

ISSUED TO

M/S -----

**DY. CHIEF ENGINEER (I/C) OFFICE
NCZO, KANPUR**

TECHNICAL- BID (PART-I)

**TENDER FOR DESIGN, SUPPLY, INSTALLATION, TESTING AND
COMMISSIONING OF AIR CONDITIONING & VENTILATION SYSTEM AND
IBMS WORK AT INVESTMENT BUILDING, PLOT No. INS-16, SECTOR-14,
VASUNDHARA (GHAZIABAD)**

Uploading Tender in LIC website : 20.03.2016

Date of Pre-Bid Discussion : 31.03.2016

Last Date of Submission of Tender : 11.04.2016 (Up to 15.00 Hrs)

Date of Opening of Technical Bid : 11.04.2016 (at 15.30 Hrs)

(Opening of Price Bid will be intimated separately)

**TENDER FOR AIR CONDITIONING & VENTILATION WORK and IBMS WORK FOR
INVESTMENT BUILDING AT INS-16, SECTOR 14, VASUNDHRA, GHAZIABAD, U.P.****INDEX (PART-I)-TECHNICAL- BID**

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LIFE INSURANCE CORPORATION OF INDIA
CONDITIONS OF CONTRACT

1.0 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 “Dy Chief Engineer(I/C)” 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 Dy Chief Engineer (I/C) 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, these Conditions, the General Instructions to Contractor, General Preambles to Schedule of Quantities, Special Conditions, the priced Schedule of Quantities, the Specifications, the Appendices, the Drawings and other related correspondence.
- 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(Incharge)	Dy. C.E.(I/c)
Superintending Engineer	S.E
Senior Architect	S.A.
Executive Engineer	E.E.
Deputy Senior Architect	D.S.A
Asst. 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 “allow” shall mean that the Contractor shall include in his rates for the particular matter referred to.
- 1.16 “Day Work” shall mean items of labour and/or materials which in the opinion of the Corporation’s Engineer are not capable of being evaluated by the accepted method of measurement and analysis.

2.0 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 and to the satisfaction of the Corporation's Engineer. The Corporation's Engineer may issue further drawings and/or 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 Drawings or between the Schedule of Quantities and/or Drawings and/or Specifications;
- 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 Dy Chief Engineer (I/C) whose decision shall be final & binding.

3.0 DISCREPANCIES:

3.1 If there are varying or conflicting provisions made in any one document forming part of Contract, the Dy Chief Engineer (I/C) 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. General preambles to schedule of quantities
- c. General instructions
- d. Conditions of contract

3.3 In case of discrepancies between the Schedule of Quantities, the specifications and/or drawings the following order of precedence shall be observed

- a. Description in Schedule of Quantities
- b. Specifications of relevant Trade
- c. Drawings; detailed drawings shall be followed in preference to small scale drawings and figured dimension in preference to scale.
- d. Indian Standard Specifications of 'BIS'

4.0 DRAWINGS AND SCHEDULE OF QUANTITIES:

4.1 Two complete sets of the Drawings and Specifications and Schedule of Quantities shall be furnished by the employer to the contractor. Two copies of the additional Drawings, if any, shall be furnished within such time as the Chief Engineer may consider reasonable which may be necessary for execution of any part of the work. Such copies shall be kept on the work site and the CE and his representatives shall at all reasonable times have access to the same and they shall be returned to the EE by the Contractor on completion of the contract.

This Contract and the signed Drawings, Specifications and Schedule of Quantities shall remain in the custody of the Employer.

5.0 CONTRACTOR TO PROVIDE EVERYTHING NECESSARY FOR EXECUTION OF WORK:

5.1 The Contractor shall provide everything necessary for the proper execution of the work according to the intent and meaning of 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 DY. CE (I/C) 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 Centering, 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 Centering, 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.

6.0 **AUTHORITIES NOTICES AND PATENTS**

- 6.1 The Contractor 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 and Abolition) Act 1970 and Rules thereunder 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 fees that may be properly chargeable in respect of the work and lodge the receipts with the Employer.
- 6.4 The Contractor 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 Dy..Chief Engineer (I/C) before any such infringement and received his permission to proceed and should himself pay all royalties, license 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 neighboring occupants 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;

7.0 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.

8.0 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.

9.0 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 octroi, excise and import duties, sales tax payable to all authorities and other charges. 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/outside sources 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.

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 ceilings, 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 authorized by any one of them shall at all reasonable time have free access to the work and / or to the workshops, factories or other places where materials are being prepared or constructed for the Contract and also to any place where the 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 persons 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 written permission of the Corporation's Engineer for doing so.

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

- 11.1 The Contractor shall either himself supervise the execution of the contract or shall depute an experienced foreman supervised by the Chief Engineer/ Dy. Chief Engineer and Executive Engineer, NCZ, Kanpur and who shall be constantly in attendance at the building while the HVAC and basement ventilation work is proceeding. Any directions, explanations, instruction or notices given by the Corporation's Engineer to such foreman shall be deemed to be given to the contractor.

- 11.2 Corporation's Engineer shall have power to give notice to the contractor or to his foreman of non-approval of any work or materials and such work shall be suspended or the use of such materials shall be discontinued until the decision of the Dy Chief Engineer(I/C) NCZ is obtained. The work will from time to time be examined by the Dy. Chief Engineer (I/C) / Dy Chief Engineer NCZ. and the corporation's Engineers but such examination shall not in any way exonerate the contractor from the obligations to remedy and defects which may be found to exist in such of the work or after the completion of the same.

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.

12.0 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.

13.0 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.

14.0 ASSIGNMENT:

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.

15.0 DEVIATION, VARIATION, EXTRA/DEVIATED ITEMS AND PRICING:

- 15.1 The Contractor should note that unless otherwise stated, the tender is strictly on Item Rate basis and his attention is drawn to the fact that rates for each and every item should be correct, workable and self supporting. The quantities in the Schedule of Quantities approximately indicate the total extent of work and no variation i.e. additions, omissions or subtractions shall vitiate the Contract. No liability shall attach to the Employer for any error therein or variation therefrom.
- 15.2 The contractor may when authorized and shall when directed, in writing by the DY.CE (I/C) or the Corporation's Engineers, whom the Dy CE (I/C) may for that purpose appoint, add to, omit from, make alterations in, substitutions for, or vary the works shown upon the Drawings or described in Specifications or included in the priced Schedule of Quantities but the Contractor shall make no additions, omissions, alterations, substitutions or variations without such authorization or direction. A verbal authority or direction by the Dy CE (I/C), if confirmed by the contractor in writing within 7 (seven) days, be deemed to have been given in writing.
- 15.3 The rates of such altered, additional or substituted works shall be determined in accordance with the following:
- a. The net rates or prices in the original tender shall determine the valuation of the extra work where such extra work is of similar character and executed under similar conditions as the work priced therein.
 - b. The net price of the items in the original tender shall determine the value of the items omitted. However, if omissions vary the conditions under which any remaining items of the work are carried out or if the amount of any omission relative to the amount of the whole of the Contract works or to any part thereof shall be such that in the opinion of the Dy .Chief Engineer(I/C), the net rate or price contained in the Priced Schedule of Quantities or Tender or for any item of work involves loss or expenses beyond that reasonably contemplated by the Contractor and is by reason of such omission rendered unreasonable or inapplicable, the Dy.Chief Engineer (I/C) shall fix another rate or price as in the circumstance he shall think reasonable and proper.
 - c. If the rate for any altered, additional, or substituted item of work is not specified in the schedule of quantities, the rate for that item shall be derived from the rate for the nearest similar item specified therein.
 - d. If the rate for altered, additional or substituted item of work cannot be determined in the manner specified above, then such items 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.

- e. Where such coefficients 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.
- f. 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 CE the names of workmen employed) and materials incorporated be delivered for verification to the CE or his representative at or before the end of the week following that in which the work has been executed. The CE 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.
- g. While fixing rates of extra items 15% (Fifteen percent only) shall be allowed over and above the cost of material, labour and all applicable taxes, cess, statutory levies (excluding income tax) to cover all supervision, overheads, statutory Taxes and Levies and profits.
- h. Where the quantities of any item in the schedule [except items declared abnormally high / low rated - refer Sub-clause 9(i)] exceeds by 100% in foundation and in plinth, and 50% in super-structure (above plinth), these extra quantities over 100% & 50% respectively will be treated as extra items of work and priced accordingly as above. [Items such as roads, pavements etc. shall be considered as below plinth]. The decision of Dy CE (I/C) for terming items below or above plinth is final & binding on the contractor.
- i. Items for which the rates, as assessed by the employer are higher or lower by more than 35% of the market rates shall be termed as Abnormally High Rated Items (AHRI) and Abnormally Low Rated Items (ALRI) respectively. The deviation limit for variation in quantities of AHRI & ALRI shall be 25% in foundation and plinth, and 5% in super-structure. Quantities in excess of the deviation limit shall be treated as extra items of work and priced accordingly as above. The decision of the Dy.Chief Engineer (I/C) on categorization of items as AHRI / ALRI shall be final and binding.
- j. 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 DCE (I/C) shall proceed to fix the rate for the item(s) and the same shall be final and binding on the contractor.

- k. 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.

16.0 SUB-CONTRACTORS:

- 16.1 All specialist Merchants, Tradesmen and others, executing any work or supplying, fixing any goods for which provisional sums are included in the Schedule of Quantities and/or Specifications, who may be nominated or selected by the CE, who shall be the final authority are hereby declared to be Sub-Contractors and are herein referred to as nominated Sub-Contractors.
- 16.2 No nominated Sub-contractor shall be employed on or in connection with the work against whom the Contractors shall make reasonable objection or (save where the CE and the Contractor shall otherwise agree) who will not enter into a Contract providing:-
- a. That the nominated Sub-Contractor shall indemnify the Contractor against the same obligation in respect of the Sub-Contractor as the Contractor is under, in respect of this Contract;
- b. That the nominated Sub-Contractor shall indemnify the Contractor against claims in respect of any negligence by the Sub-Contractor or his servants or agents or any misuse by him or them of any scaffolding or other plant or the property of the Contractor or under any Workmen's Compensation Act in force.

17.0 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** to cover all such risks detailed above viz. loss, damage & third party liability etc. The policy shall be of adequate amount 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 (WORKMENS'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 to Rs 10,000/- for each extension.
- 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 therefrom.
- 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.

18.0 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 neighboring owners, or public authorities,
- (d) by the work, or delays, of other Contractors or Tradesmen engaged by the Employer,
- (e) by reason of any additional work or instruction ordered by the employer,
- (f) by reason of Civil Commotion, local commotion of workmen or strike or lock-out affecting any of the building trades,
- (g) 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,
- (h) from other causes which the CE may certify as beyond the Control of the Contractor,
- (i) 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 endeavors to make good this delay.

- 18.2 Request for extension of time shall be made by the contractor well in advance but least 30 days before schedule date of completion along with revised programme for completion of the work.
- 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 Dy.CE (I/C) 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 within 3 (Three) months of the date of receipt of such request. 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 DY.CE (I/C).
- 18.5 The decision of the Dy CE(I/C) 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.

19.0 DAMAGE FOR NON-COMPLETION:

- 19.1 If the Contractor fails to complete the work by the date of completion stated in the "Appendix to Condition of Contract" or within time properly extended under Clause (18) hereof and the DCE (I/C) certifies in writing that in his opinion the same ought, reasonably so, to have been completed, the Contractor shall pay or allow the Employer the sum named in the Appendix as "Liquidated Damages" for the period during which the said works shall so remain incomplete and the Employer may deduct such damages from any money due to the Contractor. In case liquidated damages in accordance with the above provision accrue to maximum limit as mentioned in the Appendix to the Conditions of the Contract, the Dy.Chief Engineer (I/C) shall be at liberty to rescind the Contract and to get it completed entirely at the risk and cost of the Contractor through any other agency he decides to appoint. All extra expenses incurred shall be recoverable from the money due to Contractor or lying to his credit with the Employer against the present or any other Contract.

20.0 FAILURE BY CONTRACTOR TO COMPLY WITH CE'S INSTRUCTIONS :

- 20.1 If the Contractor after receipt of written notice from the CE / Dy. CE (I/C), requiring compliance with such further Drawings and/or his instructions, fails within 7 (seven) days to comply with the same the Dy.CE(I/C) 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. MEASUREMENT OF WORK:

- 21.1 All items having a financial value shall be entered in the Measurement Book. All measurements and levels shall be taken jointly by the Site Engineer or his authorised representative and by the Contractor or his authorised representative from time to time during the progress of the work and such measurements shall be signed and dated by both the parties in token of their acceptance. If the Contractor objects to any of the measurements recorded, a note shall be made to that effect with reason, signed by both parties and referred to Dy.CE (I/C) whose decision in the matter shall be final and binding. Measurements can also be recorded through electronic medium where specifically approved by Dy. Chief Engineer (I/C).
- 21.2 If the contractor or his authorised representative does not remain present at the time of such measurements after the contractor or his authorised representative has been given a notice in writing 3 (three) days in advance or fails to countersign or to record objections within a week from the date of measurement, then, such measurements recorded in his absence by the Site Engineer shall be deemed to be accepted by and binding on the Contractor.
- 21.3 The Contractor shall, without any extra charge provide all assistance with every appliance, labour and other things necessary for taking measurements and recording levels including test checking of such measurements by any person authorised by the Employer.
- 21.4 All work shall be measured net as fixed in its place. All measurements of 'cutting' shall be held to include for the consequent wastage on the materials used.
- 21.5 Except where any general or detail description of the works expressly shows to the contrary, measurements shall be taken in accordance with the procedure set forth in the specifications notwithstanding any provision in the relevant Standard Method of measurement or any general or local custom. In the case of items for which procedure is not covered in the specification, measurement shall be taken in accordance with the relevant Standard Method of measurement issued by BIS and if for any item no such standard is available then a mutually agreed method shall be followed.
- 21.6 Measurements of all hidden/concealed items of work including extra items if any, such as, work in foundations including excavations, plinth filling, masonry, concrete etc. steel in all R.C.C. work, pipe to be encased etc. shall be jointly recorded 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 measurements, Contractor will give specific notice to the Site Engineer for recording the measurements. If the Site Engineer or his authorised representative fails to record the measurements, the Contractor will refer the matter to the Corporation's Engineer for instructions, but in no case shall cover up work without the latter's permission.

22. PAYMENT TERM & VALUE OF WORK FOR INTERIM CERTIFICATE

22.0 The terms of payment for equipments, Chillers, AHUs, Pipes, valves shall be as % of contract amount as under:

- 70% of the quoted rate upon delivery of equipments / materials for which details of bills/ cost of equipment shall be submitted.
- 15% of the quoted rate upon installation of the materials.
- 10% upon Testing & commissioning of the work.
- 5% balance amount will be paid upon handing over to the department and submitting Bank Guarantee of equal amount (5%) as per format in lieu of security deposit covering Defect Liability of one year and three years of period for annual maintenance contract . On successful expiry of defect liability period of twelve month and CAMC period of three years, this BG shall be returned back.

22.1 The contractor shall be paid by the employer, from time to time, by installment under Interim Certificate to be issued by the Suptdg. Engineer / Corporation's team to the Contractor on account of the work executed, when in the opinion of the Suptdg. Engineer / Executive Engineer, work to the approximate value named in the Appendix as "Value of work for Interim Certificate" or less at the reasonable discretion of the Suptdg. Engineer / Corporation's team has been executed in accordance with this contract, subject however to a retention of the percentage of such value named in Appendix hereto as "Retention percentage on account of Security Deposit". The Interim Certificate shall be based upon Interim Bills or Running Account Bills to be prepared by the Contractor and supported by the detailed measurements. The Executive Engineer may include 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;

22.2 In case any materials have been supplied by the Employer to the Contractor in connection with the work, necessary recovery for the same shall be effected from the bills of the Contractor by the Dy Chief Engineer(I/C) at the issue, rates of such material as stipulated while calling for tenders and in other cases at a stock rate or market rates of such materials, whichever is higher.

The Contractor will, however, not be entitled to modify his rates for items of work requiring use of such materials and when the work has been virtually completed and the Dy. Chief Engineer (I/C) shall have certified in writing that it has been so completed on the basis of detailed measurements and after obtaining the written endorsements by the Dy.Chief Engineer (I/C) that the Dy.Chief Engineer (I/C) has made a final scrutiny and that there are no disputed items, rates and quantities, the Contractor shall be paid by the Employer in accordance with the certificate to

be issued by the Dy. Chief Engineer(I/C) the sum of money named in the Appendix as "Instalment after virtual completion" and the Contractor shall be entitled to the payment of the final bill in accordance with the final certificate to be issued in writing by the Dy.Chief Engineer (I/C) with the approval the Dy. Chief Engineer (I/C) with expiration of the period referred to as "Defects Liability Period" in the Appendix hereto from the date of virtual completion or as soon after the expiration of such period as the work shall have been finally completed and all defects made good according to the true intent and meaning hereof, whichever shall last happen;

- 22.3 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 of itself be conclusive evidence that any work or materials to which it related are in accordance with the Contract;
- 22.4 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;
- 22.5 The Dy CE (I/C) shall have power to withhold any Certificate if the work or any parts thereof are not being carried out to his satisfaction.
- 22.6 The measurements and valuation in respect of the Contract shall be completed within the "period of Final Measurement" 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.
- 22.7 Final certificate shall be issued by the Corporation Engineer after the Conditions are met with as per 23.4, 23.5, 23.6, and 27 and Contractor's submission of **No Claim Certificate cum receipt** as per the Performa given in Appendix to Condition 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) 80% of the market value of materials required for the work and brought on site.

OR

80% of the cost of such materials (brought on site) as derived from the relevant accepted tender rate for the particular item involving such materials;

whichever is lower.

- 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 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 Dy.CE (I/C) 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 Dy.CE (I/C) 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 Dy .Chief Engineer (I/C). 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

Dy.CE (I/C) to this effect. The Dy.Chief Engineer (I/C) 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 equipment supplied and erected shall be guaranteed against defective workmanship, defective material and defective performance for a minimum period of 12 (Twelve) months to be reckoned from the date the HVAC and Basement ventilation works are completed and handed over to LICI along with NOC from chief fire officer, Ghaziabad for basement ventilation. Any defect or defects in performance, workmanship or material arising during the guarantee period shall be rectified by the contractor under this contract free of cost to Life Insurance Corporation of India. During the guarantee period the HVAC and Basement ventilation work shall be serviced by the contractor by deputing once every month or earlier when directed by Life insurance Corporation of India. Any supply of oil, grease or even gas charging required for servicing of the equipment shall be supplied by the contractor at his cost during the guarantee period. In addition to the servicing of the equipment as above, the contractor shall attend to all the breakdown calls during this period of 12 months at his own cost within four hours of reporting of defect. All the traveling expenses, incidental charges, etc. incurred for deputing the personnel for carrying out servicing will have to be borne by the contractor.

28.0 PROVISIONAL SUMS, APPLICATION OF:

28.1 For all the work listed under items for which provisional sums are provided in the tender, the Dy.CE (I/C) reserves the right to invite separate tenders or select or order from any manufacturer or firms at his discretion and reserves to himself the right of paying direct to persons or firms for any such work. The Contractor will not have any claims over these items, but if tenders are invited for such items, he will also be invited to quote along with others.

28.2 If ordered by the Dy.CE(I/C), Contractor shall be required to carry out provisional sum items at the same conditions and rates as applicable for this Contract.

29. OTHER PERSONS ENGAGED BY THE EMPLOYER:

29.1 Dy.CE(I/C) 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 Dy.CE (I/C) 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 Dy.CE (I/C) that he is able to carry out and fulfil the Contract and if required by the Dy CE (I/C) 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 Dy.CE (I/C) 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 Dy. CE (I/C) 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 Dy.CE (I/C) 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 Dy.CE (I/C) 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 Dy.CE (I/C) 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 released. The Dy.CE (I/C) 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 Dy.CE (I/C) 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 Dy.CE(I/C) 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 Dy. Chief Engineer (I/C), 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 Dy.CE (I/C) 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:

- 35.1 Amount towards Security deposit shall be calculated as per details given in "APPENDIX TO CONDITIONS OF CONTRACT" in Part – I & Part-II of 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 deductions from Running Account Bills at 7.5 % (maximum) of gross amount of bill. 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 and three year period of comprehensive annual maintenance contract period OR, two Bank Guarantees of like amounts each equal to half the half the security deposit; one valid till virtual completion and the other till end of defects liability period and three years of comprehensive annual maintenance contract period.

- 35.2 Performance Guarantee under "Appendix to Conditions of Contract" shall be only in the form of Bank Guarantee valid upto scheduled date of completion
- 35.3 The Bank Guarantee/s shall be from any Nationalised / Scheduled Bank approved by the Dy.Chief Engineer I/C), which is located at the Zonal Office Headquarters of L.I.C within whose jurisdiction the work falls or at the place of work.
- 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 A and B. These guarantee/s shall be submitted within 21 (twenty one) days of issuance of letter of acceptance. The Bank Guarantee/s against Performa Guarantee (PG) shall be submitted with in 20 (Twenty) days from the date of commencement of work.
- 35.5 If the contractor fails to furnish the prescribed performance guarantee within the prescribed period or duly approved extended period ,50% of the earnest money will be absolutely forfeited automatically without any notice & the balance 50% will be refunded.

- 35.6 50% of the Security Deposit (cash option) shall be refunded after the certificate of virtual completion is issued to the contractor & 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 and three year period of comprehensive maintenance contract 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 the certificate of Virtual completion is issued to the contractor and second shall be released after the satisfactory completion of Defects Liability Period and three years of comprehensive annual maintenance contract 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 lying 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).

35.-A EMD :

Earnest Money shall be remitted in the form of crossed Demand Draft/ Pay Order/ Bankers Cheque on any nationalized / scheduled bank at the place of submission of tender. EMD of amount less than Rs. 50, 000/- can also be deposited in cash in any of the Corporation's designated offices and a miscellaneous receipt obtained for the same. **As an alternative, Earnest money can be accepted in the form of bank guarantee and in such cases 50% of EMD or Rs. 20 lacs whichever is less, needs to be deposited in the form of cash (upto Rs.49999.00) /crossed DD/ Pay order/ bankers Cheque on any nationalized / Scheduled bank at the place of submission of tender and the balance amount in the form of Bank guarantee. But for such cases tenders have to be opened after verification of bank Guarantee with issuing bank.**

The Demand Draft, copy of M.R. as the case may be, is to be enclosed with the tender documents at the time of submission.

36.0 SETTLEMENT OF DISPUTES, ARBITRATION:

- 36.1 All disputes and differences of any kind whatsoever arising out of or in connection with the Contract or the carrying out of the work (whether during the progress of the work or after its completion and whether before or after determination, abandonment or breach of the Contract) shall be referred by the Contractor to the Dy Chief Engineer (I/C) within 15 (fifteen) days of any such matter arising. The Dy. CE (I/C) shall upon receipt of such reference convey his written instructions or decision within 30 (Thirty) days to the contractor. If the contractor be dissatisfied with the decision of the Dy.CE (I/C) on any matter, other than EXCEPTED MATTERS, then and in any such case, the Contractor shall within 30 (Thirty) days after receiving notice of such decision give a written notice to the Employer requiring that such matters in dispute (other than excepted matters) be arbitrated upon. Such written notice shall specify the matters which are in dispute or difference of which such written notice has been given and no other shall be and is hereby to be referred to the Arbitration. In case the Contractor fails to serve the written notice on any or all the issues in dispute within 30 (Thirty) days the decision conveyed by the Dy. CE (I/C) shall be taken as final, binding and conclusive and shall not be open to arbitration.
- 36.2 Any disputes or differences that the employer may have with the contractor shall also be referred to Arbitration.
- 36.3 All disputes between the parties to the contract (other than those for which the decision of the Dy.CE (I/C) or any other person is by the contract expressed to be final & binding) shall after written notice by either party to the contract to the other of them be referred to sole arbitration by an Arbitrator to be appointed by the Executive Director (Engineering).
- 36.4 The sole Arbitrator shall be a qualified and experienced professional Engineer/Architect who is holding or held office in Central / State Govt. or public undertaking (of the rank Dy. Chief Engineer (I/C) / Senior Surveyor of works / Dy. Chief Architect and above), OR a member of Indian Council of Arbitration.

- 36.5 If the arbitrator so appointed resigns his appointment or vacates his office or is unable or unwilling to act due to any reason whatsoever, the appointing authority shall appoint a new arbitrator in his place.
- 36.6 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 The Sole Arbitrator shall determine all matters in disputes other than EXCEPTED MATTERS (referred in Cl.No.34) which shall be referred to the Sole Arbitrator.
- 36.8 The Arbitration shall be conducted in accordance with the provisions of the Arbitration and Conciliation Act 1996 or any statutory modifications thereof.
- 36.9 The Contractor hereby also agrees that Arbitration under this Clause shall be a condition precedent to any right of action under the Contract.
- 37.0 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 5% of the Contract sum may be advanced against a Bank Guarantee and at the interest rate as specified in Appendix to the Conditions of Contract, repayable half-yearly-compounded. 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 approved 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.
- 37.4 The amount of loan which may be given to the Contractor shall be at the sole discretion of the Dy.CE (I/C) and may be in one or more instalments.
- 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 as fixed by the Dy. CE (I/C) subject to the condition that entire amount of loan with interest thereon shall be fully recovered by the time the work amounting to 75% of the Contract sum is completed or completion period whichever is earlier. 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.

LIFE INSURANCE CORPORATION OF INDIA

GENERAL INSTRUCTIONS TO CONTRACTORS

1.0 DRAWINGS:

- 1.1 The contractor upon commencement of work shall Drawings shall be kept open for inspection at places as mentioned in the letter to the contractor from the Dy.Chief Engineer (I/C). Drawings generally include the site plan, floor plans, elevations and sections of the proposed work. The contractor shall prepare detailed working drawings and get the same approved by the consultants, ultimately by the Dy.Chief Engineer (I/C) of LICI.

2.0 INSPECTION OF SITE:

- 2.1 The Tenderer 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 Tenderer 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 Tenderer and no claims for reimbursement thereof shall be entertained.

3.0 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.

4.0 TIME AND PROGRESS CHART:

- 4.1 A time and Progress Chart shall be submitted by the successful contractor.. The Contractor shall submit his version of time and progress chart fitted within the specified overall period of completion (as stated in Appendix to Conditions of Contract) within 21 (Twenty One) days of the communication of acceptance of the tender, to the Corporation's Engineer.

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.

5.0 **DRAWINGS ON SITE:**

5.1 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.

