as per IS: 8623. Vendor has to arrange for the Test Reports.

Following routine / acceptance and types shall be done at factory.

The panels shall be checked and tested after fabrication, assembling and wiring at factory as per the following:

Checks

1. Manufacturer of panel as per the agreement Technical Particular, SLD, SOQ/BOQ and related specifications.
2. Compliance of using approved makes.
3. Manufactured as per approved drawings.
4. Inspection for any damages.

Tests

The following are the routine tests:

a) Measurement of resistance of the main circuits
b) Operation tests
c) One minute power frequency voltage dry withstand tests on the circuit breakers
d) One minute power frequency voltage dry withstand tests on auxiliary circuit.
e) Functional test for all safety and control.

TYPE TESTS

The type test certificate as per IS for similar panel shall be submitted.

SITE TESTS

In addition to the tests at manufacturer's premises, all relevant pre-commissioning checks and tests as well as relay co-ordination from upstream to downstream as per applicable electrical load shall be done at site before energizing the switch board.

Following shall be minimum checks/tests to be done at site.

a) Physical inspection for breakages/damages /orderliness.
b) Insulation resistance test with 5 KV meggar.
c) Earth continuity test
d) Tightness of joints / connections / terminations.
e) Safety checks
f) General operation / performance checks
g) All test results are to be recorded and reports should be submitted to the department.

CALIBRATIONS

All the protective relays shall be calibrated and test certificate shall be submitted.

TEST CERTIFICATES

Following test certificates shall be submitted by the agency:

a) Test certificate for the routine / acceptance tests.
b) Test certificate for the type tests such as temperature rise test, short circuit withstand test, degree of protection for similar panels.
c) Test certificates for the calibrations.

MEDIUM/ HV VOLTAGE PANELS

TESTING

The power control centers shall be tested at factory after assembling of all components and completion of all interconnections and wiring. Tests shall be conducted in accordance with the requirements of BS:3659.

Insulation Test

Insulation of the main circuit, i.e. the insulation resistance of each pole to the earth and that between the poles shall be measured.

Insulation resistance to earth of all secondary wiring should be tested with 1000 Volt magger. Insulation test shall be carried out both before and after high Voltage test. High Voltage Test A High Voltage test with 2.5 KV for one minute shall be applied between the poles and earth. Test shall be carried out on each pole in turn with the remaining poles earthed, all units raked in position and the breakers closed. Original test certificate shall be submitted along with panel.

TESTING

The power control centers shall be tested at factory after assembling of all components and completion of all interconnections and wiring. Tests shall be conducted in accordance with the requirements of BS:3659.

SHORT CIRCUIT AND TYPE TEST:

Bus way system shall comply with following standards:

IEC 61439-1&6

All type test certificates according to above standards shall be of International Lab of repute such as CPRI or equivalent.

Type test certificate shall be produced for validation before ordering for Rated Short Circuit breaking capacity for 1sec.

Type Test certificates confirming Mechanical Operation and Temp. Rise of Tap Off Box of similar design in accordance with IEC-61439 are must.

BUS DUCTS & BUS BAR CAHMBERS

Busway manufacturer shall produce a Type Test Report determining Rating of Busway at

Ambient Temp. with no deration. Failure to submit such reports will disqualify the manufacturer.

A Type Test report confirming Degree of Protection in accordance with IEC 60529 is must.

The type test for IEC-60068 of seismic certificate of green premium product from independent test house is a must.

Type test reports.

Switchboard configurations offered shall be CPRI /Independent international test house tested for all the tests as per IEC61439-1 & 2 and internal arc tests as per IEC61641. Copies of the test certificates shall be submitted with the tender.

Testing At Works

Copies of type test carried out at ACB/ MCCB manufacturers works and routine tests carried out at the switchboard fabricators shop shall be furnished along with the delivery of the switchboards. Engineer-in-Charge reserves the right to get the switchboard inspected by their representative at fabricators works prior to dispatch to site to witness the followings.

Physical variation and dimensional check

Functional check

HV test

IR test

TESTS

Unless otherwise specified, the specifications for testing shall be as follows.

SWITCH GEARS

TESTS & INSPECTIONS

Switchgear shall be subjected to routine tests as per IS 8623. Vendor has to arrange for the Test Reports.

All meters and other reference devices used for testing shall be valid calibration from reputed national laboratories / Institutes. Inspection by purchasers shall not be carried out unless the vendor confirms that equipment is ready for proceeding with the tests.

Shop test shall be witnessed by Engineer-In- Charge or his authorized representative. Prior notice of minimum 4 weeks shall be given to the inspector for witnessing the tests.

Acceptance tests on completed switchboards shall be as follows:

a) A general visual check shall be carried out. This shall cover measurement of over all dimension, location, number and type of devices, terminal boxes, location and connection of terminals etc.

b) Checking of bill of materials as per approved drawing.

c) Checking of operation of various feeders as per approved schematic drawings.

d) Operation check shall be carried out for every control function as per schematic drawings by manually simulating fault conditions and operation of control switches/relays etc.

e) Checking of inter-changeability of identical feeders.

f) Insulation resistance test and value measurement on power and control circuits before and after high voltage withstand test.

g) High voltage test on power and control circuit as per IS 8623.

h) For equipment bought from other suppliers, certified test reports of tests carried out at the manufacturers works shall be submitted. Normally all routine tests as specified in the relevant standards shall be conducted by the sub supplier at its works and copies of routine test reports shall be furnished.

