NIUM
NATIONAL INSTITUTE OF UNANI MEDICINE
BANGALORE

TENDER
FOR
RENOVATION
OF
MATERNITY WARD OPERATION THEATRE FOR NIUM AT BANGALORE

VOLUME- I & II

NOVEMBER - 2011

HSCC (INDIA) LTD.

(Consultants & Engineers for Mega Hospitals & Laboratories)
E - 6 (A), Sector - I, NOIDA (U.P.) - 201 301 (INDIA)

PHONE : 0120-2542436-440 FAX : 0120-2542447
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TENDER NO. HSCC/112/PM/ MATERNITY WARD/PG-I/11

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NIUM

(National Institute of Unani Medicine, Kottigepalya, Magadi Road, Bangalore)

No. HSCC/112/PM/Maternity Ward/PG-I/2011 **Dated: 26/11/2011**

Notice Inviting Tender

Item rate tenders are invited by Director, National Institute of Unani Medicine (NIUM), Bangalore through **HSCC (India) Ltd** in two bid system from the contractors/firms for the following works:

Name of Work	Estimated Cost (Rs.)	Bid Security (Rs.	Cost of document (Rs.)	Period of Completion	Sale of Tender	Date of submission & opening
"**Renovation for Maternity ward" OT** for National Institute of Unani Medicine (NIUM), Kottigepalya, Magadi Main Road, Vishwaneedom Post, Bangalore- 560 0911	29.00Lakh	58,000/-	3500/-	4 months	28.11.2011 to 08.12.2011	09.12.2011at 15.00 hrs & opening on 09.12.2011at 15.30 hrs

For details in regard of eligibility, bid security, purchase & submission of tender document, please refer detail advertisement and tender documents made available at HSCC website www.hsccltd.co.in & NIUM website www.nium.in

Perspective bidders are advised to regularly scan through NIUM/HSCC website as corrigendum/amendments etc, if any, will be notified on the NIUM/HSCC website and separate advertisement will not be made for this.

Director, NIUM

NIUM

(National Institute of Unani Medicine, Kottigepalya, Magadi Road, Bangalore)

No. HSCC/112/PM/Maternity Ward/PG-I/2011 **Dated : 26/11/2011**

Notice Inviting Tender

Director, National Institute of Unani Medicune, (NIUM) Bangalore, invites sealed tenders through HSCC(I) Ltd in two bid system from the contractors/firms for the following works:

Sl. No.	Name of Work	Estimated Cost (Rs.)	Bid Security (Rs.	Cost of document (Rs.)	Period of Completion
1	"**Renovation for Maternity Ward OT"** for National Institute of Unani Medicine (NIUM), Kottigepalya, Magadi Main Road, Vishwaneedom Post, Bangalore- 560 091	29.00lakhs	58,000/-	3500.00	4 Months

Eligibility Criteria :

(a) Average annual turnover during the last three years [2007-2008, 2008-2009, 2009-2010] shall be at least should be at least 30% of estimated cost

(b) The contractor should possess experience of having successfully completed similar works during last 7 years ending last day of month previous to the one in which applications are invited should be either of the following: -

i) Three similar completed works each costing not less than the amount equal to 40% of estimated cost.

ii) Two similar completed works each costing not less than the amount equal to 60% of estimated cost.

iii) One similar completed work costing not less than the amount equal to 80% of estimated cost.

Similar Work:- Construction of New / Renovation of existing facility for Operation Theatre /Clean room with associated HVAC works.

(c) Solvency Certificate: Solvency of the amount equal to 40% of the estimated cost of the work.

(d) Profit / loss: The Company should have positive Net Worth and should not have incurred any loss in more than two years in last Five years ending 31st March 2010 duly certified by the Chartered Account.

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(e) JV/ Consortium are not permitted

(f) The Applicant should submit an affidavit duly notarized that they have not abandoned any work of Union Government/ State Governments/ PSU's etc. during the last 5 years. They should also submit an affidavit that they have not been blacklisted, debarred, declared non performer or expelled by Union Government/ State Governments/ PSU's etc. during the last 5 years

(g) Registration / Licence : The firm should have registration with the appropriate authorities for the Works Contract Tax , VAT, ESI, PF, Labour Cess **In case the firm is not registered at the time of submission of bid, they will submit an undertaking that they will get themselves registered with the concerned authorities in case they are awarded the work**

Applicants may obtain the tender documents on any working day between **10.00 AM** and **4.00 PM** from **28.11.11 to 08.12.11** on written request from HSCC (I) Ltd, E 6A, Sector-1, Noida**- 201301**, against a non refundable amount of **Rs. 3500/-** payable in cash or in the form of Demand Draft/ Banker's Cheque in favour of **HSCC (INDIA) Limited** from any nationalized bank/ scheduled bank payable at **Noida** / **DELHI.** The applicant may collect the documents in person with authorization letter or on request, HSCC will promptly dispatch the documents by courier on payment of an extra amount of **Rs. 500/-** over & above the said document fee of **Rs. 3500/-**, but under no circumstances HSCC will be held responsible for late delivery or loss of the documents so mailed. The applicant may also download the tender document from HSCC website www.hsccltd.co.in and submit the same along with the tender document fee of Rs 3500/- through demand draft in favour of **HSCC (INDIA) Limited** from any nationalized bank/ scheduled bank payable at **Noida** / **DELHI.**

Last date of tender submission in sealed envelopes by hand or by registered mail to HSCC at the above address on **09.12.2011** by 3.00 PM. Tender shall be opened on **09.12.2011**at HSCC Office, Noida at 3.30 PM. Applicants are also advised to keep checking the website regularly for any amendments/clarifications if any

Director NIUM

INSTRUCTION TO BIDDERS

General

1.0 Scope of work :

1.1 Director, National Institute of Unani Medicune, (NIUM) Bangalore, invites sealed tenders through HSCC (I) Ltd in two bid system from the contractors/firms for the following works:

i) **Renovation for Maternity Ward OT** at National Institute of Unani Medicine, Kottigepalya, Magadi Main Road, Bangalore defined in these documents as the site of works.

1.2 **The Principal Employer** :

The National Institute of Unani Medicine, Bangalore shall be Principal employer / owner for the subject work.

1.3 The successful bidder will be expected to complete the works within 120 days from the date of Engineer's order to commence the work.

2.0 **Cost of Bidding :**

2.1 The bidder shall bear all costs associated with the preparation and submission of his bid, and the Employer will in no case be responsible or liable for those costs.

3.0 **Site Visit :**

The bidder is advised to visit and examine the site of works and its surroundings and obtain for himself on his own responsibility and at his own risk all information that may be necessary for preparing the bid and entering into a contract for the above works. The costs of visiting the Site shall be at the bidder's own expense.

Bidding documents

4.0 Content of bidding documents :

4.1 The set of bidding document comprises of the following as given below and amendment issued in accordance with Clause 6.

- Instruction to Bidders
- Conditions of contract
- Technical Specifications
- Bill of Quantities

5.0 Clarification of bidding documents :

5.1 A prospective bidder requiring any clarification of the bidding documents may notify HSCC in writing or by Fax. HSCC will respond to any request for clarification, which he receives earlier than 3 days prior to the deadline for submission of bids. Copies of such

response/clarification will be forwarded to all purchasers of the bidding documents, including a description of the enquiry but without identifying its source.

6.0 Amendment of bidding Document :

6.1 Before the deadline for submission of bids, HSCC may modify the bidding documents by issuing amendment.

6.2 Any amendment thus issued shall be part of the bidding documents and shall be communicated in writing or by Fax to all purchasers of the bidding documents. Prospective bidders shall acknowledge receipt of each amendment by Fax to HSCC.

6.3 To give prospective bidders reasonable time in which to take an addendum into account in preparing their bids, HSCC shall extend as in their opinion be necessary, the deadline for submission of bids, in accordance with Sub-Clause 14.2.

Preparation of Bids

7.0 Language of bid :

7.1 All documents relating to the bid shall be in the English Language

8.0 Documents comprising the bid :

8.1 The bid submitted by the bidder shall comprise the following :

a) Bid Form

b) Bid Security

c) Priced Bill of Quantities

and any other materials required to be completed and submitted by bidders in accordance with these instructions.

9.0 Bid Prices :

9.1 Unless stated otherwise in the bidding documents, the Contract shall be for the whole works as described in Sub-Clause 1.1 based on the priced Bill of Quantities submitted by the bidder.

9.2 The bidder shall fill in rates and prices for all items of the works described in the bill of quantities. Items for which no rate or price is entered by the bidder will not be paid for by the Employer when executed and shall be deemed covered by the other rates and prices in the Bill of Quantities.

9.3 All duties, taxes and other levies payable by the Contractor under the Contract or for any other cause, shall be included in the rates, prices, and total Bid Price submitted by the bidder.

9.4.1 The rates and prices quoted by the bidder shall be firm for the duration of the contract/till completion of work which ever is later and shall not be subject to adjustment on any account.

9.4.2 The rates shall be inclusive of supply, transportation, installation, commissioning & no

price escalation/variation shall be allowed. Further no statutory variation in taxes & duties or for any other reasons whatsoever shall be payable & shall be considered as included in the rates quoted by the bidder.

10.0 Currencies of bid and payment :

10.1 The unit rates and the prices shall be quoted by the bidder entirely in Indian Rupees.

11.0 Bid Validity :

11.1 Bids shall remain valid for a period of 90 days after the deadline for bid submission specified in Clause 14.

11.2 In exceptional circumstances, the bidders may be required to extend the period of validity for a specified additional period. The request and the bidders' responses shall be made in writing or by cable. A bidder agreeing to the request will be required to extend the validity of his bid security for the period of the extension, and in compliance with Clause 12 in all respects.

12.0 Bid Security :

12.1 The bidder shall furnish, as part of his bid, a security of Rs. 58,000/-(Rupees Fifty Eight Thousand only.)

12.2 The bid security shall be in the form of a pay order/Demand Draft in favour of HSCC (India) Limited, Plot No. E-6(A), Sector -I, NOIDA (U.P) - 201 301 payable at Noida / from any nationalised bank/Schedule bank or by bank guarantee for an equal amount from any nationalised bank. valid for 90 after the deadline for bid submission

12.3 Any bid not accompanied by an acceptable bid security shall be rejected by the Engineer.

12.4 The bid security of unsuccessful bidders will be returned within 15 days of the end of the bid validity period specified in Sub-Clause 11.1.

12.5 The bid security of the successful bidder will be discharged when the bidder has signed the agreement and furnished the required performance security.

12.6 The bid security will be forfeited

a) If the bidder withdraws his bid during the period of bid validity;

b) If the bidder does not accept the correction of his bid price, pursuant of Clause 21; or

c) In the case of a successful bidder, if he fails within the specified time limit to

i) sign the Agreement; or

ii) Furnish the required performance security.

13.0 Sealing, marking and submission of bid :

13.1 The bid shall be submitted in accordance with the procedure detailed herein. Specified

documents shall be enclosed in envelope of appropriate size each of which shall be sealed.

i) Envelope No. 1: Shall contain the bid security as indicated in clause 12 of these instruction to bidders.

ii) Envelope No. 2: Shall contain the covering letter and the other bid documents duly signed including the following:

a) Power of attorney of person authorised to sign the bid.

b) Original bid documents Vol I & II & Tender drawings duly signed,

iii) Envelope No. 3: Shall contain the Bill of Quantities (Vol III) and price bid duly filled in and signed.

The contractor must fill up prices in the Bill of Quantities both in words and figures. Please note that the price should not be indicated in any of the documents enclosed in envelope 1 and 2. No conditions shall be put in the price bid. If so, the same shall be rejected.

13.2 The bidder shall seal the bid.

13.3 All the three envelopes shall be sealed and enclosed in an envelope and addressed to the General Manager (PG-I), HSCC (India) Limited Plot No. E-6(A), Sector - I, NOIDA (U.P)- 201 301.

13.4 All the above envelope shall bear the following identification:
Name of work: : Renovation for Maternity Ward OT for NIUM Bangalore.

13.5 All the envelopes shall indicate the name and address of the bidder to enable the bid to be returned unopened, if required.

13.6 All recipients for the purpose of submitting a bid shall treat the contents of the documents as private and confidential.

14.0 Deadline for submission of bids :

14.1 Bids must be received by the Engineer, HSCC (India) Ltd., at the address specified above not later than **15:00 hrs** of the designated date.

14.2 HSCC (India) Ltd may extend the deadline for submission of bids by issuing an amendment in accordance with Clause 6 in which case all rights and obligations of HSCC (India) Ltd and the bidders previously subject to the original deadline will then be subject to the new deadline.

15.0 Late bids :

15.1 Any bid received by HSCC (India) Ltd after the prescribed deadline for submission will be returned unopened to the bidder.

16.0 Modification and withdrawal of bids :

16.1 The bidder may modify or withdraw his bid by giving notice in writing before the deadline

prescribed in Clause - 14.

16.2 The bidder's modification or withdrawal notice shall be prepared, sealed marked, and delivered in accordance with the outer and inner envelopes additionally marked "MODIFICATION" or 'WITHDRAWAL" as appropriate.

16.3 No bid may be modified after the deadline for submission of bids.

16.4 Withdrawal of bid between the deadline for submission of bids and the expiration of the original period of bid validity specified in the form of bid may result in the forfeiture of the bid security pursuant to Clause 12.

Tender Opening and Evaluation

17.0 Bid Opening :

17.1 Bid shall be opened in the office of HSCC (India) Ltd at E-6(A), Sector-I, NOIDA (U.P) - 201 301 /half an hour after the prescribed time for tender submission in presence of the bidder's representatives who may wish to be present.

Envelope No. 1 : Shall be opened first. If the bid security is not found as prescribed the bid shall be summarily rejected.

Envelope No. 2 : Shall then be opened. Bids of parties who do not accept the conditions laid above in the bid documents are also liable to be rejected.

17.2 The Tender Scrutiny Committee will examine the original bids to determine whether they are complete, whether the requisite bid securities have been furnished, whether the bids have been properly signed and whether the bids are generally in order.

17.3 Telephonic/Fax offer will be treated as defective, invalid and rejected. Only detailed complete bids received prior to the closing time and date of the bids will be taken as valid.

17.4 The bidder's names, general technical details, the presence of the requisite bid security and such other details as HSCC (India) Ltd , at their discretion may consider appropriate will be announced at the bid opening.

Envelope No. 3: Contain the sealed price bid of parties whose bid is found to be generally in order and substantially responsive shall be opened either at the bid opening or at a subsequent date to be intimated in advance to such eligible bidders.

17.5 Only summary of prices quoted by the bidders will be read out.

17.6 The bid of any bidder who has not complied with any of the instructions contained herein may not be considered.

18.0 Process to be confidential :

18.1 Information relating to the examination, clarification, evaluation and comparison of bids and recommendations for the award of a contract shall not be disclosed to bidders or

any other persons not officially concerned with such process until the award to the successful bidder has been announced. Any effort by a bidder to influence HSCC (India) Ltd in processing of bids or award decisions may result in the rejection of his bid.

19.0 Clarification of bids :

19.1 To assist in the examination, evaluation, and comparison of bids, HSCC may at their discretion, ask any bidder for clarification of his bid including breakdowns of unit rates. The request for clarification and the response shall be in writing or by cable, but no change in the price or substance of the bid shall be sought, offered or permitted except as required to confirm the correction of arithmetic errors discovered by HSCC in the evaluation of the bids in accordance with Clause 21.

20.0 Examination of bids and determination of responsiveness :

20.1 Prior to the detailed evaluation of bids, HSCC will determine whether each bid (a) meets the eligibility criteria (b) has been properly signed; (c) is accompanied by the required securities; (d) is substantially responsive to the requirement of the bidding documents; and (e) provides any clarification and/or substantiation that HSCC may require.

20.2 A substantially responsive bid is one, which conforms to all the terms, conditions, and specifications of the bidding documents, without material deviation or reservation. A material deviation or reservation is one (a) which effects in any substantial way the scope, quality, or performance way, inconsistent with the bidding documents, the Employer's right or the bidder's obligations under the affect contract or (b) whose rectification would affect unfairly the competitive position of other bidders presenting substantially responsive bids.

20.3 If a bid is not substantially responsive, it may be rejected by HSCC, and may not subsequently be made responsive by correction or withdrawal of non conforming deviation or reservation.

21.0 Correction of errors :

21.1 Bids determined to be substantially responsive will be checked by HSCC for any arithmetic error. Errors will be corrected by HSCC as follows :

a) where there is a discrepancy between the amounts in figures and in words, the amount in words will govern ; and

b) where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern.

21.2 The amount stated in Form of Bid will be adjusted by HSCC in accordance with the above procedure for the correction of errors and, shall be considered as binding upon the bidder. If the bidder does not accept the corrected amount of bid, his bid will be

rejected, and the bid security may be forfeited in accordance with sub-clause 12.6(b).