6.0 **ORDER OF WORK:**

6.1 The Dy. Chief Engineer (I/C) 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.

7.0 **WORKMANSHIP:**

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

8.0 **REJECTED WORKMANSHIP OR MATERIALS:**

8.1 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.

9.0 **QUOTED RATES:**

9.1 Rate quoted by the contractor shall be **firm throughout the currency of the contract** (including extensions of time, if any granted) **No price fluctuation** due to variation in cost of materials or labour or any variation under any state or Central Legislation or any other reason whatsoever shall be allowed. Contractor should note that unless otherwise stated the tender is strictly on Item Rate basis and his attention is drawn to the fact that

rates for each and every item should be correct, workable and, self supporting.

10.0 WATCHING AND LIGHTING:

10.1 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.

11.0 SECURITY AND PROTECTION:

11.1 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.

11.2 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.

11.3 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.

11.4 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.

12.0 MINIMUM WAGES ACT:

12.1 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.

13.0 SHEDS FOR MATERIALS:

- 13.1 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.

14.0 WORKS AND SITE TO BE KEPT AND DELIVERED UP CLEAN:

- 14.1 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.

15.0 SIGN BOARD AND HOARDINGS:

- 15.1 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.

16.0 SCIENTIFIC AND MEASURING INSTRUMENTS:

- 16.1 All necessary instruments for installation and checking as required, shall be provided by the Contractor at his expense for the due performance of this Contract as instructed by the Corporation's Engineer.

17.0 ATTENDANCE ON SUB-CONTRACTORS:

- 17.1 Co-ordination: The Contractor shall be responsible for the co-ordination of all the work including that of Sub-Contractors, 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.
- 17.2 The Contractor shall accept liability for and bear the cost of the supply of all necessary water, electricity, lighting, watching etc. for the Sub-Contractors work.
- 17.3 The Contractor must allow in his rates for making good any holes and chases left by the Sub-Contractors or other Contractors nominated by the Employer before the Builder's Work is completed and handed over.

17.4 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.

18.0 OCCUPATION BY EMPLOYER:

18.1 The Employer reserves the right to take possession of the H.V.A.C. and Basement ventilation work in sequence as completed, as may be considered deemed fit by the Chief Engineer both practicable and reasonable and without hindrance to the Contractor's progress.

19.0 TAXES, DUTIES, LEVIES AND DEDUCTION AT SOURCE:

19.1 The Contractors shall be responsible to pay all statutory levies imposed by the State and Central Government such as Income Tax/ Sales Tax/ Sales Tax on works contract, Value Added Tax (VAT), Excise Duty, Octroi, etc., and the rates quoted in the tender shall allow for the same. The price quoted shall be firm until completion of work.

19.2 Deduction at source of Income/Trade Tax / Labour cess, on works contract etc. shall be made by LIC of India as per the provisions prevailing from time to time from the Running Account or Final Bills and remitted to the concerned Taxation Authorities / State Government on behalf of the contractor.

20.0 WATER:

20.1 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.

21.0 ELECTRICITY:

21.1 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.

SPECIAL CONDITIONS OF CONTRACT

TENDER FOR AIR CONDITIONING & VENTILATION & IBMS WORK FOR PROPOSED INVESTMENT BUILDING AT INS-16, SECTOR 14, VASUNDHRA, GHAZIABAD, U.P.

VISIT OF SITE OF WORK :

1. The tenderer shall visit the site of work before filling in his tender and get acquainted with all the information required before submitting the tender.

The dimensions given on the drawings, if any, supplied along with the tender should be considered as only indicative and it is obligatory on the part of the tenderer to satisfy them- selves regarding actual dimensions available on the site. Depending on the actual dimensions of the HVAC Plant and Basement ventilation fans' work etc. at site the contractor shall include in his quotations for any additional structural steel work (like brackets to support guide rails, etc.) that may be necessary to erect and install the HVAC Plant etc. in its final position within the available space. No extra claims on account of any such extra work will be entertained at a later date.

2. PRICES :

The price quoted shall be firm until completion of the work and not subject to any variations. The tender prices shall include for all packing and unpacking, all loading and unloading, all freight, custom duty, Octroi duty, etc. insurance for the equipment during the storage as well as during the erection and for all damages from any cause whatsoever during the contract and defects liability period. The charges shall also include for delivery of the equipment at the site of work. No claim for extra or otherwise on account of the foregoing shall be entertained as the rates quoted shall be deemed to be inclusive of all the charges applicable.

3. TAXES & DUTIES, ETC.:

Tenders are invited on the basis of works contract. The contractors shall be responsible to pay the Sales Tax/ Trade Tax / Commercial Tax on works contract and such other duties and taxes as Turn Over Tax, Sales Tax on materials, Excise Duty, Octroi etc.. Service tax shall be reimbursed subject to submitting of documentary proof for payment of same to the concerned authority.

Deduction of Trade / Commercial /Works contract Tax/ Sales Tax on works contract at source shall be made by LIC of India as per the provisions prevailing and as per directive of Government from time to time from the running account or final bills and remitted to the concerned taxation authorities / State Government on behalf of the contractor under whose jurisdiction of work is executed Chief Engineer, LICI, North Central Zonal Office, Jeevan Vikas , 16/275 Mahatma Gandhi Marg, Civil Lines, Phool Bagh, Kanpur - 208001).

4. OVERRIDING AND PRINTED CONDITIONS :

Overriding conditions, if any, imposed by the tenderer, having financial implications or otherwise are to be submitted with the technical bid.

5. PART I – (TECHNICAL & COMMERCIAL) :

Part I shall contain the un-priced tender consisting of complete technical specification including drawings and documents and commercial terms and conditions technical aspects of the tender such as equipment data sheets, tests and inspection, makes of materials, technical description, drawings in envelop super scribing Part I. Earnest money in the form of DD shall be submitted with the Part I of the tender.

Part I of the tender shall contain the following:

- a. Power of Attorney/authorisation with the seal of the company/firm in the name of the person signing the tender documents.
- b. List of deviations, if any, in commercial terms and conditions.
- c. List of deviation, if any, in technical specification.
- d. Detailed proposed layout drawing and full equipment details.
- e. A letter from the OEM, authorising the bidder to participate in the tender along with a copy of the agreement with the OEM as regards implementation of similar projects in India and their after sales service.
- f. Guaranteed Tonnage of Chiller at ambient conditions of Ghaziabad..

Detailed specifications of each of the offered items such air cooled ac plant, control panels, control & monitoring systems, cables etc. matching with the specifications contained under this contract along with manufacturer's catalogue / product brochure. If there are some variations in specifications and dimensions of the equipment / products as contained under the manufacturer's catalogue / product brochures vis-a vis those given under the specifications contained under this tender document, the specifications and dimensions given in this tender document shall prevail.

Complete technical details and any special features proposed for incorporation must be given for full technical evaluation. Supporting documents for the claimed facilities/ features shall also be attached while submitting the technical bid.

The tenderer should have maintenance set-up at Ghaziabad or in National Capital Territory New Delhi, address & telephone / fax nos. of maintenance set-up shall be indicated.

Other Certificates / Declarations as per Annexures enclosed to be submitted.

The Tenderers are advised to visit the site of installation and acquaint themselves of the site conditions before tendering.

The tenderers are advised to submit the tender based strictly on the General Conditions of the Contract and Technical Specifications contained in the tender documents, and not to stipulate any deviations. If acceptance of the terms and conditions given in the tender documents has any price implications, the same should be considered and included in the quoted price. A tender containing deviation from the terms and conditions may be liable for rejection.

The tenderers shall submit full details of the patent, trade mark, registered design, intellectual property rights, and copy rights, industrial property rights held by them or used by them of any third party with regard to design or any part of the system.

All information, correspondence letters shall be addressed to **The Dy. Chief Engineer (I/c), LIC of India, Engg Dept. North Central Zonal Office, Jeevan Vikas , 16/275, Civil Lines, Kanpur - 208001.**

6. PART II – (PRICE BID) :

Part II containing price bid in envelope, super scribing Part II (Air-Conditioning , Ventilation and IBMS work for Investment building at Plot No INS-16, Sector 14, Ghaziabad, U.P) – “Price bid”, supplied along with the tender.

- (a) This part shall contain prices in Indian Rupees only with detailed break-up of price as per format (Part II) both in figures and words. No other enclosure is permitted in Part II. Change of terms and conditions and technical deviations, if any, found in Part II of the tender will not be taken into account and will be treated as null and void.

The rate quoted shall include supply of the air cooled chilling equipment , accessories and any other imported equipment shall cover export packing, freight and insurance up to the site and any other charges as applicable to deliver the equipment upto the site. .

(The rate shall include Furnishing of test certificate at Full load capacity test in factory with design operating conditions in conformance with AHRI / ARI/Euro vent required standards. The test shall be at AHRI / ARI/ Eurovent certified Test bed as per specification. It includes Costs of handling and transport from nearest port to site including rigging and lifting up the Chiller or any other imported equipment to the Chiller platform of MS foundation on terrace or required floor respectively, Receiving at site imported equipment if any , unloading, storing, security, rigging , lifting shifting. The rates also shall inclusive to attend Routine service / break down calls for chiller during the warranty / defects liability period)

- (b) The tenderer must use only the forms issued by the LICI to fill in the rates. The tender form must be filled in English and all entries must be made by hand and written in ink. If any of the documents is missing or unsigned, the tender may be considered invalid by the LICI in its discretion.
- (c) Rates should be quoted both in figures and words in columns specified. All erasures and alterations made while filling the tender must be attested by initials of the tenderer. Overwriting of figures is not permitted. Failure to comply with either of these conditions will render the tender void at the LICI's option.
- (d) No request for any change in rate or conditions after the opening of the part II of the tender will be entertained.
- (e) The rates quoted shall be deemed to be for the finished work and shall be firm and binding without any escalation whatsoever till the system is handed over to the LICI.
- (f) For any item, if the rate and amount do not tally with respect to the quantity, then the amount arrived on the basis of quoted rates shall only be acceptable and in case of variation of rates in figures and words, the rate quoted in words will only be considered for arriving at the total amount for that item.

7. BRIEF SCOPE OF WORK : The scope of work shall include the following

- **Design, Supply, Installation, Testing and Commissioning of all equipment's materials for the captioned work, to LICI's site at plo No INS-16, Sector 14, Vasundhra, Ghaziabad including packing, handling, transporting, loading/unloading etc. at site.**
- Providing Regular Maintenance inclusive of periodic service including all spares, etc. during warranty period.
- The tenderer should indicate in his tender the complete description of the working of the system/sub systems and their power requirements with all relevant brochures/literature etc. in addition to those called for in the Technical Specifications:
- The Tenderer shall carefully check the specifications and shall satisfy himself that the equipment offered is suitable as per the LICI's Technical Specifications.
- Tenderer shall supply all tools, plants, scaffolding, labour and consumables etc as required for installation, testing and commissioning of the system.
- The tenderer shall state clearly in his tender the standard tools, spare parts which he will supply free of cost when installing the equipment's and handover same to the LICI after completion of the work.
- The tenderer shall furnish a separate Bank guarantee of 5% of the contract value as Security for due fulfilment of terms and obligation of defects liability period from the date of

commissioning and handing over of the works as specified in the tender to the LICI. The amount of Bank Guarantee will be valid till satisfactory completion of the defects liability period of one year and comprehensive annual maintenance contract of three years for entire HVAC and basement ventilation work.

8. TERMS OF PAYMENT :

The payment for the works to be executed under this contract shall be made as follows and no variation in the mode of payment will be acceptable.

- 70% of the quoted rate upon delivery of equipments / materials for which details of bills/ cost of equipment shall be submitted.
- 15% of the quoted rate upon installation of the materials.
- 10% upon Testing & commissioning of the work.
- 5% balance amount will be paid upon handing over to the department and submitting Bank Guarantee of equal amount (5%) as per format in lieu of security deposit covering Defect Liability of one year and three years of period for annual maintenance contract . On successful expiry of defect liability period of twelve month and CAMC period of three years, this BG shall be returned back.

- (i) Manufacturer's Inspection and Test Certificates
- (ii) Contractor's Certificate that all components, parts, sub systems, consumables etc. for successful installation, commissioning and testing of the systems including maintenance have been received at site in good condition and if any shortfall is noticed during installation, commissioning and testing they will be supplied free to the LICI.
- (iii) Policies of insurance covering all the risks during transit, storage, installation, commissioning, testing and handing over including third party liabilities.
- (iv) The pro-rata payment against all inclusive Maintenance contract shall be made half yearly on completion of satisfactory services rendered and on confirmation regarding achievement of specified inside temperature.

9. SERVICE TAX :

The rates quoted shall be exclusive of service tax under partial reverse charge mechanism. Contractor quoted rate excluding the service tax liability for its full extent ie 100 % service tax on Serviceable portion .In case of service provider being a corporate entity, service tax shall be paid fully by them to the concerned authority directly and reimbursement will be made by LICI on production of proof of remittance. No recovery towards service tax will be effected from their bill. However, if the service provider is other than corporate entity (Individual, HUF, Proprietary,

Partnership firm, LLP and AOP), LIC will remit 50 % of Service tax liability towards service recipient (LIC) liability and Contractor has to directly remit to the concerned Authorities remaining 50% of Service tax towards their liability (Service provider) and reimbursement will be made by LICI on production of proof of remittance. No recovery towards service tax will be effected from their bill.

11. WARRANTY/ DEFECTS LIABILITY PERIOD :

The mechanical structures, Chillers, Pumps, Fans, electrical works including power conditioners / inverters / charge controllers / distribution boards/ digital meters / switchgear/, etc. and overall workmanship of the one year from the date of successful commissioning of AC plant, / **systems must be warranted against any manufacturing /design/ installation defects for a minimum period of one years.** During this period, the successful tenderer shall make periodical inspection of the working of the system free of charge at least once in two months or less and attend to various equipment's and other service/settings that may be required of him.

12. ALL INCLUSIVE MAINTENANCE DURING WARRANTY PERIOD:

All Inclusive for Maintenance Contract of the entire system as provided, including all spares and consumables for a period of 01 years after successful completion of work.

13. PACKING AND DESPATCH:

The equipment shall be properly and securely packed in boxes and multiple handling and transportation by sea/ air / rail / road under Indian conditions. All equipment/components shall be delivered at **Plot No. INS-16, Sector 14, Ghaziabad, U.P.**

14. SIGNING OF CONTRACT AGREEMENT:

The General instructions to the tenderers and special conditions, conditions hereinbefore referred to Conditions of Contract and Technical Specifications and drawings enclosed with the tender documents, the subsequent correspondence exchanged between the LICI and the tenderer and the work order placed shall be the basis of the final contract to be entered into with the successful tenderer.

The Tenderer shall go through the terms and conditions given in the general conditions of contract herewith and his offer shall be strictly in line with the terms specified therein. No deviation from the terms and conditions specified shall be acceptable. Each page of the tender documents should be signed for his/their having acquainted himself/themselves in the general conditions of contract, Technical specifications, etc.

The tender submitted on behalf of a firm shall be signed by all the partners of the firm or a partner who has the necessary authority on behalf of the firm to enter into the proposed contract. Otherwise the tender may be rejected.

The contractor shall not assign the contract. He shall not sublet any portion of the contract except with the written consent of the Employer. In case of breach of these conditions, the Employer may serve a notice in writing on the Contractor rescinding the contract whereupon the security deposit shall stand forfeited to the Employer, without prejudice to his other remedies against the Contractor

15. SUFFICIENCY OF SCHEDULE OF QUANTITIES:

The Contractor shall be deemed to have satisfied himself before tendering as to the correctness and sufficiency of his tender for the works and of the prices stated in the Schedule of Quantities and/or the Schedule of Rates and Prices which rates and prices shall cover all his obligations under the Contract, and all matters and things necessary for the proper completion of the works.

The quantities in the schedule of quantities approximately indicate the total extent of work, but may vary to any extent and even be omitted thus altering the aggregate value of the contract. However, during actual execution of work if the quantities of any of the items of work exceeds by more than 25% of the tender quantities, the quantities of such items executed, by the authority of the chief engineer, in excess of 25% of the tender quantity shall be considered as an extra item of work for which the contractors shall submit fresh rates supported by rate analysis worked on the actual cost basis plus 15% towards establishment charges, contractor's overhead and profit. The rate for all such items of work, being current ones, will not be eligible for price adjustment due to increase or decrease in prices of materials and labour rates as per escalation formula, if any, given in the tender. If any of the items of work is omitted from the accepted tender at the sole discretion of the employer, the contractor shall not be entitled to any claim on this account.

Right to Accept Part Tender

The LICI reserves the right to accept the tender either in whole or in part at the same prices quoted by the Tenderer.

16. TESTING:

Before dispatching the equipment to site, the equipment, will be inspected at the discretion of the LICI and tested for various parameters by the LICI's Engineers at the manufacturer's works and then cleared for shipment. This will however, not in any way absolve the contractor of his responsibility for the continued performance of the system/components after erection & commissioning at the designated site during the period of defects liability. However, if testing is of equipments like chillers is out of India, the contractor will submit necessary test certificates for chillers.

17. DRAWINGS :

All required drawings for all the equipment lay out viz: layout of chillers, chilled water pumps, Chilled water pipe layout with all the valves, makeup water tank, pressurization pumps, Pressurized Expansion Tank and pumps, Control Panels for Chilled water pumps and HRW, Basement Ventilation and all the control panels, AHU's with required piping with valves and ducts' cross-section of ducts with gage of sheet etc. should be prepared by the tenderer and submitted to the LICI's engineer for approval before commencement of work.

Other Issues

The Contractor shall carry out all the work strictly in accordance with the approved drawing, detailed specifications and instructions of the LICI's engineer. If in the opinion of the Chief engineer/, nominal changes have to be made to suit the site condition and with the prior approval in writing of the Employer, the Contractor shall carry out the same without any extra charge.

The rates quoted in the tender shall include all charges for scaffoldings, watching and lighting by night as well as day including Sundays and holidays, protection of all other erections, matters or things and the Contractor shall take down and remove any or all such centring, scaffolding etc. as occasion shall require or when ordered so as to do, and fully reinstate and make good all matters and things disturbed during the execution of work and to the satisfaction of the LICI.

18. Recovery of Charges against Electricity /Water from Contractors (Bill):-

Contractors shall have to make his own arrangement for temporary Electrical supply for installation work. However for testing and commissioning of plant, LICI will provide three phase 415 volt, electric power supply.

19. Fire safety N.O.C.:-

Fire NOC from statutory authority for basement ventilation is deemed to be included in the quoted rates and nothing extra shall be paid on this account. Any statutory fees to be paid to authority, only shall be paid by LICI of India / reimbursed to the contractor based on receipt for the said amount/fees to authorities.

20. Electrical Safety N.O.C.:-

Electrical safety NOC from statutory authority for whole HVAC and basement ventilation is deemed to be included in the quoted rates and nothing extra shall be paid on this account. Any statutory fees to be paid to authority, only shall be paid by LICI of India / reimbursed to the contractor based on receipt for the said amount/fees to authorities.

ANNEXURE – 'A'**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

1. 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 – 'B'**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

1. 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.**

ANNEXURE – 'C'

LIFE INSURANCE CORPORATION OF INDIA
FORM OF BANK GUARANTEE FOR LUMP SUM ADVANCE
IN INDIVIDUAL CONTRACTS

To

THE LIFE INSURANCE CORPORATION OF INDIA

1. 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.**

Annexure-X

FORM OF BANK GUARANTEE IN LIEU OF PART OF THE EARNEST MONEY DEPOSIT

(On Non-judicial Stamp Paper to be stamped in accordance with stamp act, the stamp paper to be issued in the name of Executing Bank)

BID BOND

B.G. No. _____ dated _____.

This Deed of Guarantee ("Bid Bond") executed at _____ by _____ (Name of Bank) having its Head / Registered office at _____ (hereinafter referred to as "the Guarantor") which expression shall unless it be repugnant to the subject or context thereof include its executors, administrators, successors and assigns;

In favour of

the Life Insurance Corporation of India having its North Central Zonal Office at Kanpur in the State of Uttar Pradesh (hereinafter called "the Corporation" which expression shall unless repugnant to the subject or context include its successors and assignees)

Whereas M/s. _____, a [Legal Entity] having its registered office at _____ (hereinafter called "the Tenderer") which expression shall unless it be repugnant to the subject or context thereof include its executors, administrators, successors and assigns, has decided to bid for the Tender for invited by the Corporation vide NIT dated (hereinafter referred to as "the Tender").

Whereas in terms of the Tender as specified hereinabove issued by the Corporation, the Tenderer is required to furnish to the "the Corporation" an unconditional and irrevocable bank guarantee for an amount of Rs. Lakhs (Rupees only), as Bid Bond in lieu of the part of the Earnest Money Deposit (EMD) as per the Tender and the Guarantor has at the request of the Tenderer agreed to provide such Guarantee being these presents:

Now this deed witnesseth that in consideration of the premises, We, _____ the Guarantor hereby declare, undertake and agree as follows:

a) We as primary obligor shall unconditionally and irrevocably pay to the "the Corporation" without demur, an amount not exceeding Rs. lakhs (Rupees only), within 5 days of receipt of a written demand from the "the Corporation" stating that the Bid Bond has been invoked and forfeited upon the Tenderer being declared and notified by "the Corporation" as a Successful Bidder and the Tenderer not fulfilling the requirements as per terms of the tender Document. Any such demand made on us by the "the Corporation" shall be conclusive and absolute as regards to the invocation and the forfeiture of the Bid Bond and the amount due and payable under this Guarantee. We expressly acknowledge that this Guarantee may be invoked multiple times.

b) The above payment shall be made by us without any reference to the Tenderer or any other person and irrespective of whether the claim of the "the Corporation" is disputed by the Tenderer or not.

c) This Guarantee shall remain in full force for a period of six months from or for such extended period as may be mutually agreed between the "the Corporation" and the Tenderer and shall continue to be enforceable till all amounts under this Guarantee are paid.

d) In order to give full effect to this Guarantee, the “the Corporation” shall be entitled to treat the Guarantor as the principal debtor and the obligations of the Guarantor shall not be affected by any variations in the terms and conditions of the tender Document or other documents or by extension of time of performance of any obligations by the Tenderer or any postponement for any time of the powers exercisable by the “the Corporation” against the Tenderer or forebear or enforce any of the terms and conditions relating to non-compliance of the tender Document by the Tenderer and we shall not be relieved from our obligations by reason of any variation or extension being granted to the Tenderer or forbearance or omission on the part of the “the Corporation” or any indulgence by the “the Corporation” to the Tenderer to give such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

e) This Guarantee shall be irrevocable and shall remain in full force and effect until all our obligations under this Guarantee are duly discharged.

f) Any payment made hereunder shall be made free and clear of and without deduction for, or on account of, any present or future charges, fees, commissions, deductions or whatsoever and by whom ever imposed.

g) The Guarantor has power and authority to validly execute and issue this Guarantee and the undersigned is duly authorised to execute and deliver this Guarantee pursuant to the power granted under _____ and its obligations under this Guarantee will be legally valid and binding and enforceable against it.

h) Notices.

Any demand certificate, notice or any other communication under this Guarantee shall be (i) in writing and (ii) faxed or sent by person, or overnight courier or by electronic mode at the following addresses:

.....
[insert]

All such Demand Certificates, notices and communications shall be effective (i) if sent by fax, when sent (with the correct answerback), (ii) if sent by person, when delivered, (iii) if sent by courier one (1) Business Day after deposit with an overnight courier, and (iv) if sent by registered letter when the registered letter would, in the ordinary course of post, be delivered whether actually delivered or not.

i) This Guarantee is subject to the laws of India. Any suit, action, or their proceedings arising out of this Guarantee or the subject matter hereof shall be subject to the exclusive jurisdiction of courts of Kanpur, India.

In Witness whereof the Guarantor has set its hands hereunto on the day, month and year first hereinabove written.

Signed and Delivered by _____
Bank by the hand of Shri _____
Its _____ and authorised official.

PRE CONTRACT INTEGRITY PACT**General:**

This pre-bid pre-contract Agreement (hereinafter called the Integrity Pact) is made on..... day of the month of201 , between, on one hand, the Life Insurance Corporation of India (hereinafter referred to as "LIC") a statutory Corporation established under section 3 of Life Insurance Corporation Act 1956 (XXXI of 1956) and having its corporate office at "Yogakshema" Jeevan Bima Marg Mumbai 400021. (hereinafter called the "BUYER" which expression shall mean and include, unless the context otherwise requires, his successors in office assigns) of the First part. And M/s represented by Shri..... .(hereinafter called the "BIDDER /SELLER" which expression shall mean and include , unless the context otherwise requires, his successors and permitted assigns) of the Second part.

WHEREAS the BUYER proposes to procure (Name of the Stores/ Equipment/Item) and the BIDDER/Seller is willing to offer/has offered the stores and

WHEREAS the BIDDER is a private company/public company/Government undertaking/partnership/registered export agency, constituted in accordance with the relevant law in the matter and the BUYER is performing its function under the LIC Act 1956.

NOW, THEREFORE,

To avoid all forms of corruption by following a system that is fair, transparent and free from any influence/prejudiced dealings prior to, during and subsequent to the currency of the contract to be entered into with a view to:-

Enabling the BUYER to obtain the desired said stores/equipment/item at a competition price in conformity with the defined specifications by avoiding the high cost and the distortionary impact of corruption on public procurement, and

Enabling BIDDERS to abstain from bribing or indulging in any corrupt practice in order to secure the contract by providing assurance to them that their competitors will also abstain from bribing and other corrupt practices and the BUYER will commit to prevent corruption, in any form, by its officials by following transparent procedures.

The parties hereto hereby agree to enter into this Integrity Pact and agree as follows:-

Commitments of the BUYER

- 1.1** The BUYER undertakes that no official of the BUYER, connected directly or indirectly with the contract, will demand, take a promise for or accept, directly or through intermediaries, any bribe, consideration, gift, reward, favour or any material or immaterial benefit or any other advantage from the BIDDER, either themselves or for any person, organisation or third party related to the contract in exchange for an advantage in the bidding process, bid evaluation, contracting on implementation process related to the contract.
- 1.2** The BUYER will, during the pre-contract stage, treat all BIDDERS alike and will provide to all BIDDERS the same information and will not provide any such information to any particular BIDDER which could afford an advantage to that particular BIDDER in comparison to other BIDDERS.
- 1.3** All the officials of the BUYER will report to the appropriate "CVO" any attempted or completed breaches of the above commitments as well as any substantial suspicion of such a breach.
- 2.** In case any such preceding misconduct on the part of such official(s) is reported by the BIDDER to the BUYER with full and verifiable facts and the same is prima facie found to be correct by the BUYER, necessary disciplinary proceedings, or any other action as deemed fit, including criminal proceedings may be initiated by the BUYER and such a person shall be debarred from further dealings related to the contract process. In such a case while an enquiry is being conducted by the BUYER the proceedings under the contract would not be stalled.

