NOTICE INVITING TENDER (N.I.T)

ENQ.NO. CDFD/ENGG/ELECT/BSL-3/HVAC/WORKS/2019-20/05

"Sealed Tenders are invited on behalf of the Director, CDFD in **TWO BID SYSTEM** for procurement of **Heating Ventilation and Air-Conditioning Works for Proposed BSL-3 at CDFD, Laboratory Building, Uppal, Hyderabad**.

Scope of Work: Design, Supply, Installation, Testing and Commissioning of the above Equipment.

Qualification Criteria for issue of Tender:

The Tender shall be issued on submission of an application with following details.

To be eligible for receiving tender and subsequently award of contract, bidders shall provide evidence satisfactory to the CDFD of their eligibility and of their capability and adequacy of resources to carry out the contract effectively as detailed below:

i. Copies of original documents defining the constitution or legal status, place of registration and principal places of business of the company or firm or partnership.

ii. The Bidder should be in the similar business for the last 5 years and have successfully supplied and executed at least One similar equipment to any of the Department of State / Central / PSU / University / R&D Institutes / Pharmaceutical Laboratories /MNC Companies, Public Limited Companies during the last 5 years.

Similar Equipment means Supply and Installation of chillers, Pumps & Cooling towers etc i.e. Chiller Plant room or Similar Extension of chiller plant etc., Proof to be enclosed with the quote.

iii. All warranty and support must be serviced directly by the OEM. CDFD requires that there be a Single Point Of Contact (SPOC) from OEM/Vendor who is responsible for all issues between CDFD and the OEM.

iv. Bidder should be either an Original Equipment Manufacturer (OEM) or should be authorized System Integrator Partner having back to back Support Agreement with the OEM. Manufacturer's Authorization Form (MAF) for participating in this tender is mandatory for bidders and should be attached along with technical bid.

v. OEM should have a local service centre in Hyderabad. Documentary proofs should be enclosed.

vi. The OEM must have an India based support infrastructure by maintaining a local spares depot in the country. This is to ensure immediate delivery of spare parts from OEM to its channel partner/system integrator.

vii. The complete proposed solution must have all encompassing comprehensive onsite warranty of 3 years for all Chillers and associated components is mandatory.

viii. Products offered should have official OEM support for next three years from the date of acceptance of installation.

ix. That the Bidder will assume total responsibility for the fault-free operation of equipment, application software, if any, and maintenance during the warranty period and provide necessary maintenance services after end of warranty period if required.

x. The bidder should be free from all encumbrances and possess adequate resources for executing the contract in the case it is awarded

xi. **Actual Proof of Annual Turn Over:** The bidder should have achieved a minimum annual financial turnover of **Rs. 150 Lakhs** in any one of the last five years. The proof of annual turnover shall be duly certified by chartered Accountant / Income Tax Authorities.

xii. **Work Experience**: The tenderer should have satisfactorily completed in his own / firm name at least one work of similar nature of minimum value of **Rs. 125 Lakhs** or two works of each aggregate cost not less than **Rs.94 Lakhs** or three works of similar nature of minimum value not less than **Rs. 63 Lakhs** during the **last 5 (five) years** prior to the date of submission of the bid. Works completed prior to the cutoff date shall not be considered, only such works will be considered which are 100% completed in all respects.

Similar Works:

Similar works shall mean the work of Supply & installation of Water cooled Chiller plant of capacity at least 500 TR carried out in India under a Single contract (including additional work carried out under the contract)

The tenderer should submit the details of such completed works. In support of having completed these works, the tenderer should submit copies of the completion certificates from the owner companies indicating the name of work, the description of work done by the tenderer, value of contract executed by the bidder, date of start, date of completion (contractual and actual), value of the material supplied by the client.

1 CDFD does not bind itself to accept the lowest or any other tender and reserves the authority to reject any or all tenders without assigning any reason. All the tenders, in which any of the prescribed conditions are not fulfilled or incomplete, in any respect, are liable to be rejected.

2 This Notice Inviting Tender (N.I.T) shall form the part of the Contract Document.

3 The Director, CDFD reserves the right to postpone the tender issue date, submission / opening date and to accept or reject any or all tenders without assigning any reasons.

4 Tender completed in all respects shall be submitted as per “Submission of Tenders” forming part of the tender document.

5 Any tender received without Earnest Money in the form as specified shall be summarily rejected.

6 The successful tenderer on the acceptance of his tender by CDFD shall within seven days from the stipulated date of start of the work sign the formal contract.

7 The tenderer shall sign all the pages of the tender documents and other documents submitted by him along with the tender.

8 The tenderer should ensure that rates / amounts quoted should appear only in the price bid document and nowhere else, otherwise, the tender is liable to be rejected.

9 Technical bid and price bid shall be submitted simultaneously on due date as per clause “Submission of Tenders” within the due date. Only technical bid shall be opened on that date, the price bids shall be kept sealed. Later on, a date shall be fixed and intimated for opening of price bids only of those contractors whose technical bids are found acceptable by CDFD.

10 CDFD does not bind itself to accept the lowest or any other tenderer and reserves the authority to reject any or all tenders without assigning any reason. All the tenders, in which any of the prescribed conditions are not fulfilled or incomplete, in any respect, are liable to be rejected.

11 Director, CDFD reserves the right of accepting the whole or part of any tender and tenderer shall be bound to perform the same at the rate or amount quoted.

12 Documents duly completed in all respects shall be dropped in the tender box kept for the purpose in the office of Executive Engineer, CDFD, Uppal, Site-A Hyderabad.

MISCELLANEOUS RULES AND DIRECTIONS

1. If required by the Employer, the Tenderers shall sign a declaration under the officials Secret Act 1923, for maintaining secrecy of the tender documents drawings or other records connected with the work given to them. The unsuccessful Tenderers shall return all the drawings given to them.

2. In the case of any Item rate tender where unit rate of any item/items appears unrealistic, such tender will be considered as unbalanced and in case the Tenderer is unable to provide satisfactory explanation, such a tender is liable to be disqualified and rejected.

3. Price/rates quoted by the contractor in respect of the contract shall be after considering all input credits and inclusive of all taxes and cess etc. other than GST on Contract Price. The GST leviable on Contract Price shall be paid in addition to the Contract Price as mentioned below.

4. In the bill for the works done, the contractor shall charge GST separately. It is the responsibility of the contractor to pay GST to the Government concerned and file statutory return within due date prescribed under the respective Act. For **CDFD**-to get input credit, it is necessary that the amount get reflected in the return. In case the next Running Account Bill (RA Bills) are submitted before due date of filing of return, documentary evidence is to be submitted by the contractor/agency in the subsequent running account bill. The procedure for payment of bills shall be as under:

   i. The contractor may be asked to charge GST separately in his bills.

   ii. The GST amount so claimed shall be paid along with payment of running account bill.

   iii. The contractor has to furnish the documentary evidence of the deposit of the GST or a copy of the return in case of adjustment of available input credit, whichever is earlier, before processing of subsequent RA bills. Else, the Engineer-in-Charge shall with hold the GST amount so paid in the previous bill(s), in the subsequent/next RA bill(s).

   iv. Amount to be withheld shall relate only to the extent of GST not deposited or adjusted within due date of filling of return.

5. In case of final bill, GST amount so deposited shall be reimbursed by the CDFD only after the contractor furnishes the documentary evidence of actual deposit of GST to the credit of Government and is reflected against the GSTIN of the employer.

6. Regarding payment of GST to the contractor, the decision of CDFD shall be binding on the contractor.

7. Each Bidder shall submit only one Bid either as an individual or as a Proprietor in Proprietary firm or as a Partner in a Partnership firm or as a Director of a Limited Company/Corporation or as a Partner in a Joint Venture. Any Bidder who has submitted a Bid for a work, shall not be a witness for any other Bidder for the same work. Failure to observe the above stipulations would render all such Tenders submitted as a Bidder and/or as a witness, liable to summary rejection.

8. The Contractor shall be fully responsible for all matters arising out of the Performance of the Contract and shall, at his own expense, comply with all laws/acts/enactments/orders/ regulations/obligations whatsoever of the Government of India, State Government, Local Body and any Statutory Authority.

9. In case the bidder does not quote his rate for any item(s) in Item Rate Tender or Mixed Tender containing one or more Item Wise Schedules, it will be presumed that the bidder has included the cost of that/those item(s) in the rates of other items and the rate for such item(s) shall be considered as Zero and the tender will be evaluated by the Employer accordingly and the work executed by the successful bidder accordingly.

10. In case of credit items/recovery items/deduction items for which the bidder has to pay the amount to **CDFD**/Employer, the rate quoted by the bidder shall be taken as negative (bidder is allowed to make positive entry only) and the negative amount so calculated shall be considered to work out the total bid amount.

EXECUTIVE ENGINEER

I. Details of Tender:

Earnest Money Deposit (EMD): **Rs. 1, 56,385/- (RUPEES One Lakh Fifty Six Thousand Three Hundred and Eighty Five ONLY**) favoring Director, CDFD, Hyderabad.

2. Tender Form is not transferable.

3. The above tender will be dealt with under "TWO BID SYSTEM". **Technical Bid** (Part I) and **Financial Bid** (Part II).

4. Both Part – I and Part – II duly sealed and then be placed in a bigger cover bearing the Tender Notice Number on the top, date and time of opening the tender.

5. The technical bid shall contain the following:

   i) Technical bid document comprising N.I.T. instruction to tenderer, letter of submitting the tender, general conditions of the Tender with detailed specifications.

   ii) Tender Document each page duly signed by the Bidder as token of acceptance, If any minor deviation is proposed by the Bidder, the same must be clearly indicated and enclosed as deviation list as Annexure but Tenders with significant deviations list may be liable for rejection.

   iii) EMD: Earnest Money Deposit of Rs. Rs. 1,56,385/- (RUPEES One Lakh Fifty Six Thousand Three Hundred and Eighty Five ONLY) in the form of demand draft favoring Director, CDFD and payable at Hyderabad drawn on any Nationalized Bank, in separate envelope marked as such

   iv) Other Information / documents / literature / catalogues as indicated in Instructions to Tenderer.

   v) All necessary catalogues / technical literature, data as are considered essential for full and correct evaluation of bids.

   vi) Availability of number of trained support personnel, both application and service support.

   vii) Compliance statement indicating yes / no as per the specifications.

   ix) Copy of the bidder's price schedule without prices mentioned.

   x) The complete Technical Bid (Part I) to be signed and enclosed.

   xi) Any alternate design the tenderer should like to submit.

6. The Financial Bid shall contain the following:

i) Duly filled in price bid document as per Tender.

ii) Tenderers are required to quote individual item rates for each item given in the price bid documents. The rates and amount shall be quoted in figures in the price bid document. The rates and amount shall be quoted in figures as well as in words. In case of difference in quoted rates, the rates in words will be taken as final rates.

iii) The Bidders are to quote both in Indian Rupees only.

iv) Bid prepared on similar format as in 6 (i) above for alternate design offered by the tenderer

7. Sealed tenders are to be deposited in the Tender Box kept for the purpose in the office of Executive engineer CDFD, Campus site A,Uppal, Hyderabad-500039.

8. Any tender received without Earnest Money Deposit in the form as specified shall be summarily rejected.

9. The tenderer shall sign all the pages of the tender documents and the other documents submitted by him along with the tender.

10. **The Tenderer should ensure that rates / amounts quoted should appear only in the Financial Bid document (Part II) and nowhere else, otherwise, the tender is liable to be rejected.**

11. Technical bid and Financial bid shall be submitted simultaneously on due date as above within the due date. Only Technical Bids shall be opened on the due date and the Financial Bids shall be kept sealed. Later on, a date shall be fixed and intimated for opening of Financial Bids only of those Vendors whose Technical Bids are found technically suitable by CDFD.

12. Documents duly completed in all respects shall be dropped in the tender box kept for the purpose in the office of Executive Engineer, Engineering Department, CDFD, **Uppal, Hyderabad**.

I	Due date for receipt of Tenders at 3:00 PM on	22-10-2020
II	Mandatory Prebid meeting	15-10-2020
III	Opening of Technical Bids at 3.30 PM on	22-10-2020

NOTE:

1. All the Bidders are mandatorily to attend the Prebid meeting as per schedule.
2. Any further queries /short fall of documents either personal/Mail/any type of clarifications/communications related to tender will not be entertained after the pre-bid meeting

TECHNICAL BID

I.0 GENERAL INSTRUCTIONS:

Director, Centre for DNA Fingerprinting and Diagnostics, Hyderabad, will receive Tenders in respect of the items mentioned in the Tender specifications.

1.1. Tenders received after the date and time fixed for receipt of Tenders as indicated above are liable to be rejected. CDFD takes no responsibility for delay, loss or non-receipt of Tender documents sent by Post. Telex / Telegraphic / Fax / Email offers will not be accepted.

1.2. Director, CDFD is not bound to accept lowest or any tender or to assign reasons for non-acceptance of any tender.

1.3. The bidder shall not be entitled to claim any cost, charges, expenses incidental to or incurred by him through or in connection with his submission of Tender, even if the Director, CDFD decides to withdraw or cancel the Tender.

1.4. Unsealed Tenders, unsigned Tenders, incomplete Tenders, or Tenders otherwise considered defective are liable to be rejected.

1.5. Director, CDFD reserves the right to accept the Tender either in whole or in part and the prices quoted by the bidder shall be deemed to hold good even if the Tender is accepted in part by the Director, CDFD.

2. CAPACITY OF THE BIDDER:

2.1 Any person signing a Tender shall submit documentary evidence that his signature on the Tender, submitted by him, is legally binding upon himself, his firm.

2.2. If it is detected that the person so signing the Tender has no authority to do so, the Director, CDFD may, without prejudice to other civil and criminal remedies, not consider the Tender and hold the signatory liable for all costs and damages.

3. BIDDER TO INFORM HIMSELF FULLY:

3.1 The bidder is required to carefully examine the documents contained in this Tender document and fully inform himself as to all conditions and matters which may in any way affect the works or the cost therefore, before submitting his offer If the bidder finds discrepancies, omissions, or contradiction in the documents or in doubt as to true meaning of any part, he shall at once frequent in writing for clarification to CDFD. CDFD will issue such clarification in writing. The bidder however shall not be entitled to any extension of time for submission of his Tender on such account.

4.0 EARNEST MONEY:

4.1 The Tender must be accompanied by Earnest Money Deposit (EMD) in the form of a Demand Draft drawn on the State Bank of Hyderabad or any scheduled Bank in favour of Director, CDFD, for an amount of Rs. 1,56,385/- (RUPEES One Lakh Fifty Six Thousand Three Hundred and Eighty Five ONLY). If the bidder after submitting his Tender revises his offer or modifies the terms and conditions thereof in a manner not acceptable to the Director, CDFD, the earnest money shall be liable to be forfeited.