22.0 Currency for bid evaluation :

22.1 Bids shall be evaluated as quoted in Indian Rupees in accordance with sub-clause 10.1.

23.0 Evaluation and comparison of bids :

23.1 The Employer will evaluate and compare only the bids determined to be substantially responsive in accordance with clause 20.

23.2 In evaluating the bids, the Employer will determine for each bid the Evaluated Bid Price by adjusting the Bid Price as follow :

a) making any correction for errors pursuant to clause 21.

b) excluding Provisional Sums and the provision, if any, for Contingencies in the Summary of Bill of Quantities.

23.3 NIUM / HSCC reserves the right to accept or reject any variation, deviation, or alternative offer, and other factors which are in excess of the requirements of the bidding documents or otherwise result in unsolicited benefits for the Employer shall not be taken into account in bid evaluation.

Award of Contract

24.0 Award Criteria :

24.1 Subject to Clause 25, Employer will award the Contract to the bidder whose bid has been determined to be substantially responsive to the bidding documents and who has offered the lowest evaluated bid price, provided that such bidder has been determined to be qualified in accordance with the provisions of clause and he is found capable of executing the work. as per the technical specification issued to the bidder.

25.0 Employers right to accept any bid and to reject any or all bids :

25.1 Notwithstanding clause 24, Employer reserves the right to accept or reject any bid, and to cancel the bidding process and reject all bids, at any time prior to the award of contract, without thereby incurring any liability to the affected bidder or bidders.

26.0 Notification of award :

26.1 Prior to expiration of the original period of bid validity prescribed by the Engineer, he will notify the successful bidder by Fax confirmed by registered letter/courier that his bid has been accepted. This letter (hereinafter and in the conditions of Contract called the Letter of Acceptance) shall indicate the sum which HSCC / NIUM will pay to the Contractor in consideration of the execution, completion and maintenance of the works by the Contractor as prescribed by the Contract (hereinafter called the "Contract Price").

26.2 The notification of award will constitute the formation of the contract, subject only to the furnishing of a performance security in accordance with the provision of Clause 27.

26.3 Upon furnishing the performance security by the successful bidder, the Engineer will promptly notify the other bidders that their bids have been unsuccessful.

27.0 <u>Performance Security :</u>

27.1 Within 15 days of receipt of the notification of award from the Engineer, the successful bidder shall furnish to the Engineer a performance security in the form of a DD or bank guarantee as per enclosed format of an amount equivalent to 5% of the contract price. The validity of the performance security shall be upto the end of the defect liability period which shall be 6 months from the date of completion.

27.2 Failure of the successful bidder to comply with the requirements of sub-clause 27.1 shall constitute sufficient grounds for cancellation of the award and forfeiture of the bid security.

General Conditions of Contract

1.0 Definitions :

1.1 Terms which are defined in the Contract Data are not also defined in the Conditions of contract but keep their defined meanings. Capital initials are used to identify defined terms.

Acceptance is the date when the contract came into existence upon receipt by the contractor of the Letter of Acceptance issued by the Engineer.

The **Activity Schedule** is a schedule of the activities comprising the Supplying, installation, testing and commissioning of the works.

The **Completion Date** is the date when the Engineer notified that the works can be used by the Engineer.

The **Principal employer/Owner** is National Institute of Unani Medicine (NIUM), Bangalore. HSCC (India) Ltd as consultant to employer shall represent them for tendering, award of work & execution of work.

The **Consultant** is M/s HSCC (I) Ltd. (HSCC), E-6A, sector 1 Noida.

The **Contract** is the contract between the consultant on behalf of the Employer of the one part and the Contractor of the other.

The **Contract Data** defines the documents and other information which comprise the Contract.

The **Contractor** is a person or corporate body whose bid to carry out the works has been accepted by the Employer.

The **Contractor's Bid** is the completed bidding documents submitted by the contractor to the Engineer.

The **Contract Price** is the price stated in the Letter for Acceptance and thereafter as adjusted in accordance with the provisions of the contract.

Days are calendar days: **Months** are calendar months.

A **Defect** is any part of the works not completed in accordance with the contract.

The **Engineer** is the person appointed by consultant who is responsible for supervising the Contractor, administering the Contract, certifying payments due to the Contractor, issuing and valuing variations to the Contract, awarding extensions of time etc.

Equipment is the Contractor's machinery and vehicles brought temporarily to the Site to construct the works.

The **Initial Contract Price** is the Contract Price at the date of the Employer's written acceptance of the bid.

The **Intended Completion Date** is the date on which it is intended that the contractor shall complete the works. The intended completion date is specified in the contract data. The intended completion date may be revised only by the Engineer by issuing an extension of time.

Plant is any integral part of the works which is to have a mechanical, electrical, electronic or chemical function.

The **Site** is the area defined as such in the contract data.

Site Investigation Reports: - Deleted.

The **Start Date** is given in the contract data. It is the date when the contractor can commence work on the contract. It does not necessarily coincide with any of the site Possession Dates.

A **Sub-contractor** is person or corporate body who has a contract with the contractor to carry out a part of the work in the contract, which includes work on the site.

Temporary works are works designed, constructed, installed and removed by the contractor which are needed for construction or installation of the works.

A **Variation** is an instruction given by the Engineer which varies the works.

The **Works** are what the contract requires the contractor to construct, install and hand over to the Employer.

2.0 Interpretation :

2.1 In interpreting these conditions of contract, singular also means plural, male also means female and vice versa. Headings and cross-reference between clauses have no significance. Words have their normal meaning under the language of the contract unless specifically defined.

2.2 If sectional completion is specified in the contract data, references in the conditions of contract to the works, the completion date, and the Intended Completion Date apply to any Section of the Works. (other than references to the completion date and intended completion date for the whole of the works)

3.0 Language and law :

3.1 The language of the contract and the law-governing contract are stated in the contract data.

4.0 Engineer's decisions :

4.1 The Engineer is to decide contractual matters between the Employer and the Contractor fairly and impartially.

5.0 Delegation :

5.1 The Engineer may delegate any of his duties and responsibilities to other people after notifying the contractor and may cancel any delegation after notifying the contractor.

6.0 Communication :

6.1 Communications between parties which are referred to in the conditions are effective only when in writing.

7.0 Sub-Contracting :

7.1 The contractor shall not subcontract the whole works. Except where otherwise provided by the contract, the contractor shall not subcontract any part of the works without the prior consent of the engineer.

8.0 Other Contractors :

8.1 The contractor is to cooperate and share the site with other contractors, Public authorities, utilities, and the Employer as per requirements of the Employer. He is also to provide facilities and services for them as per Engineer's directives.

9.0 Personnel :

9.1 The contractor is to employ the key personnel to carry out the functions stated in the Scope of works or other personnel approved by the Engineer. The person so appointed shall be duly authorised to receive instructions from the Engineer and carry out the instructions issued.

10.0 If the Engineer asks the contractor to remove a person who is a member of his staff or his work force and states his reasons the contractor is to ensure that the person leaves the site immediately and has no further connection with the work in the contract.

11.0 Contractor's risks :

11.1 All risks of loss of or damage to physical property and of personal injury and death which arise during and in consequence of the performance of the contract are the responsibility of the contractor.

12. ESCALATION:

It is a fixed rate contract.

13.0 Indemnities :

13.1 The contractor indemnifies the Employer against claims for damage caused by the movement of his equipment or temporary works outside the site.

14.0 Site Investigation report : Deleted

15.0 Queries about the Contract data :

The Engineer is to give instructions clarifying queries about the Contract data.

16.0 Contractor to construct the works :

16.1 The contractor is to construct the works in accordance with the specification and drawings.

17.0 The works to be completed by the intended completion date :

17.1 The contractor may begin the works on the start date and is to carry out the works in accordance with the program submitted by him, as updated with the approval of the Engineer, and complete them by the intended completion date.

18.0 Approval of the contractor's temporary works :

18.1 The contractor is to submit drawings and specifications showing his proposed temporary works to the Engineer, who shall to approve them if they comply with the contract data.

18.2 The contractor is responsible for design of temporary works.

18.3 The Engineer's approval does not alter the contractor's responsibility for his design of the temporary works.

18.4 The contractor is to obtain approval of third parties to his design of the temporary works where required.

19.0 Safety :

19.1 The contractor is responsible for the safety of all activities on the site.

20.0 Special Applications

Deleted.

21.0 Possession of the site :

21.1 The Employer is to give possession of all parts of the site to the contractor. Possession of site may be given in parts and the contractor is required to take such delay, if any, in his account.

22.0 Access to the site :

22.1 The contractor is to allow the Engineer and any person authorised by the Engineer access to the site and to any place where work in connection with the contract is being carried out or is intended to be carried out.

23.0 Instructions :

23.1 The contractor shall carry out all instructions of the Engineer, which comply with the law of the country in which the site is located.

24.0 Procedure for disputes :

24.1 If any dispute or difference of any kind what so ever shall arise between the Employer and the contractor or the Engineer and the contractor in connection with or arising out of the contract, or the execution of the works, whether during the progress of the works or after their completion and whether before or after the termination, abandonment or breach of the contract, it shall in the first palace, be referred to and settled by the

engineer who shall, within a period of ninety days after being requested by either party to do so, give written notice of his decision to the Employer and the contractor subject to arbitration, as hereinafter provided, such decision in respect of every matter so referred shall be final and binding upon by the Employer and by the contractor and shall forthwith be given effect to by the Employer and by the contractor, who shall proceed with the execution of the works with all due diligence whether he or the Employer requires arbitration, as hereinafter provided, or not. If the engineer has given written notice of his decision to the Employer or the contractor within a period of ninety days from receipt of such notice, the said decision shall remain final and binding upon the Employer and the contractor. It the engineer shall fail to give notice of his decision, as aforesaid within a period of ninety days after being requested as aforesaid, or if either the Employer or the contractor be dissatisfied with any such decision, then and in any such case either the employer or the contractor may within ninety days after receiving notice of such decision within ninety days after the expiration of the first named period of ninety days as the case may be require that the matter or matters in dispute be referred to arbitration as hereinafter provided all disputes or differences in respect of which the decision if any of the Engineer has not become final and binding as aforesaid shall be finally settled under the Indian Arbitration Act 1996 or any statutory modification or enactment thereof and the rules made there under and for the time being in force shall apply to the arbitration proceedings under this clause. Such arbitration shall be settled by two arbitrators, one to be appointed by each party to the dispute and the arbitrators shall before taking upon themselves the burden of reference appoint an umpire. If, the arbitrators can not agree on the appointment of the umpire, the umpire shall be appointed by Chairman-cum-Managing Director, HSCC. The arbitration shall take place at Noida unless both parties agree otherwise neither party shall be limited in the proceedings. Before such arbitrator/s to the evidence or arguments put before the Engineer for the purpose of obtaining his said decision no decision given by the Engineer in accordance with the foregoing provisions shall disqualify him from being called as a witness and giving evidence before the arbitrator/s on any matter whatsoever relevant the dispute or difference referred to the arbitrator/s as aforesaid. The reference to arbitration may proceed notwithstanding that the works shall not then be or be alleged to be complete provided always that the obligations of the Employer the Engineer and the contractor shall not be altered by reason of the arbitration being conducted during the progress of the works.

Time Control

25.0 Programme :

25.1 The Contractor shall submit to the Engineer for his approval a programme showing the general methods, arrangements order, and timing for all the activities in the works, within one week of getting the letter of commencement.

25.2 The Engineer's approval of the program does not alter the Contractor's obligations.

26.0 Extension of the intended completion date :

26.1 Extension of completion time shall be considered & may be granted by the Engineer based on merit of the case which is required to be submitted by the Contractor along with full justifications & supporting documents for the reasons of delay not attributable to the Contractor. However the rates shall be firm & binding during the extended period of completion. No extra payment/compensation for extended stay shall be permissible.

27.0 Acceleration : Deleted

28.0 Delays ordered by the Engineer :

28.1 The Engineer may instruct the Contractor to delay the start of progress or any activity within the works. However no compensation on any account for such delay shall be payable to the Contractor.

29.0 Management Meetings :

29.1 Either the Engineer or the Contractor may require the other to attend a management meeting. The business of a management meeting is to review the plans for remaining work and to deal with matters raised in accordance with the early warning procedure.

29.2 The Engineer is to record the business of management meetings and is to provide copies of his record to those attending the meeting and to the Employer. The responsibility of the parties for actions to be taken is to be decided by the Engineer either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.

30.0 Early warning : Deleted

31.0 Identifying defects :

31.1 The Engineer is to check the Contractor's work and to notify the Contractor of any

defects, which he finds. Such checking does not affect the Contractor's responsibilities. The Engineer may instruct the Contractor to search for a Defect and to uncover at test any work, which he considers may have a Defect.

32.2 Tests :

32.1 If the Engineer instructs the Contractor to carry out test not specified in the specification to check whether any work has a Defect and the test shows that it does, the Contractor is to pay for the test and its samples. If there is no defect the test is compensation event.

33.0 Correction of defects :

33.1 The Engineer is to give notice to the Contractor of Defects of which he is aware before the end of the Defects Notice Period, which begins at Completion.

33.2 Every time notice of a Defect is given, a Defect Correction Period for the notified defect beings. The Contractor is to correct the notified defect within the Defects Correction Period. The length of the Defects Correction Period is stated in the Contract Data.

33.3 The Contractor is to correct defects which he notice himself before the end of the Defects Notice Period.

33.4 The Engineer is to certify that all Defects have best corrected when all known Defects have been corrected. If the Engineer considers that correction of a Defect is not essential he can request the Contractor to submit a quotation for the corresponding reduction to the Contract Price or an earlier Intended Completion Date or both. If the Engineer accepts the quotation the corresponding change in the contract Data is Variation.

34.0 Uncorrected defects after completion date :

34.1 After Completion the Engineer may arrange for a third party to correct a Defect if the contractor has not corrected it within the Defects Correction Period.

34.2 The Engineer is to give the Contractor at least 28 days notice of his intention to use a third party to correct a Defect. If the Contractor does not correct the Defects himself within this notice period, the Engineer may have the Defect corrected by the third party. The cost of the correction will be deducted from the Contract Price.

35.0 Bill of Quantities :

35.1 The Bill of Quantities is to contain items for the construction of Renovation of OT & Maternity Ward & miscellaneous works to be done by the Contractor.

35.2 The Bill of Quantities is used to calculate the Contract Price. The Contractor is paid for the quantity of the work done at the rate in the Bill of Quantities for each item.

36.0 Changes in the quantities :

36.1 The quoted rates for all the items shall be firm, fixed and binding on the contractor irrespective of any variation of quantities stated in the contract.

37.0 Variations:-

All variations are to be included in updated programs produced by the Contractor.

38.0 Payments for variations :

38.1 The Contractor is to forecast the cost effect of a proposed variation on the Contract Price and provide the Engineer with a quotation for carrying out the variation when requested to do so by the Engineer before the variation is ordered by him.

38.2 If the Contractor's quotation is unreasonable, the Engineer orders the variation and make a change to the contractor's price which is based on his own, forecast of the effects of the variation on the Contractor's costs and which shall be binding on the contractor.

39.0 Cash flow forecasts :

39.1 The Contractor shall provide cash flow forecast at the start of work to the engineer.

40.0 Payment certificates :

40.1 The Contractor shall submit to the Engineer weekly statements of the estimated value of the work completed less the cumulative amount certified previously.

40.2 The Engineer shall check the Contractor's weekly statement and certify the amount to be paid to the Contractor.

40.3 The value of work completed is determined by the Engineer.

40.4 The value of work completed comprises the value of the quantities of the items in the Bill of Quantities completed and brought to the site of work.

40.5 The value to work completed includes the valuation of Variation and deductions for retention.

40.6 The Engineer may exclude any item certified in a previous certificate or reduce the proportion of any item previously certified in any certificate in the light of later information.

41.0 Payments :

a) The Contractor shall be paid on the certification of the Engineer, the amount due to him.

b) Retention Money at the rate of 10% (ten percent) shall be deducted from each interim certificate subject to a maximum of 5% (five percent) of the contract price.

c) Payment upon each of the Engineer's certificates shall be made by the HSCC (India) Ltd. acting for and on behalf of Employer within 30 days after such certificate has been issued by the Engineer.

However, 75% of the estimated amount as determined by the Engineer of the payment due against the monthly running bill shall be paid within 10 (Ten) working days after submission of the bill by the contractor in the approved format and complete in all respects.

d) The Engineer may at any time make any corrections or modifications to any certificate, which shall have been issued by him and shall have power to withhold any certificate if the Works or any part thereof are not being carried out to his satisfaction.

e) The responsibility for making the payments or meeting other obligations to the Contractor in respect of all Works as certified by the Engineer shall be that of the Employer and not of the Engineer.

f) After completion of work and prior to final payment, the contractor shall furnish to the engineer, a release of claim against the Employer arising out of contract, other than claims specifically identified, evaluated and excepted from the operation of the release by the contractor.

42.0 Taxation

The contractor and his staff shall pay all taxes, duties, levies, etc. of the Government provisions of the Income-Tax Act or as per the advice of the Income Tax Authority, Labour Cess as per labour regulation act. Deduction of Income-Tax, VAT, / other taxes shall be made from each certificate of payment as per the relevant provisions of the Income Tax Act or as per the advice of the Income Tax authority/ other competent authority.