Commitments of BIDDERS

1. The BIDDER commits itself to take all measures necessary to prevent corrupt practices, unfair means and illegal activities during any stage of its bid or during any pre-contract or post-contract stage in order to secure the contract or in furtherance to secure it and in particular commit itself to the following:-
 - 3.1** The BIDDER will not offer, directly or through intermediaries, any bribe, gift, consideration, reward, favour, any material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to any official of the BUYER, connected directly

- 3.2** or indirectly with the bidding process, or to any person, organization or third party related to the contract in exchange for any advantage in the bidding, evaluation, contracting and implementation of the contract.
- 3.3** The BIDDER further undertakes that it has not given, offered or promised to give, directly or indirectly any bribe, gift, consideration, reward, favour, any material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to any official of the BUYER or otherwise in procuring the Contract or forbearing to do or having done any act in relation to the obtaining or execution of the contract of any other contract with the government for showing or forbearing to show favour or disfavor to any person in relation to the contract of any other contract with the Government.
- 3.4** Foreign BIDDERS shall disclose the name and address of their Indian agents and representatives in India, and Indian BIDDERS shall disclose their foreign BUYERS or associates.
- 3.5** BIDDERS shall disclose the payments to be made by them to their agents/brokers or any other intermediary, in connection with this bid/contract.
- 3.6** The BIDDER further confirms and declares to the BUYER that the BIDDER is the original manufacturer/ integrator/authorized agent of the stores/equipment/items and has not engaged any individual or firm or company whether Indian or foreign to intercede, facilitate or in any way to recommend to the BUYER or any of its functionaries, whether officially or unofficially to the award of the contract to the BIDDER, nor has any amount been paid, promised or intended to be paid to any such individual, firm or company in respect of any such intercession, facilitation or recommendation.
- 3.7** The BIDDER, either while presenting the bid or during pre-contract negotiations or before signing the contract, shall disclose any payments he has made, is committed to or intends to make to officials of the BUYER or their family members, agents, brokers or any other intermediaries in connection with the contract and the details of services agreed upon for such payments.
- 3.8** The BIDDER will not collude with other parties interested in the contract to impair the transparency, fairness and progress of the bidding process, bid evaluation, contracting and implementation of the contract.

- 3.9** The BIDDER will not accept any advantage in exchange for any corrupt practice, unfair means and illegal activities.
- 3.10** The BIDDER/Contractor will not commit any offence under the relevant India penal code (IPC) /Provision of corruption (PC) act .Further improperly , for purposes of competition or personal gain, pass on to others, any information provided by the BUYER as part of the business relationship, regarding plans, technical proposals and business details, including information contained in any electronic data carrier. The BIDDER also undertakes to exercise due and adequate care lest any such information is divulged.
- 3.11** The BIDDER commits to refrain from giving any complaint directly or through any other manner without supporting it with full and verifiable facts.
- 3.12** The BIDDER shall not instigate or cause to instigate any third person to commit any of the actions mentioned above.
- 3.13** If the BIDDER or any employee of the BIDDER or any person acting on behalf of the BIDDER, either directly or indirectly, is a relative of any of the officers of the BUYER, or alternatively, if any relative of an officer of the BUYER has financial interest/stake in the BIDDER's firm, the same shall be disclosed by the BIDDER at the time of filing of tender.

The term 'relative' for this purpose would be as defined in section 6 of the Companies Act 1956.

- 3.14** The BIDDER shall not lend to or borrow any money from or enter into any monetary dealings or transactions, directly or indirectly, with any employee or the BUYER.

2. Previous Transgression

- 4.1** The BIDDER declares that no previous transgression occurred in the last three years immediately before signing of this Integrity Pact, with any other company in any country in respect of any corrupt practices envisaged hereunder or with any Public Sector Enterprise in India or any Government Department in India that could justify; BIDDER's exclusion from the tender process.

- 4.2** The BIDDER agrees that if it makes incorrect statement on this subject, BIDDER can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

5. Earnest Money (Security Deposit):

- 5.1** While submitting commercial bid, the BIDDER shall deposit an amount Rs..... (to be specified in RFP/Tender) as Earnest Money as applicable/Security Deposit, with the BUYER through any of the following instruments:

- (i) Bank Draft of Pay Order in favour of LIC.
- (ii) A confirmed guarantee by an Indian Nationalized Bank, promising payment of the guaranteed sum to the BUYER on demand within three working days without any demur whatsoever and without seeking any reasons whatsoever. The demand for payment by the BUYER shall be treated as conclusive proof of payment.
- (iii) Any other mode or through any other instrument (to be specified in the RFP/Tender).

- 5.2** The Earnest Money /Security Deposit shall be valid up to the complete conclusion of the contractual obligations to the complete satisfaction of both the BIDDER and the BUYER, including warranty period, whichever is later.

- 5.3** In case of the successful BIDDER a clause would also be incorporated in the Article pertaining to Performance Bond in the Purchase Contract that the provisions of sanctions for Violation shall be applicable for forfeiture of Performance Bond in case of a decision by the BUYER to forfeit the same without assigning any reason for imposing sanction for violation of this Pact.

- 5.4** No interest shall be payable by the BUYER to the BIDDER on Earnest Money/Security Deposit for the period of its currency.

6. Sanctions for Violations:

- 6.1** Any breach of the aforesaid provisions by the BIDDER or any one employed by it or acting on its behalf (whether with or without the knowledge of the BIDDER) shall entitle the BUYER to take all or any one of the following actions, wherever required:-

- (i) To immediately call off the pre contract negotiations without assigning any reason or giving any; compensation to the BIDDER. However, the proceedings with the other BIDDER(s) would continue.

(ii) The Earnest Money Deposit (in pre-contract stage) and/or Security Deposit/ Performance Bond (after the contract is signed) shall stand forfeited either fully or partially, as decided by the BUYER and the BUYER shall not be required to assign any reason therefore.

(iii) To immediately cancel the contract, if already signed, without giving any compensation to the BIDDER.

(iv) To recover all sums already paid by the BUYER, and in the case of an Indian BIDDER with interest thereon at 2% above the prevailing Prime Lending Rate of State Bank of India, while in case of a BIDDER from a country other than India with interest thereon at 2% above the LIBOR (London Inter Bank Offer Rate). If any outstanding payment is due to the BIDDER from the BUYER in connection with any other contract for any other stores, such outstanding payment could also be utilized to recover the aforesaid sum and interest.

(v) To encash the advance bank guarantee and performance bond/warranty bond, if furnished by the BIDDER, in order to recover the payments, already made by the BUYER, along with interest.

(vi) To cancel all or any other contracts with the BIDDER. The BIDDER shall be liable to pay compensation for any loss or damage to the BUYER resulting from such cancellation/recission and the BUYER shall be entitled to deduct the amount so payable from the money(s) due to the BIDDER.

(vii) To debar the BIDDER from participating in the future bidding processes of LIC for a minimum period of five years which may be further extended at the discretion of the BUYER.

(viii) To recover all sums paid in violation of this Pact by BIDDER(s) to any middleman or agent or broker with a view to securing the contract.

(ix) In cases where irrevocable Letters of Credit have been received in respect of any contract signed by the BUYER with the BIDDER, the same shall not be opened.

(x) Forfeiture of Performance Bond in case of a decision by the BUYER to forfeit the same without assigning any reason for imposing sanction for violation of this pact.

6.2 The BUYER will be entitled to take all or any of the actions mentioned at para 6.1(i) to (x) of this pact also on the Commission by the BIDDER or any one employed by it or acting on its behalf (whether with or without the knowledge of the BIDDER), of an offence as defined in chapter IX of the Indian Penal code, 1860 or Prevention of Corruption Act, 1988 or any other statute enacted for prevention of corruption.

6.3 The decision of the BUYER to the effect that a breach of the provisions of this pact has been committed by the BIDDER shall be final and convulsive on the BIDDER. However, the BIDDER can approach the Independent Monitor(s) appointed for the purposes this Pact.

7. Fall Clause:

7.1 The BIDDER undertakes that it has not supplied/is not supplying similar product/systems/items or subsystems at a price lower than that offered in the present bid in respect of any other Ministry/Department of the Government of India or PSU and if it is found at any stage that similar product/systems or sub systems/items was supplied by the BIDDER to any other Ministry/Department of the Government of India or PSU at a lower price, then that very price, with due allowance for elapsed time, will be applicable to the present case and the difference in the cost would be refunded by the BIDDER to the BUYER, if the contract has already been concluded.

8. Independent Monitors:

8.1 The BUYER has appointed (hereinafter referred to as Monitors) for this Pact in consultation with the Central Vigilance Commission.

Name address of the Monitor(s):

*

*

8.2 The task of the Monitors shall be to review independently and objectively, whether and to what extent the parties comply with the obligations under this Pact.

8.3 The Monitors shall not be subject to instructions by the representatives of the parties and perform their functions neutrally and independently. It will be obligatory for him to treat the information & documents of the Bidder /Contractor as confidential.

8.4 Both the parties accept that the Monitors have the right to access all the documents relating to the project/procurement, including minutes of meetings.

8.5 As soon as the Monitor notices, or has reason to believe, a violation of this pact, he will so inform the Authority designated** by the BUYER.

8.6 The BIDDER(s) accepts that the Monitor has the right to access without restriction to all Project documentation of the BUYER including that provided by the BIDDER. The BIDDER will also grant the Monitor, upon his request and demonstration of a valid

interest, unrestricted and unconditional access to his project documentation. The same is applicable to Subcontractors. The Monitor shall be under contractual obligation to treat the information and documents of the BIDDER/Subcontractor(s) with confidentiality.

8.7 The BUYER will provide to the Monitor sufficient information about all meetings among the parties related to the Project provided such meetings could have an impact on the

contractual relations between the parties. The parties will offer to the Monitor the option to participate in such meetings. **8.8** The Monitor will submit a written report to the designated authority** of BUYER /Secretary in the Department/ within 8 to 10 weeks from the date of reference or intimation to him by the BUYER /BIDDER and, should the occasion arise, submit proposals for correcting problematic situations.

9. Facilitation of Investigation:

In case of any allegation of violation of any provisions of this pact or payment of commission, the BUYER or its agencies shall be entitled to examine all the documents including the Books of Accounts of the BIDDER. The BIDDER shall provide necessary information and documents in English and shall extend all possible help of the purpose of such examination/inspection.

10. Law and Place of Jurisdiction:

This Pact is subject to Indian Law. The place of performance and jurisdiction is the seat of the BUYER.

11. Other Legal Actions:

The actions stipulated in this Integrity Pact are without prejudice to any other legal action that may follow in accordance with the provisions of the extent law in force relating to any civil or criminal proceedings.

12 Validity:

12.1 The validity of this Integrity Pact shall be from date of its signing and extend upto 5 years or the complete execution of the contract to the satisfaction of both the BUYER and the BIDDER/Seller, including warranty period, whichever is later. In case BIDDER is unsuccessful, this Integrity Pact shall expire after six months from the date of the signing of the contract. **12.2** Should one or several provisions of this Pact turn out to be invalid; the remainder of this pact shall remain valid. In this case, the parties will strive to come to an agreement to their original intentions.

13. The parties hereby sign this Integrity Pact at.....on.....

BUYER

BIDDER

Name of the Officer:

CEO

Designation

Deptt./MINISTRY/PSU

Witness

1.....

1.....

2.....

2.....

(* Provisions of these clauses would need to be amended/deleted in line with the policy of the BUYER in regard to involvement of Indian agents of foreign suppliers.)

(** Please specify the "Name of Authority" in place of "Authority Designated" wherever mentioned in the Agreement)

ARTICLES OF AGREEMENT**(Applicable for Contracts with completion period more than Six Months)**

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 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 drawings and specifications and the Schedule of Quantities 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 and included in the said Abstract Schedule of Quantities at the item rates 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 in the Specifications and/or the priced Schedule of Quantities.
2. The Employer shall pay the contractor the said Contract Amount or such other sum as shall become payable for the items and 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 _____ and only the Courts in _____ shall have jurisdiction to determine the same.
5. The contract comprises :-
 - i) Tender Documents Serial Pages.....
 - ii) Subsequent Correspondence Serial Pages.....
 - iii) 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 authorized 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 Engineer and 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

Dy.CHIEF ENGINEER(I/C)

1. Signature :

FOR AND ON BEHALF OF THE

Name :

LIFE INSURANCE CORPORATION
OF INDIA

Address :

Date :

2. Signature :

Name :

Address :

In the presence of

1. Signature :

FOR AND ON BEHALF OF THE

Name :

CONTRACTOR

Address :

M/S

Date :

2. Signature :

Name :

Address :

1.0 GENERAL SPECIFICATION (HVAC HIGH SIDE WORK)**GENERAL****SCOPE:**

The specifications, read in conjunction with the drawing and BOQ cover the Supply, Installation, Testing and Commissioning of Chillers for LICI's Investment Building at INS-16, Sector-14, Vasundhara, Ghaziabad (U.P.)

BUILDING:

Location Ghaziabad (U.P.)

Basis of Design

Location	Ghaziabad
Altitude	250 Meters
Latitude	28.35 Deg N

Inside Design Condition

Working office areas	23°C Dry Bulb $\pm$ 1°C RH around 60% (no control on RH)
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Outside Conditions

Summer Conditions	43.3°C Dry Bulb (110° F DB) 23.9°C Wet Bulb (75° F WB) 20% RH
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Monsoon Conditions	35°C Dry Bulb (95° F DB) 28.3°C Wet Bulb (83° F WB) 60% RH
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Winter Conditions	7.2°C Dry Bulb (45° F DB) 5.0°C Wet Bulb (41° F WB) 70% RH
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Consultant's Drawing:

The Consultant's drawings are not meant to be used as working drawings. The contractor shall prepare detailed working drawings and get them approved by the consultants, ultimately by the Chief Engineer of LICI.

The bidders shall list out all the deviations from the drawings and specifications at the time of their enquiry for offer.

Electrical Equipment:

All electrical equipment shall be suitable for 230V $\pm$ 10%, 1 phase, 50 Hz / 415V $\pm$ 10%, 3 phase, 50 Hz, 4 wire AC supply unless otherwise stated.

COMMISSIONING:

The vendor shall be responsible for the successful testing and commissioning of the Chiller systems. The HVAC contractor shall coordinate with site engineer of LICI for ensuring that all the requirements of the Water system are met as per his requirement. A similar procedure will be agreed up on for Electrical installation.

GENERAL NOTES

- 1.0 These specifications are for work to be done, item to be supplied and materials to be used in the works as shown and defined on the drawings and herein to the satisfaction of the Owner/Engineer
- 2.0 The workmanship is to be the best possible and of a high standard. The contractor shall take all steps immediately to make up deficiency if any noticed by the Owner / Chief Engineer. Use must be made of special tradesmen in all aspects of the work and allowance must be made in the rates for the same
- 3.0 The materials to be provided by the contractor shall be in accordance with the samples/submittals approved by the Owner / Chief Engineer and in conformity with specification and approved list of manufacturer /brand. The contractor shall produce all

invoices, vouchers or receipts for any materials if called upon to do so by the Owner/ Chief Engineer

- 4.0 Samples of all materials are to be submitted to the Owner/ Employer for their approval before the contractor orders or delivers the material to the site. Samples together with their packing are to be provided free of charge by the contractor and should any materials be rejected they will be removed from the site at the contractor's expense. All samples will be retained by the Owners / Employer for comparison with materials which will be delivered at site.
- 5.0 The contractor shall be responsible for providing and maintaining temporary coverage required for the protection of works in progress and also finished work.
- 6.0 Contractor shall maintain uniform quality and consistency in workmanship throughout the execution of the work.
- 7.0 The contractor shall provide: All materials, labour, maintenance, fixing, carrying, cleaning, and making good, etc. temporary canvas, plastics and any other requisite protection of the works. All the necessary equipment, labour and removal of the same at the completion of the work. The Engineer will be the sole judge in deciding as to the suitability of the tools or plants that may be brought on the works by the contractors, for the proper execution of the work.
- 8.0 All measuring tapes shall be of steel and scaffolding and ladders that may be required for taking measurements shall be supplied by the Contractors.
- 9.0 The Contractor shall place at the disposal of the Employer and the advice of himself and his firm, and their staff or Foreman of trades or other skilled person employed by him or them for the conduct of the works comprised in the Contract.
- 10.0 The Contractors are to take care in loading and unloading materials for the works, so that the roads and footpaths are not obstructed, damaged or the traffic impeded, and they must conform with the Police Regulations for carrying, loading and unloading all materials, plant, earth, debris, etc. to and from the buildings. Quoted rates to include cost of carting away debris arising out of this work.

- 11.0 The Engineer shall have full powers and authority to issue such instructions as to the order of proceeding with or carrying out the work as he may deem necessary for the guidance of the Contractor and contractor shall be bound by such instructions of the Engineer or any person authorized by Chief Engineer of LICI to give such instructions.
- 12.0 The levels and measurements of the existing site, as shown in the drawings, are believed to be correct, but the Contractor should verify them for himself. No claim or allowance whatsoever will be entertained hereafter on account of any errors or omission in the description of the site turning out different from what was expected or shown in the drawings.
- 13.0 The Contractor shall work in co-ordination with the site engineer of LICI and contractors from other services like Electrical, Fire Fighting/Detection, Building Management System (Being Provided by The Builder Contractor), Security System and any other contractor working for other works involved in the project and provide all necessary assistance to them for successful completion of the project.
- 14.0 Any loss or damage caused due to fault or negligence on the part of Contractors laborers, staff etc. during working in the premises will be made good by contractor at no extra cost or the damage and repair cost will be reimbursed in full to the Employer.
- 15.0 All the contractor should consider the below mentioned points before quoting for the job.
- Ducting, Piping, Insulation and Grilles samples have to be submitted and approved and the materials supplied must exactly match the samples submitted before they are fixed as required.
 - The expenses for paying Municipal Taxes for dumping materials on/off site, etc. to be borne by the contractor.
 - Expenses of bearing ward officer's sanction, etc. To be borne by the contractor.
 - Contractor should be responsible for lifting of the material to the respective floors and expenses of the same should be borne by him.

3.0 TECHNICAL SPECIFICATIONS**Air Cooled Chillers****Design Data:**

Chilled water in – 12.22° C (54 ° F)

Chilled water out – 6.7° C (44 ° F)

Air on condenser – 43.3°C Dry Bulb

Chiller Fouling Factor – 0.0001 SI units

Power – 415V / 3 Ph / 50 Hz

KW/TR Maximum – 1.13

Refrigerant – R 134a / CFC free (as per green building criteria)

Minimum COP - (At ARI 550 /590-1998) Not less than 3.16

Minimum IPLV - (IPLV at ARI 550 /590-1998) not less than 3.16

IKW Corresponding to Minimum COP(2.90) = 1.13 KW/Ton

Please note that the IKW shall be inclusive of condenser fan load also i.e. total load input to the package.

Guarantee:

The contractor shall guarantee the chiller system to maintain conditions as per specifications and drawings.

Scope:

The scope of this consists of but is not necessarily limited to the following

Supply, Installation, Testing and Commissioning of air cooled, rotary screw chillers with associated motors, soft starters and accessories, complete.

- a) All associated items herein to be supplied delivered and installed.
- b) Assembly of chiller components including connection of coolers, condensers, motors, compressors, etc. into complete refrigeration machines.
- c) Provide manufacturer's factory representatives services including co-ordination and start-up and testing supervision.
- d) Testing (factory & field), start-up supervision, training and providing necessary documentation and tools for operation.
- f) Carry out performance test run.

Quality Assurance:

Chillers shall be rated in accordance with parameters indicated in the Bill Of Quantities. The performance shall be certified in accordance with ARI-550/590-1998/ EUROVENT.

Pressure vessels shall be designed, constructed, tested, stamped and complete with devices in accordance with ANSI/ASHRAE 15 - 1989 Safety Code and ASME Code. Only chillers that are listed in the ARI Certification program for Rotary Screw Water Chillers are acceptable.

Chillers shall be the product of a manufacturer normally supplying this type of equipment and who can show evidence having completed at least ten installations of approximately the same capacity, that have been in successful operation for the last five years.

The chiller shall be factory performance tested under full load conditions in an ARI certified test facility. The manufacturer shall supply a certified test report to confirm the performance as specified.

The chiller shall be designed/ manufactured and tested in accordance with the applicable portions of the latest revisions of the recognized Standards and Codes.

General:

The chiller shall be completely factory assembled including all interconnecting refrigerant piping and internal wiring of controls, mounted on a steel base frame which accommodates the air cooled condenser, compressors and coolers. Operating test shall include operation with water flowing through the cooler. The unit structure shall be heavy gauged galvanized steel and shall be painted with baked on enamel and shipped with a full operating charge of R134a. Each unit shall contain 2 or more refrigerant circuits, each with a single compressor of appropriate capacity.

Compressors:

There shall be a maximum of 1 compressor per refrigerant circuit. The compressor shall be rotary screw type. Compressor shall be semi-hermetic field re-buildable and utilize horizontal rotors. Vertical rotor compressors are not acceptable. The chiller should be able to unload to 10% of design tonnage. The compressors shall be driven by electric motor via. speed increase gear or direct drive. Manufacturers with speed increasing transmission shall annually inspect the gears and the bearings. The design working pressure shall be 144 psig on the suction side and 450 psig on the discharge side. The compressor parts and profiles should be designed specifically for chilled water applications. The compressor shall be mounted on vibration isolators. The compressor shall incorporate a complete anti-friction bearing design to reduce power and increase reliability; four separate cylindrical roller bearings to handle radial loads; and two 4-point angular contact ball bearings to handle axial loads. The compressor shall have an internal oil reservoir to assure a constant supply of oil to the bearings at all times. A spring actuated positive seating check valve shall be incorporated in the compressor housing to prevent rotor backspin during shutdown. The compressor housing shall be of cast iron, precision machined towards minimal clearance for rotors. The rotors shall be of high steel alloy. The compressors shall also contain a 500 W (115-1-50) temperature actuated immersion heater to prevent refrigerant condensation during shut down. Power wiring to control center shall be contained and protected within a liquid tight conduit. There shall be minimum 2 compressors for each chiller.

Capacity Control:

The control system shall modulate capacity from 100% to 10% of chiller full load by use of a slide valve in the rotor section of the compressor. The slide valve is driven by a piston and cylinder actuated by oil pressure controlled external solenoid valve via. the microprocessor control center.

Compressor Motor:

The motor shall be hermetic and either suction or liquid refrigerant cooled and operated at approx. 2900 rpm (50 Hz). Hot gas motor cooling is not acceptable.

The motor stator shall have U. L. Class H Insulation. The terminal boxes shall be rain tight. The hermetic motor shall be high torque, soft start and equipped with six internal heat sensing thermistors. Open drive motors factory installed and supplied are acceptable. Open drive motors shall be TEFC IP 55 type. The motor shall have 3 RTD's in the motor windings, one per phase to protect high motor temperature at start-up.

Oil Separator and Lubrication:

An external oil separator of horizontal design, located at the discharge end of the compressor with no moving parts, shall be provided to minimize the carryover, before refrigerant enters the heat exchangers. The oil separator shall consist of a perforated cylinder that surrounds a helical passage. Oil separation shall be achieved by means of centrifugal force through the helical passage way which forces the oil to collect on the exterior walls of cylinder. The oil thus separated, shall be collected in an oil sump located at the bottom of the housing. Oil separator shall be designed for a maximum working pressure of 450 psig and shall be UL and CSL listed. The oil separator shall include a sight glass.

The compressor shall also have oil reservoirs to lubricate the bearings during startup, coast down and in case of power failure. This could also be achieved by prelube or postlube oil pump operation. During operation, oil shall be delivered by positive system pressure differential or a full time operation of an oil pump.

An immersion oil heater [500 Watt (230-1-50)] shall be provided, temperature actuated to effectively remove refrigerant from the oil. An external replaceable cartridge, 3 micron oil filter shall be provided along with manual isolation stop valves for ease of servicing. An oil eductor shall be provided to automatically remove the oil which may have migrated to the evaporator and return it to the compressor.

Oil cooling shall be provided by liquid injection to maintain proper oil and discharge temperatures for all conditions. A temperature blending solenoid valve controlled via the Control Center shall provide consistent oil temperature at all times to ensure proper oil viscosity independent of system conditions.

Economizer:

An economizer shall be included in each circuit to enhance the overall system performance. The refrigerant to refrigerant, plate type economizer shall be constructed of acid resistant stainless steel. The compact and pressure resistant heat exchanger package shall be formed, brazed and the entire material shall be utilized for heat transfer. The heat exchangers shall be OSA listed and designed for 450 psig. The temperature limits shall be 320° F minimum to 365° F maximum.

Cooler:

The cooler shall be of the shell and tube type designed for 300 psig working pressure on refrigerant side and be tested at 450 psig. Shell shall be fabricated from rolled carbon steel plate with fusion welded seams, have carbon steel tube sheets, drilled and reamed to accommodate the tubes, and intermediate tube supports spaced no more than four feet apart. The shell shall be built in accordance with ANSI/ASHRAE-15-1992 Safety code for Mechanical Refrigeration. The refrigerant side shall be designed tested and stamped in accordance with the ASME Boiler and Pressure Vessel Code Section VIII, Div I. The tubes of the cooler should be individually replaceable.

Water boxes shall be flanged and gasketed for easy removal and access to the tubes. The water boxes shall have flanged water connections/ grooved connections for easy field chilled water connections. Cooler tubes shall be internally enhanced seamless copper and externally finned to achieve maximum efficiency. The nominal tube wall thickness shall be 0.028" for cooler tubes. Cooler tubes shall be 1" dia. Water velocity through the tubes shall not exceed 10 FPS. Tubes shall be mechanically expanded with tube sheets. Liquid level sight glasses shall be located on the side of the shell in determining proper refrigerant charge.

The waterside should be hydro statically tested at 1 1/2 times the design working pressure but not less than 225 psig. Vent and drain arrangements/connections shall be provided on the water box.

Condenser:**Coils:**

The condenser coils shall be constructed of seamless copper tubes, arranged in staggered rows, mechanically expanded into aluminum fins and include an integral sub cooling section. The design working pressure of the condenser coil shall be 450 PSIG. The condensers shall be arranged in a VEE formation.