4.2 EMD should be kept along with Technical bid in one envelope. Tenders not accompanied by EMD shall be liable for rejection at the sole discretion of the Director, CDFD.

4.3 The Earnest Money will be returned without any interest to the unsuccessful bidders after the finalization of the order with the successful bidder.

4.4 The Earnest Money Deposit shall be returned to the successful bidder after the supply and installation of all the items as per Purchase Order.

5.0 MANNER, METHOD AND PLACE FOR SUBMISSION OF TENDERS:

5.1 Tenders shall be made in favour of:

The Director, Centre for DNA Fingerprinting and Diagnostics, Uppal, Hyderabad – 500 039.

5.2 **Tenders shall be submitted in 2-PARTS.**

5.2a **FILLING OF TENDERS:**

The tender bids shall have 2 Parts - Technical Bid and Price Bid.

Part I Technical Bid

The Technical Bid is to be filled as detailed below:

Bid for The Tender Design

The contractors shall indicate details such as make model etc. of equipment items of BOQ all as per the schedule of items or work included in the tender document all as per our design.

This is mandatory and the tender is likely to be set aside if not filled.

ALTERNATE DESIGN OFFER IF ANY BY THE TENDERER

In this part the contractor can offer his own HVAC design for the **BSL-3 HVAC works at CDFD Premises Uppal Hyderabad Complex-500 039.** This part of the bid should include the details of the design proposed and bring out the advantages there of with respect to / cost, cost and ease of operation and maintenance or better technology as compared to the system given in the tender.

The Alternate Design bid should be prepared in a pattern similar to tender schedule given in the tender. That is different items of work required but as per the alternate design being offered, clearly giving accounting unit / quantity / unit rate and amount.

The bid of, contractors own design, need not be submitted in case there is no other alternative to offer, in which case, tender shall be evaluated on the basis of tender schedule bid, submitted.

The technical details of Alternate design offer shall be treated as confidential and shall not be disclosed.

CDFD reserves that right to accept or reject any of the bids, submitted as per tender or alternate design, or all of them without assigning and reason thereto. In case of Alternate Design bids, when accepted the CDFD is not bound to explain the reason for such selection nor enter into any dialogue / correspondence on merits or demerits of any of the other bids.

The rates and amounts for each tendered item should filled in separate columns provided for in the Schedule of quantities and all the amounts should be totaled up in order to show the aggregate value of the entire tender. All rates shall be filled in both words and figures. These figures and words shall be preceded by ‘Rs’ and ‘Ps’ as the case may be, and while filling in words, must end with “Only”. Example:

i) Rs.15.25 (Rupees fifteen and paise twenty five only)

ii) Rs.20.00 (Rupees twenty only)

The rates quoted in figures should be clearly show the rates in full. While filling rates in words, each line should end in ‘-‘, and if continued further, last line for the rate of each item shall end in “Only”. All corrections, by the contractor in the tender schedule shall be duly attested by the initials of the tenderer. Corrections which are not attested or overwriting in rates may entail the rejection of the tender.

In case the rate written in figures/words/amount defer, the following procedure shall be followed:

a) When there is a difference between the rates in figures and in words, the rates which correspond to the amounts worked out by the contractor will be taken as correct.
b) When the amount of an item is not worked out by the contractor or it does not correspond with the rate written either in figures or in words, then the rate quoted by the contractors in words shall be taken as correct.
c) When the rates quoted by the contractor in figures and in word tallies but the amount is not worked out correctly, the rate quoted by the contractor shall be taken as correct and not the amount.

SUBMISSION OF TENDERS:

The Tender document shall be submitted as follows in a sealed envelope duly marked as "Tender for **Heating Ventilation and Air-Conditioning Works**, **BSL3**" with contents as follows.

a. The Technical bids in two separate envelops clearly marked as "TECHNICAL BID TENDER DESIGN" and "TECHNICAL BID ALTERNATE DESIGN".

Note: "Technical Bid Tender Design" shall contain details of equipment mentioned in the tender such as make model etc., intended to be supplied by the tenderer "TECHNICAL BID ALTERNATE DESIGN" shall contain full details of design, equipment etc., proposed to be used by the tenderer with full clear explanation of the advantages of such system.

b. E.M.D. Demand draft in another envelope duly marked as E.M.D. The DD shall have the tenderers name written in pencil on the backside.

c. Two commercial bids for the bids mentioned in a above in (a) in two separate Sealed envelopes duly marked as "FINANCIAL BID TENDER DESIGN" And "FINANCIAL BID ALTERNATE DESIGN"

5.3 PART-I of the Tender must contain the following:

i) Tender Document, each page duly signed by the bidder as token of acceptance If any minor deviation is proposed by the bidder the same must be clearly indicated and enclosed as deviation list as Annexure but Tenders with significant deviation list may be liable for rejection.
ii) Copy of the bidder's price schedule but without prices.
iii) Earnest Money Deposit as indicated above.
iv) All necessary catalogues / technical literature, data as are considered essential for full and correct evaluation of offers.

v) Details of installations of similar equipment in India.
vi) Availability of number of trained support personnel, both application and service support.
vii) Compliance statement indicating yes/no as per the specifications
viii) The complete Technical Bid (Part I) to be signed and enclosed.

THIS ENVELOPE SHOULD BE ADDRESS TO:

The Director,
Centre for DNA Fingerprinting and Diagnostics,
Uppal, Hyderabad-500039

AND SHOULD BE PUT IN THE SEALED BOX KEPT AT THE ENGINEERING SECTION, CDFD LABORATORY BUILDING, UPPAL, HYDERABAD ON OR BEFORE 3.00 P.M. OF 22-10-2020. THE TENDER DOCUMENT AT ANY COST SHOULD NOT BE HANDED OVER TO ANY PERSONS.

6.0 TENDER OPENING:

6.1 THE TECHNICAL BIDS WILL BE OPENED AT 3.30 P.M ON: 22-10-2020 AT CDFD LABORATORY BUILDING, UPPAL, HYDERABAD IN THE PRESENCE OF THE BIDDERS OR THEIR REPRESENTATIVE WHO WHIS TO BE PRESENT.

6.2 The Technical evaluation of the bids will be conducted by CDFD at which time the bidders must be prepared to make a presentation on their bids, if asked to do so by CDFD.

6.3 The Price bid of the acceptable Technical bids will be opened after the technical evaluation by CDFD.

6.4 All queries / clarifications prior to submission of Tenders shall be addressed to the Consultant M/s SMEP CONSULTANTS, MasabTank, Hyderabad – 500 057. Mobile: 9849711682.

7.0 DELIVERY:

7.1 Please make appropriate commitments in writing that the instrument model being offered is current and is not likely to be obsolete within the next couple of years and that spare parts will be available for it for at least seven years after the installations.

8.0 PRICE:

8.1 The prices quoted must contain the break-up of unit prices and such prices shall include all essential tests for acceptance of the stores as specified in the technical specifications.

8.2 The price details should not appear in any other page except in the PRICE BID (PART II).

PROFORMA – I

CERTIFICATE CONFIRMING THE AVAILABILITY OF STAFF/MAN POWER

This is to certify that I/We shall deploy the essential staff/man power as specified in the tender if I/We am/are awarded the work of …… at Centre for DNA Fingerprinting and Diagnostics, Hyderabad as per details indicated below. I/We agree that the staff/man power indicated below is the minimum and essential for the project execution and in addition to these, other staff/man power necessary to complete the work successfully and in time, shall also be deployed by me/us.

Position	Name	Year of Experience	Year of Experience in proposed Position

PROFORMA – II

CERTIFICATE CONFIRMING THE AVAILABILITY OF MACHINERY AND EQUIPMENT

This is to certify that I/We shall deploy the essential staff/man power as specified in the tender if I/We am/are awarded the work of …… at Centre for DNA Fingerprinting and Diagnostics, Hyderabad as per details indicated below. I/We agree that the staff/man power indicated below is the minimum and essential for the project execution and in addition to these, other staff/man power necessary to complete the work successfully and in time, shall also be deployed by me/us.

Item of equipment	Make and Age (years)	Condition (new good poor) available	Owned leased (from whom) To be purchased from whom

PROFORMA –III

PERFORMA FOR SUBMISSION OF CREDIT FACILITY

This is to certify that M/s……(Name of the firm) is reputed company with a good financial standing.

The firm/company is enjoying a credit facility of Rs…….To meet its working capital requirements.

Sd/- Name & Address of Bank

PROFORMA – IV

PROFORMA FOR SUBMISSION OF PAST CONTRACTUAL PERFORMANCE

This is to certify that we M/s…… is submission of this offer.

Have not made any misleading or false representation in the forms statements and attachments in proof of the qualification requirements.

Do not have records of poor performance such as abandoning the work not properly completing the contract inordinate delays in completion litigation history or financial failure etc.

Business has never been banned/blacklisted with us by an Central/State Govt. Department/Public Sector Undertakings of Enterprises of Central/State Govt.

Have submitted all the supporting documents and furnished the relevant details as per the prescribed format.

SIGNATURE OF AUTHORISED REPRESENTATIVE

PROFORMA-V

LIST OF SIMILAR WORKS COMPLETED DURING THE LAST 5 (FIVE) YEARS UPTILL – 30/09/2020

Sl	Client name	Name of the work	Scope of work	Bidders Agreement	Contract value		Location	Date of Start	Date of completion As per Loa		Arbitration if any details

TENDER FORM

PROJECT: PROPOSED BSL3 HVAC WORKS AT CDFD PREMISES, HYDERABAD.

REF : 1) HVAC WORKS

Dear Sirs,

I/We the undersigned have carefully gone through and clearly understood after visiting the site and the Tender drawings and tender documents comprising of the tender form, Notice to contractors, and conditions for building contract, Special Conditions, Specifications and Schedule of Probable quantities and Draft Agreement prepared by your M/s SMEP CONSULTANTS, HYDERABAD, TELANGANA.

I/We do hereby undertake to execute and complete the whole or part of the work (as desired by you) at the respective rates which/I/We have quoted for the respective items of the Probable Bill of Quantities and at which rate the items specified amount to Rs. _____

I/We are depositing as Earnest Money a sum of Rs. ----------/- (Rupees ----------only) by demand draft in favour of The Director, M/s. Centre for DNA Fingerprinting and Diagnostics, Hyderabad along with this tender for due execution of the work at my/our tendered rates together with any variations which shall be adjusted by the Consultant at prices based on our tendered rates. I/We shall deposit further sum equivalent to ----% of tender amount, less EMD paid in the event of my/our tender being accepted, towards initial security deposit.

In the event of this Tender being accepted I/We agree to enter into an agreement as and when required and execute the contract according to your form of Agreement, within a month of receipt of work order, in default thereof, I/We do hereby bind my-self/ourselves to forfeit the aforesaid initial security deposit.

I/We further agree to complete the work covered in the said schedule of quantities within 3 months for BSL-3 HVAC works at CDFD Premises Uppal Hyderabad Complex and reckoned from the date of issue of the letter of intent to commence the work or on which contractor is instructed to take possession of the site, whichever is later.

I/We agree not to employ Sub-contractors other than those that may be specifically approved by your Consultant for this contract work.

I/We agree to pay the Government, General Sales Tax (State And Central), Excise and Octroi duties, Insurance, Seigniorage charges and all other taxes including works contract tax etc., as the prevailing from time to time, on such items for which the same are leviable, and to get the work, workers, employers (of contractor, Consultant & Employer) engaged on the work at site and all materials and machinery collected and kept/operated at site for execution of the work

shall be insured comprehensive insurance including fire/accidents/ rain/ floods/riots/CAR policy (contractor's all risk insurance policy) and the insurance shall cover the period from date of start of work to date of actual completion of work plus 3 months. In case part work is taken over by the Employer before final completion of the whole work, such parts may not be covered by the insurance from the date of taking over that part of work by the Employer. Draft Insurance deed will be got vetted by the Consultant, before obtaining the same. All the rates quoted by me/ us are inclusive of the same in full and nothing extra shall be claimed anytime on account of any of these.

I/We agree to pay Income tax, to be deducted at source, at the rate of as per prevailing rate on the Gross value of the work done, and the rates quoted by me/we are inclusive of same.

I/We agree to pay works contract tax, to be deducted at source, at the rates prevailing from time to time as per VAT Act, as amended and rates quoted by me/us are inclusive of the same.

Yours faithfully,

Contractor's Signature

Address: Date:

_____

_____

_____

_____

NOTICE TO CONTRACTOR

ADDRESS:

_____

_____

_____

PROJECT: PROPOSED BSL-3 HVAC works at CDFD Premises Uppal Hyderabad Complex-500 039.

REF : 1) HVAC WORKS

Dear Sirs,

1. M/s. Centre for DNA Fingerprinting and Diagnostics, Uppal Hyderabad, Invites you to tender for the aforesaid work.

2. The scope of work broadly as given below is for Proposed Additions and creation of New Facilities for **BSL-3 HVAC works at CDFD Premises Uppal Hyderabad Complex-500 039.** Heating Ventilation and Air-Conditioning Works at Uppal, Hyderabad

3. Tender Documents can be downloaded from CPP Portal/CDFD Website and enclose Demand Draft i.e., Rs. 10,000/- (Ten Thousand only). in favour of the Director, CDFD, Hyderabad along with tender document.

4. Sealed tenders in the prescribed format, in a sealed envelope should be addressed to The Director, M/s. Centre for DNA Fingerprinting and Diagnostics, Hyderabad and super scribed tender for Proposed BSL-3, HVAC Works, Laboratory Building at Uppal, Hyderabad.

5. The tenderer must obtain for himself, on his own responsibility and at his own expenses, all the information which may be necessary for the purpose of filling this tender and for entering into a contract for the execution of the same and must examine the drawings and inspect the site of the work and acquaint himself with all local conditions and matters pertaining thereto.

6. Each of the tender documents page is required to be signed by the person or persons submitting the tender in token of his/their having acquainted himself/themselves with the General conditions etc., as laid down. Any tender with any of the documents not so signed will be rejected.

7. The tender documents must be filled in English and all the entries must be made by hand and written in ink. **If any of the documents are missing or un-signed, the tender shall be considered invalid.**

8. Each and every one of all erasures and additions/alterations made, while filling the tender, must be attested by initials of the tenderer. Over-writing of figures must be attested by initials of the tenderer. Overwriting of figures is not permitted. Failure to comply with either of these conditions will render the tender void. After submission of the tender no advice or any change in rate or conditions will be entertained. All the rates should be quoted both in figures and words. In-case of any discrepancy in rates quoted in words/figures and the amounts, the rate quoted in words shall be taken as final and binding.