TYPE TEST

The type test certificates shall be submitted to inspecting officer

The agency shall be CPRI test certificate for similar panel (LT Panels or MCC). Panels shall be got manufactured by only reputed panel manufacturers having got type tested by CPRI or other Government testing laboratory on similar panels (LT panel or MCC) of minimum 50KA fault level with stand capacity and IP protection.

ROUTINE/ACCEPTANCE TESTS

The panels shall be checked and tested after fabrication, assembling and wiring at factory as per the following.

Tests

1 Insulation resistance test. Wiring test shall be carried with 1000-volt Megger to ensure adequate insulation resistance. (At manufacturer's works). While carrying out the IR test the capacitor banks shall be isolated.

2 H.T. test shall be carried out as per IS at manufacturer's works.

3 Functional tests.

4 Primary/secondary current injection test for relays if protection relays are supplied as part of BOQ

SITE TESTS

In addition to the tests at manufacturer's premises, all relevant pre-commissioning checks and tests shall be done at site before energizing the panel. Following shall be the minimum checks/tests to be done at site.

1. Physical inspection for breakages/damages/orderliness.
2. Insulation resistance test with 500 V Megger by isolating the Capacitor bank. The insulation resistance shall be not less than 100 mega ohms.
3. Earth continuity test.
4. Tightness of joints/connections/terminations.
5. Safety checks.
6. General Operation/Performance Checks

HT CABLES

TESTS AND TESTING FACILITIES:

TYPE TESTS:

All the type tests in accordance with IS: 7098 (Part 2) - 1985, amended up to date, shall be performed on cable samples drawn by purchaser. Type tests are required to be carried out from the first lot of supply on a sample of all sizes of cables ordered for each voltage grade. In case facilities of any of the type tests are not available at the works of the supplier, then such type test shall be carried out by the supplier at the independent laboratory at the cost of supplier. Sample for the type test will be drawn by the purchaser's representative and the type test will be witnessed by him. In case of other Government recognized laboratories / Test House valid approved Government certificate shall be enclosed along with test.

ROUTINE TESTS:

All the Routine tests as per IS: 7098 (Part 2) - 1985 amended up to date shall be carried out on each and every delivery length of cable. The result should be given in test report. Partial discharge test must be carried out in a fully screened test cell. It is, therefore, absolutely essential that the manufacturer should have the appropriate type of facility to conduct this test which is routine test. The details of facility available in the manufacturer's works in this connection should be given in the bid.

ACCEPTANCE TESTS:

All acceptance tests as per IS: 7098 (Part 2) - 1985 as modified up to date including the optional test as per above clause and Flammability Test shall be carried out on sample taken from the delivery lot.

SHORT CIRCUIT TEST:

The contractor shall also undertake to arrange for the short circuit test as a type test on any one size of each voltage grade i.e on one size of 11 kV, one size of 22 kV and one size of 33 kV earthed grade shielded TR-XLPE cables ordered at a recognized testing center such as Central Power Research Institute at Bangalore/ Bhopal at the cost of supplier. If facilities for carrying out short circuit tests are available at the works of the supplier, and provided the certification procedure is approved by the Purchaser, testing at the supplier's works will be acceptable. Short Circuit test shall be witnessed by the purchaser's representative.

The short circuit test shall be preceded and followed by the following tests so as to ensure that the characteristics of the cable remain within the permissible limits even after it is subjected to the required short circuit rating.

a) Partial Discharge Test.

b) Conductor Resistance Test.

c) High Voltage Test.

The manufactured cable will be acceptable only after such a sample test is successfully carried out at CPRI or at suppliers works and approved by the Purchaser.

TESTING FACILITIES:

The supplier / tenderer shall clearly state as to what testing facilities are available in the works of manufacturer and whether the facilities are adequate to carry out type, routine and acceptance tests mentioned in specified IS. The facilities shall be provided by the bidder to purchaser’s representative for witnessing the tests in the manufacturer’s works. If any test cannot be carried out at manufacturer’s works reason should be clearly stated in the tender.

When requested, a certified test report shall be supplied for production runs of cable. The report is to include all actual production test values required by the referenced specifications. The manufacturer should provide the traceability information from cable till the materials used in the manufacturing.

EARTHING & LIGHTNING

TESTS

In accordance with stipulations of the specifications galvanised steel shall be subjected to four one minute dips in copper sulphate solution as per IS: 2633.

EARTHINGS

A. The entire earthing installation shall be tested as per requirements of Indian Standard Specification IS : 3043.

B. The following earth resistance values shall be measured with an approved earth meggar and recorded.

1. Each earthing station
2. Earthing system as a whole
3. Earth continuity conductors

C. Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 1 Ohm in each case. This is responsibility of contractor to get the final value for resistance.

D. Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.

E. All tests shall be carried out in presence of the consultant

LIGHTNING PROTECTION

- The lightning protection system shall not be in direct contact with underground metallic service ducts and cab.
- Conductors of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.
- Down conductors shall be cleated on the structures at 600 mm interval.
- Connection between each down conductor and rod electrodes shall be made via test joint (pad type compression clamp) located approximately 1500 mm above ground level. The rod electrode shall be further joined with the main earth mat.
- Lightning conductors shall not pass through or run inside G.I. conduits.