Condenser coil coating shall be Thermogaurd/ Blygold. Corrosion coating for complete condenser, condenser U bends and all copper tubing and parts. The coating shall be done in the manufacturers factory only.

Fans:

The condenser fans shall be glass re-inforced polypropylene, high efficiency, airfoil type, providing vertical air discharge. The fans shall be directly driven by independent motors, and positioned in extended orifices for low sound. The fan guards shall be constructed of heavy gauge, rust resistant steel. Fan blades shall be dynamically and statically for vibration free operation and protected above by PVC coated fan blade guards. Fan speed 720 rpm.

Motors:

The fan motors shall be totally air-over, squirrel cage type, and current protected. They shall feature ball bearings that are doubled sealed and permanently lubricated. Each motor shall have class F insulation and be off IP 55 construction.

Refrigerant Circuit:

The refrigerant circuit should be constructed of copper tubing with brazed joints. The refrigerant flow to the cooler shall be metered by a single fixed orifice with no moving parts. The liquid line shall include a shut off valve with a charging port, sight glass with moisture indicator, thermal expansion valves, solenoid valve and filter drier. Additional valves shall be provided to facilitate removal of refrigerant charge. Factory insulation shall be 3/4" foam insulation and cover all low temperature surfaces to include the evaporator and water flanges, suction elbow, economizer, motor housing (only for hermetic motors) and motor cooling lines.

Power Panels:

The machine should include a unit starter/power panel. The power panel shall contain the following:

Compressor power terminal, compressor motor starting contractors, current transformer sensing for each compressor phase for protection against under current, over current, unbalanced current, single phasing compressor stall, phase reversal protection and voltage spikes and control power supply terminal strip for 115-1-50.

Power will be supplied at a single point. Necessary enclosure, terminal block, interconnecting wiring from power panel to compressors to be included by manufacturers.

Manufacturers to also provide a factory mounted disconnect switch with internal fusing and an external lockable handle (in compliance with N.E.C. Article 440-14) to isolate the power, voltage for servicing.

Each refrigerant system shall contain a factory mounted circuit breaker with external handle (in compliance with N.E.C. Article 440-14) to isolate the system for servicing fusing to be included by the manufacturer.

Starters:

Motor Starters:

The starter shall be factory installed and wired on the chillers. The starter enclosure shall be IP-54 with a hinged access door with lock and key. The following specific requirements for motor starters must comply with this specification.

- a) Chiller to be complete with a soft starter.
- b) Starter shall be free-standing NEMA-1 enclosure designed for top and bottom able entry and shall have front access with adequate working clearance for line and load wiring below 650 amperes and, where possible, sized to be "compact". Adequate separation of high and low voltage sections and proper mechanical and electrical interlocks will be provided to meet all applicable safety and operating codes.
- c) Starter shall have a permanent nameplate mounted inside the cabinet showing manufacturer's identifying numbers, order number, voltage, rated load amps and locked rotor amps, and overload trip settings. Starter shall have affixed to the inside of the door a complete, as built, wiring schematic showing all accessory items provide.
- d) Starters shall be equipped with solder-less line and load side connectors to handle wire sizes indicated by standard electrical industry practice and the National Electrical Code. Lug sizes and types are for copper conductors only. Starter line (L1, L2, L3) and load (T1, T2, T3, T4, T5, T6) terminals must be identified by suitable markers. The starter shall also be equipped with a clearly marked control terminal strip. Wire markers are required at each end of each wire lead, both control and power, and shall correlate with schematic and/or wiring connection diagrams.
- e) The starter shall be equipped with redundant motor control relays with coils in parallel and contacts. The MCR relays interlock the starter with the screw control center and directly operate the motor contractors (start and run). They shall constitute the only means of energizing the motor contractors and no other devices - manual and automatic, factory installed or remote shall be wired so as to energize the starter. The

- relays shall have 115 VAC coils with a maximum combined inrush of 500 VA and a maximum combined sealed rating of 50 VA.
- f) The main contractor that completes the starting sequence shall contain two sets of auxiliary contacts, one normally open and one normally closed with ratings of not less than 125 VA at 115 VAC. An additional set of normally open contacts rated at 125 VA pilot duty at 115 VAC shall be provided on both MCR relays.
 - g) Overload relays shall be microprocessor motor controller. There shall be an overload in each phase set at 107% of the rated load amps of the connected motor. Overloads shall be manual reset and shall de-energize the main contractor when over current occurs. Overload shall be adjustable and selected for mid-range. Overload shall be adjusted for locked rotor trip time of 8 seconds at full voltage and must trip in 60 seconds or less at reduced voltage.
 - h) Starter shall be equipped with a line to 110 volt/50 Hertz control transformer, fused in both primary and secondary, to supply power to the screw unit control box and oil pump motor. The transformer shall be rated at 2 KVA minimum in addition to any starter requirements and shall additionally have an inrush rating of 11.5 KVA minimum at 80% power factor and 95% secondary voltage. The secondary shall be furnished with $\pm 10\%$ voltage taps for all international orders. The secondary fusing shall be a dual element rated 20 amp, 250V. CP-2 terminal shall be grounded at the starter.
 - i) Starter shall include an advance motor protection system incorporating 3 phase overloads and current transformers. This electronic protection system shall monitor and protect against following conditions:
 - a) Three current transformers and 3-phase digital ammeter (1% accuracy).
 - b) Motor current as a percent of full load amps for each phase.
 - c) Phase failure/reversal protection.
 - d) Ground fault protection.
 - e) Stall protection.
 - f) High/low line voltage protection.
 - j) Space shall be left available for possible future relays and contacts to be specified later for wiring to the supervisory data center.
 - k) The starters shall be as manufactured by GEC, Square D, Siemens, Klockner Moiller, ABB and Dorman Smith.
 - l) Permanent wiring diagram to affixed to the inside of the panel load. Drawings to be of plasticised finish.

m) Provide capacitors for 95% power factor connection for each chiller. Capacitor shall be furnished complete with all associated wiring, switching and over current protection.

n) Provide power transformer in each chiller starter to enable remote KW readings by building automation system.

Controls:

The unit shall be equipped with a complete microprocessor control system. This system shall consist of temperature and pressure sensors, Input/ Output boards, power supply board, main processor board with display and keypad. Boards shall be individually replaceable for each of service. All devices and sensors shall be factory mounted and wired.

The display shall be a minimum of 160-character liquid crystal display (LCD) providing all messages in plain English. Two or three digit displays are not acceptable. The display shall be light emitting diode (LED) backlit for easy viewing in all light conditions.

The interface device shall be equipped with 18 individual touch-sensitive membrane key switches. These switches shall be divided into four separate sections and be multi-level password protected from changes by unauthorized personnel. End user interaction with the display section of the interface shall provide the following information on the 160-character LCD. In addition, all of the operation data shall be accessible by pressing one of the Quick Access keys.

a) Manufacturer of Chiller

b) Make & Model No.

c) COP of Chiller

d) IKW of Chiller (For Complete Package)

1. Entering chilled water temperature

2. Leaving chilled water temperature

3. Leaving condenser air temperature
4. Evaporator temperature
5. Suction temperature
6. Suction superheat temperature
7. Discharge temperature
8. Discharge superheat temperature
9. Outside air temperature
10. Motor amps (1 amp resolution) (compressor & fan motor)
11. Oil feed temperature
12. Oil sump temperature
13. Oil pressure
14. Condensing temperature
15. Liquid line temperature
16. Liquid sub cooling
17. Condenser approach

18. Evaporator pressure
19. Condensing pressure
20. Lift pressure
21. Motor amps at % of RLA
22. Oil differential pressure
23. Total hours of operation
24. Number of starts
25. Hours since last start
26. Time of last start
27. Time of last stop
28. High discharge temperature
29. Low evaporator temperature
30. Soft load
31. Maximum pull down
32. Remote amp limit

- 33. Manual amp limit
- 34. Network amp limit
- 35. Manual load
- 36. Maximum amp load
- 37. Minimum amp load
- 38. Leaving evaporator set point
- 39. Reset leaving set point
- 40. Remote reset signal
- 41. Fault history (last 8) with time/date stamp
- 42. Critical sensor values at time of faults
- 43. Unit status
 - Start-up sequence status
 - Shutdown status
 - Operational status

The microprocessor shall sense any abnormal condition and take the necessary anticipatory action to either unload or shut down the compressor. As a minimum the following safeties shall be incorporated in the control system and shall be indicated on the display:

- 1. Low discharge set point

2. High discharge set point
3. Low evaporator pressure - no load
4. Low evaporator pressure – unload
5. High discharge T – load
6. Condenser pressure low – freeze
7. Evaporator pressure low – freeze
8. Evaporator pump failure
9. Condenser fan failure
10. Low evaporator pressure – SD
11. Low oil delta pressure
12. Low oil feed temperature
13. High oil feed temperature
14. Low motor current (compressor & condenser fan)
15. Failed stop - high amps
16. High discharge line temperature
17. High condenser pressure
18. Mechanical high pressure switch

19. High motor temperature

20. No starter transition

21. No evaporator water flow

22. Starter fault

23. Sensor failure

- Liquid line temperature
- Discharge temperature
- Suction temperature
- Entering evaporator temperature
- Leaving evaporator temperature
- Entering condenser air temperature
- Leaving condenser air temperature
- Evaporator pressure
- Condenser pressure
- Oil feed temperature
- Oil sump temperature
- Oil pressure

Leaving chilled water temperature shall be controlled to within $\pm 0.2^{\circ}$ F of set point.

The microprocessor shall employ PI (proportional plus integral) control algorithms to insure precise control without hunting, droop or overshooting of the set point. End user shall input leaving chiller water temperature set point by interaction with the keypad and display.

The end user shall be capable of changing set points by entering the correct password, touching the desired function key, pressing the increase/decrease key to change set point, then "ENTER" or "CANCEL".

The microprocessor shall limit the amp draw of the compressor to the rated load amps (RLA) or at a user selected value from 30 to 100% of RLA (1% increments) as protection from exceeding maximum allowable amp draw. The microprocessor shall anticipate any trends above the set point and automatically unload the compressor until the amp draw is below the set point. The display shall indicate any override amperage condition if the above occurs.

The microprocessor shall be capable of resetting the chilled water temperature either based on return chilled water temperature or a remote 4-20mA DC signal from an energy management system. The amount of reset shall be programmable by inputting the amount of reset based on the signal (if remote) or the desired entering chilled water temperature (if local). The microprocessor shall also be capable of being demand limited locally from 30% to 100% RLA (1% increments) or from a remote 4-20mA DC signal from an energy management system.

The microprocessor shall incorporate a soft load function to prevent the compressor from operating at full load during the chilled water temperature pull down period. This function shall be accessed by the keypad and shall incorporate the following adjustable set points: (a) percent load at which ramp function begins, and (b) length of time in minutes that the compressor will be allowed to reach maximum amp limit. Microprocessor shall display current soft load limit value in % of rated load amps during the ramp-up function.

The microprocessor shall be equipped with a time clock to allow the end user to program a yearly schedule during the week, weekend, and holidays. This Clock Schedule shall allow for two discrete, 7-day repeatable schedules to be programmed for one automatic START/STOP per day. A 1-year programmable Holiday Schedule shall override the weekly Clock Schedule and restrict the chiller from operating on the holiday selected. The operator shall have the ability to input an override time period (0 to 50 hours) that will allow chiller operation during scheduled "OFF" periods due to Clock or Holiday scheduling.

The control system shall have auto-restart after power failure and not require battery back-up or auxiliary power supply for maintaining program memory. The microprocessor shall have a battery backed-up time clock to insure correct time of day input after power failure. The time clock function shall allow for time changes.

For ease of service and enhanced system reliability, the microprocessor shall be capable of storing the current and previous eight safety shutdowns with a time/date stamp and recording a sensor data at the time of alarm.

The microprocessor shall be capable of starting the unit from a local or remote station. The station selection shall be programmable by simple end user input via the keypad and display. Multiple machine installation applications shall be capable of non simultaneous starting to prevent overloads on the distribution systems.

The microprocessor shall incorporate two short cycle time functions: (1) Start-to-Start, and (2) Stop-to-Start function. These shall be specially programmed to provide the least amount of time off line while providing the maximum in compressor motor protection. The Start-to-Start function shall be set at 40 minutes but shall be capable of being programmed from 20 to 60 minutes. The Stop-to-Start function shall be set at 5 minutes but shall be capable of being programmed from 3 to 20 minutes. Both conditions must be met prior to machine start. The auto-restart after power failure function shall provide a restart within 2 minutes, assuming both short cycle time functions have been satisfied.

The microprocessor shall incorporate the following automatic START and STOP set points and each shall be individually programmable via the keypad and display:

a) Start-up Differential Temperature: Adjustable temperature above chilled water set point that will activate the normal start-up sequence. The Start-up Differential value shall be adjustable from 1.0 to 10.0° F.

b) Shutdown Differential Temperature: Adjustable temperature below chilled water set point that will cycle the unit OFF after satisfying chiller system load. The Shutdown Differential value shall be adjustable from 1.0 to 3.0° F.

For initial unit start-ups (Local request, Remote Start/Stop, or Automatic Time Schedule Start-up), there shall be a Load Delay Timer (adjustable by end user) that will postpone the initial temperature measurement of the leaving evaporator water for an adjustable time period in order to sample the true chilled water loop temperature and eliminate unnecessary nuisance start-ups.

Unit microprocessor shall be capable of controlling the chilled water pumps and condenser fans through the use of factory supplied optically isolated output contacts.

The microprocessor shall be capable of starting and stopping condenser fans through the use of four optically isolated digital output contacts. The end user shall be capable of start and stop temperature differential set points to provide the optimum energy savings of the compressor motor and condenser fan motors.

The chiller control panel shall provide a condenser/chiller water pump output relay that closes when the chiller is given a signal to start.

The microprocessor shall be nonvolatile requiring no battery backup while maintaining all data even during an extended shutdown or power failure.

As a standard feature, the microprocessor shall be capable of communicating to other units or a personal computer with the use of a twisted pair wire communication interface of RS-232 (100 feet) or RS-422/485 (5000 feet). Communication interface shall be RS-232 or RS-422/485.

The microprocessor shall have an auto-logging feature that will automatically log chiller functions at time of daily peak load or at a preset time and store up to six weeks of accumulated data.

The unit shall have Service Test mode for troubleshooting hardware.

The unit shall be factory configured in either English or SI units.

The unit shall include keypad programmable alarm contacts. The contacts may be set up as normally open, normally closed, or as an optional pulse output for pre-alarm conditions.

The unit shall include analog inputs for chilled water reset, demand limiting, heat recovery sensors, evaporator flow gpm, and condenser flow gpm.

The microprocessor shall possess pre-alarm logic to high and low pressure controls logic to take corrective action to avoid an alarm trip.

The unit shall display pre-alarm warnings for low and high superheat, low oil temperature, and high oil temperature.

The microprocessor shall display complete warning and alarm diagnostics in plain English. All warnings, problems and faults shall be time/date stamped. In addition, operating conditions prior to shutdown shall be retained in memory.

The microprocessor shall incorporate oil cooler valve control.

The unit shall be capable of preemptive control of low evaporator pressure conditions - inhibit loading or unload.

The unit shall possess multilevel password protection capabilities to prevent unauthorized access to set points and to the Service Test mode.

The pull down rate shall be adjustable (0.1°/min. to 5.0°/min.) by using only the keypad. As a standard feature, the lead-lag and load balance functions for dual and two-compressor units shall be contained within the unit controller code. Wiring shall consist of a single shielded twisted pair cable connecting each unit controller.

a) The unit controller shall have the capability to automatically dedicate the machine with the fewest operating hours as "Lead". The operator shall also have the ability to override the Auto-Lead feature and manually dedicate either machine as Lead.

b) "Lag" unit operation shall only occur when sufficient system load exists beyond the capability of the Lead unit. Lag unit operating shall be assured by first loading the Lead unit to its full capacity (user programmable based on % RLA) for a specific time period (user programmable) before starting the Lag unit. The stopping of the Lag unit shall be based upon both units operating a minimum of "two unit condition" where one unit is capable of handling system capacity (user programmable based on % RLA) for a specific time period before stopping the Lag unit (unit with the highest number of elapsed hours).

c) Machine sequencing with a return water thermostat shall not be allowed due to the inability to change the thermostat set point.

d) The unit controllers shall automatically start the Lag unit or maintain operation of running machine should either unit stop during normal operating due to a safety shutdown.

e) During two-compressor operation, the Load Balance feature shall equally divide the cooling capacity and power consumption between the two units. This shall be done by maintaining equal % RLA on each unit.

f) The unit compressor shall have the capability to reset the leaving chilled water and demand limit of both units.

The unit controller shall be capable of Open Protocol communications providing seamless integration and comprehensive monitoring, control and data exchange with other building automation systems. The Open Protocol Planner & Integrator including all necessary hardware required to integrate with the BMS shall be provided by the Chiller Manufacturer.

Flanges:

Provide 150 lb. R.F. flanges / Victaulic couplings to convert to flanged cooler connections, and include companion flanges.

Flow Switch:

Provide Johnson Controls model F61MG-1C vapor proof SPDT, NEMA 4X switch (150 psig DWP), -20° F to 250° F with 1" NPT connection for upright mounting in horizontal pipe. This flow switch (for evaporator) or its equivalent must be furnished with each unit.

Vibration Isolators:

Provide vibration isolators level adjusting, spring type, 1" deflection for mounting under unit base rails for roof mounted installation. Contractor must guarantee vibration isolation and if required provide prong type isolators. (Necessary Drawing shall be supplied by LICI , showing schematic mounting of Chiller on iron frame(Mentioned in low side), mounted on stuff block on the terrace)

Installation:

The chilling machine shall be installed over a structural steel platform and shall be adequately isolated as per manufacturer's recommendations against transmission of vibrations to the building structure.

Painting:

Screw water chilling machine shall be finished with durable enamel paint. Shop coats of paint that have become marred during shipment or erection shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas then coated with enamel paint to match the finish over the adjoining shop painted surface.

Chiller Acoustical Performance:

Sound pressure levels for the complete unit are not to exceed specified levels. Manufacturer shall provide necessary Acoustic treatment to the chiller as require. Sound data to be measured in accordance with ARI Standard 575-79. Data is in dB, reference 0.0002 dyne/cm², measured along a perimeter of 1 meter from machine and at a height of 1.5 meter above floor. Data is at highest levels recorded in 3 operating position: 100% load, 83% load, 50% load and 33% load.

Provide full Acoustic Attenuation Kits fitted to all chillers including sound Attenuators and **Acoustic Shrouds** to compressors. Chiller sound level 60 Db at 5 meter distance.

Emergency Shut Down Control Switch:

Furnished on front of panel one Push Button operated Shut Down Switches, red painted, to shut down all electric power to the chillers.

Integration with Building Automation System:

For the integration of the chiller with the Building Automation System. The chiller manufacturer shall provide a seamless interface and open protocol module which can communicate with the building automation system through an RS232 and RS485 port. It shall be responsibility of Chiller Contractor to provide all necessary documentation and hardware to enable the BMS Contractor to integrate the chiller operation with the BMS at one point. In case of multiple chillers the chiller panel should be networked and a connection shall be provided at one point for integration with BMS. The Chiller will be supplied with MODBUS RTU / BACNET on TCP/IP

Insulation:

Cooler shall be insulated with 20mm flexible Armaflex II or equal closed cell foam insulation. (K = 0.28 fps units).

Suction line, suction elbow and motor housing (for hermetic motors) to be similarly insulated.

All insulation shall be applied with adhesive. All joints filled.

Insulated surfaces shall be finished with factory applied painted to match the equipment.

Unit Enclosure:

Wire Panels Enclosure. These shall consist of welded-wire-mesh guards mounted on the exterior of the unit. The wire mesh is installed to prevent unauthorized access. Manufacturer shall ensure free air flow.

Performance Testing & Submittals:**Submittals:**

- a) The manufacturers shall submit drawings indicating components, assembly, dimensions, weights and loading required clearances and location and size of field connections.
- b) The manufacturer shall submit product data indicating rated capacities, C.O.P., IKW, weights, specialties and accessories, electrical requirements and wiring diagram.
- c) The manufacturer shall also submit their installation instructions.
- d) The manufacturer shall also submit reading of compressor speed, suction gas temperature and pressure, condensing gas temperature and pressure and water velocity through evaporator tubes and condenser tubes.

Testing:

The chiller shall be factory run tested under full load conditions in an ARI certified test facility. The manufacturer shall supply a certified test report of confirm performance as specified. **Proper ARI certification documents for the test loop shall be made available upon request from the manufacturer for inspection.** The performance test shall be conducted in accordance with ARI standard 550-98 procedures and tolerances. The compressor to be completely assembled at the factory and hydro statically tested either before or after assembly of shaft and rotor. After assembly the compressor to be pressure tested with a mixture of refrigerant and air, the casing, the joints and connections being tested with a Halide torch. After assembly of the complete unit on the job, pressure test the unit with a mixture of refrigerant and air, and all connections and welds tested with a Halide torch and made refrigerant-tight. The complete unit to be dehydrated by producing a vacuum to 0.01 bar absolute and maintain for 4 hours. At the end of this period the pump to be stopped and vacuum maintained in refrigerant unit for a period of 24 hours without losing more than 0.005 bar absolute.

Test shall include all safety features/interlocks, full and partial load testing of water and air flow rates, water temperatures moist levels etc.

The factory test instrumentation shall be as per ARI Standard 550, and the calibration of all instrumentation shall be traceable to the National Institute of Standards and Technology (formerly NBS).

A certified test report of all data shall be submitted to the Contracting Office prior to completion of the project. The factory certified test report shall be signed by an office of the manufacturer's company. Preprinted certification will not be acceptable; certification shall be in the original.

The equipment will be accepted if the test procedures and results are in conformance with ARI Standard 550-98. If the equipment fails to perform within allowable tolerances, the manufacturer will be allowed to make necessary revisions to his equipment and retest as required. The owner may reject any equipment which does not meet ARI standards.

Installation & Start-up:

Manufacturer shall furnish a factory trained service technician without additional charge for installation and start up. The service technician shall perform the leak testing, evacuation, and dehydration using a high quality vacuum pump furnished by the manufacturer. The standard triple evacuation procedure shall be used to insure complete removal of all water and non condensable. Unit shall be evacuated to at least 500 microns and shall hold vacuum for a period of 12 hours with a maximum increase of 100 microns. Service technician shall submit a certified report to the consulting engineer on the above evacuation procedure. Units that are factory charged or shipped with a refrigerant holding charge will not require field evacuation and dehydration. Charging and start-up of the system shall proceed once the consulting engineer has approved the certified field evacuation and dehydration report. Manufacturer shall provide instruction of the owner's personnel on the operation and maintenance of the unit. Manufacturer shall provide operating instructions and part lists.

A satisfactory operation test shall be conducted in the presence of the PMC. Power and water required for operation and testing will be furnished without cost to the Chiller Contractor. Chiller contractor shall check access to the building including to the terrace. Any damage to the units during shipment and installation shall be made good by the chiller contractor.

Technical Data to be filled in by Bidder

NO.	DESCRIPTION	
1.0	AIR COOLED CHILLERS UNITS:	
A	Capacity @11.11 deg.C (52 deg.F) EWT & 6.66 deg.C (44 deg.F) LWT for chilled water and 35 deg.C (95deg.F) EAT on condenser.	
B	Compressor KW at the above conditions	
	Condenser Fan KW	
C	COMPRESSORS:	
a	Manufacturer	
b	Model number	
c	Refrigerant	R 134a /CFC free (as per Green Building criteria)
d	Type	
e	Economizer	
f	Speed	
g	Compressor KW at ARI conditions	
h	KW consumed at : (Tons) KW per Ton	
	100%	
	75%	
	50%	
	25%	
	NPLV - 550/590-98	
i	Compressor KW at site operating conditions as stated above.	
	KW consumed at : (Tons) KW per Ton.	
	100%	
	75%	
	50%	
	25%	
	NPLV - 550/590-98	

j	Type of control	
k	No. of circuits	
D	CHILLERS:	
a	Manufacturer	
b	Model No./ shell/ diameter/ length	
c	C.O.P.	
d	IPLV	
e	Chiller IKW, Please note that the IKW shall be inclusive of condenser fan load also i.e. total load input to the package.	
	100%	
	75%	
	50%	
	25%	
f	Number of passes, gas side	
g	Entering water temperature (deg C)	11.11 deg C
h	Leaving water temperature (deg C)	6.66 deg C
i	Water flow rate GPM	
j	Expansion Valve	
k	Type of tube	
l	Tube material	
m	Face area	
n	Pressure drop water side	
o	Fouling factor	
E	CONDENSER:	
a	Manufacturer	
b	Coil face area	
c	Tube material	
d	Tube diameter	
e	Fin material/ thickness	
f	No. of condenser fans	

g	Fan diameter	
h	Fan speed	
i	Fan capacity CFM	
j	Fan motor KW/ Fan	
k	Fan material	
l	No. of blades	
m	Condensing temperature	
n	Dimensions length (W x L x H)	
o	Operating Wt. Kg.	
p	Refrigerant charge (Kg)	
q	Surface area	
r	Pressure drop water side	
s	Fouling factor	
t	Condensing temperature	
u	Condenser coil coating	
F	CHILLER PACKAGE:	
a	Dimensions length (W x L x H)	
b	Operating Wt. Kg.	
c	Refrigerant charge (Kg)	
d	Microprocessor panel	
e	Open protocol module for BMS integration	
f	Power supply	
g	KW & amps meter	
h	Starter	Soft
i	Flow switches	
j	Vibration Isolation	
k	Inlet and Outlet flanges	
G	Power Requirements:	
a	Chiller running current in amps	
b	Chiller full load current in amps	
c	Chiller starting current in amps	
d	Chiller duration of starting current in seconds	
e	Recommended MCCB size/ rating in amps for chiller	

f	Recommended copper cable size for incoming power feeder from	
g	MCCB to chiller	
H	Unit Noise level in dBa	
a	At 1 mtr. Distance	
b	At 3 mtr. Distance	
c	At 10 mtr. Distance	

4.0 LIST OF APPROVED MANUFACTURERS/SUPPLIERS**Note:**

1. NO DEVIATION SHALL BE PERMITTED.
2. Wherever Contractor proposes to use "equivalent" makes (other than specified), the same shall be done only after prior approval from Chief Engineer. Chief Engineer may take time before giving approval, time due to this will be on contractor's account and no claims will be entertained.
3. All material to be used shall be of first quality unless otherwise specified.
4. All sizes of materials mentioned shall be finished sizes.