9. The tender shall be valid for a period of 90 days from the date of opening the Envelope No.1

10. TOTAL SECURITY DEPOSIT: shall comprise of:
    a. Earnest Money deposit
    b. Initial Security deposit
    c. Retention money

10.1 The intending tenderer shall deposit with The Director, M/s. Centre for DNA Fingerprinting and Diagnostics, Hyderabad by Demand Draft a sum of Rs. 1, 56,385/- (RUPEES One Lakh Fifty Six Thousand Three Hundred and Eighty Five ONLY) as the Earnest Money, as a guarantee of good faith, which amount shall be forfeited as liquidated damages, in the event of any evasive/direct refusal or delay in starting the work and or signing the contract. The deposit of the unsuccessful tenderers will be returned, without interest, immediately after a decision is taken regarding the award of the contract. The Earnest money of the successful tenderer will be adjusted towards Security Deposit. A tender not accompanied by Earnest money deposit will not be considered. No concession will be made to Public sector companies from payment of earnest money deposit.

10.2 The successful tenderer will have to pay further sum equivalent to 10% of his contract value, less EMD already paid, as initial Security Deposit (ISD) by means of a D.D./Banker's cheque in favour of The Director M/s Centre for DNA Fingerprinting and Diagnostics, Hyderabad with in 7.days from the date of issue of Letter of Intent to commence work. The EMD and Security deposit thus paid shall be held by the M/s Centre for DNA Fingerprinting and Diagnostics, as security deposit, for due execution and fulfillment of the contract, till the completion of the work and defect liability period in all respects and shall not bear any interest.

10.3 Together with the money paid under clause 10.1 & 10.2 above, further retention of 8% of the value of the work done will be deducted from every running bill, till total retention, including EMD and initial SD paid earlier, comes to 10% of the contract value, and same shall be held by the M/s CDFD as Total Security Deposit. On the Consultant's certifying the completion of work, 50% of the total security deposit shall be released to the contractor along with the final certificate of payment, and the balance amount will be retained in the manner stated elsewhere for a further period of twelve months after the completion date recorded in completion certificate, issued by the Consultant and agreed to by the M/s. CDFD. Also refer condition 22(ii) on Page 17 of Volume 1.

11. Within seven days of the receipt of intimation from the Employer of the acceptance of his/their tender, the successful tenderer shall be bound to sign an agreement, on a stamp paper in accordance with the Draft Agreement and conditions of contract attached herewith, but the work order or the written acceptance of a tender by the Employer will constitute a binding agreement between the Employer and the person tendering whether such formal contract is or not signed by the contractor.

12. All compensation or other sums of money payable by the contractors to the clients, under the terms of this contract, may be deducted from the Security Deposit or from any sum that may be or may become due to the contractor on any account whatsoever, and in the event of the Security deposit being reduced by reasons of any such deductions, the contractor shall within 15 days of being asked to do so make good in cash or cheque, any sum which have been deducted from his security deposit.

13. The contractor shall arrange for the procurement of all the materials at site as required and directed, and store them in their go-down at the site of construction, and also bear all the expense incurred in connection therewith, including payment of taxes, octroi, storage, watch and ward etc.

14. The rates quoted by the Contractor shall include all eventualities, such as heavy rain, sudden floods, accidents, fire, riots etc., which may cause damage to the executed work or which may totally wash out the work. Until the completion certificate is issued to the Contractors, neither the Consultant nor the clients will be responsible for such damage or wash out of the construction work.

15. Time is the essence of the contract. The work should be completed within 3 Months for **BSL-3 HVAC works at CDFD Premises Uppal Hyderabad Complex-500 039.** from the date of commencement. The date of commencement shall be

    a) The day One week from the date of issue of Letter of Intent.
       Or
    b) The day on which the contractor receives the possession of the site whichever is later.
       Or
    c) The contractor is asked in writing to take over the possession of the site.

16. If the contractor fails to complete the work by the Scheduled date of completion or within any sanctioned extended time, he will have to pay liquidated damages at the rate of 1% of contract amount for each week of delay the work subject to maximum of 5% of the contract value (without extra items) as per clause 31 of the General conditions of contract.

17. The quantities contained in the Schedule are only indicative. The work as actually carried out and done will be measured up from time to time, for which payment will be made subject to the terms and conditions of contract.

18. The unit prices shall be deemed to be fixed prices. In case of extra items, a record of labour charges paid shall be maintained and shall be presented every month for extra/substituted items regularly to the Consultant for checking. The settlement will be made based on figures arrived at jointly and taking into account unit prices of items of work mentioned in the contract assigned to the successful tenderers. In case, of extra items, where similar or comparable items are quoted in the tender, extra rates shall invariably be based on those tender rates to the extent reasonable.

19. Our clients, M/s Centre for DNA Fingerprinting and Diagnostics, do not bind themselves to accept the lowest or any tender and reserve to themselves the right to accept or reject any or all tenders, either in whole or in part, without assigning any reason whatsoever for doing so.

20. No employee of the client is allowed to work as a contractor for a period of two years of his retirement from client service, without the previous permission of the client. This contract is liable to be cancelled, if either the contractor or any of his employees is found at any time to be such a person who had not obtained the permission of the client as aforesaid before submission of the tender or engagement in the contractor's service.

21 The tenderer, apart from being a competent contractor must associate himself with agencies of the appropriate class who are eligible to tender for (1) Electrical (2) Sanitary & Water Supply installations and as the case maybe.

22. Release of security deposit:

i) 50% of the total security deposit will be released along with the final certificate of payments as stipulated under para 10 on page 10, Appendix to General Conditions of contract,

ii) Balance 50% of Retention money will also be released as noted under(i) above, subject to submission of a Bank Guarantee, to the satisfaction of M/s CDFD for an equivalent amount. This Bank Guarantee shall be valid up to completion of defects/removal liability period plus 3 months.

ARTICLES OF AGREEMENT

ARTICLES OF AGREEMENT made the _____ day of _____ 2020 between _____
_____
of _____
_____
(Hereinafter called the "Employer") of the one part and _____
of _____ (hereinafter called "The Contractor") of the other part, whereas the Employer is desirous of getting the work of "Proposed **BSL-3 HVAC works at CDFD Premises Uppal Site-A Hyderabad Complex-500 039.**, Hyderabad" executed and has caused drawings, conditions of contract, specifications and schedule of quantities etc., describing the works prepared by M/s SMEP CONSULTANTS, Hyderabad.

AND WHEREAS the SAID DRAWINGS numbered as per list attached inclusive of and the conditions of contract, specifications and schedule of quantities etc., have been signed by or on behalf of the parties hereto.

AND WHEREAS THE CONTRACTOR has agreed to execute upon and subject to the conditions set forth in the Schedule hereto (hereinafter referred to as "Said Conditions") the works shown upon the said drawings and described in the same specifications and included in the said schedule of quantities for such sum as may be ascertained to be payable in terms of the Bills of Quantities, and which sum is estimated to be Rs. 1,56,38,519/- (Rupees One Crore Fifty Six Lakhs Thirty Eight Thousand Five Hundred and Nineteen Only) (hereinafter referred to as "Said Contract Amount").

NOW IT IS HEREBY AGREED AS FOLLOWS:

1. In consideration of the said sum to be paid at the times and in the manner set forth in the said conditions, the contractor shall upon and subject to the said conditions, execute and complete the work shown in the said drawings and described in the said specifications.

2. The Employer shall pay the contractor the said sum or such sums as shall become payable hereunder at the times and in the manner specified in the said conditions.

3. The term "Consultant" in the said conditions shall mean the said M/s SMEP CONSULTANTS, or in the event of their ceasing to be the Consultant for the purpose of this contract, such other person as shall be nominated for that purpose by the Employer , not being a person to whom the contractor shall object for reasons considered to be sufficient by the Arbitrator mentioned in the said conditions provided always that no persons subsequently appointed to be the Consultant under this contract shall be entitled to disregard or over-rule any previous decision or approval or direction given or expressed by the Consultant for the time being.

4. Tender documents containing Notice to the Contractor, Conditions of Contract, Appendix thereto, Special Conditions of Contract, Specifications and Schedule of Quantities with the rates entered therein, shall be read and studied as forming part of

this agreement and the parties hereto shall respectively abide by and submit themselves to the conditions and stipulations and perform the agreement on their part respectively in such conditions contained.

5. The contract is neither a fixed lump sum contract or a piece work contract, but is a contract to carry out work in respect of the entire works to be paid for according to actual measured quantities, including variations from BOQ at the rates contained in the Schedule of rates and Probable bill of quantities or as provided in the said conditions.

6. The Employer through the Consultant, reserves to himself the right of altering the drawings and natures of the work, of adding/substitution to or omitting any items of work or having portions of the same carried out through alternate agencies without prejudice to this contract.

7. Time shall be considered as the essence of this agreement and the contractor hereby agrees to commence the work soon after the site is handed over to him but within 7 days reckoned from the date of issue of Letter of Intent to execute the work, as provided for in the said conditions and complete the entire work in subject to nevertheless to the provisions for extension of time.

8. This agreement and contract shall be deemed to have been made in Hyderabad and any questions or dispute rising out of or in any way connected with this Agreement and Contract shall be deemed to have arisen in Hyderabad and only the courts in Hyderabad shall have jurisdiction to determine the same.

AS WITNESS our hand this _____ day of _____ 2020

Signed by the said in the presence of:

WITNESS: SIGNATURE

NAME :

ADDRESS: EMPLOYER

WITNESS: SIGNATURE

NAME :

ADDRESS:

APPENDIX TO GENERAL CONDITIONS OF CONTRACT

1.	Estimated cost	:	Rs. 1, 56, 38,519/- lakhs
2.	Earnest Money Deposit (EMD)	:	Rs. 1, 56,385/-lakhs
3.	Initial Security Deposit (ISD)	:	Rs. 7,81,925/-of contract value including EMD.
4.	Period of completion	:	3 Months
5.	Defects Liability period	:	12 months after completion as recorded in the completion Certificate.
6.	Agreed Liquidated Damages	:	1% of contract amount per week of delay subjected to a maximum of 5% of contract value.
7.	Period of final measurement	:	One month after completion as Recorded in the completion certificate.
8.	Minimum value of work to be Executed for issue of interim Certificates for making payment	:	Minimum of Rs. 20 lakhs
9.			
a.	Retention money from each bill	:	---------of gross value of each interim bill, subject to 9(b) below.
α.	Total retention money including Earnest money and initial security Deposit	:	---------of the contract value.
10.	Release of Security deposit after Virtual completion.	:	50% of the total security to be released along with final certificate of payment, but only after removing all his materials, equipment, all his installations, machinery etc., from the site. Balance payment to be released on submission of Bank Guarantee on any Scheduled Bank……., in the prescribed manner and valid till the completion of defects liability period of 12 months + 3 months.
11.	Period for honoring certificate	:	-------working days from date of Consultant certificate of payment for interim bills and 30 working days for final certificate.

WITNESS :

DATE : SIGNATURE OF THE CONTRACTOR WITH DATE

INDEX TO GENERAL CONDITIONS OF CONTRACT

22. Unfixed materials
23. Removal of improper work and materials
24. Defects after completion
25. Certificate of virtual completion
26. Other persons engaged by the Employer
27. Insurance in respect of damage to persons and property
28. Contractor's All risk policy
29. Commencement and completion
30. Delay and extension of time
31. Damages for Non-completion
32. Failure by contractor to comply with Consultant's instructions
33. Consultant's delay in progress.
34. Suspension of works
35. Prime cost and provisional sums
36. Certificates and payments
37. Notices
38. Termination of contract by the Employer.
39. Termination of contract by the contractor.
40. Matters to be finally determined by the Consultant
41. Settlement of dispute (Arbitration)

GENERAL CONDITIONS OF CONTRACT

1. **INTERPRETATIONS:**

In constructing these conditions and the specifications, schedule of quantities and contract agreement, the following words shall have the meaning herein assigned to them except where the subject or context otherwise required:

a. "Employer" shall mean M/s. Centre for DNA Fingerprinting and Diagnostics, Uppal, Hyderabad and shall include their heirs, legal representatives, assignees and successors.

b. "Contractor" shall mean _____
_____
and shall include his/their heirs, legal representatives, assignees and successors.

c. "Client's Engineer" shall mean any Engineer who is employed by M/s Centre for DNA Fingerprinting and Diagnostics (CDFD), Uppal, Hyderabad, and certified in writing to the Consultant and the contractor, to act as Engineer for the purpose of the Contract in place of the said engineer.

d. "Employer's Representative" shall mean Project Management Consultants employed by the client/any assistant of the Engineer or any site engineer/ PMC appointed from time to time by the employer to perform the duties set forth in clause 16 hereof whose authority shall be notified in writing to the Consultant and Contractor by the EMPLOYER.

e. "Consultant" shall mean any Engineer/ representative appointed by M/s SMEP CONSULTANTS, Hyderabad.

f. "Works" shall mean the works to be executed in accordance with contract specifications, quantities etc.

g. "Contract" shall mean the Articles of Agreement, the General Conditions, Special Conditions, the Appendix, the Schedule of Quantities, Specifications and drawings etc., attached hereto and duly signed.

h. "Contract Price" shall mean the sum named in the tender, subject to such amount additions thereto or deductions there from as may be made under the provisions, hereinafter contained.

i. "Site" shall mean the lands and other places as shown on the site plan, on which the works are to be, provided, by the Employer or Consultant for the purpose of the Contract.

j. "Drawings" shall mean the drawings referred to in the contract etc., and any modifications of such drawings approved in writing by the Consultant and the Employer and such other drawings as may from time to time be furnished or approved in writing by the Consultant and Employer.

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

l. "Act of Insolvency" shall mean any Act of Insolvency as defined by the Presidency Towns Insolvency Act, or the Provincial Insolvency Act or any act amending such original.

m. "Net Prices" if in arriving at the Contract Amount, the contractor has added to or deducted from the total of the items of the Tender any sum, either as a percentage or otherwise, then the net price of any items, in the tender, shall be the sum arrived at by adding to or deducting from the actual figure appearing in the Tender, as the price of that item, a similar percentage or proportionate sum. Provided always that in determining the percentage or proportion of the sum so added or deducted by the contractor, the total amount of any Prime cost items and provisional sums of money shall be deducted from the total amount of the Tender. The expression "net rates" or "net prices" when used with reference to the contract or account shall be held to mean rates or prices so arrived at.

n. "Virtual Completion" shall mean that the building is in the opinion of the Consultant and Employer, sufficiently completed for occupation by the Employer, in relation to the scope of work of this contract.

o. Words importing persons include firms and corporations. Words importing the singular only, also include the plural and vice versa, where the context requires.

2. **SCOPE OF CONTRACT:**

The contractor shall carry out and complete the said work in every respect in accordance with this contract with the directions of and to the satisfaction of the Consultant and Employer. Consultant, with the approval of the Employer, may issue further drawings and/or written instructions, details, directions and explanations, which are hereafter collectively referred to as "Consultant's Instructions" in regard to:

α. The variations or modifications of the designs, quality or quantity of works or the addition or omission or substitution of any work.

β. Any discrepancy in the drawings or between the Schedule of Quantities/ or drawings and/or specifications etc.

χ. The removal and/or re-execution or any works executed by the contractor.