43.0 Subsequent Legislation Deleted

44.0 Retention :

44.1 The Employer is to retain from each payment due to the contractor the proportion stated in the Contract Data until completion of the whole of the works.

44.2 On completion of the whole of the works half the total amount retained is repaid to the contractor and half when the Defects Notice Period has passed and the Engineer has certified that all Defects notified by him to the Contractor before the end of this period have been corrected.

45.0 Liquidated damages :

45.1 The Contractor is to pay liquidated damages to the Employer at the rate per calendar

day stated in the Contract Data from each day that the completion date is later than the Intended Completion date. The Employer may deduct liquidated damaged from payments due to the contractor. Payment of liquidated damages does not affect the Contractor's liabilities.

45.2 If the Intended Completion Date is extended after liquidated damages have been paid, the Engineer is to correct any overpayment of liquidated damages by the contractor by adjusting the next payment certificate. The Contractor is to be paid interest on the overpayment, calculated from the date of payment to the date of repayment.

46.0 Advance payment :

46.1 Advance is not payable.

47.0 Securities :

47.1 The performance securities are to be provided to the Employer by the start date and are to be issued in a form and by a bank or bondsman acceptable to the Employer, and denominated in the types and proportions of the currencies in which the Contract Price is payable.

47.2 If there is no reason to call the performance security, the performance security is to be returned by the Employer within 14 days of the last defects correction period.

47.3 The Employer is to notify the contractor of any claim made against the institution issuing the security.

47.4 The Employer may claim against the surety if any of the following occurs for 42 days or more ;

a) the contractor is in breach of the Contract and the Employer has notified him that he is; and

b) the Contractor has not paid an amount due to the Employer.

48.0 Day works :

48.1 The days works rates in the Contractor's bid are to be used for small additional amounts of work and only when the Engineer has given written instructions in advance for additional work to be paid for in that way.

48.2 All work to be paid for as Day works is to be recorded by the Contractor on forms approved by the Engineer. Each completed forms to be verified and signed by the Engineer within two calendar days of the work being done.

48.3 The contractor is paid for day works only when he has obtained signed day works forms.

49.0 Cost of repairs :

49.1 Loss or damage to the works or materials to be incorporated in the works between the

start date and the end of the Defects Correction is to be amended by the contractor at the contractor's cost if the loss of damage arises from the contractor's acts of omissions.

Finishing the Contract

50.0 Completion :

50.1 The Engineer is to issue a certificate certifying completion to the contractor and the Employer when he decides that the work is completed.

51.0 Taking over :

51.1 The Employer takes over the site and the works within a month of the Engineer issuing a certificate of completion.

52.0 Final account :

52.1 The contractor is to supply to the Engineer a detailed account of the total amount which he considers is payable to him under the contract before the end of the defects notice period. The Engineer is to certify any final payment which is due to the contractor within 30 days of receiving the contractor's account if it is correct and complete. If it is not, the Engineer is to issue a schedule which states the scope of the corrections or additions which are necessary. If the final account is still unsatisfactory after it has been resubmitted, the Engineer is to decide on the amount payable to the contractor.

53.0 DELETED

54.0 Termination :

54.1 The Employer or the Contractor may terminate the Contract if the other party causes a fundamental breach of the Contract which substantially deprives him of the principal benefits of the contract.

54.2 Fundamental breaches of contract include, but are not limited to :

a) the contractor stops work for 28 days when no stoppage of work is shown on the current program and the stoppage has not been authorised by the Engineer.

b) the Engineer instructs the Contractor to delay the progress of the works and the instruction is not withdrawn within 28 days;

c) the employer or the contractor is made bankrupt or goes into liquidation other than for a reconstruction or amalgamation;

d) a payment certified by the Engineer is not paid by the Employer to the Contractor within 84 days of the date of the Engineer 's certificate;

e) the Engineer gives Notice that failure to correct a particular defect is a fundamental breach of Contract and the Contractor fails to correct it within a

reasonable period of time determined by the Engineer; and

f) the contractor does not provide a security which is required.

54.3 When either party to the Contract gives notice of a breach of contract to the Engineer, the Engineer is to decide whether the breach is fundamental or not.

54.4 Notwithstanding the above, the Employer may terminate the Contract at his convenience.

54.5 If the contract is terminated the contractor is to stop work immediately, make the site safe and secure and leave the site as soon as reasonably possible.

55.0 Payment upon termination :

55.1 If the contract is terminated because of a fundamental breach of contract by the contractor, the Engineer is to issue a certificate for the value of the work done and materials ordered less advance payments received up to the date of the issue of the certificate and less the percentage of the value of the work not completed indicated in the contract data. Liquidated damages to not apply and the Employer has right to damages in respect of any delay incurred arising from the breach. If the total amount due to the Employer exceeds any payment due to the contractor the difference shall be a debt payable to the Employer.

55.2 If the contract is terminated at the Employer's convenience because of a fundamental breach of contract by the Employer, the Engineer is to issue a certificate for the value of the work done, materials ordered, the reasonable cost of removal of equipment, repatriation of the Contractor's personnel employed solely on the works, and the Contractor's costs of protecting and securing the works and less advance payments received up to the date of certificate.

56.0 Property :

56.1 All materials on the site, plant, and equipment owned by the contractor, temporary works and works are deemed to be the property of Employer and are at his disposal if the contract is terminated because of a fundamental breach of contract by the Contractor.

57.0 Frustration :

57.1 If the contract is frustrated by the out break of war or by any other event entirely outside the control of either the employer or the Contractor the Engineer is to certify that the Contract has been frustrated. The contractor is to make the site safe and stop work as quickly as possible after receiving this certificate and is to be paid for all work carried out before receiving it and for any work carried out after wards to which he was committed.

The following documents are also part of the contract :

* The Bid and letter of Acceptance
* The conditions of Contract
* The Technical Specifications
* The Drawings
* The Priced Bill of Quantities

The Contractor is to submit the program for the works within 7 days of being notified of the acceptance
of his bid.

The law which applies to the Contract is the law of the Union of India, that of Delhi High Court.

Arbitration procedure to be as per Arbitration and Reconciliation Act 1996. Court Jurisdiction New Delhi

Place where arbitration will take place: Noida

SPECIAL CONDITIONS OF CONTRACT

1. The quoted rates are deemed to include for all leads & lifts etc, and no claim on this account shall be entertained. When required by the engineer the work shall be carried out beyond office hours and at night and in such a case the contractor shall at his own cost make suitable arrangement for providing lighting etc. The quoted rates are deemed to include for all expenditures associated with overtime/night work.

2. The dimension given in the drawings are to be treated as approximate and indicative only. The contractor has to carry out the work as per actual site measurements.

3. Water & electricity shall be arranged by the Contractor at their cost or shall be supplied by Principal Employer if available, subject to recovery.

4. The BOQ, specification and other contract documents are jointly descriptive and supplementary to each other of the work involved. The items have been briefly described in the BOQ. However, the work shall be carried out as per detailed specifications and standards norms and practices followed for such type of works. The scope includes matters not specifically mentioned but required for proper completion of the work and no claim whatsoever shall be entertained on this account.

5. The contractor shall submit samples of the materials he proposes to use in the works for approval of the Engineer. Only approved material shall be used in the works. The approved samples shall be signed by the contractor and the engineer and retained in the office of the engineer for comparison.

6. The quantities indicated in the BOQ are tentative and may vary as per approved shop drawing. The contractor shall calculate the quantities of each item in accordance with approved shop drawing and get Engineer's approval for the same. The quantities of each item shall be as per this approved list. Payment shall be made as per quoted rates in BOQ.

ANNEXURE - A

FORM OF AGREEMENT

(On a stamp paper of appropriate value)

AGREEMENT

This Agreement made the _____ day of _____ 20_____ between National Institute of Unani Medicine (NIUM), Bangalore (hereinafter called "The Employer") represented by M/s HSCC (India) Ltd. who enters into this Agreement of the one part and M/s .... (hereinafter called "The Contractor") of the other part.

Whereas The Employer is desirous that certain Works should be executed by the Contractor, viz _____ ("the works") and has accepted a Bid amounting to Rs. _____ by the Contractor for the execution and completion of the Works and the remedying of any defects therein.

Now this Agreement witnesseth as follows :

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.

2. The following documents shall be deemed to form and be read and construed as part of this Agreement, viz :
   (a) The Letter of Award
   (b) The said Bid;
   (c) The General Conditions of Contract;
   (d) Instructions to tenderers and Specific Conditions of Contract;
   (e) The Specification;
   (f) The Drawings;
   (g) The Priced Bill of Quantities;
   (h) Any other relevant documents referred to in this Agreement or in the aforementioned documents;

3. In consideration of the payments to be made by the HSCC (I) Ltd. (HSCC) acting as Employer to the contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy any defects therein in conformity in all respects with the provisions of the Contract.

4. The Employer hereby covenants to pay the Contractor through HSCC in consideration of the execution and completion of the Works and the remedying of defects therein the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

In Witness whereof the parties hereto have caused this Agreement to be executed the day and year first before written.

Signed, Sealed, and Delivered by the Said _____
_____

Binding Signature of [NIUM] National Institute of Unani Medicine (NIUM), Bangalore.

Binding Signature of Contractor _____

In the presence of
Witness (1) :

Witness (2) :

ANNEXURE - B

APPENDIX TO TENDER

Important Clause	Clause No.	Remarks
Amount of performance security	27.1(Instruction to bidders)	5% of contract price.
Period of commencement from Engineer's order to commence		1 week.
Amount of Liquidated damages	45.1	0.5% (point five percent) of contract price per week of delay.
Limit of liquidated damages	45.0	10% of contract price
Defect Liability Period	27.1(Instruction to bidders)	6 months
Percentage of retention	44	10%
Limit of retention money	44	5% of the contract price.
Programme of work and progress reports	25.1	Programme updated quarterly, progress reported weekly.
Time of completion of work	1.3 (Instruction to bidders)	120 Calendar days for entire works.

ANNEXURE - C

PROFORMA FOR PERFORMANCE BANK GUARANTEE

(On a stamp paper of appropriate value from any Nationalised Bank or Scheduled Bank)

To,
M/s HSCC (India) Ltd.,
Plot No. 6(A), Block E, Sector 1,
NOIDA - 201 301.

Dear Sir,

In consideration of the National Institute of Unani Medicine (NIUM), Bangalore (hereinafter called Employer) which expression shall include his successor and assigns represented by his Consultant M/s. HSCC (I) Ltd., Plot - 6 (A), Block - E, Sector - I, Noida, Uttar Pradesh - 201 301 (hereinafter called HSCC) having awarded to M/s ._____ _____ (hereinafter referred to as the said Contractor or `Contractor' which expression shall wherever the subject or context so permits include its successors and assigns) a contract No _____ in terms inter alia, of the HSCC Letter No._____ dated _____ and the General Conditions of Contract and upon the condition of the contractor's furnishing security for the performance of the contractor's obligations and discharge of the contractor's liability under and in connection with the said contract upto a sum of Rs. _____ (Rupees _____only) amounting to _____ percent of the total contract value.

1. We,_____(hereinafter called `The Bank' which expression shall include its successors and assigns) having our branch office at _____ and registered /Head office at _____ a company registered under the Companies Act, 1956) hereby jointly and severally undertake to guarantee the payment to the Employer in rupees forthwith on demand in writing and without protest or demur or any and all moneys anywise payable by the contractor to the Employer under in respect of or in connection with the said contract inclusive of all the Employer's losses and damages and costs, (inclusive between attorney and client) charges and expenses and other moneys anywise payable in respect of the above as specified in any notice of demand made by the Employer to the Bank with reference to this guarantee upto an aggregate limit of Rs._____(Rupees _____ _____ only).

2. We_____Bank Ltd. further agree that The Employer shall be 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, cost, charges and expenses caused to or suffered by or that may be caused to or suffered by The Employer on account thereof and the decision of The Employer that the said Contractor has committed such breach or breaches and as to the amount or amounts of loss, damage, costs, charges and expenses caused to or suffered by The Employer from time to time shall be final and binding on us.
3. The Employer shall be at liberty without reference to the Bank and without affecting the full liability of the Bank hereunder to take any other security in respect of the Contractor's obligations and liabilities hereunder or to vary the contract or the work to be done thereunder vis-a-vis the Contractor or to grant time or indulgence to the Contractor or to reduce or to increase or otherwise vary the prices of the total contract value or to release or to forbear from enforcement of all or any of the security and/or any other security(ies) now or hereafter held by The Employer and no such dealing(s) reduction(s) increase(s) or other indulgence(s) or arrangements with the Contractor or release or forbearance whatsoever shall absolve the bank of the full liability to The Employer hereunder or prejudice the rights of The Employer against the bank.
4. This guarantee shall not be determined or affected by the liquidation or winding up, dissolution, or change of constitution or insolvency of the Contractor but shall in all respects and for all purposes be binding and operative until payment of all monies payable to The Employer in terms thereof.
5. The bank hereby waives all rights at any time inconsistent with the terms of this guarantee and the obligations of the Bank in terms hereof shall not be anywise affected or suspended by reason of any dispute or disputes having been raised by the Contractor stopping or preventing or purporting to stop or prevent any payment by the Bank to The Employer in terms hereof.
6. The amount stated in any notice of demand addressed by The Employer to the Bank as liable to be paid to The Employer by the Contractor or as suffered or incurred by The Employer on account of any losses or damages or costs, charges and/or expenses shall be conclusive evidence of the amount so liable to be paid to The Employer or suffered or incurred by The Employer as the case may be and shall be payable by the Bank to The Employer in terms hereof.
7. This guarantee shall be a continuing guarantee and shall remain valid and irrevocable for all claims of The Employer and liabilities of the contractor arising upto and until midnight of_____.

8. This guarantee shall be in addition to any other guarantee or security whatsoever that The Employer may now or at any time anywise may have in relation to the Contractor's obligations/or liabilities under and/or in connection with the said contract, and The Employer shall have full authority to have recourse to or enforce this security in preference to any other guarantee or security which The Employer may have or obtain and no forbearance on the part of The Employer in enforcing or requiring enforcement of any other security shall have the effect of releasing the Bank from its full liability hereunder.

9. It shall not be necessary for The Employer to proceed against the said Contractor before proceeding against the Bank and the Guarantee herein contained shall be enforceable against the Bank notwithstanding that any security which The Employer may have obtained or obtain from the contractor shall at the time when proceedings are taken against the said bank hereunder be outstanding or unrealised.

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

11. We_____the said Bank further that we shall pay forthwith the amount stated in the notice of demand notwithstanding any dispute/difference pending between the parties before the arbitrator and/or that any dispute is being referred to arbitration.

12. Notwithstanding anything contained herein above, our liability under this guarantee shall be restricted to Rs._____(Rupees_____) and this guarantee shall remain in force till_____ and unless a claim is made on us within 3 months from that date, that is before_____all the claims under this guarantee shall be forfeited and we shall be relieved of and discharged from our liabilities thereunder.

Dated_____day of_____20

For and on behalf of Bank.

Issued
under
seal :

TECHNICAL SPECIFICATIONS

1.0 CIVIL WORKS

1.01 The specifications and mode of measurements for Civil and Plumbing works shall be in accordance with C.P.W.D.specifications 1996 Volumes I to VI.

Unless otherwise specified in the nomenclature of individual item or in the specifications, the entire work shall be carried out as per the C.P.W.D. specifications with upto date correction slips upto the date of opening of tender.

1.02 For the item not covered under CPWD Specifications mentioned above, the work shall be executed as per latest relevant standards/codes published by B.I.S. (formerly ISI) inclusive of all amendments issued thereto or revision thereof, if any, upto the date of opening of tenders.

1.03 In case of B.I.S. (formerly I.S.I) codes/specifications are not available, the decision of the Engineer based on acceptable sound engineering practice and local usage shall be final and binding on the contractor.

1.04 However, in the event of any discrepancy in the description of any item as given in the schedule of quantities or specifications appended with the tender and the specifications relating to the relevant item as per CPWD specifications mentioned above, or in drawings the former shall prevail.

1.05 The work shall be carried out in accordance with the architectural, structural, plumbing and electrical drawings etc. The drawings shall have to be properly co-related before executing the work. In case of any difference noticed between the drawings, final decision, in writing of the Engineer shall be obtained by the contractor. For items, where so required, samples shall be prepared before starting the particular items of work for prior approval of the Engineer and nothing extra shall be payable on this account.

1.06 All materials to be used on works shall bear I.S. certification mark unless specifically permitted otherwise in writing. In case I.S. marked materials are not available (not produced) , the materials used shall conform to I.S. code or CPWD specifications as applicable in this contract.