All Earth pits developed around the campus shall be tested with Earth Test Megger and the results shall comply with the latest IE regulations. The Contractor shall ensure the soil resistivirty if required and develop the earth pits to get the best results ie 1 ohms where ever GI plate type earthing pit is developed and for Copper plate type earthing this

shall be less than 0.5 ohms. Any extra cost incurred to get the final results shall be borne by the Contractor.

TRANSFORMERS

Transformers shall be subjected to the following routine tests and Type tests.
Test procedure as per IS-2026 shall be adopted.

i) Routine Tests

1. Transformer shall be fully assembled with all fittings to ascertain that all the parts fit correctly
2. Resistance of each winding of each phase at principal tap and at all other taps.
3. Voltage ratio at all taps.
4. Checking of voltage vector relationship.
5. Impedance voltage at rated frequency and principal tap, lowest and highest taps.
6. Load loss at rated current.
7. Zero sequence impedance at principal tap, rated frequency.
8. No load loss and no lead current at rated frequency and 100%, 110% of rated voltage on HV side. Test shall be repeated with 433V, 3 Phase supply connected to LV side (if the LV side rated voltage is more than 433V). No Load & Load Losses shall be as per CBIP / IS with tolerance.
9. One minute power frequency withstand voltage test.
10. Induced over voltage withstand test.
11. Polarity check, ratio check, measurement of secondary winding resistance, excitation, characteristic curve, insulation resistance of all bushing CTs.
12. Calibration of winding temperature indicators,

ii) Type test

13. Temperature rise test.
14. The Contractor shall submit Type Test certificates for similar capacity Transformer supplied by him elsewhere for (i) Short time withstand capability Test and (ii) Impulse Voltage withstand Test. In case Type Test certificates for similar equipment are not available the same will be conducted in the presence of the Purchaser or his Representative if Purchaser so desires without any financial implications to the purchaser.

TESTING AT SITE.

Prior to commissioning of the transformer the following tests shall be performed.

i. Insulation resistance of the winding between phases and earth of H.V. and M.V. side.

ii. Winding resistance of all the winding on all tap positions shall be taken.

iii. Di-electric strength of transformer oil shall be checked in accordance with IS 335-1963. In case the test is not satisfactory, the oil shall be filtered till proper dielectric strength of oil is obtained.

The supplier shall given sufficient advance information about the test schedule to enable to depute his representative.

HVAC TESTING

Testing & Commissioning:

After completion of installation, the pipelines shall be hydraulically tested for leaks by a test-pump. The entire line shall be visually inspected for leaks while it is under pressure. Minimum test pressure shall be 10 Kg/cm2. Pressure shall be held for 24 hours.

All valves shall be fully open during the test. Delicate instruments and equipments shall be isolated during the test. All temporary supports shall be removed before leak testing.

Testing

All equipment and components supplied may be subjected to inspection and tests by the client / consultant or his authorized representatives during manufacture, erection / installation and after completion. No tolerances shall be allowed other than the tolerances specified or permitted in the relevant approved Standards, unless otherwise stated. If the guaranteed performance of any item of equipment is not met and / or if any item fails to comply with the specification requirement in any respect whatsoever at any stage of manufacture, test or erection, the client / consultant may reject the item, or defective component thereof, whichever he considers necessary.

The complete electrical installation shall be tested in accordance with relevant IS codes in presence of Electrical Supervisor of the client before commissioning of plant.

VENTILATION

Testing

Capacity of all fans shall be measured by an anemometer. Measured airflow capacities shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current. Contractor has to carry out the field balancing, if required.

Testing Of Pipe System

During construction the AC Contractor shall properly cap all lines, so as to prevent the entrance of sand, dirt, etc. Each system of piping shall be flushed thoroughly after completion for the purpose of removing dirt, grit, sand etc. from the piping and fittings.
All piping shall be tested to hydrostatic test pressure of at least one and half times the maximum operating pressure, but not less than 16 kg per sq. cm

BUS DUCTS

INSPECTION AND TESTING :

A. The busduct shall be subjected to routine tests in accordance with the appropriate standards. The routine tests shall be witnessed by purchaser or by an agency authorized by the purchaser. Following minimum tests shall be carried out on fully assembled busduct at bidder's works.

B. Dimensional checks and other physical requirements.

C. HV tests.

D. Insulation test.

E. Heat run test, Not required.

F. MV drop test, if required

BUS TRUNKING

LIST OF TEST TO BE CARRIED OUT

Type Tests: Copies of the following certificates Shall be submitted.

→ Verification of Temperature Rise limits.

→ Verification of dielectric properties.

→ Verification of short circuit strength.

→ Verification of degree of protection.

ROUTINE TESTS

(i) Verification of insulation, resistance.

(ii) Inspection of assembly, interlocks, locks etc.

(iii) Check on wiring if provided.

(iv) Dielectric test.