δ. The removal from the site of any material brought there on by the contractor and the substitution of any other material there from.

ε. The dismissal from the works of any person employed thereupon.

ϕ. The opening up for inspection of any work covered up.

γ. The amending and making good of any defects under clause 23 "Removal of Improper works and Materials".

The contractor shall forthwith comply and fully execute any work comprised in such Consultant's instruction, provided always that instructions, directions and explanations given to the contractor or his representative upon the works by the Consultant shall, if involving a variation, be confirmed in writing by the contractor or within 7 days, and if not dissented from in writing within further 7 days by the Consultant, such shall be deemed to be the Consultant instructions with in the scope of contract.

If compliance with the Consultant's instructions as aforesaid involved work and/or expense and/or loss beyond that contemplated by the contract, then unless the same were issued owing to some breach of this contract by the contractors, the employer shall pay to the Contractor on the Consultant's certificate, the price of the said work (as an extra to be valued as herein after provided) and/or expense and/or loss.

Other than BOQ any items that become necessary in this work at a later stage as per the employer's requirement the contractor has to provide and execute at site. The contractor will be paid as per the prevailing market rate (depending upon the type model selected by employer) actual material cost + taxes applicable + transportation charges + 15% for overhead and profit. The analysis of market rate shall be prepared by the Consultant and approved by the Employer.

3. DRAWINGS AND SPECIFICATIONS:

The works shall be carried out to the entire satisfaction of the EMPLOYER and the Consultant, in accordance with the signed contract document, drawings and specifications and such further drawings and details as may be provided by the Consultant, and in accordance with such written instructions, directions and explanations, as may from time to be given by the Consultant and the Employer, whose decision as to the sufficiency and quality of the work and materials shall be final and binding on the contractor. If the work shown on any such further drawings or work that may be necessary to comply with any such instructions, directions or explanations, be in the opinion of the contractor outside the scope of work or

reasonably could not be inferred from the contract, he shall before proceeding with such work, give notice in writing to this effect to the Consultant and the Employer, and in the event of the Consultants and the Employer agreeing to the same in writing, the contractor shall be entitled to an allowance in respect of such extra work as an authorized extra. If the Consultant and the contractor fail to agree, as to whether or not there is an extra, then, if the Consultant decided that the contractor is to carry out the said work, the contractor shall do so, and the question whether or not there is any extra and if so, the amount thereof, shall failing agreement be settled by Arbitration as hereinafter provided, but such reference shall in no way delay the fulfillment of this contract.

No drawing shall be taken as in itself an order for variation, unless in addition to the Consultant's signature, it bears express works stating that it is intended to be such an order or bears a remark "VALID FOR CONSTRUCTION". No claim for payment for extra work shall be allowed, unless the said work shall have been executed under the provisions of clause 8 (Authorities, notices, patents, rights and royalties) or by the authorities, of directions in drawing of the Consultant as herein mentioned.

One complete set of the signed drawings and a copy of contract document (specifications and schedule of quantities etc) shall be furnished by the Consultant to the contractor. The Consultant shall furnish within such time as he may consider reasonable, one copy of any additional drawings, which in his opinion may be necessary for the execution of any part of the work. Such copies shall be kept at the works, and the Consultant or hiss representatives shall, at all reasonable times have access to the same and shall be returned to the Consultant by the Contractor, before the issue of the final certificate. The original contract documents shall remain in the custody of employer.

Please refer clause 36 of Special conditions of contract.

4. SCHEDULE OF QUANTITIES:

The Schedule of Quantities unless otherwise stated shall be deemed to have been prepared in accordance with the Standard Procedure of the Consultants and shall be considered to be approximate and no liability shall attach to the Consultant for any error/variations that may be discovered therein.

Please refer Clause 5, 6 and 40 of Special conditions of contract.

5. SUFFICIENCY OF SCHEDULE OF QUANTITIES:

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

Please refer clauses 4, 5 and 33 of Special Conditions of Contact.

6. ERRORS IN SCHEDULE OF QUANTITIES:

Should any error appear in the Schedule of Quantities, other than in the Contractor's prices and calculations, it shall be rectified and such rectification shall not vitiate the contract but shall constitute a variation of the contract and be dealt with as an authorized extra or deduction.

7. CONTRACTOR TO PROVIDE EVERYTHING NECESSARY:

The contractor shall provide everything necessary for the proper execution of works according to the true intent and meaning of the drawings, specifications and the Schedule of Quantities etc., taken together, whether the same may or may not be particularly shown or described there in, provided the same can be inferred there from. The several documents forming the contract are to be taken as mutually explanatory to one another; detailed drawings and figured dimensions in preference to scale, and special conditions in preference to General conditions and particular specifications in preference to General specifications.

In case of discrepancy between the Schedule of Quantities, the specifications and/or the drawings, the following order of preference shall be observed:-

i) Description of Schedule of Quantities.
ii) Particular specifications and special condition, if any.
iii) Drawings.
iv) C.P.W.D. specifications.
v) Indian Standard specifications of B.I.S.

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

Any error in description, quantity or rate in schedule of quantities or any omission therefrom shall not vitiate the contract or release the contractor from the execution of the whole or any part of the works expressed therein according to drawings and specifications or from any of his obligations under the contract.

The contractor shall make his own arrangements for providing water, for carrying out the work, at his own cost. If water from any source other than Municipal main is to be used for construction, the same shall be tested at the contractor's cost, and a report submitted to the Consultant for his approval, before such water is used for the works. Temporary Electrical connections shall be obtained by the contractor to facilitate execution and completion of work at their cost and all the charges there of should be borne by them.

The contractor shall supply, fix and maintain at his cost, during the execution of any works, all the necessary centering, scaffolding, staging, planking, timbering, strutting, shoring, pumping, fencing, hoarding, watching and lighting during nights as well as

by day required not only for the proper execution and protection of the said works, but also for the protection of the public and the safety of any adjacent road, streets, cellars, vaults, pavements, walls, houses, buildings and all other erections, matters or things. The Contractor shall take down and remove any or all such centering, scaffolding, staging, planking, strutting, shoring etc., as occasion shall require or when ordered or so to do, and shall fully reinstate at his own cost and make good all the matters and things disturbed during the execution of the works to the satisfaction of the Consultants.

Please refer clause 6 of Special conditions of contract.

8. AUTHORITIES, NOTICES, PATENT RIGHTS AND ROYALTIES:

The contractor shall conform to the provisions of the statutes relating to the works, and to the regulation and by laws of any local authority, and of any water, lighting and other companies or authorities, with whose systems the structures are proposed to be connected; and shall before making any variation from the drawings or specifications, that may be necessitated by so conforming, give to the Consultants a written notice, specifying the variations proposed to be made and the reason for making it and apply for instruction thereon. In case, the contractor shall not within ten days receive such instructions, he shall proceed with the work conforming with the provisions, regulations or by laws in question.

The contractor shall bring to the attention of the Consultant all notices required by the said acts, regulations or bylaws to be given to any authority, and pay to such authority or to any Public Officer all fees that may be properly chargeable in respect of the works, and lodge the receipts with the Consultants.

The contractor shall indemnify the Employer against all claims in respect of patent rights, designs, trademarks or name or other protected rights in respect of any constructional plant, machine, work or material used for or in connection with works or temporary works and from and against all claims, demands, proceedings, damages, costs, charges, and expenses whatsoever in respect thereof or in relation thereto. The Contractor shall defend all actions arising from such claims, unless he has informed the Consultants, before any such infringement and received their permission to proceed, and shall himself pay all royalties, license fees, damages, cost and changes of all and every sort that may be legally incurred in respect thereof.

Please refer clause 17 of special conditions of contract.

9. MATERIALS AND WORKMANSHIP TO CONFORM DESCRIPTION:

All materials and workmanship shall, so far as procurable be of the respective kinds specified in the Schedule of Quantities and/or specifications and in accordance with the Consultant’s furnish to them all invoices, accounts, receipts and the other vouchers

to prove that the materials comply therewith. The contractor shall at his own cost arrange for and/or carry any test of any materials, cost arrange for and/or carry any test of any materials, which the Consultant & Employer may require. The costs of materials used for testing, packing, transportation and testing shall be borne by the contractor and his quoted rates/amounts shall include all such expenses/contingencies.

9a. In case of non-availability of specified Make/brand of any material including steel and cement the alternate make/brand will be given by the Employer in consultation with the Consultant.

10. **THE SETTING OUT:**

The Contractor shall at his own expense, set out the works accurately in accordance with the plans and to the complete satisfaction of the Consultant. The Contractor shall be solely responsible for the true and perfect setting out of the same and for the correctness of the positions, levels, dimensions and alignment of all parts thereof. If at any time any error shall appear during the progress or on completion of any part of the work, the contractor shall at his cost rectify such error if called upon to the satisfaction of the Consultants/Employer. The work shall from time to time be inspected by the Consultant and/or his representatives, but such inspections shall not exonerate the contractor in any way from his obligation to remedy any defects, which may be found to exist at any stage of the work or after the same is completed, at his own cost.

11. **REMOVAL OF ALL OFFENSIVE MATTERS:**

All soil, filth or other matter of an offensive nature, taken out of any trench, sewer, drain, cesspool or other place shall not be deposited on the surface, but shall at once be carried out away by the contractor to some pits or place provided by them and shall be disposed off as per the rules and regulations of the Local authorities concerned.

12. **OPENING UP WORKS:**

The contractor shall notify the Consultant in writing immediately, the trenches or excavation as shown on the drawings are get ready or as soon as any ground is cut into which, from unexpected causes, appears need for immediate attention. After notifying the Consultant, he shall await instructions, which shall be given within ten days of receipt of such notice. If the contractor put in any parts of the foundations before he has so notified the Consultant and received instructions, he shall be liable to reinstate all such work that may be subsequently, at any time, damaged on account of any defect or insufficiency of the foundations. The Contractor shall at the request of the Consultant, within such time as the Consultant so desires, open for inspection any work, and should the contractor refuse or neglect, to comply with such request, the employer, through the Consultant may employ other workmen to open up the same. If the said work has been covered up in contravention of the Consultant's instructions, or if, on being opened up, it be found in accordance with the drawings and specifications, or the instructions of the Consultant or otherwise, the expenses of such

other workmen shall be borne by and recoverable from the contractor, or may be deducted from any money due or which may become due to the contractor. If the work has not been covered up in contravention of such instruction, and be found in accordance with the said drawings and specifications and instructions, then the expenses aforesaid shall be borne by the Employer and be added to the contract sum, provided always that in the case of foundations or of any other urgent work so opened up and requiring immediate attention, the Consultant shall within seven days after receipt of the written notice from the contractor that the work has been opened, make or cause the inspection thereof to be made, and at the expiration of such time, if such inspection shall not have been made, the contractor may cover the same and shall not be required to open it up again, except at the expenses of Employer.

Refer clause 6 & 19 of special conditions of contract.

13. CONTRACTOR'S SUPERINTENDENCE & REPRESENTATIVE ON THE WORKS:

The contractor shall give all necessary personal superintendence during the execution of the works and so long thereafter as the Consultant may consider it necessary until the expiration of the "Defects Liability Period" stated in clause 24. The Contractor shall meet the Consultant or his representative, whenever required and so informed by the Consultant.

The Contractor shall maintain and be represented at site at all times, while the work is in progress, by a responsible and efficient foreman, approved by the Consultant and who must thoroughly understand all the trades entailed and be constantly in attendance while the men are at work. Any directions, explanations, instructions or notices give by the Consultant & Employer to such foreman shall be deemed to have been given to the contractor and shall be binding as such on the contractor. The Foreman shall be thoroughly conversant with the English language and should be able to read, write and speak English.

14. DISMISSAL OF WORKMEN:

The contractor shall on the request of the Consultant and Employer immediately dismiss from the works any person employed thereon who may, in the opinion of the Consultant and Employer be unsuitable or incompetent or who may misconduct himself, and such person shall not again be employed or allowed on the works without the permission of the Consultant & Employer.

15. ACCESS TO WORKS:

The Consultant, the Employer and any person authorized by them shall at all reasonable times have free access to the works and to the workshops, factories or other places where materials are being prepared or constructed by the contract and also to any place where the materials are lying or from which they are being obtained. The Contractor shall give every facility to the Consultant and the Employer and their

representatives for inspection and examination and test of the materials and workmanship. No person, unless authorized by the Consultant or the Employer, except the representatives of Public authorities, shall be allowed on the works at any time. If any work is to be done at a place other than the site of works, the contractor shall obtain the written permission of the Consultant for doing so.

16. **EMPLOYER'S REPRESENTATIVE/PMC:**

The Employer may appoint an assistant to the Engineer, any Site Engineer or Project Management Consultant (PMC), who shall be the representative of the Employer. The duties of the Employer's representatives are to watch and supervise the works and to test any materials to be used and of workmanship employed in connection with the works. He shall have no authority either to relieve the contractor of any of his duties or obligations under the contract, or except those expressly provided hereunder, to order any work involving delay or any extra payment by the Employer or any variation of or in the works.

The contractor shall afford the Employer's representative every facility and assistance for examining the works and materials and checking and measuring item and materials. Neither the Employer's representative nor any assistant to the Consultant shall have power to revoke, alter, enlarge or relax the requirements of this contract, or to sanction any new-work, additions, alterations, deviations or omissions unless such an authority may be specially conferred by a written order of the Consultant and Employer.

The Employer's representative shall have to give notice to the Contractor or his representing about the non-approval of any work or materials and such works shall be suspended or the use of such materials should be discontinued until the decision of the Consultant is obtained. The work will from time to time be examined by the Consultant or the Employer's representative, but such examinations shall not in any way exonerate the contractor from the obligation to remedy any defects, which may be found to exist at any stage of the work or after the same is completed. Subject to the limitations of the clause, the contractor shall take instructions only from the Consultant and Employer.

17. **ASSIGNMENT OF SUB-LETTING:**

The works included in the contract shall be executed by the contractor and the contractor shall not directly or indirectly transfer, assign or underlet the contract or any part/share thereof or interest therein without the written consent of the Consultant and Employer, and no undertaking shall relieve the contractor from the full and entire responsibility of the contract or from active superintendence of the works during their progress.

18. **SUB-CONTRACTORS:**

All specialists, merchants, tradesmen, and others, executing any work or supply and

fixing any goods for which prime cost prices or provisional sums are included in the Schedule of Quantities and/or specifications, who may be nominated or selected by the Consultant and employer and hereby declared to be sub-contractors employed by the Contractor, are herein referred to as nominated sub-contractors. No nominated sub-contractors shall be employed on or in connection with the works, against whom the contractor shall make reasonable objection or (see where the Consultant and contractor shall otherwise agree), who will not enter into a contract provided.

a. The nominated sub-contractors shall indemnify the contractor against the same obligations in respect of the sub-contract as the contractor is under, in respect of this contract.

b. The nominated sub-contractors shall indemnify the contractor against claims in respect of any negligence by the sub-contractor, his servants or agents or any misuse by him or them of any scaffolding or other plant, the property of the contractor or under any Workman's Compensation Act in force.

c. Payment shall be made by the contractor to the nominated sub-contractor, within 14 days of receipt of the Consultant's certificate, provided that before any certificate is issued, the contractor shall upon request furnish to the Consultant proof that all nominated sub-contractor's account included in the previous certificates have been duly discharged; in default whereof the Employer may pay the same upon a certificate of the Consultant and deduct the amount thereof from any sums due to the contractor. The exercise of this power shall not create any contract between Employer and Sub-contractor.