In such cases the Engineer shall satisfy himself about the quality of such materials and give his approval in writing. Only articles classified as "First Quality" by the manufacturers shall be used unless otherwise specified. All materials shall be tested as per provisions of the Mandatory Tests in CPWD specifications and the relevant IS specifications. The Engineer may relax the condition regarding testing if the quantity of materials required for the work is small. Proper proof of procurement of materials from authentic manufacturers shall be provided by the contractor to the satisfaction of Engineer. Grade of cement used shall be 43 /53 unless otherwise specified explicitly. Reinforcement Steel used shall be of FE-415 unless otherwise specified.

1.07 In respect of the work of the sub-agencies deployed for doing work of electrification, air-conditioning, external services, other building work, horticulture work, etc. for this project and any other agencies simultaneously executing other works, the contractor shall afford necessary coordination and facilities for the same. The contractor shall leave such

necessary holes, openings, etc. for laying / burrying in the work pipes, cables, conduits, clamps, boxes and hooks for fan clamps, etc. as may be required for the electric, sanitary air-conditioning, fire fighting, PA system, telephone system, C.C.T.V. system, etc. and nothing extra over the agreement rates shall be paid for the same.

1.08 Unless otherwise specified in the bill of quantities, the rates for all items of work shall be considered as inclusive of pumping out or bailing out water if required for which no extra payment will be made. This will include water encountered from any source such as rains, floods, subsoil water table being high or due to any other cause whatsoever.

1.09 Any cement slurry added over base surface (or) for continuation of concreting for bond is added its cost is deemed to have in built in the item unless otherwise / explicitly stated and nothing extra shall be payable or extra cement considered with consumption on this account.

1.10 The rate for all items in which the use of cement is involved is inclusive of charges for curing.

1.11 The contractor shall clear the site thoroughly of all scaffolding materials and rubbish etc. left out of his work and dress the site around the building to the satisfaction of the Engineer before the work is considered as complete.

1.12 Rates for plastering work (excluding washed grit finish on external wall surfaces) shall include for making grooves, bands etc. wherever required and nothing extra shall be paid for the same.

1.13 The rates quoted for all brick/concrete work shall be deemed to include making openings and making good these with the same specifications as shown in drawings and/or as directed. No extra payment shall be made to the contractor on this account.

1.14 Rates for all concrete/plaster work shall include for making drip course moulding, grooves etc. wherever required and nothing extra shall be paid for the same.

1.15 Rates for flooring work shall include for laying the flooring in strips / simple designs wherever required and nothing extra shall be paid for the same.

1.16 The quoted rate shall be for finished items and shall be complete in all respects including the cost of all materials, labour, tools & plants, machinery etc., all taxes, duties, levies, octroi, royalty charges, statutory levies etc. applicable from time to time and any other item required but not mentioned here involved in the operations described above. The client/HSCC/Employer shall not be supplying any material, labour, plant etc. unless explicitly mentioned so.

2.0 ELECTRICAL WORKS

2.1 The electrical Installation work shall be carried out in accordance with Indian Standard Code of Practice for Electrical Wiring Installation IS: 732-1989 and IS: 2274-1963. It shall also be in conformity with the current Indian Electricity rules and regulations and requirements of the Local Electricity Supply Authority and Fire Insurance regulations, so far as these become applicable to the installation. Electrical work in general shall be carried out as per following CPWD Specifications with upto date amendment.

- Specifications for Electrical Works Part-I (Internal) by CPWD – 1994 or latest revision
- Specifications for Electrical Works Part-II (External) by CPWD – 1994 or latest revision
- Specifications for Electrical Works Part-III (Lift & escalators) by CPWD - 2003 or latest revision
- Specifications for Electrical Works Part-IV (Substation) by CPWD – 1994 or latest revision

Wherever these specifications calls for a higher standard of material and or workmanship than those required by any of the above mentions regulations and specification then the specification here under shall take precedence over the said regulations and standards.

2.2 The scope of work includes testing & commissioning of all electrical installations, obtaining approvals from Chief Electrical Inspectors, Local Electricity Supply Authority, Pollution Control Board and any other statutory authorities required for the completion of electrical works.

DETAILED SPECIFICATIONS

SYSTEM DESIGN DATA

1.0 GENERAL

The system design, basis of design, estimated requirements and other relevant data are outlined in this section.

2.0 LOCATION

The proposed OT work is coming up at NIUM , Bangluru.

3.0 SCOPE OF WORK

3.1 The work proposed under this tender includes supply, installation, testing & commissioning of independent central air-conditioning systems for the proposed hospital as detailed in the technical specifications and schedule of prices.

4.0 BASIS OF DESIGN

4.1 **Assumptions**

Following assumptions have been made for calculation of air-conditioning cooling load:

a)	Fresh air	:	As per attached Table
b)	Window glazing	:	Single pane glass
c)	Lighting load	:	2W/ Sq. ft
d)	Occupancy	:	As per attached table
e)	Equipment load	:	As per attached Table
f)	Electrical power supply:		415v/3ph/50Hz, AC power supply
g)	Humidity control	:	1) Considered in OT's only.

4.2 **OUTSIDE AMBIENT CONDITIONS**

Season	Dry Bulb temp	Wet Bulb temp.

SUMMER:	96 deg F DB	78 deg F WB
MONSOON	82 deg F DB	78 deg F WB
WINTER:	58 deg F DB	

4.3 **INSIDE CONDITIONS**

INSIDE DESIGN CONSITIONS					
S.No	Area/ Room	Design temp	Relative Humidity	Min total air change per hour	Minimum fresh air changes per hour
Surgery & critical care					
1	Operating rooms	22±1	50±5%	25	5
2	Sterile corridor	22±1	30-60%	6	2
Balance areas		22±1	30-60%	6	2

5.0 ESTIMATED LOAD

On the basis of data given above, the estimated load for the air conditioning system is summarised in Table-I:-

TABLE-I

SPACE	**AREA**	**Occupancy**	**EQUIPMENT LOAD**	**DEHUMIDIFIED**	**AC LOAD**
	SQFT	**NOS**	**(WATT)**	**CFM**	**(TR)**
OT	325	8	6000	2500	6.5
Ante Room	97	1	0	193	0.5
Total	**429**	**9**	**6000**	**2693**	**6.5**

(Tenderers shall work out the heat loads on their own and satisfy themselves that the plant specified in this tender shall be able to maintain the inside conditions as per specification)

To cater to the above load, the air conditioning system proposed is as follows:

6.0 System Design

The total load works out to be 7 TR. For this requirement 1 set 7 TR DX system is proposed.

System Design Description

6.1 It is proposed to provide a DX air conditioning system to maintain the specified inside design conditions during summer & monsoon for the proposed area.

6.2 The DX coil AHU shall be located in AHU room on terrace and outdoor unit shall be located on terrace.

6.3 Electric type heater shall be provided for provision for winter/ monsoon heating.

6.4 The main electrical panel, distribution board will be located in the plant room.

6.5 For fire safety motorised fire dampers with electrical actuators interlocked with the air blowers shall be provided in supply and return air paths. All materials used for insulation shall be fire proof type. The air handling units motors shall also be interlocked with the central fire alarm system such that in case of detection of smoke or fire by the fire alarm system, the air handling units shall automatically shut off.

6.6 A central control console shall be provided with indication lamps and push buttons for remote start/stop of the equipment.

6.7 The system adopted for the air-conditioning of OTs shall be:

OPERATION THEATRES

- The operation theatres shall have independent air handling unit to prevent cross contamination.
- The OT shall be designed for re-circulatory system with 5 air changes fresh air.
- The laminar flow air distribution system shall be followed. Air shall be supplied from ceiling level to flow unidirectionally up to the operation table. The return air shall be collected from four corners of the room to prevent the contamination from recirculation in space.
- Both supply and return air shall be ducted.
- Three level filteration shall be adopted with pre filters, fine filters and HEPA filters of following filteration efficiency :

Hepa Filters	99.97% down to o.3 μ
Fine Filters	99% down to 5 μ
Pre Filters	90% down to 10 μ

All these filters shall be with aluminium frame to prevent formation of bacterial colonies. Epoxy resin shall be used to seal filter media with the framework.

OT shall be maintained at positive pressure by supplying about 15% more air than return air to prevent any contamination from entering OT space.

- AHU with hepa filters shall be designed for high static pressure to over come high pressure drops

7.0 GENERAL DESIGN GUIDELINES

Design parameters for selection of air handling units and its components shall be: -

Maximum face velocity across pre filters	150M/MIN
Maximum face velocity across Microvee	100M/MIN
Maximum face velocity across cooling coil	150 M/MIN
Maximum face velocity across Heating coil	200 M/MIN
Maximum fan outlet velocity	600 M/MIN
Maximum fan motor speed	1450 RPM

Design parameters for duct design shall be :-

Maximum flow velocity	450M/MIN
Maximum friction	1CM WG/100M
Maximum velocity at supply air outlet	150 M/MIN

8.0 Items to be provided by other Agencies to AC contractor:

8.1 Civil works such as trenches for piping, cables and making foundations of equipments.

8.2 Construction of AC plant rooms, AHU rooms etc.

8.3 Main 3 ph, 415 v, 50 hz, A.C. supply power supply upto main Electrical Distribution Panel in A/C plant room.

8.4 Drain trap in plant room and AHU rooms.

8.5 Any kind of false ceiling, boxing etc and insulation of boxing in non AC areas.

8.6 Making frames for fixing grilles & diffusers in false ceiling, boxing or in walls.

9.0 Drawings:

The drawings forming part of these specifications provide a feasible scheme for locating the equipment. The contractor may re-arrange the equipment for improving the layout and meeting the site conditions. All such changes shall however be subject to the architect's approval. These drawings are not meant to be working drawings which shall be prepared by the contractor or as required.

10.0 Test Data:

The complete HVAC system shall be tested as per the specifications given elsewhere and complete test data shall be furnished on prescribed data sheets:

11.0 Technical Data:

The contractor shall furnish complete technical data, on the equipment offered as required under the heading `Technical data'. In this specification every effort has been taken to put forth only general specifications of various equipments/ material. If inadvertently, any of the specification drawn happens to match with the specifications of any one particular firm's product only, in respect of critical parameters, than it will not automatically mean that this particular firm's offer is only technically suitable. In general, the specifications offered by other firms will be assessed in their own entirety to ascertain whether or not the broad functions in general expected of the requirements are available with reasonable tolerance on the desired requirements of the client and accordingly the offers would be considered based on prudent assessment and sole discretion of the Engineer.

12.0 Performance Guarantee:

12.1 The contractor shall guarantee that the air-conditioning plant and system shall maintain the desired inside temperature within +/- 2 % tolerance.

12.2 The contractor shall guarantee that the capacity of various components as well as the whole system shall not be less than specified.

12.3 The contractor shall ensure that the system shall be free of vibrations and disturbing sounds.

13.0 Foreign Exchange

The contractor shall make his own arrangements to procure the necessary, specified equipments, controls for which no foreign exchange shall be made available.

Air cooled Package Type DX Units

1. Scope:

The section sets out the general requirements for factory built or assembled Air cooled condenser type Package DX Units complete with safety controls, instruments electrical installation including installation testing and commissioning

2. Components of Machines:

Each Air cooled Package DX unit shall be complete with hermetic type compressor/s, Indoor Unit, Outdoor Unit, compressor motor, interconnecting refrigerant piping of required size from indoor to outdoor unit with necessary valves, strainers ,thermal insulation etc, refrigerant controls and accessories, gauge panel, motor starters, and electrical controls, safety controls and devices and first charge of refrigerant, oil etc.

3. Compressor:

Compressor shall be multi cylinder semi hermetic/hermetic type complete with drive and motor, dynamically balanced removable cylinder sleeves, oil return check valves suction and oil strainers, discharge and suction shut-off valves, site glass etc .Compressor and motor assembly shall be installed on a spring mounted floating platform to provide quite vibration less operation. Compressor shall be provided with overload protection switches etc.

The compressor shall be enclosed in a hermetically sealed casing and shall be suitable for R-22 Refrigerant.

4. Outdoor Unit (Air cooled Condenser)

The air cooled condenser coil shall be of heavy gauge suitable copper tubes with aluminium fins and condenser shall be so designed to give the required capacity for the specified peak ambient conditions. Suitable axial flow heavy duty condenser Fans for low speed quite operation shall be selected. The condenser Fan shall be suitable for 415 V/3Ph/AC supply. The casing shall be fabricated from galvanized steel, zinc phosphated and finished with baked enamel paint. The casing shall make the whole unit weather proof suitable for outdoor installation. The unit shall include a remote control assembly with thermostat and starting and speed switches. The necessary charge of refrigerant gas and lubricated oil shall be provided to run the system.

5. Indoor Unit (Double skin Air Handling unit)

The Indoor Unit/air handling units shall be double skin fully enclosed construction, draw-thru type and shall include pre filter section, fan section, coil section, Microvee(fine) and hepa Filter sections, and humidifier section etc with necessary vapour arrangement. The AHU shall be two tier type with the fine and hepa filter sections in the upper tier.

5.1 Fan Section

Fan shall be centrifugal non over loading type with backward curved blades. Fan casing shall be made of galvanised steel sheet. Fan wheels shall be made of galvanised steel. Fan shaft shall be ground C40 carbon steel or superior and supported in pre-greased ball bearings operating less than 75% of first critical speed. Fan wheels and pulleys shall be individually tested and precision balanced dynamically. The fan shall be selected for a fan speed not exceeding 1000 rpm for fan dia of more than 350 mm .The fan outlet shall be connected with casing with the help of fire retardant canvas.

5.2 Coil Section

The cooling coil shall be of seamless copper tubes, the internal and outer dia of the cooling coil shall be as per the standards of the approved makes with aluminium fins firmly bonded to copper tubes assembled in zinc coated steel frame. Face and surface areas shall be such as to ensure rated capacity from each unit and such that the air velocity across the coil shall not exceed 500FPM. The coil shall be pitched in the unit casing for proper drainage. The fins shall be spaced by collars forming integral part of the fins. The tubes shall be staggered in the direction of air flow.

The fins shall be uniformly bonded to the tubes by hydraulic mechanical expansion of the tubes. Fin spacing shall not exceed 5fins per cm. The coiling coil assembly shall be on aluminium rails and nylon rollers for easy with drawl from either side.

5.3 Pre filter

Each unit shall be provided with a factory assembled filter sections containing washable synthetic type air filters. Filter framework shall be duly sealed and constructed from aluminium alloy. The media shall be supported with HDP mesh on one side and aluminium frame mesh on other side. Filters face velocity shall not exceed 500 FPM. Filters shall fit so as to prevent by pass. Holding frames shall be provided for installing a number of filters cells in bank. These cells shall be held within the frames by sliding the cells between guiding channels.

5.4 Humidifier Section

A separate humidifier section shall be provided in the AHU in the lower tier. Pan humidifier shall be placed outside the AHU & within the AHU room & steam shall be supplied in the humidifier section.

5.5 Housing/ Casing

The housing /casing of the air handling unit shall be of double skin panels, sandwitched type with polyurethane foam insulation of 50 mm thickness (overall). The housing shall be so made that it can be delivered at site in the total/ semi knock down conditions

depending upon the location. The frame work shall be of extruded aluminium hollow section duly powder coat painted/ anodized. The entire frame shall be assembled using mechanical joints to make a sturdy & strong frame work for various sections.

The outer sheet of panel shall be of made of galvanised pre-plasticised sheet/powder coated CRC sheet of 0.80 mm thickness, and inner sheet of 0.63 mm thick GSS. These Frame work for each section shall be bolted together with soft rubber gasket in between to make the joints air tight, suitable doors with chrome plated hinges and latches shall be provided for access to various panels for maintenance. The entire housing shall be mounted on steel channel frame work. Units shall have hinged, quick operating access door in the fan section etc. The access doors shall also be double skin type similar to the casing.

The special (Microvee) filters shall be housed in a separate AHU upper tier casing of suitable size & length.

The enclosure shall be sized to accommodate the standard microvee filter. The inspection doors shall have double synthetic rubber seals doors & locking arrangements. The gaps between filter frames & housing shall have synthetic rubber packing to eliminate any air leakage. All filter frames & metallic parts shall be made of Aluminium. The microvee filter sections shall have provision for fixing a portable inclined manometer for taking filter pressure drop readings.

Drain pan shall be constructed of 2 mm thick SS304 with necessary slope to facilitate fast removal of condensate. It shall be isolated from the bottom floor panels through 12 mm thick kinny foam insulation or equivalent.

5.6 Fan Motor and Starter

The totally enclosed fan cooled squirrel cage fan motor shall have a minimum rating as given under "Schedule of Equipments and the starter rating shall match the motor rating and both control panel shall conform to the specifications under "Motors and Switchgears". Drive to fan shall be provided through belt-drive arrangement. Belts shall be of oil resistant type.

5.7 Controls

Each air handling unit shall be provided with a modulating valve motor and modulating thermostat, conforming to specifications under "Controls".

5.8 Accessories

Each air handling unit shall be complete with: -

Thermostat at coil inlet and outlet with dispay on microprocessor base contropanel of the system.

Pressure gauges at inlet and outlet of the coil.

Drain line from unit to drain trap.