Certificate

Thebusbar,offullrangeandeachrating,shouldpassfulltypetestsspecifiedinIEC61439Part6(2012).Thecertificateshallbeissuedbyaniindependenttestingauthority.Aproductsafetymark(e.g.KEMA-KEUR,ASTADIAMOND,UL)shouldbeontheproductofferinga visibleassurancetoalloffullproductsafetytesting,factoryinspectionandongoingsurveillance under independentauthorityto ensuretheongoingsafetyof product.

FIRE ALARM SYSTEM

TESTING

Each of the alarm conditions that the system is required to detect shall be introduced the system. Verify the proper receipt and the proper processing of the signal at the FA and the correct activation of the control points.

When the system is equipped with optional features, the manufacturer's manual shall onsulted to determine the proper testing procedures. This is intended to address su items as verifying controls performed by individually addressed or grouped devic sensitivity monitoring, verification functionality and similar.

DIESEL GENERATOR

For testing, following procedure shall be followed:

All major items/ equipments i.e. engine & alternator in assembled condition, associated electrical control panels etc. shall be offered for inspection and testing at factory/ manufacturers works. The successful tenderer shall give a notice of minimum two weeks for carrying out such tests. The Engineer-in-charge / or his authorized representative shall witness such inspection & testing at mutually agreed date. The cost of the representative's visit to the factory shall be borne by the Department.

The department also reserves the right to inspect the fabrication job at factory and the successful tenderer has to make arrangement for the same.

DG set shall be tested on load of unity power for the rated KW rating. During testing, each of the DG sets covered under scope of work, shall be operated for a period of 2 hours on the rated KW at DG set's KW rating including one hour on 10% overload after continuous run of the 2 hours. During testing all controls/operations safeties shall be

checked and proper record shall be maintained. Any defect/ abnormality noticed during testing shall be rectified. The testing shall be declared successful only when no abnormality/ failure is noticed during the testing. The DG set shall be cleared for dispatch to site only when the testing is declared successful by authorized representative/ Engineer-in-charge.

Site Trial Run/ Running-in-Period

After successful testing of the DG set, a trial run at available load shall be carried out for 18 Hours (6 hrs each day). The DG set shall be operated and a log of all relevant parameters shall be maintained during this period. The arrangement of staff for trial run/ running in period shall be made by the successful tenderer. However, diesel shall be provided by the successful tenderer. The cost of diesel shall be reimbursed by on production of documentary evidence. The contractor shall be free to carry out necessary adjustments. The DG set shall be successfully completed the trial run, if no break down or abnormal/ unsatisfactory operation of any component of the entire installation included in the scope of work of the contractor, occurs during this period. After this the DG set shall be made available for beneficial use. After the DG set shall be operated without any major break down/trouble, it shall be taken over by the department subject to guarantee clause of this contract. This date of taking over of the DG set, after trouble free operation during the trial run/ running-in period, shall be the date of acceptance/taking over.

Testing of Lift Installation:

Tests at site:Vendor has to submit the Factory Test reports for the Major items like Motors, gear Box, Panel, controllers, Ropes, cable, Drive and any other items desired by Engineer In charge.

(a) Leveling Test:

Accuracy of the floor leveling shall be tested with the lift empty, fully loaded. The lift shall be run to each floor while traveling both in upward and downward directions and the actual distance of car floor above, below landing floor shall be measured. In each case there shall not be any appreciable difference in these measurements for leveling at the floors when the car is empty and when it is fully loaded.

(b) Safety Gear Tests:

Instantaneous safety gear controlled by a governor should be tested with, contract load and a contract speed, the governor being operated by hand. Two tests should be made,

however, with wedge clamp or flexible clamp safeties, one with contract load in the car and the other with 60 kg (equivalent to one person) in the car. The stopping distance obtained should be compared with the specified figures and the guides, car platform, and safety gear should be carefully examined afterwards for signs of permanent distortion. Counterweight safety gear should be tripped by the counter weight governor and the stopping distance noted. In this case, however the governor tripping speed may exceed that of the car safety governor but by not more than 10 percent. During the safety gear tests, car speed (from the governor or the main sheave) should be determined atthe instant or tripping speed with that stated in IS. The governor jaws and rope should be1 examined for any undue wear.

(c) Contract speed:

This should be measured with contract load in the car, with half load, with no load, and should not vary from the contract speed by more than 10 percent. The convenient method is by counting the number of revolutions, made by the sheave or drum in a known time, Chalk mark on the' sheave or drum and a stop switch will facilitate timing but care must be exercised to ensure that no acceleration or retardation periods are included. If the roping is 2 to 1 the sheave speed is twice the car speed. Alternatively, the speed can be measured by a tachometer applied directly to shaft immediately below the sheave.

(d) Lift balance:

After the above test, some of the weight shall be removed until the remaining weights represent the figures specified. With this condition at half way travel the effort required to move the lift car in either direction with the help of winding wheel shall be as nearly as can be judged by the same.

(e) Car and landing doors interlock:

The lift shall not move with any door open. The car door relay contact and the retiring release cam must be tested. The workings of the door operation and the safety edges and light equipment if any provided shall also be examined.

(f) Controllers:

The operation of the contactors and interlocks shall be examined and it shall be ascertained whether all the requirements laid down in the specifications have been met.

(g) Normal terminal stopping switches:

These shall be tested by letting the car run to each terminal landing in turn, first with no load and then with contract load and by taking measurements, top and bottom over travels can be ascertained.