19. **VARIATIONS NOT TO VITIATE CONTRACT:**

The contractor shall when directed in writing by the Consultant, omit from or vary works shown upon the drawings or described in the specifications or included in the priced schedule of quantities, but the contractor shall not make any alterations or additions to or omissions from the works or any deviations from the provisions of the Contract without such authorizations or direction in writing from the Consultant and Employer.

No claim for any extra item or deviations shall be allowed, unless it shall have been executed by the Authority of the Consultant and Employer as herein mentioned. Any such extra item or deviation is hereinafter referred to as an authorized extra item or deviation. No variations i.e., additions, omissions or substitutions shall vitiate the contract.

The rate of items not included in the bill of quantities shall be settled by the Consultant and Employer in accordance with the provisions of clause 21, hereof.

20. MEASUREMENTS OF WORKS:

The Consultant/PMC may from time to time intimate the Contractor that he requires the works to be measured and the contractor shall forthwith attend or send a qualified agent to assist PMC/Consultant's representative in taking measurements and calculations, and to furnish all particulars or give all assistance required by either of them.

Should the contractor no attend or neglect or omit to send such an agent, then the measurements and calculations, and to furnish all particulars or give all assistance required by either of them.

Should the contractor not attend or neglect or omit to send such an agent, then the measurements taken by the PMC/Consultants representative approved by them shall be taken to be the correct measurements. The mode of measurements wherever not mentioned in contract documents be taken in accordance with the Indian Standard of Method of measurements of building works (I.S.1200 – 1958) and its revisions, if any. In case of any discrepancy between various contract documents on mode of measurements, the mode given in Bill of Quantities will take precedence over others.

The contractor or his agent may at the time of measurement take such notes and measurements as he may require.

All authorized extra works, omissions and all variations made without the Consultant's knowledge, if substantially sanctioned by him in writing shall be included in such measurements.

21. PRICES FOR SUBSTITUTIONS/EXTRA ETC., ASCERTAINMENT OF:

Should it be found after the completion of the works from measurements taken (in accordance with the previous paragraph) that any of the quantities or amounts specified for the works in the priced schedule of quantities of work thus ascertained are less or greater than the amounts and/or tender or that any variations, is made, and any substituted/ extra (new) items have been executed, the valuation of such quantities/items, amounts or variations, unless previously or otherwise agreed upon, shall be made in accordance with the following rules:

a. The net rates or prices in the original tender shall determine the valuation of the extra (additional quantities and or extra/substituted item of work), where that work is of a similar character and executed under similar conditions of the work priced therein. This applied to extra and substituted items of work to the extent, they are similar in nature to the items in the contract.

b. The net prices given in the original ender shall determine the value of the items omitted, provided if omissions vary the conditions under which any remaining items of work are carried out, the prices for the same shall be valued under thereof.

c. Where extra/substituted item of works are not of similar character (either partly & fully) and/or executed under similar conditions as aforesaid or where the omissions vary the conditions under which any remaining items of works are carried out or if the amount of any omission or additions relative to the amount of the whole of the contract works or to be any part thereof shall be such that in the opinion of the Consultants the net rate or price contained in the priced schedule of quantities or tender or for any item of the work involves less or more beyond that reasonably contemplated by the Contractor or is by reason of such omission or addition rendered unreasonable for in-applicable, the Consultant shall fix in consultation with the Employer such other rates or prices as in the circumstances he shall think reasonable and proper, which shall be final and binding on the contractor. For extra and substituted items this will apply for portions of the items for which, items of similar nature are not available in the contract.

d. Where extra and or substituted items of work cannot be properly measured or valued, the contractor shall be allowed based on the net local day work rates and wages for the district and prevalent market rates for materials etc., at the time of ordering that item; provided that in either case vouchers for wages paid specifying the daily time (and if required by the Consultant, the workmen's name) and materials employed at or before the end of the week following that in which the work has been executed.

The measurements and valuations in respect of the extra and substituted items of work shall be completed within the "Period of final measurement" or within 3 (three) months from the completion of the contract works as defined under clause No.25 (certificate of virtual completion.

See Special Conditions of Contract Clause 35.

22. UNFIXED MATERIALS:

When any materials intended for the works shall have been placed at site by the contractor, such materials shall not be removed therefrom (except for the purposes of being used on the works) without the written authority of the Consultant and Employer and when the contractor shall have received payment in respect of any certificate in which the Consultant shall have stated that he has taken into account the value of such unfixed materials on the works such materials shall become the property of the Employer and the Contractor shall be liable for any loss or damage to any such materials.

23. REMOVAL OF IMPROPER WORK AND MATERIALS:

The Consultant shall, during the progress of the works, have power to order in writing from time to time the removal from the works, within such reasonable times as may be specified in the order, of any materials which in the opinion of the Consultant and Employer are not in accordance with the specifications or the instructions of the

Consultant and Employer; and the substitution with proper materials and the removal and proper re-execution of any work, which has be executed with materials or workmanship, not in accordance with the contract/drawings and specifications or instructions etc., the contractor shall forthwith carry out such orders at his own cost. In case of default on the part of the contractor to carry out such orders, the Employer shall have the power to employ and pay other persons to carry out the same and all expenses consequent thereon or incidental thereto shall be borne by the Contractor, and shall be recoverable from the contractor by the Employer, or may be deducted by the Consultant, from any money due or may become due to the contractor for this work or on any other account.

Instead of this procedure for work not done in accordance with the contract, the Consultant and Employer may allow such work to remain, and in that case may make allowance for the difference in value together with such further allowance for damages to the Employer, as in his opinion may be reasonable. This allowance shall be recoverable from the contractor by the Employer, or may be deducted by the Consultant, from any money due or may become due to the contractor for this work or on any other accounts. The decision of Consultants in these matters shall be final and binding on the contractor.

24. DEFECTS AFTER COMPLETION:

Any defect, shrinkage, settlement or other faults which may appear with in the "Defects Liability Period" stated in the Appendix on Page 26 i.e. within 12 months after the virtual completion of the works arising in the opinion of the Consultant and the Employer, from materials or workmanship not in accordance with the contract, shall upon the directions and writing of the Consultant and Employer and within such reasonable time as shall be specified therein, be rectified and made good by the Contractor at his own cost. In case of default, the Employer may employ any other person to amend and make good such defects, shrinkage, settlements or other faults. All damages, loss and expenses consequent therein or incidental thereto shall be made good and borne by the contractor and such damage, loss and expenses shall be recoverable from him by the employer or may be deducted by the Employer, the damages, loss and expenses from any sums that may be due to the contractor or amount retained under condition 36 (Certificate and payment) and in event of the amount retained being insufficient recover the balance from the amount held against EMD & Security deposit under clause 10.1 & 10.2 on Page 14, 15 or any other amounts due or may become due later.

25. CERTIFICATE OF VIRTUAL COMPLETION:

The contractors shall intimate in writing to the Consultants, as and when the works are complete in all respects in order to enable the Consultant to intimate the Employer to take possession of the same. The works shall not be considered as virtually completed, until the Consultant has certified in writing that the same have been "Virtually completed" and accepted by the employed. The defects liability period shall commence, only from the date of such virtual completion certificate.

26. OTHER PERSONS ENGAGED BY THE EMPLOYER:

The Employer reserves the right to use the premises and any portions of the site for the execution of any work not included in this contract which he may desire to carry out through other persons, and the contractor is to allow all reasonable facilities for the execution of such work, except by special arrangement with the Employer. Such work shall be carried out in such a manner a not to impede the progress of the works included in the contract, and the contractor shall not be responsible for any damage or delay which may happen to or be occasioned by such work.

27. INSURANCE IN RESPECT OF DAMAGE TO PERSONS AND PROPERTY:

The contractor shall be responsible for all injury to persons, animals or things and for all structural and decorative damage to property, which may arise from operation or neglect of himself or any of his or sub-contractor's employees, whether or any other cause whatever in any way connected with the carrying out of this contract. This clause shall be held to include, interlay any damage to buildings, whether immediately adjacent or otherwise, any damage to roads, caused to the buildings and works forming the subject of this contract by frost or other inclement weather. The contractor shall indemnify the employer and hold him harmless in respect of all and any expenses arising from any such injury or damage to persons or property as aforesaid and also in respect of any claim made in respect of injury or damage under any acts of government or otherwise, and also in respect of any award of compensation or damages consequent upon such claim.

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

The contractor shall indemnify the Employer against all claims which may be made against the Employer, by any member of the Public or other party, in respect of anything which may arise in respect of the works or in consequence thereof and shall at his own cost, effect and maintain until one month after the works are taken over by the Employer or three months after the date of completion of the contract with an approved office, a policy of Insurance in the joint names of the Employer and the contractor against such risks and signing of the contract. The contract shall also indemnify the employer against all claims which may be made upon the Employer whether under the Workmen's compensation act or any other stature in force during the currency of this contract or at common law in respect of any employees of the contractor or of any sub-contractor and shall at his own expense effect and maintain until one month beyond the virtual completion of the contract, with an approved office. A policy of Insurance in the joint names of the Employer and the Contractor against such risks and deposit such policy or policies with the Consultants from time to time, during the currency of the contract. In default of the contractor insuring as

provided above, the Consultant on behalf of the Employer may so insure and may deduct the premiums paid from any money due or which may become due to the contractor.

The contractor shall be responsible for anything which may be excluded from the Insurance Policies above referred to and also for all other damages to any property arising out of and incidental to the negligent or defective carrying out of this contract however, such damage shall be caused.

The Contractor shall also indemnify the Employer in respect of any costs, charges or expenses arising out of any claim or proceedings and also in respect of any Award of or compensation of damages arising therefrom.

The Employer with the concurrence of the Consultant shall be at liberty and is hereby empowered to deduct the amount of any damages, compensations, costs, charges and expenses arising or occurring from or in respect of any such claims of damages from any sums due or to become due to the contractor.

28. CONTRACTOR'S ALL RISK POLICY:

The contractor shall within 7 days from the date of commencement of the work insure the works at his cost and keep them insured until one month after the works are taken over by the Employer or three months after the date of completion whichever is earlier, against loss or damage by fire and usual risks other than fire against which insurers generally provide cover in a CONTRACTOR'S ALL RISK POLICY, with an insurer to be approved the Consultants, in the joint names of the Employer and contractor (the name of the former being placed first in the policy), progressively for the full amount of the contract, in three stages, beginning with 1/3 of the contract value, and for any further sum as called upon to do so by the Consultant, with the prior written consent of the Employer, the premium of such further sum being allowed to the contractor as an authorized extra. Such policy shall cover the property of the Employer only and Consultants and surveyor's fees for assessing the claim and in connection with his services generally in reinstatement and shall not cover any property of the contractor of any subcontractor or employee. The contractor shall deposit the policy and receipts for the premiums paid with the Consultants, within twenty one days of the date of commencement of work, unless otherwise instructed, as provided above failing which the employer or the Consultant on his behalf may insure and may deduct the premium paid from any money that may be due or that may become due to the contractor. The contractor shall as soon as the claim under the policy is settled, or the work reinstated by the insurers should they elect to do so, proceed with all due diligence with the completion of the works in the same manner as though the fire or other such risk had not occurred and in all respects under the same conditions of contract.

The contractor in case of rebuilding or reinstatement after fire or other such usual risk shall be entitled to such extension of time for completion as recommended by the Consultant.

Please refer Special Conditions of Contract, clauses.

29. **COMMENCEMENT AND COMPLETION:**

The contractor shall be allowed admittance to the site on the "Date of Commencement" stated in the Appendix, and he shall thereupon and forthwith begin the works and shall regularly proceed with and complete the same (except such painting or other decorative work as the Consultant may desire to delay) on or before the 'Day of Completion" started in the Appendix subject nevertheless to the provisions for extension of time hereinafter contained.

Refer clause 8 & 30 of Special Conditions of Contract.

30. **DELAY AND EXTENSION OF TIME:**

If in the opinion of the Consultant the works is delayed:

a. by force majeure, or

b. by reason of any exceptionally inclement weather, or

c. by reason of proceedings taken on threatened by or dispute with adjoining or neighboring owners or public authorities arising otherwise, than through the contractor's own default, or

d. by the works or delays of the contractors or tradesmen engaged or nominated by the Employer or Consultant and not referred to in the Schedule of Quantities and/or specifications, or

e. by reason of civil, commotion, local combination of workmen or strike or lock-out affecting any of the buildings/traders, or

f. by reason of the Consultant's instructions as per clause 2, or

g. In consequence of the contractor not having in due time, necessary instructions from the Consultant, for which he shall have specifically applied in writing ahead of time, giving reasonable time to prepare such instructions.

The Consultant shall make a fair and reasonable assessment for extension of time, for completion of the contract works which may be approved by the Employer.

In case of such strike or lock-out, the contractor shall as soon as possible, give written notice thereof to the Consultant, but the contractor shall nevertheless constantly use his endeavors to prevent delay and shall do all that may reasonably be required, to the satisfaction of the Consultant to proceed with the work.

31. **DAMAGES FOR NON-COMPLETION:**

If the contractor fails to complete the works by the date stated in clause 29 (date of completion) or within any extended time certified under clause 30 (extension of time)

and if the Consultant shall certify in writing on or before the date of issue of the certificate for the last payment to which the contractor may become entitled hereunder that the works could have been reasonably completed by the said date or within the said extended time, then the contractor shall pay to the Employer or allow the employer to recover from dues to the contractor on any account the sum stated in clause 16 of "Notice to contractors" (Page 16) (liquidated damages and not by way of penalty), subject to a maximum amount of 5% as stated in Appendix of General Conditions of contract (page 26) and as stated in clause 16 of "Notice to contractors"(Page 16) and such damages may be deducted from any money due or which may become due to the contractor.

The deduction of such sums shall not, however, absolve the contractor of his responsibility and obligations to complete the work in its entirety.

Please refer clauses 8 & 31 of special conditions of contract.

32. **FAILURE BY CONTRACTOR TO COMPLY WITH Consultant'S INSTRUCTIONS:**

If the contractor after receipt of written notice from the Consultant requiring compliance with such further drawings and/or Consultants instruction, fails within seven days to comply with the same, the Consultant and Employer may employ and pay other persons to execute any such work whatsoever as may be necessary to give effect thereto and all costs incurred in connection therewith shall be recoverable from the contractors by the employer on a Certificate by the Consultant as a debit or may be deducted by him from any money due or which may become due to the contractors.