Description	Approved Brands / Manufacturers
Air Cooled Chillers	Trane, Carrier, York, CLIMAVENETA

Note:

- All materials used shall be of I.S.I grade wherever applicable.
- Read or Approved Equivalent' at the end of all materials listed above.

HVAC LOW SIDE WORKS

THE LOW SIDE HVAC WORKS INCLUDE:-

1. Pumps
2. Air handling units with VFDs
3. Sheet Metal Works
4. Air Distribution Devices
5. Insulation.
6. Variable Frequency Drives
7. Chillers and Pumps Foundation of M S Frame
8. Electrical works include chiller panel, AHU panel, cabling etc.
9. Painting
10. All other works required to be carried out to complete the building as per drawing and specifications & Bill of Quantity or Schedule of Quantity.

3.0 TECHNICAL SPECIFICATIONS

DOUBLE SKIN AIR HANDLING UNITS

SCOPE OF SUPPLY:

Supply, Installation, Testing and commissioning of factory constructed air handling units as shown in the drawings and as per the schedule of equipment. Necessary test certificate for Fans and motors shall be submitted. .

Each air handling unit shall be complete with casings, preferably Backward(If readily available in the market) / Forward curved fans, internally mounted spring vibration isolator, insulation, drain pans, cooling coils, suitable filter frames, factory mounted fan motors with adjustable bases, belt guards, and belt drives, flexible connections and filters.

CASINGS

Each unit will be of modular sectionalized construction. The outer wall shall be painted with baked polyester paint finish. The inner wall shall be galvanized steel. The paint for outdoor application shall be weather resistant and ultraviolet resistant. A rigid perimeter frame with modular system based on standardized double wall panels shall be provided. Side panels shall be easily

removable and such removal will not affect the structural integrity of the unit.

The unit shall consist of a fan section, a coil section, filter section and an insulated drain pan. Suitable long life gaskets shall be used to seal all joints between casing sections.

The frame shall be made of non corrosive extruded aluminum channels fitted with proper thermal break. The casing shall be attached to the framework through a self locking mechanism to give air tight construction. The casing shall be able to withstand upto 8" of total static pressure. The floor panel shall have double wall construction to allow maintenance personnel access without damage to the insulation. The whole unit shall be mounted on a galvanized sheet steel base frame work. The minimum height of the base shall be 125mm and designed to ensure air circulation and avoid entrapment of moisture below the unit.

The panel shall be 45mm thick double wall type with injected PUF for a rigid non vibrating construction. The insulation shall not absorb moisture and shall be fire resistant. The fixing of each panel shall be flush mounted. The support sections shall have thermal break profile between the inner and outer wall.

The drain pan shall be rigid and watertight with pipe drain connection. Provide drain pan of the double pan insulated type with a GI outer pan and a 1mm thick GI inner pan. Provide 30mm thick PUF insulation cemented and vapor sealed between the inner and outer pan. Drain connection shall be provided on both sides of the AHU coil and shall be GI with threaded connection.

The sectionalized construction shall have minimum thickness of sheet as under:

a. Casing Outer skin	0.8mm (with vinyl coating)
Inner skin	0.6mm
b. Drain pan outer skin	1mm GI
Inner skin	1mm GI

FAN SECTION:

Fan section shall be provided with an access door on the drive side of the fan.

FANS:

The fan shall be preferably backward (If readily available in the market) / Forward curved, double

inlet, double width type. The fan shall be of imported origin, AMCA Certified for air and sound, factory tested and assembled by the original manufacturer. The Wheel & housing shall be fabricated from heavy gauge galvanized steel. The fan impeller shall be mounted on EN8 or C-40 carbon steel solid shaft supported to housing and heavy duty ball bearings. The impeller & fan shaft shall be statically and dynamically trim balanced to ISO 1940 quality grade after assembly. A computer printout with vibration spectrum analysis shall be submitted. The fan outlet velocity shall not be more than 500 meters /mm (1600 FPM). Fan housing with Motor shall be mounted on a common extruded aluminium base mounted inside the air handling housing on anti-vibration mounts. The fan outlet shall be connected to casing with the help of fire retardant neoprene impregnated fabric of imported origin, mounted on aluminium extruded channels, acting as a flexible connection for anti-vibration. The same type of connection shall be provided at the AHU outlet for the connection of AHUs to the duct.

Units shipped without motors and drives completely assembled will not be acceptable. The manufacturer shall replace all components that cannot meet these field balance and vibration requirements without additional cost to the Owner.

The fan drives shall be selected with a minimum belt horsepower capacity of 120% of the motor nameplate horsepower. Provide the fan drive components as follows

Standard "V-groove" belts suitable for the service intended with the capacities specified in the schedule shall be provided before.

Provide belt guards for all fan drives mounted outside the unit casing. Guards shall conform to the contour of the drive assembly.

**Motor shall be mounted on the coil connection side Fan speed should not exceed 1500 rpm
Air handling units shall be isolated from the floor by means of vibration eliminators having 95% efficiency. The inlet/outlet connection of the AHU to the main ducts shall be achieved by double flexible connections of fire retardant/type not less than 100mm width.**

COIL MODULE:

Coil shall be fabricated by the Air Handling manufacturer to maintain consistency in quality and reliability. Coil shall be installed such that unit casing enclose headers and return bends. Coil shall be designed to maximize the utilization of the availability unit cross-section area. Coil connections shall be clearly labeled on outside of units. Coil shall be cartridge type mounted on steel channel

for easy removability. Coils shall have aluminium plate fins and seamless copper tubes. The fins shall be sine-wave design with slits for better heat transfer efficiency and moisture carry-over limit performance. Fins shall have collars drawn, belled and firmly bonded to tubes by mechanical expansion of the tubes. Soldering or tinning shall not be used in the bonding process. Capacities, pressure drops and selection procedure shall be designed in accordance with ARI Standard 410. The aluminium plate fin thickness shall be 0.00512" (0.13mm). The copper tube shall be 0.5" OD and 0.016" tube wall thickness. Necessary test certificate shall be submitted by the contractor to LICI.

Provide manual air vent connections for all. Furnish Coils with manual drain connection extended outside the unit casing. Coils shall be circuited, and have connections arranged for counter flow of air and water with inlet on bottom and outlet on top of the coil headers.

Coil casing shall be 1.5mm thick stainless steel with formed and supports and top and bottom channels. Coil casing shall be a series of drain holes at the bottom channels to insure condensate drainage.

If stacked coil in the unit, intermediate drain-pan shall be installed between coils to drain condensate to the main drain pans without flooding the lower coils air passing condensate through the airstreams of the lower coil. The coil working pressure at site shall not exceed the leak test value on each coil type given below.

WATER COILS:

Supply and return shall be clearly labeled on the outside of the unit to ensure that direction of coil water flow is counter to direction of unit airflow. Coils shall be proof tested to 375 psig (26bar) and leak tested under water to 250 psig (17bar). Necessary test certificate shall be provided for the same.

The headers shall be connection option.

- a. Unthreaded copper header connection.
- b. Copper header with BSPT external threaded brass adaptor for quick job site connection.
- c. Steel header with steel flanges for quick job site connection.

Extended surface shall consist of die-formed continuous aluminum fins with formed channels. Fins shall have fully drawn collars to accurately space fins and to form a protective sheath for the

primary surface. Face Velocity for coils shall not exceed 500FPM. Provide not less than six (6) rows deep with 8-10 fins per inch, but more rows if required to meet or exceed the specified design load for the sensible heat removal requirements as well as the total heat removable. Do not exceed five (5) feet per second water velocity in the tubes and 12-15 feet water pressure drop through the coil at design conditions. Water velocity in the tubes must be above laminar flow at 36% of design capacity. Do not exceed cooling coil face velocities indicated on the drawings. Water coil capacities and pressure drops shall be in accordance with ARI Standard 420-81. All coils must be circuited to operate at design loading with water velocity within the ARI range of rating conditions. Necessary test certificate shall be provided.

Test at 100% capacity with the design air flow and water flow, and determine the total heat transfer and leaving air temperature at site. Test at other load points at the test CFM and design leaving air temperature, and determine the water quantity required.

Filter Section:

FILTER MODULES:

Filter sections shall have filter racks, an access door for filter removal and block-offs as required to prevent air bypass around filters. Modules shall be supplied with 2" flat. Filter shall be sized so as not exceed scheduled face velocities.

WASHABLE OR PERMANENT FILTERS:

Filter shall be 2" synthetic fibers capable of operating up to 400fpm face velocity without loss of filter efficiency and holding capacity. Filters shall have a rated average dust spot efficiency of not less than 25% to 35% when tested in accordance with ASHRAE 52-1-1992 atmospheric duct spot method. Filter media shall be layers of cleanable wire maze. Filter frame shall be constructed of galvanized steel. Filter access shall be accessed from either right or left hand side as standard. Back access shall be as option. Provide one complete set of commissioning filters with the Air Handling Units. Filters will be replaced after commissioning trials and before start of defects liability period.

Motors:

Fan motors shall be 415 $\pm$ 10% volts, 50 cycles, 3 phase, squirrel – cage, totally enclosed fan cooled with class F Insulation and IP – 55 protection. Motor shall be especially designed for quiet

operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through v-belt – drive arrangement. Belts shall be of the oil-resistant type.

Technical Details of proposed AHUs to be filled by the bidder (for Each AHU)

NO.	DESCRIPTION	
1.0	AIR HANDLING UNITS:	
A	GENERAL:	
a	Manufacturer	
b	Type of unit	
c	Overall dimensions	
d	Weight (including water circulation kg)	
e	Approximate noise level	
f	Fan Discharge position	
g	Inside panel thickness	
h	Outside panel thickness	
i	Insulation thickness	
B	FAN SECTION:	
a	Air quantity CFM	
b	Total static pressure (mm.WG)	
c	Fan speed (RPM)	
d	Fan diameter (MM)	
e	Balance (static and dynamic)	
f	Fan motor KW make and type	
g	Motor BKW	
h	Motor suitable for type starter and VFD	
C	COOLING COIL:	
a	Coil fin material (aluminium or copper)	
b	Tube diameter (mm)	
c	Water through coil (GPM)	
d	Fin size	
e	No. of fins	
f	Water velocity through coil (FPS)	
g	Water coil pressure drop (kg. sq.mm)	
h	Outside coil surface (sq.ft)	

i	Face area (sq.ft)	
j	Rows deep	
k	Water in and out temperature °C	
l	Air off coil temperature	
D	FILTERS: (FOR AHU)	
a	Type	
b	Gross filter area (sq.m)	
c	Velocity through filter	
d	Pressure drop through when new (mm wg)	
e	Efficiency	

Fans

SCOPE

This specification covers the general design, materials, construction features, manufacture, shop inspection and testing at manufacturer's works, delivery at site, handling at site, erection testing, commissioning, performance testing and handing over of Centrifugal Fans of Ventilation and process plants.

CODES AND STANDARDS

The design, materials, construction, manufacture, inspection, testing and performance of Axial fans shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. The equipment shall also conform to the latest applicable Indian or equivalent standards. Other international standards are also acceptable, if these are established to be equal or superior to the listed standards. Nothing in this specification shall be construed to relieve the VENDOR / CONTRACTOR of this responsibility.

Fans shall be of the type, size, arrangement and capacity as indicated in the schedule and/or as shown on the drawings.

A computer printout of fan performance rating corresponding to the AMCA licensed data, with corrected ratings for altitude and temperature, fan operating speed, bearing life, etc. shall be submitted for approval.

All fans shall be dynamically trim-balanced and to prove it, necessary test certificate shall be submitted by the contractor.

Fan motors shall comply in all respects with continuous rating in accordance with IEC34 or equivalent. Motor bearings shall be of ball or roller type, grease or lubricant sealed for life. Fan and drive shall be earthed to prevent accumulation of static charge.

CONSTRUCTION FEATURES

CASING

The casing shall be of welded construction, fabricated from heavy gauge material. It shall be rigidly reinforced and supported by structural members. The seams shall be permanently sealed air tight. Split casing shall be provided on larger sizes of fans as per manufacturing standard or if specified in technical data sheets.

IMPELLER

The impeller shall have die formed blades welded to the rim and back plate. Rim shall be spun to have a smooth contour. Shaft sleeves shall be provided, if necessary. If required, intermediate stiffening rings shall be provided. The impeller shall be statically and dynamically balanced as per ISO and AMCA standards.

GENERAL

Belt driven fans shall be provided with V belts, V-belt pulleys and belt guards.

Pulleys shall have minimum two (2) grooves to prevent start-up failure and premature belt failure. Pulleys shall be statically and dynamically balanced. Belts shall have a minimum service factor of 1.5.

Common base frame for belt driven fans shall be with adjustable rails for motors.

Bolts, nuts and washers used shall be of non-corrosive material and of superior quality.

Bearings shall have minimum life of 50,000 hours.

DRIVE MOTOR

Drive motor shall be rated at least 15% higher than the power requirement at the duty point or 10% higher than the maximum power requirement at selected speed, whichever is higher. Starting

torque requirements of fans shall also be considered while selecting the motor. Necessary test certificate shall be submitted by the contractor to LICI.

AXIAL FAN

Axial Fan shall be licensed to bear the AMCA Air and Sound Certified rating seal. The fan casing shall incorporate the following design features:

1. Cover the overall length of the motor and impeller.
2. Size same as ductwork
3. Bolted connections for easy removal from ductwork.

NOISE AND VIBRATION.

Noise level produced by any rotating equipment individually or collectively shall not exceed 65 dB (A) measured at a distance of 1.0 meters from the source in any direction. The overall vibration level shall be as per zones A and B of ISO 10816-1. Balance quality requirement shall be G 6.3 conforming to ISO 1940/1. Necessary test certificate shall be submitted.

PERFORMANCE GUARANTEES

Performance parameters to be guaranteed by the VENDOR / CONTRACTOR and tolerances permitted shall be as indicated in specifications. Bidder shall confirm acceptance of these by indicating values in data sheet attached along with the document. Fan or any portion thereof is liable for rejection, if it fails to give any of the guaranteed performance parameters.

Bidder to note that all fan performance curves shall be AMCA certified. Contractor shall also submit corrected performance curves for the fan considering the as installed condition of the fan at site.

DATA TO BE FURNISHED BY THE VENDOR / CONTRACTOR AFTER THE ISSUE OF PURCHASE ORDER / AWARD OF CONTRACT

1. Schedule of drawings and documents to be submitted for review, approval and information with submission dates.
2. Quality Assurance Plan (QAP).

3. General arrangement and section drawing with all dimensions and complete part list with codes and materials of construction. These drawings shall include all data indicated in technical data sheets.
4. Foundation drawing with static and dynamic loads, unbalanced forces and moments, if any, pocket details. Etc.,
5. Drawing showing fabrication and constructional details of the fan.
6. Fan rating charts or tables with selection marked.
7. Performance curves for fans with duty point marked (AMCA Certified, as well as installed condition at site).
8. Torque-speed curve for fans.
9. Erection, operation and maintenance manual with lubrication schedule.

PUMPS:**Scope:**

The scope of work under this article comprises the supply, installation, testing, commissioning and erection of pumps of the type and capacities specified in the schedule of equipment. Pumps shall be suitable for the purpose they are intended.

Work Included:

End Suction Horizontal Back pull out type Base Mounted Pumps.

Submittals:

Submit manufacturer's latest data.

Shop drawing submittals to indicate certified pump curves NPSH, pump performance characteristics with pump and system operating point plotted.

Quality Assurance:

Select pumps to operate at or near their point of peak efficiency, allowing for operation at capacities of approximately 25% beyond design capacity.

In addition, select the design impeller diameter so that the design capacity of each pump (GPM and Total Dynamic Head) does not exceed 85% of the capacity obtainable with maximum impeller diameter at the design speed for that model. Necessary test certificate shall be submitted by the contractor. (Necessary certificate regarding same will be submitted)

In order to ensure stable operation and to prevent any possibility of hunting, the pump curve must be continuously rising from maximum capacity up to the shutoff point.

Make the entire pump assembly including, but not limited to, the casing or enclosure, suction and discharge flanges, and seals, suitable for operation with the "Pump Working Pressure" and temperatures indicated on the drawings. For the purpose of this specification, the pump working pressure is defined as the sum of the scheduled maximum suction pressure and the maximum dynamic head at shutoff developed by the pump for pumping duty specified. Test each entire pump assembly hydraulically at the factory at least 50 psig pressure above the pump working pressure.

Perform a complete factory electric operating and sequence test, capacity performance test, and hydrostatic test for each factory assembled pumping system prior to shipment. Include a system operating flow test from zero to 100% of design flow for the pumping unit with specification suction and net discharge pressure conditions specified on the drawings. Verify the accuracy of the system flow with an independent calibrated test flow meter. The factory operating and performance test may be witnessed by the Engineer and Owner. Notify the Owner in writing at least 3 weeks prior to the factory performance test. Before the pumping assembly is shipped from the factory, transmit certified factory performance test data for factory testing including flow, head, and horsepower at all flow rates on a plot of the system flow test. Certify that the pumps have been satisfactorily tested as specified herein before and are in compliance with the requirements of the Contract Documents. Do not install the pumping system before the test data has been reviewed by the Engineer.

Provide flanged connections on suction and discharge drilled to ANSI standards.

Construction:

Pumps shall be as per IS 1520-1960 and shall be of the following construction.

Pump casing to be cast iron with smooth water passages and fitted with a bronze replaceable bearing ring.

The impeller supplied for the specified conditions is to be one piece bronze. Diameter not to exceed 85% of the casing cut water diameter. Impeller should be statically and dynamically balanced.

Pump shaft to be stainless steel of a size and design to limit shaft deflection at shaft seal box to not more than 0.002 inches.

Seal the pump liquid cavity with a face type mechanical seal with NI-Resist stationary seat, carbon washer, ethylene propylene flexible members, brass metal parts and 18-8 stainless steel spring. Seal to be mounted over a bronze shaft sleeve.

Couple the pump flexibly to a TEFC IP55 electric motor. Motor and pump bearing to be grease lubricated and sized for a minimum of 100,000 hours average bearing life. Motor and pump to be aligned and mounted on a steel base. Provide a coupling guard.

Mount pump and motor on a common fabricated structural steel base furnished by the pump manufacturer. Provide in the base provisions for grouting and anchor bolts. Machine surfaces for the motor and pump mounting. Motor mounting to permit horizontal adjustment. Provide the base of sufficient strength to prevent vibration, wrapping or misalignment of the pump and motor when installed without grouting on anti vibration pad which will be mounted on Mild Steel Foundation.

N.B. Ensure that the pump is vibration isolated from the structure and that no resonance occurs with structural elements.

Pumps	:	End suction back pull out
Casing	:	Cast Iron/Cast Steel
Impeller	:	Bronze conforming to BS
Shaft	:	Stainless Steel
Shaft Sleeve	:	Bronze
Seal	:	Mechanical Seal
Bearing	:	Ball / Roller

Driver ratings shown are only tentative and bidders shall select their drivers at least 15% in excess of the maximum B.H.P. of the pump plus transmission losses, if any. (But not less than specified ratings)

Pump and driver shall be mounted on a single bed plate and directly driven through flexible coupling.

Accessories and fittings:

The following accessories shall be provided with each pump among other standard accessories required.

- a. Coupling guard
- b. Lubrication fittings and seal piping.
- c. Test or air vent cocks
- d. Mechanical sealing

The following fittings shall be provided with each pump along among other standard fittings required:

- a. 25mm GI gland drain.

Installation:

Pumps shall be installed as per manufacturer recommendations. Pumps sets are to be mounted on M S. Frame which in turn is mounted on vibration restrained isolation springs. The restrained spring isolators etc. shall be supplied by the contractor.

Pump sets shall preferably be factory aligned. Whenever necessary site alignment shall be done by competent persons. Pump alignment results shall be submitted to the engineer.

Motors:

Operating Conditions:

Ambient Design temperature for motors shall be 40 deg C

Motors shall be of the squirrel cage induction motor type having the following features.

- | | | |
|----|-----------------------|---|
| a. | Frequency | 50 Hz $\pm$ 3% |
| b. | Standards | Latest editions of relevant Indian or International Standards. |
| c. | Type of enclosure | Totally enclosed for fan cooled (TEFC) |
| d. | Degrees of Protection | IP 55 for all motors with class "F" insulation
continuous duty |
| e. | Type of Motor | Three phase squirrel cage induction motor with single bare shaft
extension with keyway and key. Shaft to be drilled and tapped
with standard diameter hole. |
| g. | Direction of Rotation | Suitable for bi-directional rotation, or as Specified in equipment
specification. |
| j. | Terminal box | a. Six terminals with shorting stripes to be provided.

b. To be Rota table. |
| k. | Earthing | Two external and one internal Earthing terminal. |
| l. | Starting duty | Motor up to 5.5kw suitable for DOL starting & above 5.5 kw for
star delta starting / Auto Transformer starting. |
| n. | Painting | Synthetic Enamel manufacturer's standard paint. |
| s. | Bearing | Grease Lubricating ball or roller bearing. Vertical motors shall have
thrust bearings designed to carry the maximum axial thrust. |
| t. | Cables Entries | Any provision required for cable entry to the Motor Shall be
provided i.e. separate junction box, if required. |

Testing:

Bidders 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 for their discharge head, flow and BHP test results shall correspond to the performance curves.

Bidders shall furnish the required testing instrument and arrange for their connection required without any additional cost.

Painting:

After complete installation and testing, pumps, accessories and fittings shall be given two coats, three mills each of approved finishing paint.

Execution:

Base of restrained isolation spring shall be welded on ISMC frame . All necessary accessories (Rubber bellows type flexible connection etc.) shall be provided by the contractor and rates for the same shall be quoted accordingly.

The contractor shall be responsible for aligning in the field prior to startup of flexibly coupled pumps. Alignment to be with dial indicator with accuracy of plus or minus 0.002 inch. The pump manufacturer must submit a written report certifying that the alignment work has been performed by his personnel and that the pumps are ready for operation.

Pump motors are to be covered during construction period if the motor has to be run, the Contractor will be responsible to make sure that the area in which the motor is running is clean.

Contractor to provide lifting eye ring above each vertical inline pump to facilitate removal of motor for repair.

Paint the entire assembly of each pump with two coats of enamel after shop testing.

All operating controls and safety devices must be demonstrated after each system has been installed and put into operation at the project site.

Provide drains for bases and stuffing boxes piped to discharge into floor drains.

Provide air cock and drain connection on horizontal pump casings.

AIR COOLED CEILING CONCEALED DUCTABLE SPLIT UNITS/ HIDEAWAY AC UNIT:

SCOPE:

The scope of work comprises supply, installation, testing and commissioning of the ductable split air conditioning units as per the following:

1. Evaporator unit with mounting brackets/supports.
2. Air-cooled condensing unit with outdoor support structure. The outdoor support structure shall be painted with 2 coats of epoxy primer and 2 coats of epoxy paint.
3. Electrical panel with starters etc., for compressor motor condenser fan motor, evaporator motor interlock local isolators for motors.
4. Digital thermostat and safety controls.
5. Single phase preventers.
6. Installation accessories mounting brackets, refrigerant piping, filter Drier etc.
7. First charge of R –410 A/R-407C refrigerant gas and oil.
8. Refrigerant Piping with insulation as specified elsewhere
9. Ducting with insulation and Air terminal devices as specified elsewhere
10. Drain piping for evaporator unit.
11. Insulation of indoor unit, refrigerant piping and drain piping.
12. Electrical wiring from power supply provided by others.
13. Testing and commissioning.

The Contractor shall submit the technical data sheet as published by manufacturer along with the tender

INDOOR UNIT/ EVAPORATOR UNIT:

COOLING COIL:

Cooling coil of the Evaporator shall be selected for face velocity not exceeding 500 fpm and shall be constructed from 3/8" O.D. copper tubing (22 G) with serrated and extended aluminum fins. Provide hydrophilic coated aluminum fins to minimize the angle of contact between water droplets and fins.

BLOWER:

The fan blower shall be statically and dynamically balanced to give required air flow against desired static pressure. The contractor shall submit the static pressure drop based on the final approved drawing for approval. Further the contractor shall ensure that the selected unit will deliver the required airflow.

FILTERS:

This shall be non combustible fibrous cleanable filters to ensure clean air and easy replacement. Filters shall have a minimum thickness of 25mm and shall be 4 Nos per unit. The contractor shall supply one set of additional filters which will be used to replace the filters used for pre-commissioning activities

DRAIN PAN:

The drain pan shall be suitably insulated shall be protected from corrosion. **The HVAC vendor must provide an additional insulated drain tray below the unit. The BMS vendor will provide a water leak detection system for connection to a BMS system to give alarm in case of water overflow from the unit Drain tray.**

AIR COOLED CONDENSING UNIT:

The air cooled condensing unit shall be complete with the following:

- a. Hermetically sealed Scroll Compressor
- b. Condenser coil
- c. Condenser fan with motor.
- d. Sheet steel casing with louvered bird screen etc.
- e. Suitable base frame on/ mounting bracket for outdoor installation.
- f. Anti-vibration mounts
- g. Electrical isolating switch

COMPRESSOR:

The compressor shall be hermetically – sealed scroll compressor with internal high and low pressure cutouts and having low noise level with a refrigerant cooled motor. The entire unit shall be mounted on anti vibration mounts. Provision for incorporating refrigerant suction and discharge pressure gauges is required.

CONDENSER COIL:

The coil shall be 3/8" O. D. copper tubing (22 G) with serrated and extended aluminum fins. Condenser coil shall be designed for a working pressure of 300 psi.

CONDENSER FAN:

Axial flow fan for condenser shall be adequately sized and shall be direct driven. The fans shall be selected for low noise level and shall operate at a speed not exceeding 920 rpm. Condenser fan motor shall have IP 55 protection (suitable for outdoor mounting) and all electrical components shall be housed in a water proof enclosure.

CASING:

The unit casing shall be heavy gauge MS construction and finished with anticorrosive powder coating to give protection against rusting in high humid condition.

The thermostat supplied with the unit shall be of digital type and shall be capable of performing the following minimum functions

- a) Manual Start – stop of the units
- b) Temperature setting
- c) Weekly programming for Start stop of units with Weekly Holiday option

ELECTRICAL CHARACTERISTICS:

The units shall be suitable for operation on $230V \pm 10\%$, 1 phase, 50 Cycles/ $415V \pm 10\%$, 3 phase, 50 Cycles, 4 wire electrical supply.