Flexible connection between fan outlet and duct.

Vibration isolators of high efficiency.

6.0 Refrigerant System

The air conditioning units shall be complete with pre-charged refrigerant line including fittings, valves and thermostatic expansion valve. Automatic resetting type low and High Pressure cut outs shall be provided to safe guard the unit against abnormal operation.

7.0 Control, Instrumentation and Accessories

Each unit shall be equipped with but not restricted to the following:

Crankcase heaters

High –low cut outs

Safe guard against short cycling of compressor

Insulated drain piping

Compressor and Fan motor starters with bi-metallic overload relays with resetting.

Isolation valves for air cooled condensers in refrigerant lines

Expansion Valves

Vibration isolation Pads below the units

Double canvass connection b/w indoor unit and starting ducts

A snap acting type fixed differential double throw type air thermostat shall be provided to start and stop the compressor depending upon the air conditioned space requirements in addition to a manually operated switch. The thermostat shall be able to be adjusted from 18 deg C to 26deg C with an increment of minimum 0.5deg C

All the moving parts in the units shall be mounted in the steel frame work with the help of suitable vibration isolators in order to ensure quite operation of the unit

8.0 Microvee filters (fine filters)

Microvee filters shall be of dry type. Filters media shall be made from washable non woven synthetic fibre replaceable media reinforced with HDPE cloth & Aluminium mesh, specially treated with antifungal and bactericidal agents to prevent growth of micro organisms. The filter media shall be treated to permit washing with water several times before discharged. The media shall be properly supported and spaced so that air flow through the filter is uniform. The filter shall be housed in aluminium frame work. Filters shall be designed to remove particle down to 5 micron size and with efficiently of 98.0 percent tested as per BS 2831 using Test Dust II. The filters shall be installed in the air handling units after the chilled water coils. They shall be capable of being replaced or removed for servicing without the use of special tools.

9.0 High efficiency Particulate Absolute (HEPA) filters

HEPA filters shall be made in extended surface configuration of deep space folds of sub micron glass fibres. The filter media shall be housed in an aluminium sheet frame provided with double turned flanges and closed cell neoprene gasket. The filter media shall not absorb moisture, stretch, swell or undergo chemical change with moisture. The

filter shall be resistant to fungus and bacterial growth. Filters shall be free from pin holes and other leaks.

The housing shall be designed to install the Hepa filters in the terminal locations in the false ceiling or in the duct plenum so that it is removed easily without risking the infilteration of dust whatsoever. The arrangement for filters shall be strictly in accordance with the manufacturers recommendations and shall be approved by the Engineer prior to fabrication and installation. The filters shall be protected with aluminium slotted protective grille from the bottom in case of installation of filters in false ceiling air terminals. All M.S. parts shall be de rusted and shall be epoxy painted. The Aluminium grilles shall be made from 1.6 mm aluminium sheets with minimum clear area of 60 percent. The grilles shall be anodised stove enamel painted as approved by the Engineer

9.0 Refrigerant Piping:

The indoor and outdoor unit shall be interconnected by suitable type seamless copper refrigerant liquid and suction lines using flared or brazed fittings. Necessary accessories shall be incorporated in the circuit for safe and trouble free operations.

10.0 Limitations:

The air velocity across the cooling coil shall not exceed 500 FPM.

The fan outlet velocity shall not exceed 1800 FPM.

The air velocity across the filters shall not exceed 500 fpm.

HEATING & REHEATING SYSTEM

1. **General:**

The electric heating system and hot water heating system shall comply with the specifications as laid down.

2. **Electric Heaters:**

2.1 The heaters shall be enclosed type with external fins for heat radiation.

2.2 The heating element shall be of superior grade Nichrome wire of required resistance for the specified capacity.

2.3 The heating element shall be enclosed in aluminium sheet casing with suitable insulator blocks to prevent grounding.

2.4 The aluminium casing shall have aluminium fins spaced at least 4 inches. The fins should have a snug tight fit over the casing.

2.5 The heater terminals shall be secured at one end through insulated connectors.

2.6 The individual heater shall be secured at one end through insulated connectors.

2.7 The heater shall be supplied in sets of 3 heaters, for balanced loading of 3 phase and neutral supply.

3. **Heater Frames:**

Each bank of heaters shall be mounted on aluminium angle frame work of suitable size and length to suit the heaters.

4. **Contactors:**

Each bank or banks of heaters shall be controlled through a contactor of ample rating and having a 220 volt holding coil. The contractor shall be indication lamps etc. as specified. The heaters shall be interlocked electrically with the fan so that these are shut off in the event of fans break down.

5. **Heating Thermostats:**

Each group of heaters shall be controlled by one single stage for pre heater and one two stage snap acting heating thermostat for re heaters.

6. **Humidistat:**

There shall be one snap acting dehumidifying humidistat in parallel with the single stage heating thermostat. They shall be used for re heater control in monsoon.

7. **Safety Thermostat**:

Each group of heaters in a unit shall be provided with a heating safety thermostat having manual reset.

8. **Controls:**

The safety thermostat and other controls shall be interlocked with the motor and shall be as specified under controls.

9.0 **Hot Water Generator**

9.1 Hot water generator shall be the electric water heater consisting of a vertical tubular shell, closed to both the ends with bolted end covers. The shell shall be fabricated from M.S. sheet and joints shall be welded. It shall be mounted on a rigid chain iron tripod stand. A drain shall be provided at the lower and outlet and inlet connections with flanges shall be on upper end lower sited. Connections for safety wall and controls shall be provided on the top. A required no. of sockets for heater elements shall be provided at 120 deg. Angle. The construction shall conform to the Indian standards/international standards. It shall be designed for a working pressure of 21 Kg/cm2 and tested accordingly.

9.2 Sheathed tabular electric resistance type heater elements shall be used and connected for equal loading.

9.3 The heater shall be connected in a manner to provide capacity control as under:

Upto 100 KW	- 2 Steps
101 KW to 300 KW	- 3 Steps
301 KW to 600 KW	- 4 Steps

Upto 2 sets, a remote bulb 2 step thermostat shall be used in conjunction with contactors of same size and fire 3 or more steps. A modulating type thermostat, modulation motor and step controller shall be used.

9.4 The electric water heater shall be equipped with a safety thermostat to cut off the power in case the temperature of water exceeds the normal limits. A safety valve shall be provided on the top of the heater and the outlet of the same be piped out of the plant room. The drain shall be connected to the nearest drain point. Stem type thermometer & pressure gauge at inlet & outlet of the boiler shall be provided.

9.5 The elctric heater shall be insulated with 50 mm thick resin bonded fibre glass or equivalent material. The thermal conductivity of the insulating material shall not exceed 0.03 Kcal. per m/hr. at 10 deg. C mean temperature and density shall not be less than 24 Kg/Cum for fibre glass and 48 Kg/Cum for mineral wool. The insulation shall be cladded with 1 mm thick aluminium sheet.

9.6 The electric hot water heater shall be installed as per the manufacturer's instruction and as shown on drawings.

Pan Type Humidifier

Type:

The pan type humidifier shall be closed type and connected to the supply air duct for introduction of steam when required.

Construction

The body of the humidifier shall be fabricated out of stainless steel sheet at least 2mm thick with all joints welded with stainless steel welding rods and all edges rounded off. The pan shall be made completely air tight and leak proof. On top of the pan an openable cover shall be provided for maintenance of internal components.

The humidifier shall be externally insulated with Resin bonded fibreglass of density not less than 32 Kg/cub.m and then cladded with 0.8 mm thick aluminium sheet.

The humidifier shall have two chambers with two banks of heaters. One bank of heaters shall always remain ON when the AHU is in operation to maintain the temperature of water between 60 - 70 deg. C and the other bank should come on when there is signal from the humidistat for humidification.

The electric heaters shall be submersible type made out of incloy sheeth and brass/bronze flanges. The heaters shall be of suitable rating to produce instant steam when required.

Electrical panel (Pan Type Humidifier)

The electrical panel box shall be made of 16 GCRC sheet and painted with heat and water resistant paint. All switchgears and internal components of the panel shall be of L&T/Seimens/EE make only.

Controls and accessories:

The humidifier shall be complete with following controls and accessories:

a. Water proof light in the tank
b. Water level indicator
c. Low water level cut off switch
d. Float valve with bronze ball
e. Make up, quick fill and drain connections
f. Safety thermostats.
g. Fault indication lamp.

VENTILATION FANS

1. **General:**

The ventilation fans shall be complete in all respects and shall generally comply with the following specifications given below:

2. **Exhaust Fans:**

2.1 The exhaust fans shall be propeller type with steel hub and blades, mounted directly on the shaft of a totally enclosed motor.

2.2 The fan blades shall be of pressed steel of aerofoil design for high efficiency and static pressure.

2.3 The mounting frame shall be of cast/sheet steel with steel brackets to connect the frame, with the fan/motor assembly. Rubber mounts shall be provided between the mounting frame and the mounting brackets.

2.4 The fan motor shall be to totally enclosed squirrel cage type.

3. **Centrifugal Blowers:**

3.1 The centrifugal blowers shall be double/single inlet, double/single width, non-overloading type, of suitable construction. The blower performance must be rated in accordance with approved test codes and procedures.

3.2 The blower housing comprising of scroll & side plates shall be accurately cut, heavy gauge all welded sectional construction and reinforced with angle bracings. Outlets shall be flanged to assure proper duct connections. Inlet cones shall be spun venturi type or curved vane type to ensure smooth air entry. The base frame shall be of angle iron in bolted/welded construction.

3.3 Impeller shall be fabricated from sheet steel with backward curved, properly designed blades, heavy c.i. hub and shall be both dynamically and statically balanced, to a close tolerance for quiet and vibration free performance.

3.4 Shaft shall be of hot rolled steel or forged steel, sized adequately, but in no case less than 40 mm dia-meter and shall be accurately ground and polished to a close tolerance.

3.5 Bearings shall be self aligning, heavy duty ball or tapered roller type with integral dust and grease seals.

3.6 After assembly, the complete fan shall be painted with rust proof primer and two coats of synthetic enamel paint.

3.7 Fan having wheel diameter of 1220 mm or more, shall be supplied with split, bolted housing for convenience of handling and installation.

4. **Blower Drive Assembly:**

4.1 Drive assembly for each blower shall consist of blower pulley, motor pulley, a set of `V' belts, belt guards, and belt tension adjusting device.

4.2 Pulleys shall be selected to provide the required speed. They shall be multi-grove type, with section and grooves selected to transmit 33% more load than the required power and shall be statically balanced.

4.3 The belt guards shall be of m.s. sheet with angle iron reinforcement and expanded metal screen.

5. **Exhaust Blowers (Fan Section of AHU)**

5.1 The exhaust fans (fan section of AHU) shall be as described in under AHU.

6. **Motors and Starters:**

6.1 The motor for each blower shall be squirrel cage induction type and conform to specifications as given under section on control panel, motors and switchgear. The motor h.p. shall be at lease 20% more than the limit load of fan and of minimum rating as given under `Schedule of Equipments'.

7. **Limitation:**

The air velocity limits are as follows:

7.1 Velocity at blower outlet shall not exceed 12.5 mps.

8.0 AXIAL FLOW FANS

i) Casing shall be constructed of heavy gauge sheet steel. Casing shall be provided with hinged door enabling easy replacement of wheel, shaft and bearings. A small inspection door with handle and neoprene gasket shall also be provided. Casing shall have flanged connection on both ends for ducted applications. Support brackets for ceiling suspension shall be welded to the casing for connection to hanger bolts. Straightening vanes shall be aerodynamically designed for maximum efficiency by converting velocity pressure to static pressure potential and minimizing turbulence. Casing shall be de-rusted, cleaned, primed and finish coated with enamel paint.

ii) Rotor hub and blades shall be of cast aluminium, or cast steel construction. Blades shall be die-formed aerofoil shaped for maximum efficiency and shall vary in twist and width from hub to tip to effect equal air distribution along the blade length. Fan blade mounting on the hub shall be statically and dynamically balanced. Extended grease leads for external lubrication shall be provided. The fan pitch control maybe manually readjustable at site, upon installation, for obtaining actual airflow values, as specified.

iii) Motor shall be of 3 phase squirrel-cage totally enclosed, fan cooled type. Motor and starter shall be in accordance with para 6.6. (V) and 13.9. The speed of fan shall not exceed 1000 RPM for fans with impeller diameter above 450 mm, and 1450 RPM for fans with impeller diameter of 450 mm and less.

iv) Drive to fan shall be provided through belt drive with adjustable motor sheaves and belt guard or direct driven . Belt shall be oil resistant type.

MOTOR STARTERS CONTROL PANELS

1. **General:**

The motors and switchgears required for various items shall generally be as per specifications given below. All electric motors shall be suitable for 3 phases, 50 cycles 415 volts a.c. supply.

2. **Control Panel:**

2.1 These panels should be floor/wall mounted, sheet steel clad, modular construction, cubicle design, compartmentalised .These panels shall comprise of incoming & outgoing feeders (circuit breakers, fuse switch units/switch fuse units, contactor starters with overload relays, single phasing preventor etc. as indicated in the drawings.

2.2 The panels shall be provided wherever necessary with necessary interlocks designed to prevent incorrect operation and to ensure safety of operating personnel and equipment.

2.3 All feeders are to be operated from the front and they shall be interlocked suitably. Padlocking arrangement and interlock defeating device shall also be provided. Each module shall have separate door and partition plate. The feedre incomer switches shall be interlocking with the door so that the door can only by opened when switch is in `off' position. The doors and covers shall be provided with thick gaskets to make it dust tight. All the door covers shall be provided with synthetic rubber gaskets to make it dust tight. Feeder name tags shall be provided.

2.4 **Air Circuit Breaker and Fuse Switch Units**

The circuit breaker shall be air break fully draw out type equipped with arc chutes and their face barriers of proper design. The continuous current rating of the circuit breakers shall be as given in the detailed technical specifications. The circuit breakers shall have a breaking capacity of 31 mva at 415 volts, 50 hz ac & they shall be able to withstand full fault current for one second.

2.5 The circuit breaker shall be provided with manually operated spring closing mechanism. The operating mechanism shall be trip-free throughout the breaker travel. The breaker shall be equipped with inside `on' & `off' position indicator mechanism and so located that the position of the circuit breaker i.e. whether closed or open, is indicated on the front door of the compartment. The `on' & `off' trip indicating lights shall also be provided for each breaker feeder.

2.6 The moving portion of the circuit breaker shall be so interlocked that it is not possible to isolate it and draw out from the service position or to plug it in from the isolated position when the circuit breaker is closed. The interlock being provided shall be such as to prevent operation of a circuit breaker unless it is fully plugged in or fully isolated and is locked correctly in either of the two positions.

2.7 The circuit breaker compartment doors shall be so interlocked as to prevent access to the breaker while in the plugged in position. However special means shall be provided for undoing this interlocked in an emergency.

2.8 The draw out feature shall clearly provided three distinct positions of the circuit breaker viz., `service', `test' & isolated. Inadvertent withdrawal of a circuit breaker removable unit too for beyond its supports shall be prevented by a suitably interlock, the design shall provide for the testing of breaker in the test positions i.e. when the breaker's moving unit is in fully disconnected position and the secondary circuit remains connected or energised. The secondary connections between the fixed and removable units shall be provided with means of spring loaded sliding type contacts to make the breaker fully draw out type.

2.9 The circuit breaker unit shall be provided with complete range of releases including the overload releases and release for short circuit protection.

2.10 The circuit breaker shall be provided with necessary auxiliary contacts with 2 No. spare contacts. All contacts shall be wires up to the terminal board.

2.11 The fuse switch unit shall be of load break heavy duty, industrial design and of double break pattern with quick make and quick break mechanism, however, the design shall be such that it shall ensure positive opening even if quick break action is lost due to spring stretchening or breaking.

2.12 The `on' and `off' position of the switch handle shall be distinctly indicated and inter locks shall be provided to ensure that switch cover can not be opened unless the switch is in the `off' position.

2.13 The fuse switch units shall be provided with non-deteriorating type of hrc cartride fuse link and having rupturing capacity not less than 31 mva at 415 volts.

2.14 All alive parts inside switch shall be properly shrouded and interphase barriers shall be provided. Design of the switch handles shall be such that they do not protrude out of the panel in the manner so as to prevent free passage of operating personnel. Design with normal conventional position of switch handle up in `on' position & down in `off' position shall be preferred.

2.15 **415 Volts Bus Bars**

2.15.1 The 415 volts main bus-bar shall have continuous current rating as indicated in the specification or equivalent standard rating of at least 50 percent of these of the phase bus bars. The bar and its connections shall be so arranged and supported as to withstand without any damage or deformation, the specific shortcircuit current. The bus bars shall be braced and supported on reinforced fibre glass support and shall be of electrolytic grade type E 91e of IS:5082. These bus bars shall withstand 43.12 ka for one second during short circuit conditions. The bus bars shall be colour coded with pvc tapes or insulating painting for identification purposes. The bus bars shall be sleeved with special type heat shrinkable pvc sleeving.