33. **Consultant'S DELAY IN PROGRESS:**

The Consultant may delay the progress of the works in case of rains or otherwise, without vitiating the contract and grant such extension of time with the approval of the Employer for the completion of the contract as he may think proper and sufficient in consequence of such delay, and the contractor shall not make any claim for compensation or damage in relation thereto.

34. **SUSPENSION OF WORKS:**

If the contractor, except on account of any legal restraint upon the employer preventing the continuance of the works, or on account of any of the causes mentioned in the clause "Extension of time" or in the case of certificate being withheld or not paid when due, shall suspend works or in the opinion of the

Consultants, shall neglect or fail to proceed with due diligence in the performance of his part of the contract or if he shall more than once make default in the respects mentioned in clause 23 (removal of improper work and materials), the Employer through the Consultant shall have the power to give notice in writing to the contractor required that the works be provided within a reasonable manner, and with reasonable

dispatch, such notice shall not be unreasonably given and must signify that it purports to be a notice under the provisions of this clause and must specify the acts or defaults on the part of the contractor upon which it is based. After such notice shall have been given, the contractor shall not be at liberty to remove from the site of works, or from any ground contiguous thereto, the site of works, or from any ground contiguous thereto, any plant or materials belonging to him which shall have been placed thereon for the purpose of work, and the Employer shall have lien upon such plants and materials to subsist from date of such notice being given until the notice shall has been complied with, provided always that such line shall not under any circumstances subsist after the expiration of 30 (thirty) day from the date of such notice given, unless the employer shall have entered upon and taken possession of the works and site, as hereinafter provided.

If the contractor shall fail for seven days after such notice has been given, to proceed with the works as therein prescribed, the Employer may enter upon and take possession of the works and site, and of all such plants, machinery and materials thereon intended to be used for the works, and the Employer shall retain and hold a lien upon all such plants, machinery and materials until the work shall have been completed, under powers hereinafter conferred upon him;

If the Employer shall exercise the above power, he may engage any other person to complete the works and exclude the contractor, his agents and servants from entry upon or access to the same, except that the contractor or any person appointed in writing may have access at all times during the progress of the works to inspect, survey and measure the works. Such written appointments or a copy thereof shall be delivered to the Consultants before the person appointed comes on to the works and the Employer shall take such steps as in the opinion of the Consultant may be reasonably necessary for completion the works, without undue delay or expenses using for that purpose the plant, machinery and materials above mentioned in so far as they as they are suitable and adopted to such use.

Upon the completion of the works, the Consultants shall certify the amount of the expenses properly incurred consequent on and incidental to the default of the contractor as aforesaid and in completion the works by other persons.

Should the amount so certified as the expenses properly incurred be less than amount which should have been due to the contractor upon the completion of the works by him, the difference shall be paid to the contractor by the Employer, should the amount of the former exceed the later, the difference shall be paid by the contractor to the Employer. The Employer shall not be liable to make any further payments or compensations to the contractor for or on accounts of the proper use of the plant for the completion of the works under the provisions herein before mentioned other than such payments as is included in the contract.

After the works shall have been so completed by persons other than the contractor, under the provisions herein before contained, the Consultant shall give notice to the

contractor to remove his plan and all surplus materials as may not have been used in the completion of the works from the site.

If such plant and materials are not removed within a period of 14 days after the notice shall have been given, the Employer may remove and sell the same, holding the proceeds less the cost of the removal and sale, to the credit of the contractor. The Employer shall not be responsible for any loss sustained by the Contractor from the sale of the plant in the event of the Contractor not removing it after notice.

35. **PRIME COST AND PROVISIONAL SUMS:**

a. Where "Prime Cost" (P.C.) prices or provisional sums of money are considered for any goods or works in the specifications or Schedule of quantities or deviations hereof, the same are exclusive of any trade discounts, or allowances, discount for cash, or profit which the contractor may require and or carriage and fixing.

b. All goods or work, for which prime cost prices or provisional sums of money are considered may be selected or ordered from any manufacturer's or firms, at the discretion of the Consultant or the Employer. The Employer reserves to himself the right of paying directly for any such goods or work and the Consultant may deduct the said prices or sums from the amount of the contract. Should any goods or works for which prime cost prices or provisional sums are considered or portions of same be not required, such prices or sums, together with the profits allowed for such additional amount as the Contractor may have allowed for carriage and fixing will be deducted in full from the amount of the Contract. Whether the goods be ordered by the Contractor or otherwise, the contractor shall at his own cost fix the same, if called upon to do so, and the contractor shall also receive and sign for such goods and be responsible for their safe custody as and from the date of their delivery upon the works.

c. In cases in which provisional quantities of items/materials are contained in the contract, the contractor shall provide such materials and or execute such items to such amounts or to greater or lesser amounts as the Consultant shall direct in his schedule of quantities.

d. No prime cost sum or sums (or any portion thereof) shall be included in any certificate for payment to the contractor until the receipted accounts relating to them have been produced by the contractor to the Consultant. Such accounts shall show all discounts and any sum or sums in respect of such discounts shall be treated as a trade discount. Provided always, that should the contractor in lieu of producing such receipted accounts, request the Consultant in writing to issue a certificate to the

e. Employer for such sum or sums, due either on account or in settlement to a sub-contractor direct, the Consultant shall, upon satisfying himself that the sub-contractor is entitled to the same, so issue the certificate and such sum or sums be deducted from the amount of the contractor, at the settlement of accounts and any profit or sum to

which the contractor is properly entitled, in respect of such sub-contract, and which is in conformity with the terms of contract as though the amount of such certificates to the sub-contractor has been included in a certificate drawn in favor of the contractor.

f. If the contractor neither produces the receipt not gives authority to the Consultant to issue a certificate in favor of such sub-contractor direct, the Consultant may upon giving the contractor SEVEN DAYS NOTICE in writing of his intentions to do so, issue to the sub-contractor such certificate direct to the Employer and obtain a receipt from the sub-contractor, which receipt shall be deemed as a discharge for the amount of such certificates, as though given by the contractor. In such event, the contractor shall not be allowed any profit he may have added in the Schedule of Quantities upon such sub-contract.

g. The exercise of the option before referred to by the Contractor and the issue of certificates, as before described to sub-contractor direct of certificates by the Consultant, shall not however, relieve the contractor from any of the liabilities in respect of insufficient, faulty of in-completed work of the sub-contractor for which he may be liable under the terms of the contract.

36. CERTIFICATES AND PAYMENTS:

The contractor shall be paid by the Employer after due checking and after making necessary correction from time to time, by installments under Interim Certificates to be issued by the Consultant on account of the works executed by the contractor based on the joint measurements taken by the PMC, the Consultants representative and the contractors representative when in the opinion of the Consultant, work to the approximate value named in the Appendix on Page 26 as “Value of work for Interim Certificates”, (or less at the reasonable discretion of the Consultant & Employer) has be executed in accordance with the Contract, subject however, to a retention of the percentage of such value named in the Appendix hereto mentioned as “Retention Percentage for Interim Certificates”, until the total amount retained shall reach the sum named in the appendix as Total Retention Money, after which time the installments shall be up to the full value of the work subsequently so executed plus such amount as he may consider proper on account of materials delivered upon the site by the contractor for use in the work and available on the date of billing.

And when the works have been virtually completed and the Consultant shall have certified in writing that they have been so completed, the contractor shall be paid by the Employer after satisfying himself in accordance with the certificate to be issued by the Consultant, the sum of money named in the Appendix as ‘Installment after Virtual Completion’ being a part of the said Total Retention Money.

The Contractor shall be entitled to the payment of the final balance (balance security deposit/retention money) in accordance with the final certificate to be issued in writing by the Consultant at the expiration of the period referred to as ‘The Defects

Liquidation Liability period' in appendix on page 10 hereto, from the date of virtual completion or as soon after the expiration of such period as the work shall have been finally completed and all defects made good according to the true intent and meaning hereof, whichever shall happen, provided always that the issue by the Consultant of any Certificate during the progress of the works or after the completion shall not relieve the contractor from his liabilities in cases of fraud, dishonesty or fraudulent concealment relating to the works or materials or any matter dealt within the certificate, and in case of all such defects and insufficiencies in the works or materials, which reasonable examination would have disclosed. No certificate of the Consultant shall by itself be conclusive evidence that any works or materials to which it relates are in accordance with the contract.

The Consultant shall have power to withhold any Certificate, if the works or any parts thereof are not being carried out to his and employers satisfaction. The Consultant may by any certificate make any correction in any previous Certificate, which shall have been issued by him. Payment upon the Consultant's Certificates shall be made within the period named in the Appendix as 'Period of Honoring of Certificates, after such certificates have been delivered to Employer.

Please refer clause 31 & 39 of Special conditions of agreement.

37. **NOTICES:**

Notices for the Employer, the Consultant, or the Contractor may be served in person by obtaining a personal endorsement or may be sent to their respective Registered Office addresses by registered post with acknowledgment due, or may be sent to an address specified by them by registered post with acknowledgement due. Any notice sent by registered post shall be deemed to have been served at the time when in ordinary course of time it would be delivered.

38. **TERMINATION OF CONTRACT BY THE EMPLOYER:**

If the contractor being an individual or a firm, commit any act of insolvency, or shall be adjudged as Insolvent or being an incorporated Company shall have an order for compulsory winding up made against it or pass an effective resolution for winding up voluntarily or subject to the Supervision of the Court and of the Official Assignee of the Liquidator in such acts of insolvency or winding up, shall be unable within seven days after notice to him requiring him to do so, to show to the reasonable satisfaction of the Consultant that he is able to carry out and fulfill the contract, and to give security thereof, if so required by the Consultant.

Or if the contractor (whether an individual, firm or incorporated Co.) shall suffer execution to be issued.

Or shall suffer any payment under this contract to be attached by or on behalf of any of the creditors of the contractor.

Or shall assign or sublet this contract without the consent in writing of the Consultants/Employer first obtained.

Or shall charge or encumber this Contract or any payments due or which may be due to the Contract there under.

Or if the Consultant shall certify in writing to the Employer that the contractor,

a. has abandoned the contract or

b. has failed to commence the works, or has without any lawful excuse under these conditions suspended the progress of the works for 14 days, after receiving from the Consultant written notice to proceed, or

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

d. has failed to remove materials from the site or to pull down and replace work for 7 days after receiving from the Consultant written notice that the said materials or work were condemned and rejected by the Consultant under these conditions, or

e. has neglected persistently to observe and perform all or any of the acts, matters or things by this contract to the observed and performed by the Contractors for 7 days after written notice shall have been given to the contractor requiring the contractor to observe or perform the same, or

f. Has to the determent of good workmanship or in defiance of the Consultant's instructions to the contrary, sublet any part of the contract.

Then and in any of the said cases the Employer with written consent of the Consultant, may notwithstanding any previous waiver, after giving 7 days' notice in writing to the contractor, determine the contract, but without hereby affecting the powers of the Consultant to continue in force as full as if the contract has not been so determined and as if the works subsequently executed has been executed by or on behalf of the contractor.

And further, the Employer under recommendations of the Consultant, by his Agents, or servants may enter upon and take possession of the works and all plants, tools, scaffoldings, sheds, machinery, and other equipment and materials also laying upon the premises or the adjoining lands or roads, and use the same as his own property or may employ the same by means of his own servants and workmen in carrying on and completion the works or by

employing any other contractors or other persons to complete the works and

the contractor shall not in any way interrupt or do not act, matter or thing to prevent or hinder such other contractor or other persons or person employed for completing and finishing or using the materials and plant for the works. When the works shall be completed or soon thereafter as convenient, the Consultant shall give a notice in writing to the contractor to remove his surplus materials and plant, and should the contractor fail to do so, within a period of 14 days, after receipt thereof by him, the Employer shall sell the same by publication and shall give credit to the contractor for the amount realized. The Consultant shall thereafter ascertain and certify in writing under his hand when (if anything) what shall be due to or payable by the Employer for the value of the said plant and materials so taken possession of by the Employer, and the expense or loss, which the Employer shall have incurred due to the contractor, and the amount which shall be so certified shall thereupon be paid by the Employer to the contractor or by the contractor to the Employer, as the case may be.

39. **TERMINATION OF CONTRACT BY CONTRACTOR:**

If payment of the amount payable by the Employer under certificate of the Consultant as provided for hereinafter shall be in arrears and unpaid for 30 (thirty) days after notice in writing requiring payment of the amount, as aforesaid shall have been given by the Contractor to the Employer, or if the Employer obstructs the issue of any such certificates, or if the employer commits any Act of insolvency, or if the Employer (being an incorporated company) shall have an order made against him or pass an effective.

Resolution for winding up, either compulsorily or subject to the supervision of the Court or voluntarily, or if the Official Liquidator or the Employer shall repudiate the contract, or if the if the Official Liquidator in any such winding up shall be unable within 15 days' notice to him requiring him to do so, to the reasonable satisfaction of the contractor that he is not able to carry out and fulfill the contract and to give security for the same (including Earnest money), or if the works be stopped for any payments due, and to become due thereunder and if required under the order of the Consultants or the Employer or by an injunction or other order of any court of law, then in any of the said cases, the contractor shall be at liberty to determine the contract by notice in writing to the Employer/Consultant, and he shall be entitled to recover from the Employer, payment for all works executed and for any losses he may sustain, upon any plant or materials supplied or purchased or prepared for the purpose of the contract.

In arriving at the amount of such payment, the net rates contained in the contract shall be followed, or where the same may not apply, valuation shall be made in accordance with clause 21 thereof.