Balancing Valve:

Balancing valves up 50mm size shall be made of copper alloy with Brinell hardness of at least 130 and a pressure rating of 20 Bar. Valves 65mm and larger shall be of CI flanged (CI as per BS 1452). Valve shall be fitted with a pressure balanced cone to allow the valve to be closed and opened easily. Adjustment and setting shall be made with a digital Hand wheels.

Flow measurement and balancing shall be with an accuracy of 4% to 7% in the normal operating range. Pressure measuring nipples shall be provided for measuring differential pressure and shall be integral with the body. Nipples shall have leak tight shutoff when not in use.

All valves shall be double regulation type with indicator scale from 0 (full shut) to full open with integer setting position. Valves shall be suitable for 20 Bar operating pressure.

All valves shall be manufactured as per ISO 9001.

One computerized balancing instrument with ISO certificate shall be supplied by the contractor to the Client which shall be handed over after testing and commissioning. In addition to measuring flow rate, DP and temperature the instrument shall have capability to store the results of balancing and to log the measured values. The saved data shall be printed out as part of the contractors commissioning documents.

Check Valves:

Check valves shall be provided conforming to the following specifications:

Size	Construction	Ends
12mm to 50mm	Gun Metal	i. Screwed Female
65mm & over	Body – C.I. Seat & Disc Gun Metal	ii. Flanged.

Swing check valves shall normally be used in all water services. Lift type valves may be used in horizontal runs. All release and clean out plugs shall be provided and valves shall be suitable for 21 kg/sq.cm. test pressure. Check valves shall be of non slamming type to prevent water hammer either by providing springs or accumulators. Valves shall be suitable for 15 kg/cm² operating pressure.

Strainers:

Strainers shall be “Y” type with Cast Iron or fabricated steel bodies designed to the test pressure specified for the gate valves. Strainers shall have a removable brass screen with 3mm Sq. perforations. 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. All strainer shall be provided with equal size isolating valves so that they may be cleaned without draining the system. Strainers shall be provided on the suction side of the pump as indicated in the drawings.

“Y” type strainers shall be provided at the inlet side of heat exchange equipment and where shown on drawings.

Filter Element:

These strainers shall be provided with stainless steel wire mesh.

Test Pressure:

These strainers shall have pressure rating of 10 Bar. These strainers shall be tested at 15 Bar. They shall be of thread ends for 20mm to 50mm and above shall be with flanged ends.

Piping Installation:

The drawings indicate schematically the size and location of pipes. Pipe runs and sizes may, however, be changed to meet the site conditions. The contractor on the award of the work shall prepare detailed drawings, showing the cross section, longitudinal sections, details etc. They must keep in view the specific openings in buildings and other structures through which the pipes are designed to pass. All the working drawings shall be approved by the Chief Engineer before starting of the installation. Piping shall be pressure tested at 1.5 times the actual pressure to which the pipe will be subjected in routine work but not less than 10 Bar for a minimum period of 4 hours without drop of pressure or as required by The Chief Engineer. All the tests will be witnessed by the site engineer.

Piping shall be properly supported on or suspended from stands, clamps, hangers, etc. as specified and required. The bidder shall adequately design all the brackets saddles, clamps handles, etc and be responsible for their structural integrity.

Pipes supports shall be of steel, adjustable for height and prime-coated with rust preventive paint and finish coated black. Where pipe and clamp are of dissimilar material, a gasket shall be provided in between.

Di-electric couplings or unions shall be provided between and copper pipes and on connection to cooling coils.

Hanger rods shall be the following diameters:

Pipe Size (mm)	Hanger Rod dia. (mm)
20 to 50	10

60 to 90	12
100 to 125	20
125 to 200	20
200 and above	22

Spacing for the pipe supports shall be as follows:

Pipe Size (mm)	Spacing (mtrs)
12 to 20	1.5
25 to 40	2.0
50 to 75	3.0
100 and above	3.0

Where required additional supports shall be provided at no extra cost, as per the directions of the Chief Engineer / Dy. Chief Engineer (I/C).

Pipe hangers shall be fixed on walls and ceilings by means of approved shear load fasteners of required sizes. Where pipes are supported from steel structure provide beam clamps as approved by the Chief Engineer.

All piping connected to coils and apparatus requiring tube cleaning or removal, shall run clear of such area except for removable connections.

All piping shall be independently supported at equipment so that the weight of piping shall not be carried by the equipment.

All pipe supports should be painted with 2 coats of primer, 2 coats of epoxy paint, finally apply 2 coats of paint with the approved shade.

Piping shall not be located over electrical equipment without adequate protection against condensation dripping and leakage.

Piping passing expansion joints shall provided with expansion loops.

Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor shall be supported at each floor by clamps or collars attached to pipe and with a 12mm thick rubber pad or any resilient material. Where pipes pass through the terrace floor, suitable flashing shall be provided to prevent water leakage. Risers shall also have a suitable elbow or concrete pipe support at the lowest point. Holes on the supporting clamps should be made using drill machines.

Pipe sleeves of 50mm larger dia meter shall be provided wherever pipes pass through walls and the annular space filled with nonflammable material and finished with retaining rings.

Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. 4.80mm metal sheet shall be provided between insulation and the clamp saddle or roller extending at least 150mm on both sides of the clamp, saddle or roller. At pipe supports provide wooden battens shaped to suit the pipe diameter between pipe and hanger so as to prevent metal to metal contact and sweating of support.

Cut-outs required in the floor slabs for taking the various pipes are indicated in the drawings. Bidders 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.

Piping work shall be carried out with minimum disturbance to the other work on the site. A program of work shall be chalked out consultation with the Project Engineer.

Contractor shall make sure that the clamps anchor sets are adequate for the pipes supported. Piping layout shall take due care of expansion and contraction in pipes.

All pipes using screwed fittings shall be accurately cut to the required sizes and threaded in accordance with IS 554 and burns removed before laying. Open ends of the piping shall be blocked 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.

Air valves shall be provided at all high points in the piping system for venting. Valves shall be of double flat type with GM/CI body, vulcanite balls, rubber seating etc. Air valves shall be associated with an equal size gate valve with rising spindle.

Mains

Air valves.

Upto 100mm	25mm
100mm to 300mm	30mm
Over 300mm	50mm

Discharge from the air valves shall be piped through and equal sized GI pipe to the nearest drain or floor waste or as shown.

Drains shall be provided at all low points in the piping system and shall be of the following sizes:

Mains	Drain.
Upto 150mm	32mm
Over 150mm	40mm

Drain shall be provided with gate valve of equal size with rising spindle. Drains shall be piped through equal size GI pipe to the nearest drain or floor waste or as shown in drawings. Piping shall be pitched towards drain points.

Pressure Gauges:

Pressure gauges shall not be less than 150mm dia. and of approximate range and be complete with shut off gauge cocks etc. duly calibrated before insulation.

Pressure gauges with U tube shall be provided at the following locations and as indicated in the drawings:

Supply and returns of chillers and condensers

Suction and discharge of pump

Supply and return of all water coils AHU's

Care shall be taken to protect pressure gauges during pressure testing.

Thermometers:

Thermometers shall be either 150mm dia. dial type of approximate range duly calibrated before installation.

Thermometers shall be installed in separate brass well with oil.

Thermometers shall be provided the following locations and as indicated in the drawings:

On supply and return of chillers.

On supply and return of all water coils in AHU's

Insulation:

Pipes shall be insulated as shown in the drawings and in accordance with specification in section "Insulation"

Vibration Eliminators:

Piping installation shall be carried out with vibration elimination fittings and supports and design and make approved by the Chief Engineer in the air conditioning plant room and upto 30 meters from plant room and upto 10 meters from AHU connections. Provide 6mm insulator equivalent material for all piping supports between pipe and support.

Specifications for Expansion Tanks:

Expansion tanks shall be pre-charged vertical type complete with replaceable heavy duty butyl rubber diaphragm. Tank shall have system, drain and charging valve (standard tire type) connection to facilitate on site charging of the tank to meet system requirements. The tank shall be constructed in accordance with section VIII of ASME boiler & pressure vessel code and stamped 10Kg/cm² working pressure. Tank required for chilled water system shall be suitable for system volume. Maximum and minimum temperature of 45° C and 5°C respectively, fill pressure of 0.8 Kg/cm² and maximum tank pressure of 8 Kg/cm².

Pressurization system shall comprise of pumps (1 working + 1 standby) Starters, pressure relief valve, complete with all components such as PVC fill tank, IP 55 control panel, pressure switch, pipes, fittings, valves etc.

Air Separators:

Air separator working on basic centrifugal force and low velocity flow, complete with 14" diameter inlet and outlet connections, high capacity float type air vent, pressure reducing valve, cold water fill connection, drain valve, flanged connections etc. The air separator shall be suitable for 450 USGPM water flow.

Testing:

All piping shall be tested to hydrostatic test pressure of at least one and half times the maximum operating pressure, but not less than 10 Kg/Sq.cm 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 Chief Engineer ..

Piping repaired subsequent to the above pressure test shall be re-tested in the same manner. System may be tested in sections and such sections shall be securely capped.

The project engineer shall be notified well in advance by the contractor of his intention to test a section or sections of piping and all testing shall be witnessed by the project engineer or his authorized representatives.

The contractor shall make sure that proper noiseless circulation of fluid is achieved through all coils and other heat exchange equipment in the system concerned. If proper circulation is not achieved due to air bound connection, the contractor shall rectify the defective connections. He shall bear all the expenses for carrying out the above rectification, including the tearing up and re-finishing of floors, walls etc as required.

No insulation shall be applied to piping until after the completion of the pressure testing to the satisfaction of the Chief Engineer.

The contractor shall provide free of any additional cost, all materials, tools, equipment, instruments, services and labour required to perform the test to remove water resulting from cleaning and/ after testing.

Painting:

After all the piping has been installed tested and run for at least ten days or eight hours each, the piping shall be given two finish coats 3 miles, each as follows:

Services	Flow	Color
a. Chilled Water	Supply	Sky Blue
b. Chilled Water	Return	Cascade Green
c. Refrigerant	Liquid Suction	
	Discharge	Wild Lilac

The direction of flow of fluid in the pipe shall be visibly marked in white arrows

PIPE CLEANING AND CHEMICAL WATER TREATMENT:

General:

Description:

Provide flushing, cleaning and chemical treatment program in accordance with the Contract Documents. Pipe cleaning and chemical water treatment is an integral part of the piping specifications and bill of quantities and will not be measured separately.

Submittals:

Submit shop drawings listing chemicals. Provide layouts of feeding equipment, details of testing equipment and describing treatment program, including calculations and quantities of chemicals to be used. Provide system schematics showing the following:

- Chilled Water
 - volume
 - circulation rates
 - pressures
 - temperature differentials

Provide written report containing log and procedures of system cleaning, giving times, dates, problems encountered and condition of water, witnessed by Contractor.

Submit written report containing result of tests and list of chemicals updated every 14 during temporary use of treated system.

Provide inspections and submit written reports on a twice monthly basis. Provide for one (1) year after acceptance of system. Take samples of water at each inspection, analyze, and certify. Submit the analysis made on the water to the Engineer and the Owner. Include in the analysis report, recommendations as to any changes in water treatment required. Provide an initial dosage of 1.5 gallons of an aqueous solution of sodium nitrite base corrosion inhibitor (NALCO 2536 or any approved make) for each 100 gallons of water in the system.

Provide written maintenance instructions to be included in Maintenance and operating Manual.

Quality Assurance:

The chemical pipe cleaning service supplier must be a recognized specialist, active in the field of industrial pipe cleaning for at least ten years, whose major business is in the field of pipe cleaning, and who has full time service personnel within the trading area of the job site. Laboratory facilities must be available.

Cleaning and Treatment Standards

- Closed Re circulating Water Systems:

System	Treatment and Chemical Conditions	Control Level
Chilled Water	Non-toxic organic, corrosion and scale inhibitor	2000 ppm as total organic inhibitor
	Molybdate as Na ₂ MoO ₄ or Nitrite as NO ₂	200-300 ppm
PH		7.0-8.0

Products:

Pipe Cleaning:

Furnish all required pipe cleaning chemicals, chemical feed equipment, materials, and labour necessary to clean

the piping as herein specified. In addition, permanently install necessary chemical injection fittings

complete with stop valves and coupon racks, etc.

Provide a pre-startup non-foaming, liquid detergent dispersant cleaner for cleaning of all systems to remove oil and foreign matter from the piping and equipment prior to the final filling of the systems. Use a chemical that is not injurious to persons, piping, pipe joint compounds, packing, coils, valves, pumps and their mechanical seals, tubes or other parts of the system.

Furnish instructions dictating the quantities of the cleaner to use, methods and duration of the operation.

Execution:

General:

Installation and startup shall be supervised by factory representatives of the equipment manufacturer and chemical manufacturer.

Preliminary Cleaning:

Clean new piping internally by flushing prior to the application of pressure tests, and before the chemical cleanout procedures specified herein. Provide temporary strainers at the inlet to the chilled water. Pumps before the start of cleaning procedures.

Block off and isolate circulating pumps, cooling coils, during the preliminary flushing and draining process.

Provide temporary by passes to fully circulate through all branch piping.

Pipe Cleaning:

All Piping Systems

Provide temporary connections with valves to fill and drain the piping and equipment after completion of the chemical cleanout procedure. Provide temporary blind flanges and /or caps to isolate the piping and equipment.

Provide temporary piping connections, valves, strainers, bypasses, and blank connections where required to clean out systems

After each hydrostatic leak testing procedure is complete drain the system until empty. The piping systems are internally chemically treated and protected during the hydrostatic testing procedure as described in the Section entitled "Testing, Balancing and Adjusting".

Thoroughly clean the piping and flush as follows:

- Cleaning will not take place more than 14 days prior to startup. Give the chemical manufacturer's representative at least 30 days notice prior to startup.
- Prior to the start of the chemical cleaning procedure submit three-two (2) foot lengths of the piping installed on this project to the chemical manufacturer for analysis of the interior coating on the piping. Refer to the Section entitled "Testing, Balancing and Adjusting" For additional requirements.
- Before the chemical cleaning procedure is begun, install in each closed recirculating water system a temporary skid mounted portable side stream filtering system. The filtering assembly shall have 6" flanged connections and multiple cartridge filters capable of least 600 gpm, an integral Barco type flow venturi, and be pressure rated for the system to which it is connected. Install the filter cartridges and change out until the system is clean. Initially provide twenty (20) micron cartridges, the intermediate set five (5) microns, and the final set one (1) micron.
- Add chemical pipe cleaning compound as recommended by the chemical manufacturer's representative to the system simultaneously with the filling of the system.
- Circulate the cleaning compounds in the system for the time period specified by the chemical manufacturer.
- Drain the system until empty from its lowest point.
- Fill the system again with fresh water and flush thoroughly until clean water is obtained. (Maintain continuous blowdown and make-up as required during flushing operation). Use a one (1) micron cartridge type strainer element at end of drain hose to confirm that discharge water is free of foreign material.
- The cleaning and flushing procedure must be approved in writing by the chemical manufacturer. The chemical manufacturer's representative shall supervise and certify in writing the

cleaning and flushing of the piping systems. The Contractor shall provide and install injection pumps, water meters, and coupon racks to control and monitor the cleaning process.

Filling of Water Systems:

After completion of chemical cleanout, fill the water system with fresh water, air vent, and immediately treatment to passivate metal.

Furnish the following chemicals as required for the system until the Owner has issued a "Certificate of Substantial Completion".

pH Adjustment Chemicals: Provide suitable pH adjustment chemicals in 50 gallon drums to control pH at the 7.8-8.8 level.

Corrosion Inhibitor: Provide thirty (30) gallon drums of liquid corrosion inhibitor. Provide non-polluting corrosion inhibitor which complies with local regulations covering waste water discharge, and as permitted by the local authorities having jurisdiction.

Dispersant: "Provide thirty (30) gallon drums of dispersant. Provide non-polluting dispersant which complies with local regulations covering waste water discharge, and as permitted by the local authorities having jurisdiction.

Biocide: Provide thirty (30) gallon drums of biocide. Provide non-polluting biocide which complies with local regulations covering waste water discharge, and as permitted by the local authorities having jurisdiction.

Recommend pH adjustment chemical, corrosion inhibitor, dispersant and biocide for the local water characteristics.

Technical Service and Control:

For a period of one year completion of system commissioning be on call at no additional cost to the Owner to make on site inspections of equipment during scheduled or emergency outages in order to properly evaluate their effect on the water treatment program.

Insulate water treatment piping and tanks containing chilled water, in accordance with insulation material as specified for the respective system.

Wherever possible, all water treatment equipment is to be located in mechanical equipment

rooms.

SHEET METAL WORK:

SCOPE:

This section covers the specification for the supply, installation, testing and commissioning of the sheet metal duct system.

MATERIALS AND CONSTRUCTION:

Unless otherwise specified, the material of construction of the ducts shall be galvanized steel sheets. The galvanized steel sheet shall conform to IS: 277

Ducts shall be rectangular in cross section and shall be fabricated in accordance with the following:

Max. Size in mm	Min. Thick in mm	Transverse joints	Reinforcement	Longer rod size mm
Below 400	0.63 (24 SWG)	Slip joints	Cross break	8
401 - 750	0.63 (24 SWG)	Slip joints	25 x 25 x 4 angle @ 1000 mm intervals	8
751 - 900	0.80 (22 SWG)	38 x 38 x 4.2 mm Companion flanges	25 x 25 x 4 angle @ 1000 mm intervals	8
901 -1500	0.80 (22 SWG)	38 x 38 x 4.2 mm Companion flanges	38 x 38 x 4 angle @ 760 mm intervals	10
1501 -2250	1.00 (20 SWG)	38 x 38 x 4.2 mm Companion flanges	38 x 38 x 4 angle @ 760 mm intervals	10
2250 and above	1.25 (18 SWG)	50 x 50 x 4.2 mm Companion flanges	50 x 50 x 4 angle @ 610 mm intervals	12
Plenums	1.25 (18 SWG)	50 x 50 x 4.4 mm	50 x 50 x 5 angle @ 300 mm	12

		Companion flanges	intervals	
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Ducts up to 2250mm size shall be supported at intervals of 2.4m and for larger ducts supports shall be provided at 1.2m intervals.

The reinforcements / bracing shall be as per ISS 655-1998.

Girth angles and companion flanges shall be mitered and welded at corners and riveted to duct sheets at 75mm centers. Flanged joints shall be made with 9.5mm G. I. bolts spaced at 15cm centers. Approved duct gaskets shall be used between the flanges. All joints and seams shall be rendered airtight. All duct seams and joints to be sealed with silicon sealant to stop supply air leakage. Duct panels are not to be cross-broken if insulated with rigid board insulation

All ducting supports, bracing & frame work shall be painted with 2 coats of epoxy primer & 2 coats of epoxy paint min. 50 microns.

The factory fabricated ducts should be in accordance to **SMACNA** standards.

Piping Insulation:

All pipes operating at temperature's lower than ambient shall be insulated with insulation of the following material.

- Expanded polystyrene (EPS), TF quality, having thermal conductivity of 0.028 Kcal/m/hr/°C and density of 16 Kg/m³/± 10%. The material shall be fire-inhibited type.
- Any other material equivalent to above and approved by the Chief Engineer .

Thickness of pipe insulation shall be as follows:

Temperature Range (C)	Pipe Dia. (mm)	Insulation Thickness (mm)
a) -1.1 to 4	i) 15 - 80	i) 80
	ii) 100 - 300	ii) 100
b) 5 to 12	All sizes	50
c) 12 to 16	upto 200	50
	300 & above	75

Application:

Chilled water piping and accessory insulation application shall be as follows:

- a) Pipes shall be thoroughly cleaned with wire brush and rendered free from all rust and grease.
- b) One coat of shalikota or equivalent primer shall be applied over the entire surface of pipe and fitting and accessories like valves etc.
- c) Two coats of industrial hot bitumen 85/40 or 85/25 as per IS 702-1961 shall be applied on the cleaned pipe surface uniformly at the rate of 1.5 kg/sq. m. (The contractor will have to demonstrate it either by calculation or by any other method)
- d) Rigid pipe sections of insulation shall be fixed tightly to the surface. Insulation shall be 50mm thick TF quality thermocole. Seal all the transverse and longitudinal joints using hot bitumen.
- e) Cover the insulation with polythene (800 gauge) sheet. Seal all joints with bitumen and tape.
- f) Every 300mm provide PVC bands over polythene sheet covering.
- g) Cover polythene sheet with Cora cloth dipped in Foster compound weatherproof grade.
- h) Finally cover all insulation with 24 G aluminum cladding. Aluminum sheet should be grooved and held in position with self tapping screws. All joints at bottom.

All valves, fittings, strainers, etc. for chilled water piping and drain piping shall be insulated to the same thickness as specified for the main run of pipes and applied generally in the manner specified for chilled water piping. Valves, joints, yokes and spindles shall be insulated in such a manner as not to cause damage to the insulation when the valves are used or serviced. All valves fittings, strainers etc. shall be insulated and finished with Al. cladding for chilled water piping.

Drain piping shall be insulated with 13mm (thickness) tubular Armaflex applied as per specifications for refrigerant piping.

Duct Insulation:

Thickness of insulation for ducting work shall be as follows:

Ducts	Insulation	Material	Remarks
a] Supply Air Ducts			
i] Conditioned Area	10mm	elastomeric nitrile rubber, class 'O'.	Ducts exposed to view shall be covered with 24 G Al i.e I in plant room or spaces having no false ceiling as per the BOQ.
ii] Un Conditioned Area	15mm	-- " --	-
b] Return Air Ducts:			
i] Conditioned Area	13mm	Elastomeric nitrile rubber class O	Ducts exposed to view shall be covered with 24G Al.i.e. in plant room or spaces having no false ceiling as per the BOQ.
ii] Un Conditioned Area	19mm	-- " --	-
c] Air Plenums:	25mm	Fiberglass Twiga-300 (density 48 kg/m ³)	To be internally lined.

i] Round ducts				
Conditioned	10mm	Same as	.	To be insulated internally
Area				rect. duct

Application of thermal insulation using Elastomeric nitrile rubber foam shall be as follows:

1) Duct Insulation - Thermal

- A. Clean all duct surfaces thoroughly to remove grease, dirt, etc.
- B. The measurement of surface dimension shall have to be taken properly to cut sheets.
- C. The foam sheets size to cut with sufficient allowance in dimension.
- D. Apply a thin coat of non-flammable adhesive recommended by manufacturer on ducts and on the insulation material.
- E. When adhesive is tack dry, insulation shall be placed in position with compression and no stretching of insulation shall be permitted to achieve a good bond.
- F. All longitudinal and transverse joints shall be sealed with and 50mm width self adhesive tape of the same material as sheet but with 3mm thickness.

Acoustic Insulation:

Coat interior of duct with Shalikote or equivalent primer. Fix 25mm thick resin bonded fiberglass Twiga 300 finished with RP tissue to duct using spot hot bitumen. Seal all joints with bitumen. The acoustic lining to be covered with RP tissue and perforated aluminum sheets of 30G thickness. The lining of aluminum sheet facing to be mechanically fastened to the duct with GI bolts/nuts & washers contractor to ensure a smooth internal finish.

All plenums, connecting pieces connected to air handling units and return air pieces shall also be acoustically treated.

There shall be a minimum of 75mm overlap between the acoustically and thermal insulation on ducts.

The nut-bolts provided to be at a minimum 200mm distance apart.

25mm x 12mm x 12mm GI Channel frames to be provided at both the edges of the duct. The Al. sheet to be fastened to these channels with Self tapping GI screws and washers. Vendor to ensure a smooth and uniform finish.

Equipment Insulation:

Insulation shall be cut and mitred wherever necessary to fit the contour of the equipment/vessels, etc. Insulation shall be applied with edges tightly butted and secured with wires and or bands. Two coats of sand cement, plaster each of 7mm thick shall be applied over the insulation and finished with two coats of enamel paint of approved color. Where equipment is mounted out doors apply two layers of tarfelt with joints properly sealed with Hot bitumen. Provide 24 Gauge Aluminium cladding over finished insulation.

Insulation specification shall be as follows:

a. Chilled Water Pump Housing:

“TF” quality thermocole for chilled water applied with adhesives/bitumen. Care shall be taken to apply the insulation in a manner so as to allow dismantling of the pumps without damaging the insulation. Thickness of insulation and application shall be same as for chilled water piping insulation. Provide aluminum jacket over pumps.

b. Tanks/Air Separator:

Wherever required expansion tanks shall be insulated to the same thickness as for the pipe to which they are connected. Insulation material shall be thermocole “TF” or equivalent expanded polystyrene insulation. Cover the insulation with sand and cement plaster over chicken wiremesh. (2 layers 7mm thickness). Provide 2 layers of tarfelt with joints sealed with hot bitumen. Provide 24 G aluminum cladding over finished insulation as for piping. Insulation sheet be grooved and held in position with self tapping screws.

Acoustic Insulation In AHU Room:

- a) Clean surface of the wall.
- b) Prepare frame work on walls of 600mm x 600mm, using 26G GI channels of 50mm x 25mm x 25mm.
- c) Fix 50mm thick 48KG/m³ glass wool in this grid wrapped in RP tissue using spot sticking with hot
- d) bitumen.
- e) The acoustic lining to be covered with aluminum perforated sheet overlapping the joints by at least
- f) 25mm. Aluminum perforated sheet to be of 24G with 3mm perforation at every 4mm interval.
- g) Aluminum beading of 25mm x 3mm thick to be used at all joints.
- h) The lining of aluminum sheet facing to be mechanically fastened to the GI frame with self tapping
- i) screws & washers. Contractor to ensure a smooth finish. The screws provided to be along with
- j) washers and at a minimum 300mm distance apart.

Under Deck Insulation:

All air conditioned areas with exposed roof shall be provided with underdeck insulation of 50mm TF quality thermocole

Underdeck duct insulation shall be applied as follows:

- a. Clean the surface and make it free from dust and loose particles.
- b. Apply a coat of bitumen primer (shalikote) to the bare RCC and allow it to dry.
- c. Apply approx. 0.5 kg per sq. m hot bitumen grade 85/25 cold adhesive CPRX to the underside of each panel for spot sticking. Press the slab in position. Butt the joints together.
- e. In addition to the above, the insulation shall be screwed to RCC slab with nylon rawl plugs and 65mm screws fixed through 75mm x 75mm washers at 600mm centers and securely tied with GI binding wire

**Comprehensive Annual Maintenance Contract of HVAC and Basement Ventilation System
for INS-16, Vasundhara, Ghaziabad(U.P.)**

PREVENTIVE MAINTENANCE CONTRACT:

The equipment supplied and installed will be maintained by contractor as follows:

REGULAR SERVICE:

All equipment will be checked and serviced 12 times in a year. Each such preventive maintenance service shall mainly consist of:

1. Checking general functioning of all the equipment.
2. Checking and adjusting belt tension/alignment of all drives, tightening of bolts, etc. (Monthly)
3. Lubricating bearings of motors and fans and checking oil levels in various equipment like compressor, motor starter and gear boxes, wherever required.
4. Checking refrigerant leaks (Quarterly)
5. Inspecting/adjusting refrigeration controls.
6. Checking microprocessor panel.