(h) Final terminal stopping switches:

The normal terminal stopping switches shall be disconnected for this test. It shall be ensured that these switches operate before the buffers are engaged.

(i) Insulation Resistance:

This shall be measured (after removing the electronic PCB's and their connection) between power and control lines and earth and shall not be less than 5 mega-ohms when measured with D.C. voltage of 500 volts. The test shall be carried out with contactors so connected together as to ensure that all parts of every circuit are simultaneously tested.

(j) Earthing:

Earthing continuity of all conduits, switches, casing and similar metal work shall be tested.

(k) Ropes:

The size, number construction and fastenings of the ropes should be carefully examined and recorded.

(I) Buffers:

The car should be run on to its buffers at contract speed and with contract load in the car to test whether there is any permanent distortion of. the car or buffers. The counter weight buffers should be tested similarly. Test report shall be intimated after testing at works.

FIRE FIGHTING SYSTEM

MATERIAL TESTING

The project incharge engineer shall have full power to get any material of work to be tested by an independent agency at contractor's expense in order to prove the soundness and adequacy.

TESTING OF THE SYSTEM

- After laying and jointing, the entire piping shall be tested to hydrostatic test pressure.
- The pipes shall be slowly charged with water so that the air is expelled from the pies.
- The pipes shall be allowed to stand full of water for a period of not less than 24 hours and then tested under pressure.

- The test pressure shall be 12 kg/cm2. The test pressure shall be applied by means of manually operated test pump or by a power driven test pump to be provided by the contractor.
- In either case precautions shall be taken to ensure that the required test pressure is not exceeded.
- The open end of the piping shall be temporarily closed for testing.
- Test shall be conducted on each pump set after completion of the installation with respect of delivery head, flow and B.H.P.
- The test shall be carried out by the contractor at his own cost.
- All leaks and defects in different joints, noticed during the testing and before commissioning shall satisfaction of engineer.
- Testing of fittings/ equipments shall be carried out either at site or at works in the presence of a representative of the engineer.
- Test certificates shall also be furnished by the contractor.
- The automatic operation of the system for the various functional requirements and alarms as laid down in his specification shall be satisfactorily carried out as per instruction / direction of the engineer.

STAGES OF PAYMENT STATEMENT FOR WORKS

i) The LICI shall make interim payments to the Contractor as certified by the LICI's Engineer/ Project Management Consultant, as specified and valued in accordance with the proportion of the Contract Price assigned to each item and its stage in Schedule of Payment.

ii) The Contractor shall base its claim for interim payment for the work executed till the end of the month for which the payment is claimed, supported with necessaryparticulars and documents in accordance with this Agreement. The basis of payment on "Pro rata basis" shall be worked out on the percentage of work done of total scope of work under their activity/itemfor the respective Cost Centre.

iii) The proportion assigned to an item will apply only to the Awarded Contract Price.It shall not apply to any additions or reductions to the Contract Price arising fromthe issue of any Change of Scope Order. A Change of Scope Order shall specifythe stages of interim payments for the works covered by such order.

iv) The Contractor shall submit a statement (the "Stage Payment Statement'), in3 (three) copies by the 7th (seventh) day of the each month (statement for the previousmonth) to the LICI's Engineer in the form as directed, showing the amount calculated to which the Contractor considers himself entitled for work executed under their activity/itemfor the respective Cost Centre. The Stage Payment Statement shall be accompanied with the progress reports, at least two set of adequate number of photographs and any other supporting documents.

v) Within 7 (seven) days of receipt of the Stage Payment Statement from theContractor, the Engineer-in-charge shall broadly determine the amount due to the Contractor and recommend the release of 75% (seventy five)percent of the amount so determined as part payment against the Stage Payment Statement. Pending issue of the Interim Payment Certificate (the "IPC") by the Engineer-in-charge. In case of discrepancy or for want of correction in the bill submitted by contractor is returned to the contractor, then time of 7 days will be considered from submission of bill after attending observations of the Engineer-in-charge. Within 7 (seven) days of the receipt of recommendation of the Engineer-in-charge, the LICI shall make payment to the contractor through electronic payment directly to the Contractor's bank account.

vi) Within 14 (fourteen) days of the receipt of the Stage Payment Statement, theEngineer-in-charge shall determine the amount due and payable to the Contractor, after adjusting the payments already released to the Contractor against the said statement. In cases where there is a difference of opinion as tothe value of any stage, the Engineer-in-charge's view shall prevail

vii) Balance payment against IPC shall be made to contractor by the LICI within 20(twenty) days of submission of Stage Payment Statement to the Engineer-in-charge. Payment by the LICI shall not be deemed to indicate the LICI's acceptance, approval, consent or satisfaction with the work done.

viii) All such interim payments shall be regarded as payment by way of advancesagainst final payment only and shall not preclude the requiring of bad, unsound and imperfect or unskilled work to be rejected, removed, taken away and reconstructed or re-erected. Any certificate given by the Engineer-in-charge relating to the work done or materials delivered forming part of such payment, may be modified or corrected by any subsequent such certificate(s) or by the final payment certificate and shall not by itself be conclusive evidence that any work or materials to which it relates is/are in accordance with the contract and

specifications. Any such interim payment, or any part thereof shall not in any respect conclude, determine or affect in any way powers of the Engineer-inchargeunder the contract or any of such payments be treated as final settlement and adjustment of accounts or in any way vary or affect the contract.