40. Matters to be finally determined by the Consultants and the Employer (Called excepted matters) – (refer 41(a) below), which shall be final, conclusive and binding on the following matters:

a) Instructions
b) Transactions with local authorities
c) Proof of quality of materials
d) Assigning or under letting of the contract,
e) Certificate as to the causes of delay on the part of the contractor and justifying extension of time or otherwise,
f) Rectification of defects pointed out during the defects liability period.
g) Notice to the contractor to the effect that he is not proceeding with due diligence.
h) Certificate that the contractor has abandoned the contract.
i) Notice for determination of the contract by the Employer.
j)

41. **ARBITRATION:**

a. All disputes or differences of any kind whatsoever, which shall at any time arise between the parties hereto touching or concerning the works or the execution or maintenance thereof this contract, or the rights touching or of this contract, effect thereof, or to the rights or liabilities of the parties arising out of or in relation thereto, whether during progress or after determination, foreclosure or breach of the contract (other than those in respect of which the decision expressed to be final and binding in cases listed out in condition 40 above), Consultants shall, after written notice to either party to the contract and to the appointing Authority, who shall be appointed for this purpose by the employer refer those disputes for adjudication to a sole arbitrator, to be appointed as hereinafter provided.

b. For the purpose of appointing the sole arbitrator referred to above, the Appointing authority will send, within thirty days of receipt by him of the written notice aforesaid, to the contractor a panel of three names of persons, who shall be presently unconnected with the organization for which the work executed.

c. The contractor shall on receipt by him of the names as aforesaid, select any one of the persons named to be appointed as a sole arbitrator and communicate his name to be appointed as a sole arbitrator to the Appointing Authority, within thirty days of receipt of the names by him. The Appointing Authority shall thereupon without any delay appoint the said person as the sole arbitrator. If the contractor fails to communicate such selection as provided above within the period specified, the Appointing Authority shall make the selection and appoint the selected person as the sole arbitrator.

d. If the Appointing Authority fails to send to the contractor the panel of three names as aforesaid within the period specified, the contractor shall send to the appointing authority a panel of three names of persons, who shall be unconnected with either party. The Appointing Authority shall on receipt by him of the names as aforesaid select any one of the persons named and appoint

his as the sole arbitrator. If the Appointing Authority fails to select the person and appoint him as the sole arbitrator within 30 days of receipt by him of the panel and inform the contractor accordingly, the contractor shall be entitled to appoint one of the persons from the panel as the sole arbitrator and communicate his name to the Appointing Authority.

e. If the Arbitrator so appointed is unable or unwilling to act or resigns his appointment or vacates his office due to any reasons whatsoever, another sole arbitrator shall be appointed as aforesaid.

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

g. The arbitrator shall be deemed to have entered on the reference, on the date he issues notice to both the parties, fixing the date of first hearing.

g. The arbitrator may from time to time, with the consent of the parties, enlarge the time for making and publishing the award.

i. The Arbitrator shall give a separate award in respect of each dispute or difference referred to him. The Arbitrator shall decide each dispute in accordance with the terms of the contract and give a reasoned award. The venue of arbitration shall be such a place, as may be fixed by the Arbitrator in his sole discretion.

The fees, if any, of the Arbitrator, if required to be paid before the award is made and published, shall be paid half and half by each of the parties. The costs of the reference and of the award including the fees, if any, of the Arbitrator, who may direct to any by whom and in what manner such costs or any part there of shall be paid and may fix or settle the amount of costs to be so paid.

j. The award of the Arbitrator shall be final and binding on both the parties.

k. Subject to aforesaid, the provisions of the Arbitration and Conciliation Act, 1996, or any statutory modifications or re-enactments thereof, and the rules made thereunder, and for time being in force, shall apply to the arbitration proceedings under this clause.

INDEX TO SPECIAL CONDITIONS OF CONTRACT

5. Quantities liable to alterations
6. Access for inspection
7. Dimensions
8. Program of works
9. Water and Electricity
10. Procurement of materials
11. Secured advance for materials on site
12. Facilities to other contractors
13. Testing
14. Site meetings
15. Custody and security of materials
16. Treasure trove
17. Notices
18. Statutory regulations
19. Measurements to be recorded before work is covered up.
20. Working at night or on holidays.
21. Working on holidays
22. Action where there is no specification
23. Reporting of accident
24. Cleaning the site on completion/determination of work
25. Possession of buildings/work completed
26. Typographic, Clerical and other errors.
27. Information to be supplied by the Contractors.
28. Force Majeure

29. Consultant's drawings and instructions

30. Completion of work and liquidated damages

31. Bill of payments

32. Workmanship

33. Schedule of quantities

34. Site Supervision

35. Rates

36. Income tax and works contract tax

37. Extra items rates

38. Service drawings/shop drawings/catalogue

39. Payment

40. Permission

41. Maintaining Registers at site

42. Agreement

43. Insurance

44. Indebtedness and liens

45. Work performed at contractor's risk

46. Inspection by the Chief Technical Examiner

47. Special conditions of contract

SPECIAL CONDITIONS OF CONTRACT

1. **INSPECTION OF DRAWINGS:**

Before filling in the tender, the contractor will have to check up all drawings and Schedule of quantities, and will have to get immediate clarifications from the Consultant on any point, that he feels is vague or uncertain. No claim/damages or compensation will be entertained on this account.

2. CONTRACTOR TO VISIT SITE:

Each tenderer must, before submitting his tender, visit the site of works, so as to ascertain the physical site conditions prices and availability and quality of materials according to specifications before submitting the quotations. No excuse regarding non-availability of any materials or changes in the price will be entertained or extra allowed on that account.

The existing adjacent buildings belonging to Government/private are in close proximity of the proposed construction; hence the contractor shall cater for all arrangements to carry out the work without causing any disturbance to the occupants by providing screens with bamboo matting or other suitable material approved by Consultants/Engineer. The contractor shall ensure that no dust or construction material falls near/around the existing buildings.

3. EXECUTION OF WORK (PRICES TO INCLUDE):

i) The whole of the work as described in the Contract (including the Schedule of Quantities, the specifications and all drawings pertaining thereto) and as advised by the Consultant & employer from time to time is to be carried out and completed in all its parts to the entire satisfaction of the Consultant & Employer. Any minor details of construction, which may not have been definitely referred to in this contract, but which are usual in sound building, road and all construction practice and essential to the work, are deemed to be included in this contract. Rates quoted in the Schedule shall be inclusive of all freights, taxes, such as octroi, Sales tax, Royalties, duties, excise, turnover tax, sales tax on works contract, etc., as well as transportation, so as to execute the contract as per the rules and regulations of Local Bodies, State Government and Government of India. Any increase in these taxes and rates, during pendency of contract, shall be borne by the contractor and no extra claim on this account will be entertained.

The rates quoted in the tender should also include all charges for:

a)
1. Carrying
2. Hauling
3. Labour
4. Fixing
5. Watering
6. Cleaning
7. Making good
8. Scaffoldings, ladders and burlap coverings.

b) The contractor should arrange timely at his cost for all required.

i) Plant, machinery, scaffolding, formwork, ladders, ropes, nails, spikes, shuttering, temporary supports, platforms, tools, all materials etc., required for executing the work, and protecting them from weather and other normal/natural causes.

ii) Covering/protecting for the walling and other works, during inclement weather, strikes etc., as and when necessary and or as directed.

iii) All temporary canvas covers/covering, lights, tarpaulin, barricades, water shoots etc.

iv) All stairs and steps, thresholds and any other requisite protection for the works.

v) All required temporary weather-proof sheds at such places and in a manner approved by the Consultant, for the storage and protection of materials, against the effects of sun and rain.

vi) All required temporary fences, lighting/sign-boards etc., guards, approaches and roads as may be necessary for execution of the contract works and for safeguarding the public.

vii) The whole of necessary plant and machinery like bull dozers, graders, road rollers, bitumen heating plants, blowers, pumps, concrete mixers, hoists, vibrators, scaffolding, formwork, tackle, cartage, labour etc., and removal of the same at the completion of works.

viii) Dewatering by bailing out or pumping out the water from foundation/trenches during the progress of work anywhere on site, to the satisfaction of the Consultant & Employer: and clearing of the site.

c) The Consultant & Employer will be the sole judge in deciding as to the suitability or otherwise of the tools/formwork/machinery or plant that may be brought to the work site by the contractor for the proper execution of the work.

d) The rates quoted by the tenderer in the Schedule of Probable items of work will be deemed to be for the finished work.

4. **SCHEDULE OF QUANTITIES:**

The Schedule of quantities forms part of the contract, but the Employer reserves the right to modify the same or any part thereof as per variation clause stated herein

below. The contractor shall not be allowed any compensation or damages for the work, which is so omitted, cancelled, added, or substituted by the Consultant & Employer.

5.a. **QUANTITIES LIABLE TO VARY:**

For all the items, the variations (+) shall be unlimited. The quantities indicated in the bill of quantities are only approximate, and hence may vary on either side (+ or -) for accomplishing the works enunciated under the scope of works, in accordance with

designs, drawings and specifications and or instructions of the Consultant & Employer. Variations may also occur, consequent upon addition or deletion or substitution of particular items, change of designs or specifications during the course of execution. The contractor, in either case, is bound to carry out the modified quantities for unlimited variation, without any enhancement in rates and at the same rates as per accepted original tendered rates.

Please refer clause 4 & 5of General conditions of contract.

6. ACCESS OF INSPECTION:

The contractor is to provide at all times, during the progress of the works and the maintenance period, means of access with ladders, gangways etc., and the necessary attendants to move and adopt the same as directed for the inspection or measurement of the work by the Consultant and Employer or any other agency employed by the client.

Refer clause 15 of General Conditions of Contract.

7. DIMENSIONS:

In all cases figured dimensions are to be accepted in preference to scaled sizes. Large scale details shall take precedence over small scale details/drawings. In case of any discrepancy, the contractor shall ask for a clarification, before proceeding with the work. Accordingly, if any work is executed without prior clarification, it is liable to be rejected and shall not be paid for,

8. PROGRAMME OF WORKS:

The contractor on starting the work shall furnish to the Employer and Consultant a PERT/CPM programme, for carrying out the work stage by stage in the stipulated time, for the approval of Consultants and Employer, and follow strictly the approved time schedule by incorporating changes, if any, so authorized by the Consultant and Employer, to ensure the completion of construction work ins stipulated time. A graph or chart on individual item/group of items/trades of work shall be maintained, showing the progress both in terms of quantities and value, week by week. The contractor shall submit to the Employer and Consultant a weekly progress report stating the number of skilled and unskilled laborers employed on the work, working hours done, quantity of cement, steel and other major items of materials (quantity and value wise) used and corresponding place, type and quantity of work done during the period.

The contractor must inform the Consultants, 10 days in advance of requirement of respective drawings and details by him, from time to time. The contractor shall strictly adhere to the approved programme and arrange for the materials and labour etc., accordingly.

Despite repeated instructions, if the contractor fails to show satisfactory progress of the work, the Employer/Consultant may take suitable action as deemed fit, including levying of liquidated damages not exceeding 1% of contract price for delay of every week or part thereof, subject to a limit of total liquidated damages levied under this clause to 5% of contract price without prejudice to any terms and conditions of the contract.

Please refer clause 29 & 30 of General Conditions of contract.

9. WATER AND ELECTRICITY:

Contractor shall be given a power point at site for satisfactory execution and completion of the work. The supply shall be through a 3 Phase, MCCB, 63 A in the cellar of the building. Further development of utility points is at contractors' cost. Necessary Energy meter shall be provided by the contractor. Drinking water for the contractor's workers is responsibility of contractors and shall not be supplied by CDFD Water for construction is contractor's responsibility.

10. PROCUREMENT OF MATERIALS:

Contractor shall procure all the materials including cement and steel required for the work from the open market. Time is the essence of the contract. Acceptance of the completion date by the contractor shall mean that he has taken into consideration the availability of all materials of approved make and quality in sufficient quantities at respective markets/sources, to enable him to complete the entire work in the stipulated period.

Contractor will get samples of all materials approved by the Consultant and employer, before placing order/purchase/procurement. They shall conform to relevant B.I.S. codes and or tender specifications as applicable.

For all materials, the contractor shall quote for the best quality of the materials of best make/source or supply and they should be got approved by the Consultant and employer, before procurement.

In case sufficient quantities of approved quality materials from approved sources are not available in time, contractor may have to procure the same from neighboring areas even with longer leads, as required and directed, at no extra cost. In case approved good quality sand is not available consistently throughout the duration of the contract period, best quality of sand locally available may have to be screened and washed, as directed by the Consultant and Employer depending upon the use of sand in different items of work, at no extra cost. The materials will be, however as per relevant I.S.S. as and wherever applicable.

Please refer clause 9 of General Conditions of contract.

11. SECURED ADVANCE FOR MATERIALS ON SITE:

The contractor will be paid secured advance against the materials required and brought and stacked safely and securely at site for consumption within. The advance paid shall be limited to 75% of the cost (limited to costs of materials based on quoted and approved rate for relevant items of work) of the materials stacked at site, and the contractor shall produce necessary cash vouchers/documents in support of the cost of each of such materials for each consignment. In case of sanitary, Water supply and electrical quoted rates for the relevant items in the tender and not exceeding 75% of the cost of those materials in the market. Whenever payment is made on stack measurement basis, necessary deductions for voids will be made, which shall be applicable both for advance and/or for final payment, wherever applicable. These materials shall be stacked on fairly level ground and at safe and secure places, as directed. No secured advance will be paid for materials brought prematurely to the site.

The materials against which advance is paid, shall be the property of the Employer and shall not be removed from the site, without written permission of the Consultant & Employer. However, the security of these materials and preventing deterioration of quality of same shall be the sole responsibility of the contractor. The materials shall also be in conformity with the contract specifications and of approved quality/make/brand etc.

The secured advances shall be recovered in the next immediate interim bill.

These advances shall be made on the basis of the quantity of each of the materials lying at site, at the time of preparation of respective interim bill. For all such advances claimed/proposed, the Contractor shall sign an indemnity bond for each of such interim bills, in favor of the Employer, against any loss either due to theft or fire etc. The format shall be finalized in consultation with Consultant/Engineer.

12. FACILITIES TO OTHER CONTRACTORS:

The contractor shall give full facilities and co-operation to all other contractors working at site doing plumbing, Electrical, civil works etc., as directed by the Consultant & Employer and shall arrange his programme of work, so as not to hinder the progress of other works. The decision of the Consultant & Employer, on any point of disputes between the various contractors, shall be final and binding on all parties concerned.

13. TESTING:

The contractor shall, as and when directed by the Consultant & Employer, arrange to test materials and/or portions of the work at site in any approved laboratory at his own cost, in order to provide their soundness and efficiency. The contractor shall transport all the materials from site to the approved laboratory at his own cost. The contractor shall carryout all the mandatory tests as per list attached at the frequencies stated therein. Even after such tests, any materials brought to site or incorporated in the

works are found to be defective or unsound or not as per approved samples, the contractor shall remove the same and re-erect at his own cost and without any additional time/period for the same, with reference to the date fixed for completing the work. In case these tests are not carried out at the frequencies stated, then proportionate costs of materials not so tested, including cost of testing and quantities of items of work executed with such materials, if otherwise accepted for retention in the work, will be deducted from the dues to the contractor. The deductions will be worked out by the Consultant/client and shall be final and binding on him.

Tolerance on various material and items of work shall be allowed laid down in the documents below and the order of precedence shall be:

a) Relevant Indian Standards Specifications.
b) CPWD norms.
c) Manufacturer's Specifications.

In absence of above Consultant's decision basing on the general practice being following shall be final.

14. SITE MEETINGS:

A senior representative of the contractor shall attend weekly meetings at works site; and in additions, meetings as and when arranged by Consultant & Employer to discuss the progress of the work and sort out problems, if any, and ensure that the work is completed in the stipulated time.

15. CUSTODY AND SECURITY OF MATERIALS:

The contractor shall be responsible for the custody and security of all materials and equipment at site and he will provide full time watchman/watchmen to look after his materials, stores, equipment's etc., including cement and steel at site and ensure that at no time unauthorized persons gains any access at works site.