2.15.2 Bus supports shall be resistant low absorption type moulded insulation of high impact strength and high creepage surface.

2.15.3 All bus work shall be braced to withstand without damage a short circuit current of 43.12 ka symmetrical for one second.

2.16 **Instruments and Meters**

2.16.1 Current transformer shall comply with the requirements of is:2705. They shall have ratio outputs and accuracies as specified or required as shown in single line diagram.

2.16.2 All indicating instruments shall be of industrial pattern and should be provided as shown in the single line diagram.

2.16.3 All instruments shall be switch board type flush mounted with proper scale dimensions so as to be clearly visible to the operators standing on the floor. The instruments shall be provided with front of board zero adjuster shall be not preferably be mounted at heights lower than one meter and higher than two meters above the floor level.

2.16.4 The operating handles, meters, instruments etc. shall be mounted at the front of the switch board. Approved means shall be provided for locking the control switch/operating handles in the open position. For fuse switch gear section of the switch board, meters where specifications shall be mounted in such a manner that it is possible to readily identify the meters for individual units and the arrangements does not create hindrance to maintenance of individual units without having to shut down the bus.

2.16.5 All wires carried within the switch gear enclosure shall be pvc insulated and shall be neatly arranged to be readily accessible and to facilitate easy replacement. Only pvc copper cables shall be used for all power and control inter connections. The cables of 660 volts shall be used. Trained copper cables lugs shall be used. All small wires shall be colour coded and provided with numbered ferrules for easy identification of circuits. As for as possible, each essential circuit shall be connected within the respective switch gear unit. Control wiring terminal shall preferably be near the panel.

3. **Cable Termination:**

3.1 The cables entries and terminals shall be provided in the switch board to suit the number, type and size of aluminium conductor cables as given in the line diagram. Cable entries shall be so designed as to avoid damage to cables and there shall be sufficient space to avoid short bending of cables. The positions of the cable lugs and terminals shall be such that the cable could be neatly drawn and connected through one meter deep trench below the switch gear and the jointing carried out in a convenient and satisfactory manner. The cable entry, design panel, cable boxes and terminals and their locations will have to be approved by the engineer/owner. However the access for cabling shall preferably be from the back of the switch board. The panels shall be provided with control transformers of suitable va rating along with control bus and hr fuses from control supply to contractors.

3.2 The cables socket shall be of copper and of crimping type. Cables risers shall be adequately supported to withstand the effects of rated short circuit current without damage.

3.3 Cable glands of sizes as required shall be provided at all cable entry paints in the bottom plate. The glands shall form part of switch board.

4. **Indication:**

Each incoming and outgoing feeder units shall be provided with `on' `off' indicating lamps of standard conventional colour coding.

5. **Subsidiary Panels:**

Subsidiary panels shall be provided wherever required such as ahu room, air washer room. The construction of these panels should be similar to the main panel and shall have all related accessories.

6. **Contactor Starters:**

6.1 **Star Delta Starter**

The star delta starter shall be air break automatic contactor starter provided with main contactor, star contactor, delta contactor, timer and automatic change over from start to delta, bimetallic over load relay, operating coil, start/stop push button, single phasing preventor, auxiliary make and break contacts, indicating lamps etc. The contactor shall quick make, quick break, double break consisting of robust silver contacts. The coil voltage shall be 415 volts ac at 50 hz. The starter shall be provided with trip indication light and overload reset push button for overload relay.

6.2 **DOL Contactor Starter**

The contactor shall be air break type coil operate, dol contractor starter, provides with cables entries, ambient temperature compensated bimetallic over load relay, single phasing preventor, solenoid coil, start and stop push buttons, 8 auxiliary make and break contacts, indicating lamps etc. The contactors shall be quick make quick make and quick break, double break type consisting of robust silver contacts. The coil voltage shall be 440 volts at 50 c/s. The starter shall be provide with trip indication light and over load reset bush button for overload relay.

7. **Squirrel Cage Induction Motors:**

7.1 The motor shall be of well tried out and design and of reputed make. The motors provided on the equipment shall conform to is:325 in general. The motors shall be squirrel cage indication motors rated for continuous operation at 415 volts, 3 phase, 50 hz a.c. supply. The motor for various equipments shall have the following enclosure level.

(a) Cooling tower & exhaust blower - IP:55(tefc)

(b) Compressor and A.H.U. motor-IP:55(tefc).

(c) Pumps ip:55 (tefc/ spdp).

7.2 The horse power and speed of the motor shall match that of driven equipment and the motor shall be suitable for star delta starting or direct on line starting with class `3' insulation. The

motors of 7.5 HP and above 7.5 HP shall be suitable for star delta starting and below 7.5 HP suitable for dol starting. The compressor motor shall be provided with automatic star delta starter

DUCT WORK AND OUTLETS

1. **General:**

1.1 The work under this part shall consist of furnishing labour materials, equipment and appliances as specified necessary and required to install all sheet metal and other allied work to make the air conditioning supply, ventilating, exhaust system ready for operation as per drawings.

1.2 Except as otherwise specified all duct work and related items shall be in accordance with these specifications.

1.3 Duct work shall mean all ducts, casings, dampers, access doors, joints, stiffeners and hangers.

Duct materials

2.1 The ducts shall be fabricated from galvanized steel sheets class VIII GSS sheets conforming to IS:277-1962 (revised) or aluminium sheets conforming to IS:737-1955(with latest amendments) (wherever aluminium ducts are specified).

2.2 All duct work, sheet metal thickness and fabrication unless otherwise directed, shall strictly meet requirements, as described in IS: 655-1963 with amendment-i (1971 edition)

The thickness of the sheet shall be as follows: -

	size of duct	**sheet thickness**		**type of joints**	**bracing if any**
		GI	**Aluminium**		
2.2.1	Upto 750mm	0.63 mm	0.80 mm	GI flange	
2.2.2	751 mm to 1000 mm	0.80 mm	1.00 mm	25x25x3 mm Angle iron Frame With 8 mm dia.nuts & bolts.	25x25x3 mm at the rate of 1
2.2.3	1001 mm to 1500 mm	0.80 mm	1.00 mm	40x40x5 mm angle iron frame with 8 mm dia. Nuts & bolts.	40x40x3mm at the rate of 1
2.2.4	1501 mm to 2250 mm	1.00 mm	1.50 mm	50x50x5 mm angle iron to be cross braced diagonally with 10 mmdia nuts & bolts at 125	40x40x3mm at the rate of 1.2

				mm centre.	
2.2.5	2251 mm and above	1.25 mm	1.80 mm	50x50x6 mm angle iron frame with 10 mm nuts & bolts at 125 mm centre.	40x40x3 mm at the rate of 1.6

2.3 The gauges, joints and bracings for sheet metal duct work shall further conform with the provisions as shown on the drawings.

2.4 Ducts larger than 450 mm shall be cross broken, duct sections upto 12 00 mm length may be used with bracing angles omitted.

2.5 Changes in section of duct work shall be affected by tapering the ducts with as long a taper as possible. All branches shall be taken off at not more than 45 deg. Angle from the axis of the main duct unless otherwise approved by the engineer-in-charge.

2.6 All ducts shall be supported from the ceiling/slab by means of m.s.rods of 9 mm (3/8") dia with m.s. angle at the bottom.

3. **Installations**

3.1 During the construction, the contractor shall temporarily close duct openings with sheet metal covers to prevent debris entering ducts and to maintain opening straight and square, as per direction of engineer-in-charge.

3.2 Great care should be taken ensure that the duct work does not extend outside and beyond height limits as noted on the drawings.

3.3 All duct work shall be of high quality approved galvanized sheet steel guaranteed not to crack or peel on bending or fabrication of ducts. all joints shall be tight and shall be made in the direction of air flow.

The ducts shall be re-inforced where necessary, and must be secured in place so as to avoid vibration of the duct on its support.

3.4 All air turns of 45 degrees or more shall include curved metal blades or vanes arranged so as to permit the air to make the abdrupt turns without an appreciable turbulence. turning vanes shall be securely fastened to prevent noise or vibration. All ducts shall be fabricated and installed in accordance with modern design practice.the sheet metal gauges and fabrication procedures as given in i.s.s specifications shall be adhered to and shall be considered as an integral part of these specifications.

3.5 The duct work shall be varied in shape and position to fit actual conditions at building. All changes shall be in accordance with accepted airconditioning duct design and subject to the approval of the engineer-in-charge. The contractor shall verify all measurements at building and shall notify the engineer-in-charge of any difficulty in carrying out his work before fabrication.

3.6 Sponge rubber of approved equal gaskets shall be installed between duct flanges as well as between all connections of sheet metal ducts to walls, floor columns, heater casings and filter casings. sheet metal connections shall be made to walls and floors by means of galvanized steel angles anchored to the building structure with anchor bolts and with the sheet bolted to the angles. sheet metal connections shall be as shown in the drawings or as directed by engineer-in-charge.

3.7 The ducts shall be supported from the structure by means of suitable supports grouted in the r.c.c. work. The type of support should meet the approval of the engineer-in-charge and should involve minimum damage or breakage. In no case the duct will be rested upon the flase ceiling/boxing or on supports grouted in the wall.

3.8 Flanges and supports are to be black, mild steel and are to be primer coated on all surfaces before erection and painted with aluminium thereafter. accessories such as damper blades and access panels are to be of materials of appropriate thickness and the finish similar to the adjacent ducting as specified.

3.9 Joints, seams, sleeves, splitters, branches, takeoffs and supports are to be as per duct details as specified, or as decided by engineer-in-charge.

3.10 Joints requiring bolting or rivetting may be fixed by hexagon nuts and bolts, stove bolts or buck bolts, rivets or closed centre top rivets or spot welding. Self tapping screws must not be used. all fixing must have a permanently non-corrosive finish such as cadmium plating or galvanizing as appropriate. Spot welds and bronze welds are to be coated on all surfaces with zinc rich paint, as approved by engineer-in-charge.

3.11 The flexible joints are to be fitted to the suction and delivery of all fans. The material is to be normally double heavy canvass or as directed by engineer-in- charge. On all circular spigots the flexible materials are to be screwed or clipband with adjustable screws or toggle fitting. For rectangular ducts the material is to be flanged and bolted with a backing flat or bolted to mating flange with backing flat.

3.12 The flexible joints are to be notless than 75 mm and not more than 250 mm between faces.

3.13 The duct work should be carried out in a manner and at such time as not to hinder or delay the work of the other agencies especially the boxing or false ceiling contractors.

4. **Dampers**

4.1 At the junction of each branch duct with main duct and split of main duct, volume dampers must be provided. Dampers shall be two gauges heavier than gauge of the large duct, and shall be rigid in construction to the passage of air.

4.2 The volume dampers shall be of an approved type, lever operated and complete with locking devices which will permit the dampers to be adjusted and locked in any positions.

4.3 The dampers shall be of splitter, butterfly or louver type. the damper blade shall not be less than 1.25 mm (18) gauge, reinforced with 25 mm angles 3 mm thick along any unsupported side longer than 250 mm angles shall not interface with the operation of dampers, nor cause any turbulence.

4.4 Automatic and manual volume opposed blade dampers shall be complete with frames and bronze bearings as per drawings. Dampers and frames shall be constructed of 1.5 mm steel and blades shall not be over 225 mm wide. The dampers for fresh air inlet shall additionally be provided with fly mesh screen, on the outside, of 0.8 mm thickness with fine mesh spacking.

4.5 Wherever required for system balancing, provide a volume balancing opposed blade damper with quadrant and thumb screw lock. provide damper rod and damper block with upset screws.

4.6 After completion of the duct work, dampers are to be adjusted and set to deliver the required amounts of air as specified on the drawings.

4.7 **Motorised Combined Smoke & Fire dampers:**

The fire dampers shall be provided at all supply and return air ducts at AHU room crossings and at all floor crossings or wherever shown on the drawings. The fire & smoke dampers shall be of atleast 90 minutes fire rating certified by CBRI, Roorkee as per UL 555 : 1973. Fire damper blade & outer frame shall be formed of 1.6 mm galvanized sheet steel. The damper blade shall be in pivoted on both ends using chrome plated spindles in self lubricated bronze bushes. Stop seals will be provided on top & bottom of the damper housing made of 16 G galvanized sheet steel. For preventing smoke leakage side seals will be provided. In normal position damper blade shall be held in open position with the help of a 24 V operated electric actuators thereby providing maximum air passage without creating any noise or chatter. The damper shall be actuated through electric actuator. The actuator shall be energised with the help of a signal from smoke detector installed in AHU room. Smoke detector shall be provided by the A/C contractor. The fire

damper shall also close due to temperature rise in SA ducts thruogh the electric temperature sensor factory set at 165 deg F micro switches with bakelite base will be provided to stop fan motor and give open & close signal at remote panel in case of motorised actuator.

Each fire dampers shall have its own panel which will incorporate necessary circuit required to step down voltage available from power supply to shown status of the damper (open or close), to allow remote testing of damper & indication in event of damper closure due to signal from smoke sensor/ temperature sensor & reset button. Additional terminal will be provided to have signal (sound beep or visual) in Central Control Room

Damper actuator shall be spring return Belimo make so as to close the damper in the event of power failure automatically and open the same in case of power being restored. Spring return action of the actuator shall be an in built mechanism and not mount externally.

The fire damper shall be mounted in fire rated wall with a duct sleeve 600 mm long. The sleeve shall be factory fitted on fire damper. The joints at sleeve end shall be slip on type. Minimum thickness of GI sheet shall be 18 G.

5. **Access panel**

5.1 A hinged and gasketed access panel shall be provided on duct work before each reheat coil and at each control device that may be located inside the duct worl.

6. **Miscellaneous**

6.1 All ducts above 450 mm are to be cross broken to provide rigidity to the ducts.

6.2 All duct work joints are to be true right angle or approaching with all sharp edges removed.

6.3 Sponge rubber gaskets also to be provided behind the flange of all grilles.

6.4 Each shoot from the duct, leading to a grille, shall be provided with an air deflector to divert the air into the grille through the shoot.

6.5 Inspection doors measuring at least 450 mm x 450 mm are to beprovided in each system at an appropriate location, as directed by engineer-in-charge.

6.6 Diverting vanes must be provided at the bends exceeding 600 mm and at branches connected into the main duct without a neck.

6.7 Proper hangers and supports should be provided to hold the duct rigidly, to keep them straight and to avoid vibrations additional supports are to be provided where required for rigidity or as directed by engineer-in-charge.

6.8 The ducts should be routed directly with a minimum of directional change.

6.9 The duct work shall be provided with addtional supports/hangers, wherever required or as directed by the engineer-in-charge, at no extra cost.

6.10 All duct supports, flanges, hangers and damper boxes etc. shall be given 2 coats of red oxide paint before installation and one coat of aluminium paint after the erection, at no extra cost.

6.11 All angle iron flanges to be welded electrically and holes to be drilled.

6.12 All the angle iron flanges to be connected to the gss ducts by rivets at 100 mm centres.

6.13 All the flanged joints, to have a 4 mm thick felt packing stack to the flanges with shellac varnish. the holes in the felt packing are to be burnt through.

6.14 The g.s.s. ducts should be lapped 6 mm across the flanges.

6.15 The ducts should be supported by approved type supports at a distance not exceeding 2.4 metres.

6.16 Sheet metal connection pieces, partitions and plenums required, shall be constructed of 1.25 (18 gauge) sheet throughtly stiffened with 25 mm x 25 mm angle iron braces and fitted with access doors.

7. **Grilles**

7.1 The supply and return air grilles shall be fabricated from aluminium extruded sections and the supply air grilles shall have single louvers and the return air grille shall have single horizontal extruded section fixed louvers the grilles may or may not be with an outer frame.

7.2 The grilles shall have opposed blade dampers of m.s. black sheets, which shall be key operated from the grille face wherever required.

7.3 The damper blades shall be of 1.00 mm (18 gauge) m.s. black sheets and shaped to form air tight joints the frame work for dampers shall be fabricated from 1.00 mm (18 gauge) m.s. black sheet the grill flange shall be fabricated out of 25 x 25 x1.5 mm aluminium angle grilles longer than 450 mm shall have intermediate supports for the horizontal louvers.

7.4 **Linear Grille**

The linear grille shall be of 1.25 mm (18 G) aluminium extruded section with flush mounted with single louvers for air flow direction adjutment.

8. **Diffusers**

8.1 The ceiling type round or square diffusers shall be of 1.25 mm (18 gauge) aluminium extruded sections with flush or step down face, as specified with fixed pattern and round neck.

8.2 The diffusers shall be die formed for proper air diffusion.

8.3 All supply diffusers shall be provided with m.s. sheet dampers, with knurled knobs for adjustment from the bottom.

9. **Laminar flow diffusers**

9.1 The laminar flow diffusers shall be fabricated from aluminium sheets supported in a framework.

9.2 The diffuser shall be fabricated from aluminium sheet of 1.25 mm thickness double folded and pressed with mechanical perforations of suitable size and at suitable spacing to provide the rated air quantity.