B. Final Payment Statement

i) Within 60(Sixty) days after receiving of the Completion Certificates and uponcompletion of all incomplete and outstanding works, the Contractor shall submit to the Engineer-in-charge for consideration six copies of a Final Payment Statement (the "Final Payment Statement") for Works, with supporting documents showing in detail, in the form prescribed by the Engineer-in-charge:

a) the summary of Contractor's Stage Payment bills for Works.
b) the amounts received from the LICI against each bill; and
c) any further sums which the Contractor considers due to it from the LICI.

ii) If the Engineer-in-charge disagrees with or cannot verify any part of the Final Payment Statement, the Contractor shall submit such further information as the Engineer-in-charge may reasonably require. The Engineer-in-charge shall deliver to the LICI:

(a) an IPC for those parts of the Final Payment Statement which are not in dispute, along with a list of disputed items which shall then be settled in accordance with the provisions of contract; or
(b) A Final Payment Certificate if there are no disputed items.

C. Final Payment Certificate

i) Within 90 (Ninety) days after receipt of the Final Payment Statement for Works, andthe written discharge, and there being no disputed items of claim, the Engineer-in-charge shall deliver to the LICI, with a copy to the Contractor, a final payment certificate (the "**FinalPayment Certificate") stating:**

(a) the amount which. in the opinion of the Engineer-in-charge, is finally dueunder this Agreement or otherwise; and
(b) after giving credit to the LICI**for** all amounts previously paid by the LICIand for all sums to which the LICI is entitled, the balance, if any. due from the LICI to the Contractor or from the Contractor to the LICIas the case may be.

ii) The LICI shall pay to the Contractor the amount which is finally due, less all amounts previously paid by the LICI and any deductions for the amounts the LICI considers itself to be entitled in accordance with this Agreement, and shall provide the particulars thereof to the Contractor.

iii) Payment against Final Payment Certificate shall be made not later than 60 (sixty)days from the date of issue of the Final Payment Certificate for Works.

D.Production of Records

i) The Contractor shall, whenever required by the Engineer, produce or cause to be produced for examination by the Engineer, any quotation. invoice, cost or other account books, vouchers, receipts, letters, memoranda or any copy of or extract from any such **documents** and also furnish information and returns, as may berequired, relating to the execution of this Contract or relevant for verifying or ascertaining the cost of execution of this Contract or ascertaining the Materials supplied by the Contractor are in accordance with the Specifications laid down in the contract. The Engineer-in-charge's decision on the question of relevancy of any document, information or returns shall be final and binding on the parties.

ii) If any part or item of the work is allowed to be carried out by a subcontractor, assignee or any subsidiary or allied firm, the Engineer-in-charge shall have power to secure the books of such sub-Contractor, assignee or any subsidiary or allied **firm** through the Contractor, and shall have power to examine and inspect the same. The above obligations are without prejudice tothe obligations of the Contractor under any statute, rules or order.

SCHEDULE OF PAYMENT

PREAMBLE

1. The total amount of each major cost centre apportionment to the total accepted contract amount, shall be worked out based on the Percentage mentioned against respective major cost centre.

2. The amount derived as per Clause no 1 above shall be for the quantity and its weightage mentioned against the respective major cost centre shall be for the total quantity in the respective major cost centre.

3. The lump sum amount for major cost center shall remain firm for the completion of the respective major cost center.

4. The nomenclature/Description of major cost center in Schedule of Payment is inbrief/indicative for reference of particular heads/trades of work. Whereas, the scope of work to be executed under the respective 'Major cost centrehas been defined substantially in the documents forming part of this tender in the form of Scope of Work, Design Basis Report (DBR), Technical Specifications and drawings etc.

5. Any work/item prescribed/reflected in scope of work, DBR, Technical Specification, drawings etc. irrespective of conflict and difference of opinion shall be deemed to be included in Major Cost Centre and contractor is bound to carry out all items/work without any extra cost. The decision of the Engineering-in-charge shall be final and binding to the contractor in this regard.

6. It will be deemed that contractor has understood the entire scope of work as reflecting /evident /incidental thereto from the individual and/or conjoint reading of one or more documents out of Scope of Work, DBR, Technical Specifications and drawings and the Schedule of Payment in its entirety. Accordingly, the contractor's quoted amount are deemed to have taken into account the complete work in order to make the buildings & complex fit for its intended purpose.

SCHEDULE OF MAJOR COST CENTRE

1.0 All running/ intermediate and final bill payments shall be made to the contractor in accordance with the apportionment of Accepted Contract Amount according to the Major Cost Centre as per following schedule:

2.0 The percentage figure filled in column (5) by the Employer for the accepted contract amount for completion of the works corresponding to the Major Cost Centre and payment shall be released for different cost centres as per percentage break up in respective SOP (Schedule of Payment).

3.0The percentage of Major Cost Centre apportioned to the accepted contract amount given in the schedule and weightage of Major Cost Centre are tentative only and shall be reviewed based on the detailed cost estimates submitted by the contractor and duly verified by Engineer In charge and will be suitably modified with mutual agreement. However, the decision of the Chief Engineer, LIC of India shall be final and binding to the contractor in this regard.