Break down call will be attended to as and when called upon by the owner.

Regular service shall also be provided during the warranty / defects liability period

7. The following will be included in Preventive Maintenance Contract:
 - a. Free replacement of defective/worn out parts with new or serviceable parts at Owner's option.
 - b. Free over hauling/repairing of equipment at site/service station as and when necessary.

- c. Chemical cleaning of air cooled condenser coil and fins whenever required during the contracted period or at least once every year.
- d. Free replacement of consumables.
- e. Replenishment of refrigerant gas and compressor oil in the system required as a result of leak in the system.
- f. Painting of equipment installed on terrace/ outdoors every "2" years by spray Painting (Two coats of paint of required shade) and two coats of primer. Before applying primer, the surface shall be thoroughly cleaned. Painting of the chillers' foundation iron frame also once in every two year.

The following are to be included in Contractor's scope:

- Day to day/routine maintenance of plant.
 - Cleaning of drain piping external to the equipment.
 - Repairs to or replacement of electrical installation like cabling, dressing of lugs, switch boards isolators, panels, fuses, strip heaters with associated ammeters/voltmeters.
8. Cleaning of AHU & FCU filters as per the Schedule
 9. Cleaning of Chiller, condenser coils as per the schedule
 10. Clean the drain water piping as per schedule. – Quarterly
 11. Greasing of electrical motors & chilled water pump bearings as per the schedule
 12. Cleaning of pump suction strainers as and when required.
 13. Checking of electrical controls tightness to ensure their healthiness
 14. Check for unusual noise or vibrations and elimination of it.
 15. Check pumps glands and attain mechanical seals
 16. Check AHU & FCU housing, blower, Shaft, duct, damper and grills
 17. Inspect the Shaft, bearings, housing and impeller of the chill out pump for corrosion.
 19. Checking and tightening of nut bolts as and when required.
 20. Checking of starters related to AHU and chilled water pumps
 21. Checking of chiller electrical panel.
 22. Supply of consumables like grease, bearings, starter, electrical & mechanical spares.
 23. Following periodic checks of chillers would be carried out.

- Checking the refrigeration system for any leakages.
 - Checking the operation of controls, control panel and checking of all safeties, cleaning of contacts
 - Cleaning /changing of filters/driers, whenever required.
24. Taking out the oil sample and carrying oil analysis – once in a year, if required
25. Items mentioned in BOQ or any other work as required not specifically mentioned but, to ensure healthy functioning of the equipments .

Mode of Measurement

- a. All duct insulation shall be measured on the basis of the finished insulation surface area and excluding all openings for grilles, diffusers but including all flanges, dampers etc.
- b. In case of bends, tapers etc. the duct prime surface shall be determined on the basis of average dimensions.
- c. **All pipe insulation shall be linear measure along the length of the pipe, over all fittings, excluding flanges and valves.**
- d. Each independent flange insulation shall be measured as 300mm equivalent length of piping of same size. Insulation of flanges associated with equipment (equipment and mating flange) and valves (flanged or screw-ended valves with flanged tail pipes) shall form part of the valve or equipment.
- e. Insulation of valves together with the flanges as above shall be measured as 600mm long equivalent length of piping of same size.
- f. All pump insulation shall be measured as 1500mm long piping of diameter equal to the suction size of the pump and this shall include the cost of insulation of the suction and discharge flanges.
- g. Insulation for tanks/vessels shall be on basis of external finished area.

All sheet metal ducting complete with duct supports, turning vanes, canvas connections, erected in position shall be measured externally and paid per unit area. All dampers shall be excluded in the duct area.

Duct area shall be calculated based on flange to flange length and duct perimeter and no extra cost for flange.

All manual control/splitter damper sections with operations linkages locking quadrant, sheet steel enclosure, frame, erection, supporting etc. shall be measured on the basis of damper cross sectional area and paid per unit area.

Fire dampers/ VCDs to be measured as the Sqft/ Sqmt area only (W x H). No additional will be claimed for extended sleeves.

Motorized fire dampers actuator with panels are to be paid as one unit upto 1.2 sqm damper area.

Intake and exhaust 138abeled with bird screen, 138abeled and frame, erection & sealing shall be measured on the basis or cross sectional area and paid per unit area.

Side wall grilles shall be measured on the basis of the core area excluding the margins and shall include necessary dampers. Minimum payable unit is 0.1 sq.m (1.0 sq.ft)

In line diffusers and grilles shall be measured per unit length. Square diffusers to be measured as unit. The back up plenum shall be not be measured as additional and to be part of the diffusers.

Refrigerant piping to be measured based on the distance between the indoor and outdoor units irrespective of number of circuits. The piping will be measured as one length for suction and liquid line. Insulation will be measured alongwith the piping and not be claimed as extra.

ELECTRICAL INSTALLATION

Scope

Scope of this section comprises the supply and installation of all electrical equipment such as motors, motor control centres, starters, cables, interlocks, etc. as required.

Codes, Standards and Statutory Regulations

Codes, standards and statutory regulations to be used for design and constructions are given below. In general all equipment, material as well as design and constructions shall be in accordance with the latest issues of Indian and relevant standards currently in force. The installation shall be carried out in accordance with the Indian Electricity Act and Rules.

Electric Supply System/Rated Voltage

415 volts, 3 phase, 4 wire, 50 Hz with solidly grounded neutral.

Variation in electric supply under which motor shall be operated continuously without any adverse effect will be as follows :

- a) Voltage : $\pm 5\%$
- b) Frequency : $\pm 5\%$ variation
- c) Any combination of voltage and frequency.

Equipment and Materials

All equipment shall be as per specifications, and/or drawings supplied along with the tender documents. Equipment/materials shall be suitable for local climatic conditions as specified in the tender.

All equipment shall be of robust construction. Enclosure of equipment shall be dust, damp and vermin proof. Equipment for outdoor installation shall have weather proof enclosures requiring no further protection by the purchaser.

Approval

The Contractor shall be responsible for obtaining approval of drawings from statutory/local authority as required.

Motor Control Centre

Motor control centre shall consist of incoming switch fuse units/isolator and a starter mounted inside the wall or floor mounting type cubicle made out of 2 mm thick MS sheet. Anti corrosion and phosphatising treatment shall be given to the sheets by a standard 5 tank/7 tank process.

All feeders shall be provided with two position (on-off) isolators, load break and quick make and break type. All isolators shall be suitable for front of board operation. Isolators for motor feeders shall preferably be of the 'motor duty' type i.e. capable of interrupting the locked rotor current of induction motors, which will be 6/8 times the full load current.

Isolators shall be interlocked with door to prevent opening or closing of the door in the closed ('ON') position of the isolator, in case of compartmental type of feeders. All live terminals on the isolators shall be adequately shrouded to prevent accidental contact and danger to the personnel.

Caution name plate "CAUTION LIVE TERMINALS" shall be provided at all points where the terminals are likely to remain live and isolation if possible only at remote end e.g. Incoming Terminals of Incomer.

Fuses & Fuse Fittings

All fuses shall be of the non-deteriorating, high rupturing capacity, link, mounted in suitable fuse carriers or fuse bases.

Contactors

- a) Contactors shall be magnetic, air break type, generally in accordance with BS 775/IS 2959.
- b) All contactors in power circuits of motor starters or other feeders shall be adequately rated for the duty required and operating conditions. Minimum rating shall, however, not be less than 16 amps.
- c) Contactor coils shall preferably be of drawout type for easy replacement. Coil voltage shall be 220V AC. Contactor coils shall operate satisfactorily between 110% and 85% of the nominal coil voltage. Drop off voltage for AC coils shall be between 80% and 45% of the nominal voltage.
- d) Making and breaking capacities of the contactors shall be suitable for AC2 and AC3 categories of duty as per IS 2959 unless the contactors are required for special duty such as inching or plugging duty or capacitor duty, in which case, they will be suitably derated.
- e) Each contactor shall be provided with 4 normally open and 4 normally closed auxiliary contacts or as required by the control scheme. If necessary, auxiliary relays or contactors may be provided to obtain necessary number of auxiliary contacts. Auxiliary contacts shall preferably be convertible from NO to NC and vice versa.

Protective Devices

- a) All feeders shall be protected by appropriate protective devices such as fused, combined bimetallic thermal overload and single phasing preventor relays.
- b) Single phasing preventor relays (SPPRS) shall operate on the principle of unbalanced currents due to single phasing. BMR's and SPPRs shall preferably have a change over contact which can be converted from hand reset to self reset and vice versa and used for contactor control as well as alarm/indication.
- c) Current transformer, when specified, shall be of bar primary, ring type or wound type, and in accordance with IS 2705 or BS 2046 or BS 81. Class and ratio of CTs shall be specified. VA burden of CTs shall be suitable for the load burden.
- d) Ammeters (144 square) voltmeters, PF meters, Run Hour meters and Kilowatt Hour meters shall be provided and shall be of industrial grade accuracy, suitable for flush mounting and in accordance with IS 1248. Suitable selector switches shall be provided in conjunction with ammeters and voltmeters.
- e) Indicating Neon lamps used shall be of low voltage, low burden type with series resistor to increase lamp life and to protect equipment from short circuits caused by broken filaments. Lamp covers shall be provided with interchangeable coloured lenses of perspex or equivalent unbreakable materials. Lenses should not get discoloured in course of time, due to the heat generated by the lamps. Name plates showing the condition indicated by the lamp shall be affixed near to the lamps.
- f) Rating of terminal blocks for power and control circuits shall be at least 30 Amps and 15 Amps respectively. Terminals in control circuits shall be suitable for receiving one conductor per terminals of specified sizes. Terminals for power circuits shall be designed for receiving aluminium conductors and shall be screw clamp type or equal. Terminals for control circuit shall be suitable for receiving copper conductors. Star/Lock/Shake proof or Spring Washers shall be provided to prevent sparking due to vibrations. Special terminals with copper strips mounted on insulating supports may be provided for large cables. Where terminals, suitable extension bars with off-set may be provided
- g) Location of controls for motor starters or other feeders shall be specified. Normally one 'stop' push button with stay-put feature (lockable) and one reset push button for hand resetting of BMR shall be provided on the door of the compartment. Colours used for push buttons shall be as follows :

Stop push button - Red

Start push button - Green

Reset push button - Black

(Note: In case 'Stop', and 'Reset' are combined, only red colours will be used.) Name plates indicating the function of the push button shall be affixed near to the push buttons.

Wiring

- a) Internal wiring of MCCs for power and control shall be carried out with copper conductor PVC insulated cables of PVC covered copper/ aluminium tapes.
- b) Wiring of components mounted on doors shall be carried out with single strand 2.5 sq. mm copper conductor flexible cables. Wires and cables shall be neatly arranged and bunched together with suitable clamps made of insulating material. Wire harnesses shall be adequately supported along the MCC metal work.
- c) Identification ferrules or tags shall be attached to each wire at each point connection.
- d) Sizes of conductors for power wiring shall be determined by the manufacturers on the basis of full load current under specified conditions, protective fuse rating and appropriate rating factors as applicable. Minimum size of conductor shall be 2.5 sq. mm Minimum size of conductor for control wiring shall be 1.5 sq. mm.
- e) The following colour code shall be used for determining the colours of wires used for internal wiring. Manufacturer shall obtain specific approval of the purchases, if this colour coding cannot be observed for any reason whatsoever :

Earth - Green

Neutral - Black

230V, A.C. phase
to neutral - Red/Yellow/Blue,
Black

f) All wiring shall be carried out in accordance with approval and certified panel wiring diagrams. Vendor shall check all wiring from point to point for correctness. All wires shall be numbered and the numbers shall be indicated on the relevant drawings.

Earthing

All metal work of the MCC and non-current carrying metallic parts of the equipment in the MCC shall be securely bonded together by adequate means e.g. use of earthing washer for bolted connections or tapped holes for mechanical connections. One copper earth bus running through the entire length of the MCC shall be provided preferably along with the terminal chambers. Size of the earth bus shall be such as to withstand phase to earth or 2 phases to earth short circuit for one second. The minimum size of the busbar shall be 25 x 3 mm. The terminals complete with hardware and cable sockets shall be provided on the earth bus for connection to external system.

Name Plates and Labels

a) One name plate giving designation of the MCC shall be affixed prominently on to the MCC. (Details of designation will be given). Each feeder shall also be labelled giving following details :

- i) Feeder No.
- ii) Feeder Designation (Eqpt.Ref.No.etc.)
- iii) Description
- iv) Rating (HP/KW/Amps)

b) All components whether mounted inside the MCC or on the door shall be permanently and clearly labelled with their reference number and/or letter or their function (rating of fuse shall form part of the fuse designation).

c) Labels for feeder designation shall be of laminated plastic or rear engraved perspex with white letters on black background.

d) Labels for feeder designation shall be fixed on the doors on respective feeders with chrome-plated self tapping screws. Designation labels shall be identical in size to permit interchanging if required later.

Miscellaneous

a) All hardware used shall be plated or passivated to resist corrosion. Type of plating or passivation shall be subject to the approval of the Chief Engineer. All fixing screws shall preferably be raised head type.

Drawings

a) Contractor shall furnish the following to the Chief Engineer for his approval before commencement of fabrication :

i) General Arrangement Drawing showing overall dimensions, arrangement of feeders, foundation plan, positions of cables entries, weight of MCC and sections in which MCC will be despatched.

ii) Single Line Diagram for the MCC showing rating of various components used for all feeders complete with feeder numbers, designations, descriptions, ratings, etc.

iii) Schematic and panel wiring diagrams for all feeders.

iv) Terminal plan for MCC, showing feeder numbers, terminal numbers and terminal markings.

b) After the final approval, six prints and one clear film reproducible of each of the above drawings shall be furnished.

c) The Contractor shall note that he shall bear full responsibility for any error, discrepancies, omissions, etc. in the drawings irrespective of whether such drawings have been approved or not. Approval of drawings shall not relieve the Contractor of his liability to complete the work in accordance with the specifications and other conditions of contract nor shall it exonerate the vendor from any of his guarantees.

Testing and Inspection

The following tests shall be carried out on the Motor Control Centres after completion of all work :

i) All power and control circuits for MCCs shall be tested for insulation resistance with a 500 volt megger, before and after the high voltage test.

- ii) High voltage test shall be carried out on all power and control circuits at 2000 volts A.C. voltage applied for one minute.
- iii) Low voltages continuity test on all power circuits shall be carried out from busbars to the outgoing terminals of each feeder with switches and contactors in closed position.
- iv) All control circuits and operations of equipment for all feeders shall be checked with only control supply made available to ensure satisfactory operation of all equipment such as push buttons, BMR reset, indicating lamps, timing relays, etc. All contactor coils shall be checked for presence of humming or chattering. Special requirements for various feeders indicated in the purchase data sheets shall also be checked.
- v) Earth continuity test shall be carried out with a low voltage supply of not more than 6 volts, between various non- current carrying metallic parts of equipment, steel work, etc. and the earth bus provided in the MCC.
- vi) Operation of all instruments and meters provided on the MCC shall be checked.
- b) All the tests listed above shall be carried out in the presence of Owner's representative, during final inspection. Contractor shall provide all facilities such as power supply, testing instruments and apparatus required for carrying out the tests.
- c) Contractor shall give a notice of not less than two weeks for inspection and testing by the Owner's representative.

Electric Motors

Rating & Duty

- a) Rating of the motors shall be as indicated in the Schedule of Equipment. Where the equipment supplied needs a higher rated motor, the Contractor shall clearly point out and motors shall be offered accordingly.
- b) All motors shall be rated for continuous duty at maximum output.
- c) Rated voltage for three phase motors shall be 415 volts.

Design Features

- a) Motor body shall be of close grained cast iron construction and shall be provided with lifting hooks or eye bolts. The motor along with the fan and half coupling shall be dynamically balanced.
- b) Fan provided for fan cooled motor shall be non-directional type.

Enclosure/Protections

Enclosure for motors shall be totally enclosed fan cooled (TEFC) unless otherwise specified - SPDP motors shall be used only where the desired output is not obtainable in a TEFC frame.

All outdoor motors shall be TEFC weather proof type.

- c) Degree of protection for all motors shall be IP 55 as per IS 491.
- d) Two earthing terminals comprising terminals studs, two plain washers, one spring washer and nut shall be provided on opposite sides of the frame. Studs shall be suitable to receive appropriate size of earth conductor.

Bearings

All motors shall have ball and/or roller bearings with limit lubricators.

Terminal Box

Terminal box shall be of ample size, suitable for termination of aluminium conductor cables (with cable sockets) which may be substantially derated for conditions of installation.

Motor terminals shall be of stud type, substantially designed and well insulated from the frame. Each terminal shall be complete with two flat washers one lock nut.

Number of terminals shall be as given below :

Squirrel Cate Motors upto 3.7 Kw - 3 Nos.

Squirrel Cage Motors upto 3.7 Kw
(with tinned copper links for delta connection) - 3 Nos.

Slip Ring Motors - 3 Nos.

Terminal boxes of all motors shall be rotatable in steps of 90 degrees, without disturbing the motor winding connections to the terminal block. Separate terminal box shall be provided for connections to anti-condensation heaters in case of motors about 50 HP. If heater terminals are provided in the main terminal box, then insulating barrier shall be provided between them with caution name plate affixed on the terminal box. "CAUTION - LIVE HEATER TERMINALS."

Separate terminal boxes for starter and motor leads to be provided for slip ring motors. Where it is not feasible, an approved type of insulating barrier to be provided.

Temperature Rise

The temperature rise of motors when tested in accordance with IS 325 shall not exceed the limits specified therein.

Starting of Motors

a) All squirrel cage motors shall be suitable for full voltage starting. Motors of 10 HP and above will generally be started with star/delta or auto transformer starters which, in addition to protective devices, shall be provided with single phasing preventor.

b) Starting current at full voltage of slip ring motors shall be limited by the rotor resistance starter. Motor manufacturer shall furnish appropriate value of external resistance required to limit the starting current as well as to obtain the required torque. However, starting current with slip rings shorted shall not exceed 600% of full load current. Starting current of squirrel cage motors with full voltage starting shall not exceed 600% of the full load current with tolerance specified in IS 325.

c) Starting torque of squirrel cage motor started on full voltage shall not be less than 200% of the full load torque. Pull out torque of motors shall not be less than 200% of the full load torque.

Insulation

All motors shall have Class 'D/F' insulation unless the ambient temperature or other conditions necessitate another class of insulation.

All materials used in the construction of motors shall be non-hygroscopic.

Painting

All motors shall be painted in an approved manner using two priming coats and two finish coats. The final colour shall be to the Owner's requirements.

Performance Particulars

Following performance particulars for all motors to be furnished well in advance before finalising orders for motors :

- a) Make
- b) Type
- c) Enclosure
- d) Class of Insulation
- e) Temperature Rise above 40 Deg.C ambient
- f) Rated Output
- g) Speed
- h) No load current
- i) Full load current
- j) Locked rotor current

- k) Starting torque (DOL)
- l) Efficiency at full load, 3/4 load, 1/2 load
- m) Power factor at full load, 3/4 load, 1/2 load
- n) Details of rating for space heater
- o) Max. size of aluminium conductor cable which could be connected to motor
- p) Rotor current at rated output
- q) Value of rotor resistance for different torque values

MV Distribution Boards

Construction

The salient features of constructions panels shall be as follows :

Sheet Steel - 2 mm thick for frames, cable gland plates and equipment mounting plates and 1.6 mm thick for front and rear doors and covers

Welded construction, with shipping section bolted together. All such joints to gasketed. Lifting lugs to be provided.

The cubicles shall be totally dust and vermin proof conforming to IP 54 of IS 2147.

All doors to be hinged type except busbar chamber covers which shall be bolted type. The panel shall be of flush front design, suitable for access from front and rear.

The construction shall be such as to facilitate easy extension at both ends.

The design shall be such as to have individual feeders in separate compartments, with proper barriers between adjacent feeders, busbar chamber and cable box chambers.

Painting

All sheet steel work shall be properly cleaned and degreased. Rust and scale shall be removed by picking and phosphatising. After phosphatising, two coats of primer shall be applied followed by two coats of finishing synthetic enamel paint of approved shade as per IS-5. The painting shall be stove enamelled.

Air Circuit Breakers

- a) The circuit breaker shall be air-break, horizontal draw-out feature shall show 3 positions viz. SERVICE, TEST and ISOLATED. These positions along with 'OPEN' and 'CLOSE' positions shall be visibly marked.
- b) All positions shall have provisions for locking. The ACB shall have shutter assembly and arc-chutes and mechanical trip features.
- c) The ACB shall have 6 NO + 6 NC auxiliary contacts rated at 10 A, 240 V, AC.
- d) 'RED' and 'GREEN' indicating lamps shall be provided on the cubicle.
- e) The ACB door shall not have any lamps or instruments. All such accessories shall be mounted on a separate compartment.
- f) The ACB shall have proper interlocks such that it cannot be 'plugged in or out' 'SERVICE' position, if the breaker is in 'ON' condition. It shall not be possible to operate as circuit breaker unless it is properly engaged in any of the three positions.
- g) The ACB shall have series CI operated over- current and short-circuit releases with facilities to mount the undervoltage and shunt-trip releases.
- h) The operating mechanism shall be independent, manual spring charged stored energy type. The mechanism shall ensure quick-break, quick make action and the ACB shall be trip-free in operation.

Air Break Switches

The air break switches shall be of AC23, (heavy) duty, quick make-quick break, fault- make type as per IS 4047. The contacts shall be silver plated.

The switches shall be capable of withstanding the mechanical and thermal stresses produced by overloads and short circuits.

All switches of all ratings shall have inter- locks with the compartment doors. Switches of 250 A and above shall be lockable in the 'OFF' position. All live parts shall be shrouded. It shall be possible to intention- ally defeat the interlocks if required.

'RED' indicating lamp shall be provided for 'ON' indication.

Fuses:

All fuses shall be of HRC cartridge fuse-link type having a certified rupturing capacity of not less than 46 KA at 415 volts AC. The HRC fuses shall conform to IS 9224 1979. All fuses shall have visible indication to indicate 'Blown' condition.

HRC Fuse Carriers

The HRC fuse carriers/bases shall be of high grade phenolic mouldings. The contacts shall be silver plated and the contact blocks shall be suitable to receive the rated conductors of aluminium.

The fuse carriers shall have an aperture to view the conditions of HRC fuse mounted inside.

Contactors

The motor starter contactors shall be of the electro-magnetic, double-break, non-gravity type rated for uninterrupted duty suitable for operation under AC 3 utilisation category as per IS 2959. The contacts shall be silver plated.

2 NO and 2 NC auxiliary contacts shall be included.

operating coils shall have Class 'E' insulation of wire and shall be suitable for operation of any specified control supply system.

Thermal Overload Relays

- a) The thermal overload relays shall be 3 element, positive action, ambient temperature compensated with a time lag and adjustable settings. The setting range shall be selected in accordance with the ratings of the motor.
- b) The relay shall be self-reset/hand reset as called for in the case of hand-reset, the reset button shall be fixed on the compartment door.
- c) The relay shall have at least one 'NC' and one 'NO' or one change-over contact.

Moulded Case Circuit Breakers

- a) The moulded case circuit breakers, MCCBs shall be provided where certified. The MCCBs shall conform to the latest applicable IS 2516-1977.
- b) For AC Circuits the MCCBs shall be triple pole construction and shall have independent manual opening and closing mechanism. The mechanism shall be quick-make and quick-break type and the breakers shall be trip-free in operation. The 'ON'. 'OFF' and 'TRIP' mechanism shall be clearly indicated.
- c) Bolted type neutral link to be provided with TP MCCB.
- d) It shall be possible to mount accessories on the MCCBs like shunt-trip and undervoltage release, alarm contacts, etc.
- e) The MCCBs shall have thermal/static trip devices.
- f) The MCCBs shall have rupturing capacities as specified in BOQ/Single Line Diagram.

Miniature Circuit Breakers

The MCBs shall be of single pole, double pole, triple pole or four pole as required. The MCBs shall be of magnetic type with a maximum rupturing capacity of 9 KA at 415 V.

Current Transformers

- a) The CTs shall be of dry type and shall have short-time withstand rating equal to the short-time withstand rating of the associated switchgear for 1 second.
- b) The measuring instrument CTs shall be of 15 VA, minimum accuracy class 1.0 and an instrument safety factor of 5.
- c) The protection relay CTs shall be of 15 VA, minimum accuracy class 5P and an accuracy limit factor of 10.

Indicating Instruments and Meters

- a) Electrical indicating instruments shall be 72 mm/96 mm/144 mm square size, suitable for flush mounting.
- b) The zero adjustment shall be done from outside the cover.
- c) The dials to be parallax free with black numerals on a white dial.

Indicating Lamps

- a) Indicating lamps shall be of the filament type and of low watt consumption, provided with series resistors and HRC fuse link for protection.
- b) The lens shall be easily replaceable from the front.

Control and Selector Switches

- a) The control and selector switches shall be of rotary type, adequately rated for the application but with a minimum rating of 10 Amps at 240 V AC and 1 Amp at 220 V DC. The plates shall have clear position markings.
- b) The control switches shall have pistol grip handles spring return to normal. The selector switches shall have oval knobs and shall be contact stay-put type.

Push Buttons

- a) The push buttons shall be of the momentary contact, push to actuate rated for 10 A at 240 V AC and 1 A 220 V DC. The 'START' push buttons shall be green and shrouded. The 'STOP' push button shall be red and unshrouded. All other push buttons shall be black.
- b) The elements shall be enclosed with 1 'NO' and 1 'NC' contacts. It should be possible to add on easily extra elements to increase the number of 'NO' and 'NC' contacts.