9.3 The framework shall be fabricated from 25 * 25 * 3 mm aluminium angle.

9.4 The dampers shall be fabricated from 1.25 mm aluminium sheet and shaped to from airtight joints. The damper shall be key operated from the face of the diffuser.

10. **Painting**

10.1 All grilles, and diffusers shall be anodised or powder coated, as required, before installation.

10.2 All ducts immediately behind the grilles/diffusers etc. are to be given two coats of black paint in matt finish.

10.3 All grilles, diffusers & registers shall be provided with rubber gasket between flanges and the wall or ceiling.

11. **Testing**

11.1 After completion, all duct system shall be tested for air leakage.

11.2 The entire air distribution system shall be balanced to supply the air quantity as required in various areas and the final balance of air quantity through each outlet shall be submitted to the engineer-in-charge for approval.

Insulation

1. General

The Insulation of water piping, air handling units, ducting, chillers etc., shall be carried out as per specifications given below:

2. Materials

The materials to be used for insulation shall be as follows, unless some other material is specifically mentioned elsewhere. The detailed specifications of the materials are listed under respective sub heads.

2.1	Pipe Insulation Option 1:		Rigid Polyurethene Foam (PUF)
2.2	Pipe Insulation Option 2:		Expanded Polystyrene (EP)
2.3	Drain Pipe Insulation	:	Polyethylene Foam (Kinney Foam)
2.4	Duct Insulation	:	Crossed linked polyethylene
2.5	Acoustic Treatment	:	Non Woven polyester fiber material/Glass wool
2.6	Equipment Insulation	:	Expanded Polystyrene (SE) (EP).

3. Pipe Insulation

3.1 (Option-I)

3.1.1 The insulation for chilled water and drain piping, chillers, pump etc. shall be carried out from rigid polyurethene foam having a 'K' value of 0.018 W/mK. At mean temperature of 10°C and a density of 27.2 to 39.9 kgs/cubm. The material shall be factory faced on one side with aluminium foil on the outside, reinforced with kraft paper and fused to the insulation material. The aluminium foil shall be extended by a minimum of 50 mm on one side of the pipe section along the length to seal all longitudinal joints.

3.1.2 The thickness of the insulation for chilled water pipes shall be 30 MM.

3.1.3 Preformed pipe sections shall be used for pipes upto and including 350 mm dia.

3.1.4 Pipes above 350 mm dia. shall be insulated with insulation slabs cut in mitred sections.

3.2 (Option-II)

3.2.1 The insulation for chilled water piping shall be carried out with pipe section made of expanded polystrene foam having a 'K' Value of 0.035 W/mK at a mean temperature of 10°C and a density not less than 20 Kg./Cubm. The material shall be of self extinguishing quality.

3.2.2 The thickness of the insulation for chilled water pipes shall be 50 mm upto 300 mm dia. and 75 mm beyond 350 mm dia.

3.2.3 Preformed pipe sections shall be used for pipes upto and including 350 mm dia.

3.2.4 Pipes above 350 MM dia shall be insulated with insulation slabs cut in mitered section.

3.3 **Drain Pipe Insulation**

3.3.1 The material for insulation of drain pipes shall be pipe section of closed cell elastomeric insulation/nitrite rubber having a 'K' valve of 0.027 W/mK at a mean temperature of 10°C and a minimum density of 55 Kg./cubm.

3.3.2 The thickness of insulation shall be a section of 6 mm thick.

3.4 **Duct Insulation**

3.4.1 The materials for duct insulation shall be fire retardant crossed linked polyethylene, conforming to I.S. 8183 of 1976. The density of insulation shall not be less than 24 kg./cubm. And material shall be in the from of blankets/rolls of uniform thickness. The 'K' value at 10°C. Shall not be less than 0.03 W/mK. It shall be factory faced with aluminium foil on one side reinforced with kraft paper and fused to the insulation material.

3.4.2 The thickness of duct insulation shall be as follows:

Duct in conditioned space - 10 mm thick

Duct in unconditioned space - 15 mm thick

Duct with treated fresh air - 20 mm thick with UV protection

3.5 **Acoustic Treatment**

3.5.1 The material for acoustic treatment of ducts, rooms, roofs etc. shall be non woven polyester Fiber material, as described earlier, conforming to I.S. 8183 of 1976. The density of material shall be 32 kg/cub.m and the material shall be in the form of rolls of uniform density. The 'k' value at 10^{O}C. shall not be less than 0.03 W/mK. Facing shall be provided with perforated aluminium sheet held with G.I. stick pins and washers.

3.6 **Equipment Insulation**

3.6.1 The complete shell of the chiller as well as its two heads, shall be factory insulated.

3.6.2 The insulation on chilled water pumps and expansion tank shall be of expanded polystyrene having a 'K' value of 0.035 W/mK at a mean temperature of 10°C and a density not less than 20 Kg/Cubm. The thickness of the insulation will be as given below :

I) Expansion tank - 50 mm
II) Chilled water pumps - 50 mm

4. **Installation**

4.1 **Chilled Water Piping (PUF)**

4.1.1 The pipe shall be throughly cleaned with a wire brush and rendered free from all rust and grease.

4.1.2 The pipes shall be with a coat of bituminous paint (tank Mastic-by shalimar painted tar products).

4.1.3 Two coats of hot bitumen shall be applied on the cleaned pipe surface (bitumen 85/40 or 80/25 in the ratio of 1.0 kg per sq.mtr. for each coat).

4.1.4 The preformed sections of insulation shall be fixed tightly to the surface taking care to seal all joints.

4.1.5 All joints along the circumference of the pipe sections shall be sealed with 50 mm wide aluminium faced adhesive tape.

4.1.6 Insulation on pipes in areas exposed to weather or underground shall not have aluminium foil facing but shall be covered with tar felt sheets manufactured by shalimar tar products (1935) Ltd. and fixed with G.I. Wires of 1.0 mm. The tar felt sheet shall be stuck with bitumen R 85/25.

4.1.7 Insulation on pipes and valves in plant room and AHU connections shall not have aluminium foil facing but shall be covered with 0.50 mm aluminium cladding.

4.2 **Chilled Water Piping (EP)**

4.2.1 The pipe shall be thoroughly cleaned with a wire brush and rendered free from all rust and grease.

4.2.2 The pipes shall be with a coat of bituminous paint (tank Mastic-by shalimar painted tar products).

4.2.3 Two coats of hot bitumen shall be applied on the cleaned pipe surface (bitumen 85/40 or 80/25 in the ratio of 1.0 kg per sq.mtr. for each coat).

4.2.4 The preformed sections of insulation shall be fixed tightly to the surface taking care to seal all joints.

4.2.5 The insulation shall be covered with chicken wire mesh of 24 Ga (0.63 mm) with space tacked to the insulation.

4.2.6 The insulation shall be finished with two layers of sand cement plaster of 6 mm thickness each in (1:4) ratio and troweled to a smooth round finish.

4.3 **Duct Insulation**

4.3.1 Clean the surface with a wire brush and make it free from rust and oil.

4.3.2 Apply two coats of cold adhesive compound to the surface.

4.3.3 Wrap the duct with insulation blankets of the thickness mentioned above.

4.3.4 The joints shall be sealed with 50 mm thick self adhesive aluminium tape before covering with wire netting.

4.3.5 The Ducts in areas exposed to the weather shall be additionally covered with one layer of tar felt B.H. The tar felt shall be stuck with bitumen R 85/40 or 80/25.

4.4 **Duct Acoustic Lining**

4.4.1 The duct surface shall first be cleaned from inside.

4.4.2 Then 25 mm square section made of 18 Ga (1.2 mm) thick G.I. sheet should be fixed on both ends of the duct piece.

4.4.3 The insulation slabs of 25 mm thickness shall be fixed between these sections with self adhesive stick pins.

4.4.4 The insulation shall the be covered with RP tissue, sealing all joints so that no fibre is visible.

4.4.5 The insulation shall then be covered with 0.5 mm perforated aluminium sheets and fixed to the stick pins.

4.5 **Insulation of Equipment**

4.5.1 The surface shall first be cleaned with wire brush.

4.5.2 Then two layers of hot 85/40 or 80/25 grade bitumen conforming to I.S. 702-1961 shall be applied.

4.5.3 The insulation shall be fixed in one layer and sealing all joints with hot bitumen.

4.5.4 The insulation shall then be covered with 0.63 mm/19 mm mesh wire netting which shall be fixed to the insulation with brass 'U' nails.

4.5.5 The final finish shall be 0.50 mm aluminium cladding.

4.6 **Room Acoustic**

4.6.1 Fix 40 mm x 50 mm G.I. channels at 0.5 MTR interval longitudinally then fix cross battens at1.0 MTR centre using suitable gutties, and brass screws.

4.6.2 Fill each rectangle with 50 mm glass wool and covered with RP tissue.

4.6.3 Tie with 24 gauge G.I. Wires at 300 mm intervals.

4.6.4 Then cover with 22 gauge (0.80 mm) perforated Aluminium sheet having 3 mm perforations at 6 mm centres. Overlap all joints and provide beading of 25 mm by 2 mm aluminium flats.

4.6.5 All corners joints shall be covered with 25 x 25 x 2 mm thick aluminium angles.

ELECTRIC WIRING

1. **General:**

The electric wiring of motors for compressors, pumps, air handling units etc. As well as controls, heaters etc. and earthing of all equipment shall be carried out as per specifications given hereunder.

2. **Power Cabling for Motors, Heaters etc:**

2.1 Unless otherwise specified, the power cables shall be PVC insulated, and PVC sheathed aluminium conductor, armoured cables to 1100 V grade conforming to IS 1554. The power cables shall be of 2 core for single phase, 4 core for sizes upto and including 25 sq.mm, 3-1/2 core for sizes higher than 25 sq.mm for 3 phase. Where high voltage equipments are to be fed, the cables shall be rated for continuous operation at the voltages to suit the same.

2.2 Power cables shall be of sizes as indicated in the tender specifications. In all other cases, the sizes shall be as approved by the Engineer-in-Charge, after taking into consideration the load, the length of cabling and the type of load.

2.3 Cables shall be laid in suitable metallic trays suspended from ceiling, or mounted on walls, or laid directly in ground or clamped on structures, as may be required. Cable ducts shall not be provided in plant rooms. Cable trays shall be fabricated from slotted angle/solid angles to make ladder type cable tray, designed with adequate dimensions for proper heat dissipation and also access to the cables. Alternatively, cable trays may be of steel sheet with adequate structural strength and rigidity, with necessary ventilation holes therein. In both the cases, necessary supports and suspenders shall be provided by the Air-conditioning Contractor as required.

2.4 Cable laying work shall be carried out in accordance with IS 1255/1967, Indian standard code of practice. The scope of work for the Air-conditioning Contractor shall include making trenches in ground and refilling as required, but excludes any masonry trenches for the cable work.

3.0 CONTROL WIRING

3.1 Control wiring in the plant rooms and AHU rooms shall be done using control wire as per IS 1554 PVC insulated and PVC sheathed, 2.5 sq.mm copper conductor, 1100 V grade, cables drawn in ISI marked steel or PVC conduits. The control cables interconnecting the plant room and the AHU rooms shall be of multi-core armoured type only, and suitable for laying direct in ground.

3.2 The number and size of the control cables shall be such as to suit the control system design adopted by the Air-conditioning Contractor.

3.3 ISI marked steel conduit pipes, wherever used, shall be of gauge not less than 1.6 mm thick for conduits upto 32 mm dia and not less than 2.0 mm thick for higher sizes. All conduit accessories shall be threaded type with substantial wall thickness.

3.4 Control cables shall be of adequate cross section to restrict the voltage drop.

3.5 Runs of control wires within the switchboard shall be neatly bunched and suitably

supported/clamped. Means shall be provided for easy identification of the control wires.

3.6 Control wiring shall correspond to the circuitry/sequence of operations and interlocks approved by Engineer-in-Charge.

3.7 In cold storage involving temperatures below zero deg. C, polythene cables shall be used instead of PVC cables.

4.0 **Laying**

4.1 The cables shall be laid, as per drawings or along a short and convenient route between switch board and the equipment, either in trenches, on wall or on trays.
Hangers, supported from the slab. Cable routing shall be checked on the site to avoid interference with structure, equipment etc. Where more than one cables are running close to each other, proper spacing should be provided between them

4.2 The radius of bends of the cable should not be less than 12 times the radius of cable to prevent undue stress and damage at the bends, the cables should be supported and fixed on M.S. supports, when running in trenches, wall or ceiling suspended hangers when laid under ground the cables should be covered with sand and protected with cement concrete covering. Suitable G.I. pipe shall be used wherever cable is laid across road, crossing of other services and when passing through R.C.C.

4.3 Wooden bushes shall be provided at the ends of pipes through which cables are taken.

5. **Earthing :**

5.1 **Pipe Earth Electrode**

G.I. pipe shall be of medium class 40 mm dia 4.5 m.long in length. galvanising of the pipe shall conform to relevant is. G.I. pipe electrode shall be cut tappered at the bottom and provided with holes of 12 mm dia drilled not less than 7.5 cm from each other upto 2m of length from bottom. The electrode shall be buried in the ground vertically with its top not less than 20 cms below ground level.

5.2 **Plate Earth Electrode**

For plate electrode minimum dimensions of the electrode shall be as under:

i. G.I. plate electrode : 60cm x 60cm x 6mm thick.

ii. Copper plate electrode: 60cm x 60cm x 3mm thick.

The electrode shall be buried in ground with its faces vertical and top not less than 3 m below ground level.

In case of plate earth electrode a watering pipe of 20 mm dia of medium class gi pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided on top of this pipe for watering the earth. In case of pipe electrode a 40mm x 20mm reducer shall be used for fixing the funnel. The watering funnel attachment shall be housed in massonary enclosure of not less

than 30cm x 30cm x 30cm. A cast iron/ms frame with cover having locking arrangement shall be suitable embedded in the masonary enclosure.

5.3 **Loop Earthing**

Loop earthing shall be providing for all mountings of main board and other metal clad switches and db's with G.I. strip of size specified but not less than 14 swg copper or 12 swg gi or 4 sq mm aluminium wite. The earthing lead from electrode owner's shall be suitably protected from mechanical injury by a 15 mm dia gipipe in case of wire and 40 mm dia medium class G.I. pipe in case of strip. Metallic covers or supports of all medium pressure or ht apparatus or conductor shall in all cases be connected to not less than two separate and distinct earths.

5.3.1 All equipment connected with electric supply shall also be provided with double earthing continuity conductors. The size of G.I. earthing conductors shall be: -

Earthing should be carried out as per is-3043

Size of phase wire sq.mm aluminium tape/wire (swg)	Size of G.I. conductor
185	25 mm x 4 mm (strip)
150	25 mm x 4 mm (strip)
120	20 mm x 3 mm (strip)

Size of phase wire sq.mm	Size of G.I. conductor aluminium tape/wire (swg)
95	20 mm x 3 mm (strip)
70	4 swg
50	4 swg
35	6 swg
25-6	6 swg
4	8 swg

6. **Miscellaneous:**

6.1 The final connections to the equipment shall be through flexible connections where the equipment is likely to be moved back and forth, such as on slide rails.

6.2 An isolator switch shall be provided at any motor which is separated from the main switch panel by a wall or partition or other barrier or is more than 15 metres away from the main panel.

6.3 Two separate and distinct earthing conduits shall be connected from the equipment upto the main switch board panel.

6.4 The entire installation shall be tested as per electricity rules and I.S. 732-1973/is-3043 with amendments 1,2&3 prior to the commissioning of the plant and a suitable test report furnished by competent local authorities. The test report will be obtained by contractor himself at his own expenses.

6.6 All exposed hangers etc. shall be given 2 coats of suitable paint of approved colour, when all work has been completed.

TESTS AT SITE

1. **General :**

The contractor must perform all inspection and tests of the system as a whole and of components individually as required, under the supervision of the architect, in accordance with the provisions of the applicable ASHRAE standards or approved equal and furnish necessary test certificates from manufacturers.