Stages of Payment

Percentage Apportionment to 'Major Cost Centre' of Accepted Contract Amount i.e. for payment of particular 'Major Cost Centre' is given in the Column 5 (Five)

Brief description of 'Major Cost Centre' and Brief descriotion of various 'Cost Centres' under particular 'Major Cost Centres'is given in the Column 3 (Three)

Weightage of each 'Cost Centre' under particular 'Major Cost Centre' is given in the Column 4 (Four). Cumulative weightage of all the 'Cost Centres' under any particular 'Major Cost Centre' shall not exceed 100%.

The basis of payment on "Pro rata basis" shall be worked out on the percentage of work done out of total scope of work under each activity/item which are completed on date of raising of bill.

The Valuation of any 'Cost Centre' for the purpose of payment of R.A.Bills / Final Bills will be worked out as under;

Valuation of Cost Centre = Contract Amount x Aportion of major Cost Centre x weightage of Cost Centre .

For Example Valuation of A-1 "Cost Centre" will be worked out as under;

Valuatuon of A-1 = Contract Amount X 20% x 1.5% = Contract Amount X (20/100) x (1.5/100)

			.	
Major Cost Centre	Cost Centre	Brief Description of item of work	Weightage of Major Cost Centre for each Cost Centre (%age)	Percentage Apportionment to Major Cost Centre of Accepted Contract Amount (%age).
(1)	**(2)**	**(3)**	(4)	(5)
A		Investigation, Planning, Designing and obtaining its approval as per scope of work, Technical Specification & Drawings etc, including submission of priced schedule of quantities supported by detailed estimate complete. Structural Design shall be vetted by Government Engineering college specified elsewhere in tender. Obtaining approvals from all statutory authorities required for Building		**1.5**

		Construction and Building Completion, all as per scope of work.		
	A-1	On preparation, submission & approval/vetting of Structural drawing & design and submission of working drawings based on vetted drawings including all required detailing for main building and ancilliary structures	20%	
	A-2	On preparation and submission of all Architectural working drawings including, Kitchen, Toilet details, Staircase details, Flooring details, Schedule of Finishes, Doors & Windows, Grills & railing details and revisions, if any.	10 %	
	A-3	On preparation and submission of working drawings of site development including Roads, pathways, Parking , Drive Ways, compound wall & Gates, External services like Sewerage, Rain water Harvesting, STP , internal & external Sanitary & Plumbing, Water mains, RWH Pits etc	10 %	
	A-4	Submission of working drawings of Fire Alarm & Fire Fighting System, SLD, Sub-Station, Internal & External Electrical Installations, Panels, Air-conditioning system, External Lighting, Street Lighting, Data cabling & Telephone wiring, Lightning arrester, Pump room details, Security Systems, LIFT, Mechanical Ventilation etc.	10 %	
	A-5	On submission of Submission of priced schedule of quantities supported by detailed estimate covering entire gamut of work	10 %	
	A-6	On obtaining all required NOCs including obtaining Approval of Building Plans and obtaining Commencement certificates as required.	20 %	
	A-7	Registration with GRIHA/IGBC and submission of the action plan for implementation of Green Building stipulations which will lead to obtaining desired rating with undertaking of obtaining the same.	20%	

		Total	**100%**	
B		**On Completion of RCC work including Form work, shuttering, RMC and Steel Reinforcement etc incl de-shuttering**		**33.0**
	B-1	RCC work in foundation	18%	
	B-2	RCC work of Basement Floor including Retaining Wall .	22%	
	B-3	RCC work of Ground Floor	20%	
	B-4	RCC work of 1st Floor	20%	
	B-4	RCC work of Second Floor & Mumty Room	20%	
		Total	**100%**	
C		**On Completion of masonry work in internal & External Walls all as per Scope of work, DBR, Technical Specifications and Drawings**		**5.0**
	C-1	Masonry work up to Basement Floor Level	5%	
	C-2	Masonry work in Ground Floor	25%	
	C-3	Masonry work in 1st Floor	25%	
	C-4	Masonry work in 2nd Floor	25%	
	C-5	Masonry work of Parapet and Mumty & Other Ancillary Structures	20%	
		Total	**100%**	
D		**On Completion of Internal & External Plastering work**		**4.0**
	D-1	Internal Plaster work in Basement Floor	10%	
	D-2	Internal Plaster work in Ground Floor	15%	
	D-3	Internal Plaster work in 1st Floor	15%	
	D-4	Internal Plaster work in 2nd Floor	15%	
	D-5	Internal Plaster work of Mumty	5%	
	D-6	On completion of External Plaster	40%	
		Total	**100%**	