Main and Auxiliary Buses

- a) The busbars shall be of high conductivity aluminium alloy of E91E grade. The busbar shall be of uniform cross-section throughout the length of the panels.
- b) All main and auxiliary busbars shall be insulated with sleeves. The sleeves shall be of high dielectric strength, non-corrosive and of phase and neutral colours.
- c) The busbars shall be supported on cast epoxy/ resin/DMC/Fibreglass insulators and the spacing of the supports shall be such as to withstand the stresses of the short circuit currents. The busbar spacings shall be adequate for 3 phase voltage upto 600 V.
- d) The busbar shall be chosen for specific current ratings with a minimum density of 1 amp for sq.mm area.

Internal Wiring

All internal wiring shall be carried out with 1100 V/650 V grades PVC insulated, stranded conductor copper wires. The minimum size of wires shall be 2.5 sq.mm copper and for CTs also 2.5 sq.mm copper.

All individual control and CTs wiring shall be labelled with engraved identifications ferrules, yellow in colour with black letters.

All wiring shall be terminated on stud type terminal blocks through crimping sockets. No more than one connection shall be made on any one terminal block.

All spare auxiliary contacts of contactors and relays shall be wired to control terminal blocks.

Terminal Blocks

Terminal blocks for power and control shall be of reputed make stud type, with washers, nuts and lock-nuts. All adjacent terminals shall have insulating barriers.

All power terminal blocks shall be appropriately rated for current with a minimum of 30 Amps. The control terminal blocks shall be rated for a minimum of 10 A and suitable for at least 2 conductors each of 2.5 sq.mm.

All sets of power and control power terminal blocks shall be identified with engraved plastic labels, black background and white letters.

Identification Labels

All labels shall be black plastic with white engravings of letters of minimum 6 mm sizes.

Earthing

All switchgears shall have continuous run of earth busbar. The size and materials of the earth bus- bar shall be specified.

Tariff Advisory Committee and CPRI Tested

The switchgear shall be approved by the Tariff Advisory Committee (for Fire Insurance) and CPRI tested for short circuit test and enclosure test.

Tests

- a) High Voltage test at 2.5 KV.
- b) Power and Control Circuits Continuity Tests.
- c) Insulation Resistance Test with 1000 V Meggar.
- d) Operational Test.
- e) Three Sets of Test Certificates to be submitted.

Drawings

Three sets of general arrangement drawings and wiring diagrams of all types of feeders shall be submitted.

Control Stations

Control station shall be of cast iron or cast aluminium enclosures, consisting of 'START' and 'STOP' push buttons and shall have stayput feature of twist unlock type.

Cable and Accessories

All cables shall be heavy duty PVC insulated armoured and PVC sheathed of 1.1 KV grade. Aluminium conductor cables shall be used for power and copper conductor cables shall be used for control wiring.

Glands

Glands used for termination shall be compression type. Cable glands shall be with single/double seal and cone and clamp for armoured clamping.

For safe and indoor areas, glands with single seal and for outdoor installation and hazardous areas, gland with double seals will be used. For use in corrosive areas, glands shall be coated with rust proofing lacquer after installation and provided with PVC hoods.

Cable lugs shall be of Dowell or equivalent approved make, suitable for connection of aluminium conductor cables. The cable lugs shall be of tinned copper and of soldering type for solid conductor cables. For stranded conductor cables, crimping type, tinned copper cable lugs shall be used.

Conduits and Accessories

Conduits wherever used with prior approval of the Contractor shall be of GI heavy gauge/black enamelled/PVC. All accessories, such as junction boxes, shall be duly approved by competent authorities. Terminal blocks of adequate rating are to be provided in the junction boxes.

Saddles

Saddles to be used for cleating cables or conduits shall be fabricated from MS or aluminium strips or any other approved material and shall be painted and dried before installation with chemical works type paint.

Cable Tags and Identification Ferrules

Cable tags and identification ferrules provided on cable cores/wires shall be of PVC/plastic. Cable tags shall be provided at every 15 meters and at all bends or change in routes.

Structural Steel

15.1 This shall include MS angles, channels, flats, etc. required for fabrication of cable trays, local supports for cables, control stations, etc. All steel sections shall be new and conform to IS 226.

Miscellaneous Materials

16.1 These shall include solders, fluxes, adhesive insulating tapes, PVC sleeves, petroleum conducting jelly, etc.

Earthing Material

Copper strips or wires of suitable sections shall be used for earthing in accordance with IS 3403.

All 3 phase 415 Volts equipment shall be earthed at two points and all single phase equipment at one point.

Painting

All metal work and metal parts of the MCC shall be thoroughly cleaned to remove rust, scale grease or any other matter. Suitable anti-corrosion treatment such as phosphatising shall be given to the metal work. All exposed surfaces of the metal work shall then be given a priming coat of zinc chromate or equivalent and finished with two coats of paint of specified shade.

Drawing

Contractor shall submit 3 copies of control of schematic wiring diagram for refrigeration unit showing all protections and interlocks for Chief Engineer's review and approval. After the final approval six prints and one clear reproducible of each drawing shall be furnished.

Installation**Motor Control Centres**

Motor Control Centres shall be installed on welded construction channel framework. Framework shall be properly grouted by means of foundation bolts or anchor fasteners.

Cable Laying

As far as possible, cable shall be run in built up trenches and on walls/ceiling. Cables shall be dressed and clamped to the wall/ceiling by means of GI strap saddles of minimum 3 mm thickness. Cables shall be kept away from wall ceiling by saddle bars of at least 6 mm thickness. Cables running in built-up trenches shall also be properly clamped when cable run is on side walls of trench. Cable entry into the building shall be through suitable GI pipes or hume pipes or trenches. All cable entry openings into the buildings shall be properly sealed with cold setting, PVC compound or other approved materials.

Cable Termination

PVC cables shall be terminated with compression type glands. For outdoor installation double seal compression glands shall be used. All cables shall be connected by means of suitable crimping type cable lugs. All connections shall be secure and vibration proof. All contact surface shall be coated with petroleum conducting jelly before connections are made.

Earthing

All metallic frame work and non-current carrying metallic parts and enclosures of electrical equipment such as MCCB, motors, control station, etc. shall be bonded to one another and earthed by means of two separate earth conductors and connected to the plant earthing system.

Motors

All motors shall be installed on a common foundation with the driver equipment coupled through flexible couplings or belt drive.

Levelling and alignment of motor and driven equipment to be carried out as per IS 900 to avoid undue strain on motors.

Insulation resistance of motor shall be measured before commissioning. In no case insulation resistance should be less than one meg ohm. If it is less than one meg ohm motor should be dried out as per procedure laid on IS 900. Pre- commissioning mechanical checks shall be carried out as per IS 900.

Cable termination and earthing of motors shall be carried out by Electrical Contractor.

On commissioning of motor, any defects like excess current, bearings getting hot, undue vibration or noise etc. are observed, it will have to be made good by the Contractor without any extra cost.

Testing and Commissioning**Operation Test**

Energise only control circuits and carry out closing and tripping operations. (Where AC supply derived from main supply is used for operation, the switchgear bus may be energised). Check tripping of circuit breakers by manual operation of protective relay contacts. Check operation of mechanical closing and tripping devices. Check lockout conditions for closing of circuit breakers by simulating the required conditions. Check control, indications, sequence interlocks and alarms.

Polarity and connections of instrument transformers check for correctness of CT and PT connections provided with transformer. Check electrical continuity of secondary circuits with ELV tester. Adjust spacing of arcing horns/rod gaps.

Check operation of instruments, meters, relays and tripping of circuit breakers by primary/secondary injection as specified. This test will be carried out only if specifically called for by Contract Documents.

Check continuity of power circuits and earth continuity of all non-current carrying metallic parts with a low voltage (6V or less) continuity tester.

Carry out IIV test on power and control circuits if specifically called for in Contract Documents.

Motors

Check equipment for free movement of rotor and play, lubrication and for any other mechanical defects and direction of rotation.

Check commutators, slip rings, brushes, brush- holders, etc. for satisfactory conditions. Insulation test of motors between winding and ground. Use 500 V megger for MV motors and 1000 V megger for HV motors. Check electrical continuity with ELV tester.

Control Cables

Carrying insulation test on all power and control circuits. Check all equipment for satisfactory operation and correct wiring.

Wiring

Insulation test between phases, between each phase and neutral and between each phase/neutral and ground.

DC High Voltage Test on HV Cables in accordance with the relevant Indian Standards and Code of Practice. This test shall be carried out on cables, installed in final position and all joints and terminations have been made. The cables, however, may not be connected to the equipment so that the equipment may not be subjected to the test voltage.

In case of lighting wiring, insulation test shall be carried out on lighting feeders with branch circuits open. Branch circuits shall be tested separately with lampholders, plug receptacles and lighting fittings in position but without lamps. In case of lighting circuits with lamp ballasts and glow starters insulation resistance may be measured between phase and ground only.

In case of directly buried cables, insulation resistance of cables shall be measured before and after the back filling. Test all receptacles for correct phase sequence.

Earthing System

Continuity test for earth continuity conductors with ELV tester.

Operation test

After successful completion of the above tests, operational tests shall be carried out by the Contractor for checking the connections done by him and satisfactory operation of all the equipment supplied by him. This test shall be carried out initially without energising power circuits. Various control conditions shall be simulated for the purpose of this test. Any defects detected during the tests such as blown fuses, damage to devices, shall be rectified by the Contractors, free of cost.

VARIABLE FREQUENCY DRIVES**Description**

This section describes the type of frequency converter to be supplied for fan and pump speed control. The drive shall not be a general purpose product, but a dedicated HVAC engineered design. The manufacturer shall demonstrate a continuous period of manufacture and development for at least 25 years.

The frequency converter shall be supported locally by the manufacturer who will provide full technical support, spares holding and trouble shooting capability from his own local facility. A training course shall be provided by the manufacturer to the Site Engineer/contractor/maintenance engineers, nominated by the Chief Engineer.

The manufacturer shall provide full technical detail of the product, with catalogues, dimension drawings, weights etc. and each drive shall be provided with a full technical manual.

Equipment supplied must conform to recognized International Standards and be manufactured to ISO 9001, BS 5750 part 1 & 2 and carry the C.E. Mark on EMC Compliance.

Frequency converters shall be suitable for use in either a 'Stand Alone' mode, complete with all necessary protection or as part of centrally controlled system via a serial communication loop to the main Building Management System (B.M.S.) via in-built RS 485 port

Technical Requirement:

The frequency converter (F.C.) shall convert Local Voltage $V \pm 10\%$, 3 Phase, 50/60 Hz utility power supply to an adjustable output voltage and frequency. The FC must be capable of delivering output voltage to the motor equal to the mains input voltage to the FC at full load and speed. In the event the FC cannot meet this requirement a oversized motor at least one frame size higher must be selected. The FC manufacturer must document this capability.

The voltage to frequency ratio shall be suitable for centrifugal pump and fan control. It should not be possible to set a constant V/F ratio, to prevent damage to connected equipment and to optimize energy usage.

The F.C. shall work in conjunction with any I.E.C. standard design motor and shall not require the motor to be derated, or cause the motor temperature to rise above the class 'B' rise expected on normal mains operation. The Motor shall not require an external blower even at slow speed running.

When selecting the FC, care shall be taken to ensure that protection against electro fluting of motor bearings and/or damage to the motor Windings shall be provided. This shall be provided by the inclusion of:

- a) Insulated motor bearings
- b) Soft switching IGBT's in the FC
- c) LC Filters fitted to the FC

The F.C. shall use AMA (Automatic Motor Adoption) techniques so that operators do not have to input motor characteristic and ensuring proper motor operation, without the need to "spin" the motor

The F.C. shall be capable of controlling parallel motors of mixed ratings, and allow disconnection of any machine whilst running without causing tripping. The F.C. shall be capable of running with no motor connected for service functions.

The F.C. shall be fully tested at the converter manufacturers works, including motor loading. Certificates of Compliance should be available on request.

The F.C. shall be of sufficient capacity to provide a quality wave form so as to achieve full output torque of the motor, without causing additional heat rise. The operating conditions shall include:-

Minimum efficiency	at 100% load - 96%
	at 20% load - 92%

Rated input voltage (local voltage) -10%, 3 phase, 50/60 Hz +/-2 Hz.

Working ambient temperature range -10°C to +45°C, humidity to 95% RH, and vibration of 0.7G.RMS in 3 directions at full load

Output frequency range - 0.5 to 1000 Hz.

Output voltage range 0 to full mains input voltage, 3 phase even at full mains voltage -10% input.

The drive shall allow connection of motors one frame size larger and 4 sizes smaller than the nominal converter rating.

VFD shall be limited to 110% of rated current for 60 seconds

The F.C. shall accept 0-10 VDC; 4-20 mA, or resistive inputs as a control signal.

The F.C. shall provide two output relays to provide signals including - ready, run, tripped, and be programmable for other selected information. Two analogue outputs of 4-20 mA or 24 VDC shall be programmable to transmit speed or other parameters to the B.M.S. In addition, 2 x digital outputs shall provide 24Vdc to signal choice of 27 conditions to the BMS.

The F.C. shall log and display "Total kWhr's consumed" and "Total Hours Run" by the motor without additional instrumentation and the facility to "Reset".

20 preset speeds shall be available (programmable values) for duties such as night setback, smoke extract and morning boost settings.

The F.C. shall provide 4 skip frequencies of adjustable bandwidth to overcome mechanical or air resonance.

A parameter lock shall be incorporated to prevent unauthorized resetting of parameters.

The FC shall be capable of running from an external DC source during periods of mains interruption.

Drive acoustic noise shall not exceed 65DbA at full load and 60DbA at 50% load.

F.C. Design Requirements:

The F.C. shall contain as standard within its enclosure D.C. Link filtering with both inductive and capacitive elements to control the mains borne harmonics. The document 'Electrical Supply Industry Recommendation G 5/3 limits for harmonic currents in the U.K.' or IEEE519, 1992 shall be used for the basis of calculation of T.H.D. for the point of common coupling

The F.C. manufacturer shall provide T.H.D. figures for the total connected load. The contractor shall provide details of supply transformer rating, impedance, etc. feeding the F.C.'s to allow this calculation to be made.

The F.C. shall comply with E.M.C.(Electromagnetic compatibility) (R.F.I. Control) document EN55011 as an integral part of its design, incorporating EMC Filters to meet both EN55011 Class 1A (150metres) and Class 1B (50 meters) up to 55Kw & Class 1A above 55Kw. It shall conform to immunity standard IEC 801 parts 2-5. Must carry the C.E. Mark of Compliance.

The drive shall be capable of automatically reconnecting to a spinning fan, forward or reverse running, without tripping, following mains interruption or on transfer from bypass running.

The F.C. design shall comprise a diode input bridge, fixed voltage D.C. link section with both inductors and capacitors to form a filter, and inverting bridge comprising I.G.B.T.'s (Insulated Gate BiPolar Transistors). All equipment must be housed within the F.C. enclosure.

4.0 LIST OF APPROVED MANUFACTURERS/SUPPLIERS**Note:**

1. NO DEVIATION SHALL BE PERMITTED.
2. Wherever Contractor proposes to use "equivalent" makes (other than specified), the same shall be done only after prior approval from Chief Engineer. The Chief Engineer may take time before giving approval, time due to this will be on contractor's account and no claims will be entertained.
3. All material to be used shall be of first quality unless otherwise specified.
4. All sizes of materials mentioned shall be finished sizes.

Description	Approved Brands / Manufacturers
Air Cooled Chiller	Trane, Carrier, York, Climaveneta
Air handling unit	Blue Star / CARYAIRE / ZECO/
Pumps	Kirloskar/ Beacon/ Grundfoss/ Bell & Grosset
CUSHY MOUNTS/VIBRATION ISOLATORS -ORS(Spring Type)	DUNLOP/ POLYBOND
Rubber bellow type flexible connection for Chillers and Pumps	RESISTOFLEX/PORI
AHU Blower	Comefri / Krugger / Nicotra / Flaktwood
Three phase motors	Crompton / ABB / Siemens
GI Sheet	Jindal / SAIL / TATA
Factory fabricated ducts	Rolastar/ Zeco
Inline Fans	Kruger / Kannel Flaktwood / Nicotra
VFDs	Danfoss/ABB/ L & T
MS / GI piping	Jindal / SAIL / Tata/Zenith
Nitrile rubber Class O	Armaflex
Butterfly	Audco/ Keystone
Ball Valves	Zoloto/Leader/Kirloskar
Balancing/Regulating/Commissioning Valves	Advance/T&A
Strainers cum flow straighteners	ANERGY/Vee Bee/Crescent
Pressure gauges	Feibig / H Guru/Baker Mercer

Automatic Air Vent valves	ANERGY
Thermometer	H. Guru/star Scientific/
Pipe Insulation CHW	Beardsell or equivalent
Propeller / Axial Flow Fans	KANNEL FLAKT / NICOTRA/GE/Crompton/HPS/Ventura
Fibre glass rigid board	UP Twiga / Kimmco/ Backelite Hylam
Grilles / Diff.	Ravi Star / TSC / SACHIN/ COSMOS
Volume Control Damper (G.I.)	SACHIN / RAVISTAR / COSMOS
Fire Damper	Caryaire / Ravistar / TSC Instrument
AHU Control/ modulating valves with controller	Johnson controls/ Siemens/ Honeywell
Sensors / controllers	Johnson controls/ Siemens/ Honeywell
Duct Silencers	Ravistar / Caryaire / Zeco
MCB / ACB	L&T / GE / Siemens / Schneider/ABB
Power & Control cable	CCI / Polycab / Gloster / Finolex
Voltmeter/Ammeter	A.E. / IMP
Switches	L&T / Siemens / ABB / GE / Schneider
HRC fuse & fittings	L&T / Siemens / GE/ABB
Current transformer	A.E. / Kappa
Contactors	L&T / Siemens / GE / Schneider
Overload Relays	L&T / Siemens / GE / Schneider
Indicating lights	Vaishnu / EMCO
Panels (electrical)	CPRI approved & ISO Certified manufacturer only
Flex. Bellow	Resistoflex/ Cori
Pre-fabricated Supports	Perfekt Support
Flexible Insulated Ducting	Atco
Electrical Control Panel	CPRI approved & ISO certified manufacturers only
Refrigerant Pipe Insulation	Armaflex
Centrifugal Ceiling Flushed Toilet Exhaust Fan	Siracco
Cable Trays	MEK/Profab

BMS:	
PVC 1000V grade Cable	Finolex, polycab, Rajanigandha.
PVC 600V grade Cble	Capilast , Finolex , Polycab.
Single Core Cu Wire	Finolex, Polycb, Rajnigndh.
Card Access System	HID, Solus , Spectra , Honeywell.
BMS System Con	Clipsal / Honeywell ,Siemens.
G.I./PVC Conduit	BEC / Jindal / TATA / Precision

Note:

- **All materials used shall be of I.S.I grade wherever applicable.**
- **Read or Approved Equivalent' at the end of all materials listed above.**

TECHNICAL SPECIFICATION INTEGRATED BUILDING MANAGEMENT SYSTEM

BUILDING MANAGEMENT SYSTEM

The Building Management System (BMS) supplier shall furnish and install a fully integrated building automation & management system for the equipment and system as listed. The premises consists of 07 Floors, wherein the services to be monitored and integrated are distributed. The BMS incorporating direct digital control (DDC) for energy management, equipment monitoring and control, suitable for the building usage. The control strategies shall be developed to ensure that specified environmental conditions are maintained, whilst giving due regard to minimizing of energy consumption. BMS system shall supposed to have an open architect, interoperable status of the art, Building automation system, for the project, for the purpose of monitoring and control, scheduling of events, and for the purpose of alarm management.

REFERENCE STANDARDS

The project is designed to meet or exceed all applicable Codes and Standards governing the site and as partially listed below:

- ASHRAE Standard 62-1999
- ASHRAE Standard 90.1-1999.
- Recommended Manufacturer's specification

SYSTEM DESCRIPTION

The system design shall utilize the latest technology in "open" network architecture, either LONWORKS or BAC net or combination of both with distributive intelligence and processing, and direct digital control. The BMS system offered should be from the latest offerings and should be freely programmable management and automation stations for the full spectrum of today's building application services.

The System shall mainly comprise of Direct Digital Controllers, Protocol Integrators, Web Server Ethernet routers, and relevant field level instrumentation. The BAS shall provide & design the system with Ethernet routers cum Web servers distributed at all floors to minimize Cabling, achieve maximum operational system redundancy & high speed communication.

The area's where critical Alarm integration is involved the BMS shall include a redundant router. The BMS shall ensure not to load any protocol integrator above 400 Mapping points. The DDC's offered shall be intelligent type with

self storage of data & expanded memory.

The BAS shall ensure that all critical / medium alarm generation points of any one services not to be linked to one DDC/PI. This will avoid failure of entire data of particular services in case of failure of the corresponding DDC/PI.

BUILDING MANAGEMENT SYSTEM functions desired as under:

Demand based ventilation shall be achieved by installing CO2 sensors and modulating fresh air input, (subject to approval)

- 1) All AHU's shall be monitored for their performance.
- 2) Fire Detection & Alarm Systems - The system comprises of Main Fire Panel located as shown in Drawing. The BMS shall monitor FIRE & fault status thru volt free contacts and soft integrated thru BACnet over RS 485.
- 3) High Sensitivity Smoke Detection Systems- The system comprises of HSSD Panel located as shown in Drawing. The BMS shall monitor Stage 1 FIRE & Fault status thru volt free contacts.
- 4) Electrical System, including Energy Meters – All panels, breakers, UPS, PDU's, SB's are located as shown in Drawing. The BMS shall monitor all ON/OFF trip status thru volt free contacts & soft integrate Energy meters on critical circuits. Further Auto change over Panels shall also be soft integrated for monitoring parameters.
- 5) DG System- DG are located as shown in Drawing on the floor. The system offers one point Soft integration for monitoring all parameters. BMS shall soft integrate DG for monitoring all parameters & critical alarm through volt free contact.

Spare Capacity

The system proposed shall provide 20% spare control points of each type in the form of universal input/output contacts and supporting software capacity at each outstation. Each Floor network shall have the capacity of a 20% increase in the number of nodes on that floor without introduction of further networks.

Alarm Monitoring

Alarms shall be initially separated into 3 priority levels as follows:

- Critical Alarms (High) –Critical Alarms including: Fire Status, Critical VAV system Alarms, Critical Switchboard Breaker Tripped Statuses, Out of Limits Temperature/Humidity in building critical areas.

- Medium Alarms– Plant Alarms including: Non critical area leak detected, Sensor Failures, Common Faults on all non-critical circuits.
- Maintenance Alarms (Low) – Maintenance Alarms including: Out of Limits Temperature/Humidity in non critical areas.

However, definition of all these alarm shall further be classified in co-ordination with individual service providers and any specific requirements from client. The BMS vendor shall ensure all alarm definitions as per priority given by client.

The system shall have its own dedicated network without any interface with the client IP network. The system shall have all necessary interface modules to direct alarms to an e-mail address, mobile phone, alpha-numeric pager or a remote monitoring head-end PC. The BMS shall utilize an engineers schedule to send e-mails, text messages or pages to the personnel that are "oncall".

Remote Computer Interface

The system proposed shall have a remote monitoring system achieved by a Internet explorer thru web browser, interface to allow full system monitoring of the premise and monitoring station from any remote site.

The System is proposed with backup power from UPS. IO summary shall be shared after final scheme of HVAC & Electrical.

SYSTEM DESCRIPTION:

CHILLERS:

Through BMS, we shall have the following controls:

1. Chiller On / Off – Control
2. Chiller On / Off - Status
3. Trip Indication
4. Auto / Manual status
5. Read – All chiller parameters through plant manager like
 - (a) Chilled water inlet and outlet temperatures
 - (b) Condenser water inlet and outlet temperatures
 - (c) Evaporator and condenser refrigerant pressure
 - (d) Oil pressure and oil filter differential pressure
 - (e) Oil temperature and oil level
 - (f) Suction and discharge temperatures

- (g) Slide valve position
- (h) Chilling package status
 - Start-up sequence status
 - Shut-down and operational status
- (i) Number of compressor starts
- (j) Total hours of operation
- (k) Hours since last start
- (l) Time of last start and time of last stop
- (m) Compressor motor current
- (n) Fault history

RELATED ACCESSORIES:

1. Motorized butterfly valve ON / OFF control and status
2. Flow meter reading
3. Chilled water header temperature – Supply and Return line
4. outside air temperature & relative humidity readings

CHILLED WATER (PRIMARY & SECONDARY) AND CONDENSER WATER PUMPS:

The following parameters shall be controlled / read on the BMS:

1. Pump on/off
2. Pump status
3. Trip indication
4. Auto/Manual status

AIR HANDLING UNITS:

The following parameters shall be controlled / read through the BMS:

1. AHU run status
2. 2 way valve position and control
3. Chilled water in/out temperature
4. Return air temperature
5. Supply air temperature
6. VFD Control
7. AHU filter status
8. Monitor the basement ventilation scheme which shall run during normal operations and also during fire. We have proposed a ductless system with jet vents.

HRW UNITS:

The following parameters shall be controlled / read through the BMS:

1. On/off
2. Run status
3. Monitor supply air, exhaust air, return air, and ambient condition.

VARIABLE AIR VOLUME SYSTEM:

All the VAVs proposed are pressure independent, net workable type. These VAVs shall be connected to the central BMS system.

The following parameters shall be controlled / read through the BMS

1. VAV Damper position
2. Air quantity
4. Room temperature
5. Set temperature

FIRE DAMPER CONTROL:

All the fire dampers proposed to install in Supply and Return air path shall be connected to BMS. These fire dampers operate with actuators. The actuators shall be controlled through the BMS as well in built fire and smoke sensor. The BMS shall get signal from the central fire alarm system. All the fire dampers installed in the floor shall close in case of fire in any part of the respective floor.

The following parameters shall be controlled / read through the BMS

1. Fire damper open / close
2. Read – Fire damper status

DG & TRANSFORMERS:

1. Monitoring of Electrical parameters like I, V, PF, KW, KWH, KVAR etc.
2. DG sets run status.
3. Diesel level in storage tanks.

ELECTRICAL:

1. Read – Energy meter parameters (I, V, A, kw, kwh, kva, pf) of all the floor panels at rising main tap-off to clients.
2. Read – Energy meter parameters (I, V, A, kw, kwh, kva, pf) at all panels.
3. Auto / On / off of external lighting.

STAIRCASE AND LIFT WELL PRESSURIZATION FANS

1. On/off
2. Run status
3. Integration with fire alarm system

PLUMBING AND FIRE FIGHTING SYSTEM

1. On/off of pumps
2. Run status of pumps
3. Level of water tanks