2. Performance Test

i) The installation as a whole shall be balanced and tested upon completion, and all relevant information shall be submitted to the architects.

ii) Air Volume passing through each unit, grills, apertures.

iii) Differential pressure readings across each filter, fan and coil and through each pimp.

iv) Static Pressure in each air duct

v) Electrical current readings, in amperes of full and average load running and strarting, together with name plate current of each electrical motor.

vi) Continuous recording over a period of ambient wet and dry bulb temperatures under varying degrees of internal heat loads and use and occupation in each zone of each part of the building

vii) Daily records should be maintained of hourly reading taken under varying degrees of internal heat loads and use and occupation of wet and dry bulb temperatures upstream "on–coil' of each cooling coil. Also suction temperatures and pressures for each refrigerant unit. The current and voltage drawn by each machine.

viii) Any other reading shall be taken which may subsequently be specified by the architect

3. Miscellaneous

i) The above tests are mentioned herein for general guidance and information only but not by way of limitation to the provision of conditions of contract and specifications

ii) The date of commencement of all tests listed above shall be subjected to the approval of the architect, and in accordance with the requirements of this specification.

iii) The contractor shall the skilled staff and necessary instruments and carry out any test of any kind on a piece of equipment, apparatus, part of systems or on a complete system if the architect requests such a test for determining specified or guaranteed data as given in the specification or on the drawings

iv) Any damage resulting from the tests shall be repaired and or damaged material replaced , all the satisfaction of the contract

v) In the repair or any adjustment having to be made, other than normal running adjustment, the tests shall be void and shall be recommended after the adjustment or repairs have been completed

vi) The contractor must inform the architect when such tests are to be made, giving sufficient notice, in order that the architect or his nominated representative may be present

vii) Complete records of all tests must be kept and 3 copies of these and location drawings must be furnished to the architect.

viii) The contractor may be required to repeat the test as required, should the ambient conditions at the time not given, in the opinion of the architect, sufficient and suitable indication of the effect and performance of the installation as a whole or any part as required.

MODE OF MEASUREMENTS

1. **Unit Prices in the Schedule of Quantities:**

1.1 The item description in the schedule of quantities is in the form of a condensed resume. The unit price shall be held to include every thing necessary to complete the work covered by this item in accordance with the specifications and drawings. The sum total of all the individual item prices shall represent the total price of the installation ready to be handed over.

1.2 The unit price of the various items shall include the following:

1.2.1 All equipment, machinery, apparatus and materials required as well as the cost of any tests which the consultant may request in addition to the tests generally required to prove quality and performance of equipment.

1.2.2 All the labour required to supply and install the complete installation in accordance with the specifications.

1.2.3 Use of any tools, equipment, machinery, lifting tackle, scaffolding, ladders etc. Required by the contractor to carry out his work.

1.2.4 All the necessary measures to prevent the transmission of vibration.

1.2.5 The necessary material to isolate equipment foundations from the building structure, wherever necessary.

1.2.6 Storage and insurance of all equipment apparatus and materials.

1.3 The contractor's unit price shall include all equipment, apparatus, material and labour indicated in the drawings and/or specifications in conjunction with the item in question, as well as all additional equipment, apparatus, material and labour usual and necessary to make in question on its own (and within the system as a whole) complete even though not specifically shown, described or otherwise referred to.

2. **Measurements of Sheet Metal Ducts, Grilles/Diffusers etc.**

2.1 **Sheet Metal Ducts**

2.1.1 All duct measurements shall be taken as per actual outer duct surface area including bends, tees, reducers, collars, vanes & other fittings. Gaskets, nuts, bolts, vibration rotation pads are included in the basic duct items of the boq.

2.1.2 The unit of measurements shall be the finished sheet metal surface area in metres squares. No extra shall be allowed for lapse and wastages.

2.1.3 All the guide vanes, deflecters in duct elbows, branches, grille collars quadrant dampers etc. shall be measured for actual sheet metal surface and paid for at the same rate as duct of same thickness.

2.1.4 The unit duct price shall include all the duct hangers and supports, exposing of concrete reinforcement for supports and making good of the same as well as any materials and labour required to complete the duct frame.

2.2 Grilles/Diffusers

All grilles/diffusers as per tender requirements shall be treated as a lump sum item. Where extra grilles diffusers are ordered up to award of work, they should be measured as follows :

2.2.1 All measurements of grilles/diffusers shall be the actual neck size excluding the outer flanges.

2.2.2 The square or rectangular grilles/diffusers shall be measured in plain sq.m.

2.2.3 All round diffusers shall be measured by their diameters in cm.

2.2.4 All linear diffusers shall be measured as per actual length in metres.

3. Measurements of Piping, Fittings, Valves, Fabricated Items :

3.1 Pipe

Including water piping, steam piping and all other piping required to be executed at site for completion of the works.

3.1.1 All pipes shall be measured in linear metre (to the nearest cm) along the axis of the pipes and rates shall be inclusive of all fittings e.g. tees, bends, reducers, elbows etc. deduction shall be made for valves in the line.

3.1.2 Exposing reinforcement in wall and ceiling and floors of possible and making good the same or installing anchor fasteners and inclusive of all items as specified in specifications and schedule of quantities.

3.1.3 Rates quoted shall be inclusive of providing and fixing vibration pads and wooden pieces, wherever specified or required by the project co-ordinator.

3.1.4 Flexible connections, wherever required or specified shall be measured as part of straight length of same diameter, with no additional allowance being made for providing the same.

3.1.5 The length of the pipe for the purpose of payment will be taken through the centreline of the pipe and all fittings (e.g. tees, bends, reducers, elbows, etc.) as through the fittings are also presumed to be pipe lengths. Nothing extra whatsoever will be paid for over and above for the fittings for valves and flanges, section 3.2 below applies.

3.2 Valves and Flanges

3.2.1 All the extra ci & cm flanged valves shall be measured according to the nominal size in mm and shall be measured by number. Such valves shall not be counted as part of pipe length hence deduction in pipe length will be made wherever valves occur.

3.2.2 All gun metal (gate & globe) valves shall include two Nos. of flanges and two numbers 150 mm long ms nipples, with one side threaded matching one of the valves, and other welded to the M.S. slip-on-flange. Rate shall also includethe necessary number of bolts, nuts and washers, 3 mm thick insertion gasket of required temp. grade and all items specified in the specifications.

3.2.3 The rates quoted shall be inclusive of making connections to the equipment, tanks, pumps etc. and the connection made with an installed pipe line shall be included in the rates as per the b.o.q.

3.3 Structural Supports

Structural supports including supports fabricated from pipe lengths for pipes shall be measured as part of pipe line and hence no separate payment will be made. Rates shall be inclusive of hoisting, cutting, jointing, welding, cutting of holes and chases in walls, slabs or floors, painting supports and other items as described in specifications, drawings and schedule of quantities or as required at site by project co-ordinator.

3.4 Copper Connections for Fan Coil Units

3.4.1 Copper connection assembly for making connections to the fan coil units shall be measured, as part of the fan coil unit price and shall include brass flare nuts, brass straight connector, brass tees, brass reducting fittings, fixing of automatic 3 way valve, making connections and leak testing, complete assembly as per specifications and drawings. Nothing extra shall be payable on account of any variation in the length of copper pipe.

4. Insulation:

4.1 The measurement for vessels, piping, and ducts shall be made over the bare uninsulated surface area of the metal.

4.2 Pipes, Ducts & Vessels

4.2.1 Pipes

The measurements for installation of piping shall be made in linear metres through all valves, flanges, and fittings. Pipes/bends shall be measured along the centreline radius between tangent points. If the outer radius is r1 and the inner radius is r2 the centre line radius shall be measured as (r1+r2)/2. Measurement of all valves, flanges and fittings shall be measured with the running metre of pipe line as if they are also pipe lengths. Nothing extra over the above shall be payable for insulation over valves, flanges and fittings in pipe line/routings. Fittings that connect two or more different sizes of pipe shall be measured.

4.2.2 Ducts

The measurements for insulation of ducts shall be made in actual square metres of bare uninsulated duct surface through all dampers, flanges and fittings. In case of bends the area shall be worked out by taking an average of inner and outer lengths of the bends. Measurements for the dampers, flanges, fittings shall be for the surface dimension for the connecting duct, nothing extra over the above shall be payable for insulation over dampers, flanges and fittings in duct routing.

4.2.3 **Vessels**

The area of standard dished and flat ends of vessels shall be the square of the diameter of the uninsulated body of the shell. Areas for other shapes shall be the actual calculated area. There shall be no deduction or additions for nozzles, handles ribs, dampers, expansion joints etc. All projections on vessels or tanks shall be measured separately as pipe/duct.

4.3 **Accessories Insulation**

4.3.1 The unit of measurement for accessories such as expansion tank, pumps, chiller heads etc. shall be uninsulated are in square metres.

4.3.2 In case of curved or irregular surfaces, measurements shall be taken along the curves.

4.3.3 The unit insulation price shall include all necessary adhesives, vapour proofing and finishing materials as well as additional labour and material required for fixing the insulation.

4.4 **Acoustic Duct Lining**

4.4.1 In case of acoustic lining of air ducts, measurements of the bare inside duct surface in square metres, shall be final for billing purposes.

4.4.2 The insulation/acoustic panels shall include cost of battens, supports, adhesives, vapour proofing, finished tiles/boards/sheets as well as additional labour and materials required for completing the work.

LIST OF APPROVED MAKES AND MANUFACTURERS

The subcontractors/makes/brands of equipment listed below are approved for installation.

All items to be used in the works samples, catalogues and specifications are to be submitted by the contractor for approval of the Engineer. Only approved makes shall be used in the works. The approved samples shall be kept in the custody of the Engineer for comparison.

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ITEM	APPROVED MAKES/SUBCONTRACTORS

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Water chilling machines

Screw Type water chilling machine	Blue star/ Carrier/ Voltas/Kirlosker Mcquay/York/Trane
Electric Hot Water Generator/Boiler	Rapidcool /Emerald / Khokar
Outdoor unit:	Bluestar/carrier/Voltas/Kirloskar/Mcquay/York/Trane

Airhandling Unit

Unitary type	Save-air India/Caryaire/Blue Star/Carrier-Aircon/ZECO
Ductable type	Save-air India/Caryaire/BlueStar/Carrier-Aircon/ZECO
Double skin type	Save-airIndia/Caryaire/BlueStar/Carrier-Aircon/ZECO
AHU cooling coils	Bluestar/voltas/carrier-aircon/Zeco/Coil co./Hitech/Caryaire
Indoor Unit	Save-airIndia/Caryaire/BlueStar/Carrier-Aircon/ZECO
Centrifugal fan of double skin type AHU.	Nicotra/Comefri/Flakt/Kruger
Cooling Towers	Advance/Bell/Paharpur/Mihir/Aadi
End suction back pull out pump	Kirloskar/Beacon-weir/Mather & Platt/KSB/Greaves
Fan Coil Units	Bluestar/voltas/carrier-aircon/Zeco/Coil co./Hitech

ITEM	APPROVED MAKES
Humidifier	Rapid cool/Emerald/Khokar
Ventillation Fans	
Centrifugal Blower	GEC/ Swent / Flakt/Nadi / Divine/Kruger
Propeller Fan	GEC(Alsthom)/Crompton Greaves/ Khaitan/Usha
Pipes	
GI	ITC/ Jindal/Tata/SAIL/HSL
MS upto 150 mm dia	ITC/ Jindal/Tata/SAIL/HSL
MS 200 to 300 dia	ITC/ Jindal/Tata/SAIL/HSL
GI Sheets	TATA/SAIL/Jindal/Bhushan Steel
Aluminium Sheet	Balco/Nalco/Hindalco
Grilles/Diffusers	Dynacraft/Servex/Ravistar/Caryaire/Opella/ Mapro
Fire dampers (Motorized)	Caryaire/Dynacraft / Ravistar
Valves	
Gate Valve	Leader/Divine/Sant/Bankim Sarkar
Butterfly Valves	Advance/C&R/Castle/Arrow/Audco/Intervalve
Balancing Valves	Advance/C&R/Castle/Arrow/Audco
Non-return Valves	Advance/C&R/Castle/Arrow/Kirloskar
Pot & Y- Strainer	Emerald/Sant/Rapid cool
Three way mixing valves Controls	Staefa/Johnson/Honeywell/Danfoss/Anergy/Rapid
Two way motorized valve	Audco/Staefa/Johnson/Honeywell/Danfoss
Actuating motor for 3 way & 2 way valve	Staefa/Johnson/Honeywell/Danfoss/Anergy/Rapid Controls

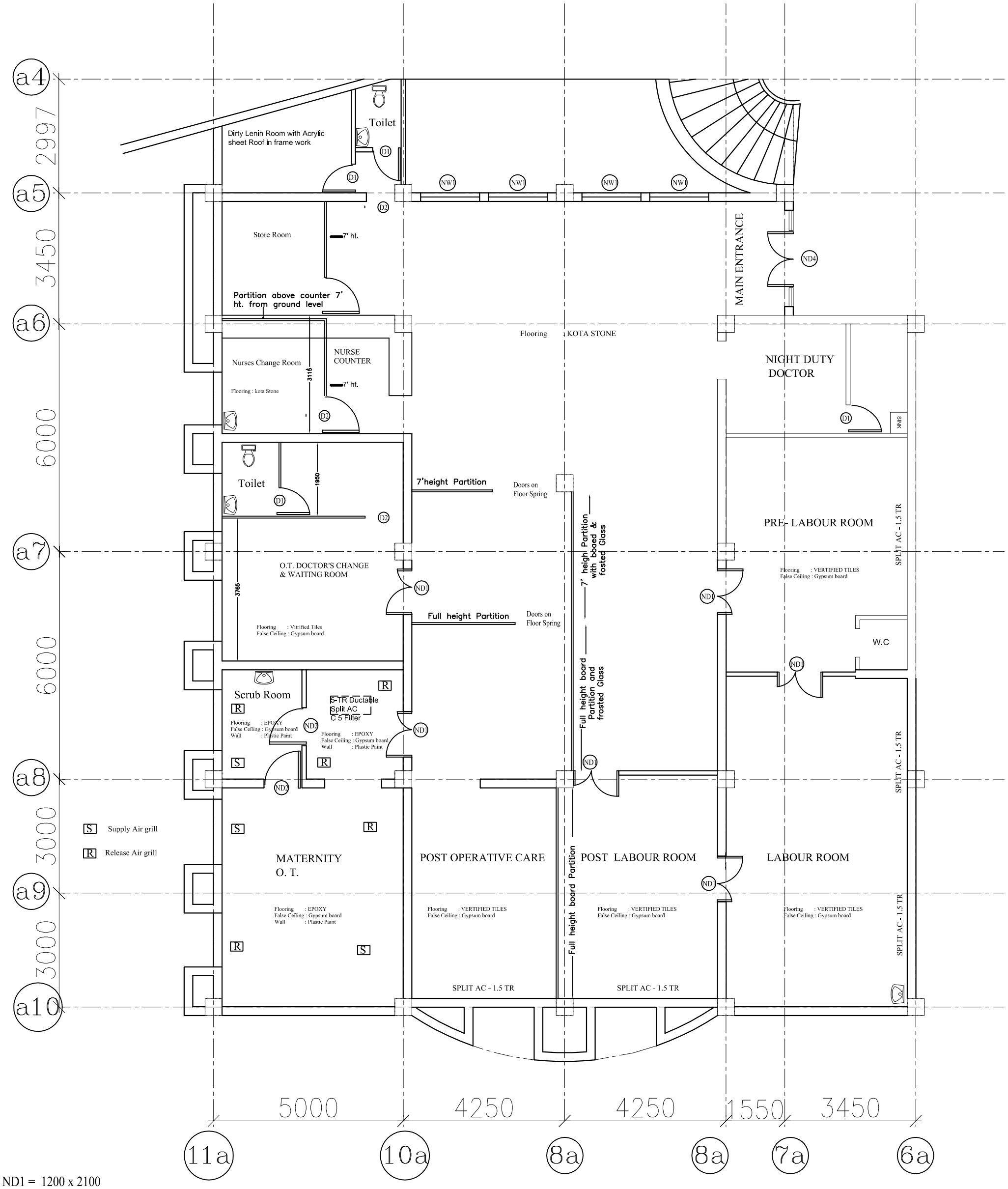
Ball Valve with & without strainer	Rapid Control/Sant/Leader

Insulation

Fibre glass	FGP Ltd./UP Twiga/Kimmco / owen corning
Expanded Polystrene	Beardsell Ltd./ BASF/Styrene Packing/ Indian Packaging Industries/Lloyd
Air Filters	Thermadyne/Klenzaids/Kirloskar /Anfilco/Johnflower/Dynafilter
Thermometers/Pressure Gauge	Fiebig/Emerald/H Guru/Japsin
Thermostats/Humidistats	Honeywell/Penn /Staefa/Johnson/ Rapidcontrol/Anergy
Electric Strip Heaters	Escorts/Daspass
Controls	Honeywel/ Johnson / Staefa .
Electric Panels	CPRI approved vendor
Electric Motors	Siemens/NGEF/Kirloskar/ABB/ Bharat Bijlee. /Crompton Greaves
Starters/Contactors	L&T/ GE Power/ Siemens/ Schneider
ACB/MCCB	L&T/ GE Power/ Siemens/ Schneider
Switch Fuse/ Fuse Switch Units	L&T/ GE Power/ Siemens/ Schneider/ Standard

Cables

PowerCables & Control cable	CCI/Universal/ICC/NICCO/INCAB/Ford Gloster/ National/Rallison Cables
Lamps & Push Buttons Relays	L&T/GE/ Siemens/ Schneider
Current Transformer/ Ammeter/Voltmeter	L&T/GE/ Siemens/ Schneider



ND1 = 1200 x 2100
ND2 = 900 x 2100
ND4 = 2000 x 2100
D1 = 750 x 2100
D2 = 1000 x 2100

MATERNITY WARD AREA