E		**On Completion of Flooring, Tiling/Stone work in Dado & Skirting etc and False Ceiling in common area and toilets**		**2.0**
	E-1	Flooring work in Basement with Ramp	30%	
	E-2	Flooring & dado work in Ground Floor Common areas, Toilet	10%	
	E-3	Flooring & dado work in Ground Floor Common areas, Toilet	10%	
	E-4	Flooring & dado work in Ground Floor Common areas, Toilet	10%	
	E-5	Flooring work in Ramp/ Staircase from Basement floor to mumty	25%	
	E-6	False Ceiling work of all Common Area & Toilet	25%	
		Total	**100%**	
F		**On Completion of Waterproofing work**		**1.5**
	F-1	Water-proofing work of Basement	30%	
	F-2	On completion of waterproofing work of Toilets	25%	
	F-3	On Completion of work of Terrace and water tanks etc	45%	
		Total	**100%**	
G		**On Completion of Door, Window and Glazing work**		**2.0**
	G-1	On Completion of Framework of Doors & Windows with sub-frame for Windows	35%	
	G-2	On fixing of Shutters	30%	
	G-3	On Completion of work including glazing and hardwares	25%	
		Total	**100%**	
H		**On completion of Painting work**		**1.0**
	H-1	On Completion of Internal Painting	25%	
	H-2	On Completion of External Painting	75%	

		Total	**100%**	
I		**On Completion of Grill / Stainless Steel Railing work and all other fabrication works**		**1.0**
	I-1	On Completion of Railing work	40%	
	I-2	On Completion of MS Grill work and all other fabrication work	60%	
		Total	**100%**	
J		**On Completion of Sanitary & Plumbing Installations work**		**2.5**
	J-1	On completion of Internal Sanitary and Plumbing Pipings	27%	
	J-2	On completion of external Sanitary and water supply Piping	23%	
	J-3	On fixing of Sanitary & Plumbing fittings	50%	
		Total	**100%**	
K		**On Completion of work of UGT & OHT**		**0.7**
	K-1	On completion of OHT including connections and waterproofing treatment	40%	
	K-2	On completion of UGR including connections and waterproofing treatment	60%	
		Total	**100%**	
L		**External Site development including Roads, pathways, parking Area etc. External sewerage , Water mains Storm water drain Compound wall and Gates, Civil work for Land Scape and Ancillary Structures, STP & RWH pits and all other miscellaneous works**		**2.8**
	L-1	On completion of levelling & filling work in Plot.	20%	
	L-2	On completion of External Sewer Lines, Storm water Drain, Rainwater Harvesting work.	25%	
	L-3	On completion Concrete work in, Roads, Pavers Blocks in parking including sub-base	30%	

		work, kerb stones etc.		
	L-4	On completion of work of RWH Pits, STP	25%	
		Total	**100%**	
M		**Horticulture & landscape**		**1.0**
	M-1	On Plantation of Trees	20%	
	M-2	On Plantation of Lawns	30%	
	M-3	On completion of remaining work like plantation of Shrubs, Bushes and Planters	40%	
	M-4	Maintenance of Landscape till Handing over of site	10%	
		Total	**100%**	
N		**On completion of Internal Electrical Installations**		**8.5**
	N-1	On completion of Conduiting works and concealed boxes of switch boards and Distribution Boards etc.	30%	
	N-2	On completion of wiring work and Distribution Boards incld. Earthing	30%	
	N-3	On completion of work of Switches and Sockets	15%	
	N-4	On Commissioning of Installations	25%	
		Total	**100%**	
O	O-1	**Light/Fan Fixtures and fittings**		**3.0**
	O-2	On procurement and fixing	50%	
	O-3	On Commissioning of Installations	50%	
		Total	**100%**	
P		**External Lighting, Lightning conductor etc**		**1.0**
	P-1	On procurement of materials	50%	
	P-2	On completion of Installations	20%	
	P-3	On Commissioning of Installations	30%	
		Total	**100%**	

Q		**On Installation Testing & commissioning of Lifts**		**2.0**
	Q-1	On procurement of materials	70%	
	Q-2	On completion of Installations	10%	
	Q-3	On completion of Commissioning and after obtaining Lift License	20%	
		Total	**100%**	
R		**Fire fighting with wet riser system including Fire alarm system with Detection System & Pressurized mechanical ventilation for basement area**		**5.5**
	R-1	On Completion of fire fighting system	80%	
	R-2	On Testing & Commissioning	20%	
		Total	**100%**	
S		**On completion of Tube Well , Pumps**		**1.0**
	S-1	On Completion of Borewell with sufficient yield	12%	
	S-2	On installation of Pumps for borewell and reservoirs including Pump Room and power connection complete	11%	
		Total	**100%**	
T		**On Completion of Installation of LT & HT Panels incld Substation, installation of DG Set & Service Connection**		**5.0**
	T-1	On Procurement of Transformer, HT/LT Panel and Service Cable etc	20%	
	T-2	On installation of Transformer, HT/LT Panel and Service Cable from Transformer upto Energy Meter	20%	
	T-3	Approval from the Electricity Service Providing Authority/Agency, Energizing the Sub-Station etc	30%	
	T-4	Installation and Commisioning of DG Set	20%	
	T-5	Service Connection	10%	

		Total	**100%**	
U		**Solar PV System**		0.3
	U-1	**Procurement and Installation**	50%	
	U-2	**Commisioning including Net Metering**	50%	
		Total	**100%**	
V		**On completion of basic security system incld CCTV, Intercom, Control Room etc and EPABX System, Illuminated Signages, Boom Barrier**		0.7
		On completion and commisioning	100%	
W		**External Façade Work**		5.0
		On completion	100%	
X		**On completion of all Miscellaneous works and Handing over of site including Municipal Occupancy Certificate and Green Building Rating**		10.0
		Total	**100%**	
			Total	**100%**