16. TREASURE TROVE:

Should any treasure, fossils, minerals, or works or art of antiquation interest be found during excavation or while carrying out the works, the same shall be the property of the Employer. The Contractor shall give immediate notice to the Consultant &

Employer about finding of any such treasure and hand over the same on demand to the Employer.

17. NOTICES:

The contractor shall give all notices and pay all necessary and relevant fees and shall comply with all Acts and Regulations, for the successful completion of the contract work.

Please refer clause 8 of General Conditions of Contract.

18. **STATUTORY REGULATIONS:**

The whole of the work including sanitation and electrical is to be complied with, as per the requirements and bylaws of the relevant statutory authorities, including Contract Labour (Regulation and Abolition) Act, 1970.

19. **MEASUREMENT TO BE RECORDED BEFORE WORK IS COVERED UP:**

The contractor shall take joint measurements with the Employer's representative (Project Management Consultant or any Engineer identified by the Employer) and Consultant's representative before covering up or otherwise placing beyond the reach of measurement any item of work. Should the contractor neglect to do so, the same shall be uncovered at the contractor's expense or in default thereof, no payment or allowance shall be made for such work or the materials with which the same was executed.

20. **WORKING AT NIGHT OR ON HOLIDAYS:**

The contractor can carry out major work at night, only with prior permission of the Site Engineer of Employer/Consultant and with proper supervision. However, all concrete work will however, be carried out only during the day light.

WORKS AT NIGHT:

If the contractor is required to do preliminary works at night, in order to complete the work within the Time Schedule, the contractor shall provide and maintain at his own cost necessary and sufficient barricades/lights etc., to enable the work to proceed satisfactorily without danger. Approaches to the site also shall be sufficiently lighted by the contractor.

21. **WORKING ON HOLIDAYS:**

No work shall be done on Sunday or other Bank holidays that may be notified by the Consultant & Employer, without the specific sanction in writing of the Consultant & employer or his representatives.

22. **ACTION WHERE THERE IS NO SPECIFICATION:**

In case of any item/class of work, for which there is no specification mentioned (either in part or full), the same will be carried out in accordance with the relevant CPWD specifications (only for the specifications missing in the contract) and if not available even there (either in part or full) in, relevant standards of BIS shall be followed (only for the portions of specifications missing in the contract specifications and CPWD specifications). Indian standard specifications, subject to the approval of the Consultant & Employer.

23. REPORTING OF ACCIDENT TO:

The contractor shall be responsible for the safety of all persons employed by him on the works and shall report serious accidents to any of them, whenever and wherever occurring one the works, to Employer who shall make every arrangement to render all possible assistance. This shall be without prejudice to the responsibility of the Contractor, under the Insurance clause of the General Conditions. Contractor shall take all the precautions as detailed in the safety code attached separately.

24. CLEARING THE SITE ON COMPLETION/DETERMINATION OF WORKS:

The contractor shall clear the site of works as per the instructions of the Consultant. The site of works shall be cleared of all men, materials, sheds, huts etc., belonging to the contractor. The site shall be delivered in a clean and neat condition, as required by Consultant, within a period one week after the job is completed. In case of failure by the contractor, the Employer, under advice to the Consultant, has the right to get the site cleared to his satisfaction at the risk and cost of the contractor.

25. POSSESSION OF BUILDINGS/WORK COMPLETED:

The contractor shall hand over to the Employer possession of the completed works in stages, as and when required, and as directed by the Consultant & Employer.

The Employer will take over the possession of completed works in stages as directed by the Consultant, and defects liability period will commence only from the date of final handing over of all the work accordingly.

Please refer Appendix to General Conditions of contract.

26. TYPOGRAPHIC, CLERICAL AND OTHER ERRORS:

The Consultants/Employer's clarification regarding partially omitted particulars or typographical, clerical and other errors shall be final and binding on the contractors.

27. INFORMATION TO BE SUPPLIED BY THE CONTRACTOR:

The contractor shall furnish to the Consultant & Employer the following from time to time:

a. Detailed industrial statistics regarding the labour employed by him, etc., every month (within 5^{th} of succeeding month),

b. The Power of Attorney, name and signature of his authorised representative, who will be in charge for the execution of work.

c. The list of technically qualified persons (to be approved by the Consultant) employed by him for the execution of the work within 15 days from date of start of work,

d. The total quantity and quality of materials used for the works, every month within 5th of succeeding month.

e. The list of plant and machinery employed for this work, every month. Copy of log books shall also be submitted every month (within 5th of succeeding month).

Last para of clause 33:

Failure to submit any of these details in time, shall be treated as a breach of the contract and likely to result in,

i) Levying a fine of Rs.500 for each default for each month, and or

ii) Withholding payments, otherwise due.

iii) For the periods for which name of technically qualified persons are not given or for which such persons are not employed, recoveries shall be made at Rs. 25,000 /- per month for each month of default.

In all these matters the decision of the Consultant shall be final and binding.

See clause 41 also.

28. BENCH MARKS:

The contractor shall construct and maintain proper benches at different places at site as required and directed by the Consultant, so that levels can be checked accurately at all times during the progress of work. In case benches are disturbed for any reason whatsoever, necessary rectification shall be carried out by the contractor at his cost as directed by the Consultant & Employer.

29. FORCE MAJEURE:

Neither party shall be held responsible by the other for breach of any condition of this Agreement, attributable to any "Act of God", Act of State, Strike, lock-out or control or any other reason, beyond the control of the parties and any breach of clauses arising from such Force Majeure conditions as aforesaid shall not be regarded as breach of the provisions of this Agreement.

30. Consultant'S DRAWINGS AND INSTRUCTIONS:

A set of major drawings, along with the contract documents shall be provided to the contractor. If any clarification or further drawings are required by the Contractor during or before the start of construction work, the contractor shall inform the Consultants and the Employer sufficiently in advance in writing to provide the same. Working details will be given to the Contractor from time to time, during the progress

of work, as and when required. In case, any other drawing/detail is required by the contractor, he will give a minimum of fifteen days' notice to the Consultant.

Refer clause 2 & 3 of General conditions of contract.

31. COMPLETION OF WORK AND LIQUIDATED DAMAGES:

The work shall be completed in 3 months for BSL3 HVAC works at CDFD Laboratory Building, Uppal, Hyderabad, and reckoned as under:

(a) The day one week from the date of issue of letter of intent.

or

(b) The day on which the contractor receives the possession of the site – whichever is later.

or

(c) The contractor is asked in writing to take over the possession of the site.

Time is the essence of the Contract. The Contractor shall strictly adhere to the programme/chart agreed to. In case the contractor fails to complete the work as mentioned above, the liquidated damages may be imposed at the rate of 1% per each week (or part thereof) of delay, subject to a maximum of 5% of contract amount.

Refer clause 30 & 31 of General Conditions of contract.

32. BILLS OF PAYMENTS:

The minimum value of work for interim payments will be Rs. 20 lakhs, as stated in Appendix on Page 26. The contractor shall submit interim bills, once a month on the basis of joint measurements recorded at site by the contractor's Employer's and the Consultants representatives. The bill will be certified by the Consultant within 7 days from the date of submission of the bill by the contractor, and the Employer will make payment as stated in the Appendix to General Conditions of Contract. All such interim payments shall not be considered as an admission of the due performance of the contract or any part thereof in any respect and shall not preclude the requiring of bad unsound and imperfect or unskilled work to be removed and taken away and reconstructed or re-erected at contractor's cost, all as per Employer and Consultant's instruction and directions.

33. WORKMANSHIP:

Quality of materials and workmanship shall conform strictly to specifications given/stipulated in the tender/contract, and contractor will ensure that the best quality of work will be done to the satisfaction of the Consultant and Employer, with strict control on the materials, workmanship and supervision.

Refer clause 9 of General Conditions of Contract.

34. SCHEDULE OF QUANTITIES:

Quantities mentioned in the Schedule of Quantities, included in the contract, are approximate and are subjected to variations as per actual site conditions & requirements and as directed by the Consultant & Employer. The work shall be executed and completed accordingly.

Refer clause 4, 5 and 6 of General Conditions of Contract.

35. SITE SUPERVISION:

The contractor shall appoint at his own cost competent and adequate number of qualified Engineers at site, for (1a) joint measurements and preparations of bills. (2b) for testing materials at site and outside laboratory. (c) for concreting and reinforcement work. (d) for other general supervision. Their appointment shall be approved by the Consultant & Employer. The site engineers shall not be removed from the site without the written consent of the Consultant & Employer.

36. RATES:

Contractor shall quote all the rates both in figures and in words and any alterations shall have to be initialed by the contractor. Rates quoted by the contractor for the same item in different schedules shall be same, and incase different rates are quoted, the lowest will be taken as correct and the schedule corrected accordingly. In case of discrepancy between rates given in words and figures or in the amount worked out, the following procedure will be followed:

When there is difference between the rates in figures and in words, the rates which correspond to the amounts worked out will be taken as correct.

When the amount of an item is not worked out by the contractor or does not correspond with the rate written either in figures or in words, then the rate quoted in words will be taken as correct.

When the rate quoted by the contractor in figures and words tallies but the amount is not worked out correctly, the rate quoted will be taken as correct and not the amount.

Rates quoted by the contractor shall hold good for all the work carried out upto any height and depth, as shown in detailed drawings and laid down in bill of quantities and or as required and directed by the Consultant.

Rates quoted by the contractor shall also hold good for any small works at any place at site.

Minor repairs and works to other existing buildings and services shall also be carried out by the contractor at rates quoted in the tender.

The rates quoted for all items of work shall include all the items of work covered by the specifications for the corresponding item of work, unless otherwise specifically mentioned to the contrary (NOT IMPLIED) elsewhere.

37. **INCOME TAX AND WORKS CONTRACT TAX:**

Income tax and works contract tax shall be deducted at source by the client from the contractor's interim and final bill payments as required by law.

38. **EXTRA/SUBSTITUTED ITEM RATES:**

Such items shall be executed as per directions/instructions of the Consultants of the employer.

The work on extra/substituted items shall be started only after the receipt of written order from the client/Consultant. Rates for additional/extra or substituted (altered) items of work, which are not covered in the contract cannot be derived from the contract item rates either in full or partly, shall be calculated on the basis of actual costs plus 15% for overhead and profit etc., only to the extent not derivable from the contract item rates.

39. **SERVICES DRAWINGS/SHOP DRAWINGS/CATALOGUE:**

After getting approval from the Consultant & Employer, the contractor shall submit to the concerned local authorities' necessary services drawings showing layouts etc., for getting approval of the schemes. On completion, the contractor shall arrange to get Drainage Completion Certificate and other Certificate necessary for obtaining Building Completion certificate. The contractor shall furnish completion drawings of all services in triplicate, showing the work as actual executed, along with levels.

Contractor shall submit for approval 4 copies of shop drawings/ catalogue/ equipment characteristics/ manufacturer's specifications, drawings etc., as and when required and directed by the Consultant & Employer. Costs of all these are deemed to have been included in the respective item rates quoted by the contractor and nothing extra shall be paid on account of any of these requirement/acts.

40. **PAYMENT:**

No payment whatsoever shall be made by the Employer, if the Contractor abandons the work, due to any site difficulties etc.,

See clause 36 & 37 of General conditions of contract.

41. **PERMISSION:**

The contractor shall also obtain necessary permission for using explosive (if required and specifically permitted by the Consultant and Employer in writing), as per rules

and regulations of relevant authorities, and all other approvals from the relevant authorities shall be obtained by the contractor at no extra cost.

42. MAINTAINING REGISTERS AT SITE:

The contractor shall maintain registers for consumption of various specials, testing of materials etc., in the proforma which shall be given by the Consultant & Employer from time to time.

43. AGREEMENT:

The successful contractor shall be required to enter into an agreement in accordance with the Draft Agreement and Schedule of Conditions etc., within 15 days from the date the contractor is advised by the Consultant & Employer that his tender has been accepted. The contractor shall pay for all stamps and legal expenses incidental thereto. However, the written acceptance of the tender by the Employer, will constitute as a binding contract between the Employer and contractor, whose tender has been accepted, whether such formal agreement is or is not subsequently executed.

44. INSURANCE:

The contractor shall provide insurance in respect of damage to persons and property and firm insurance as per clause 27 and 28 of General conditions of contract. In addition he will also insure against riots and civil commotion. The insurance shall also cover third party and all the persons working at site and visitors including contractor's, worker's, Consultant's and clients people, other contractor's workers etc. The contractor shall indemnify the Employer against any claim or compensation or mishaps of whatsoever nature at site during the progress of work.

The contractor shall prove to the Consultant/Client from time to time that he has taken

out all the insurance policies as required and directed and has paid the necessary premium for keeping the policies valid as per clause 27 & 28 of the General Conditions of Contract.

In case of failure by the Contractor or sub-contractor to effect and keep in force the insurance policies, then the client, without being bound to, may pay such premiums as may be necessary and deduct the same from any money due or which may become due to the contractor or recover the same as a debt due from the contractor.

45. INDEBTEDNESS AND LIENS:

The contractor agrees to furnish the Employer from time to time, during the progress of the work as requested, verified statement showing the contractor's total outstanding indebtedness in connection with the work covered by the contract. Before final payment is made, the Employer may require the contractor to furnish the Employer with satisfactory proof that there are no outstanding debts or liens in connection with

the contract. If during the progress of the work, the contractor shall allow any indebtedness to accrue to sub-contractor or other and shall fail to pay or discharge same with five (5) days after demand, then the Employer may withhold any money due to the contractor until such indebtedness is paid, or apply the same towards the discharge thereof.

46. **WORK PERFORMED AT CONTRACTOR'S RISK:**

The contractor shall take all precautions necessary and shall be responsible for the safety of the work and shall maintain all lights, guards, signs, barricades, temporary passages or other protection necessary for the purpose. All work shall be done at the contractor's risk and if any loss or damage shall result from fire or from any other cause, the contractor shall promptly repair or replace such loss or damage free from all expenses to the Employer. The Contractor shall be responsible for any loss or damage to materials, tools or other articles used or held for use in connection with the work. The work shall be carried on to Employer or of others and without interference with the operation of existing machinery or equipment, if any.

47. **INSPECTION BY THE CHIEF TECHNICAL EXAMINERS (VIGILANCE):**

The proposed work covered under this tender, during the progress and/ or after completion, can also be inspected by the Chief Technical Examiner/ Technical Examiner or Officers of the Central Vigilance Commission, Government of India, on behalf of Consultant & Employer to ascertain that the execution of the work has been done with materials and workmanship all as stipulated in the contract and as directed. Contractor shall afford all reasonable facilities to the above vigilance staff and also provide them with ladders, tapes, plumber, level etc., as required and directed and also necessary laborers skilled/unskilled to enable them to complete their inspection/study/technical scrutiny and no extra shall be admissible to the contractor on this account.

48. **SPECIAL CONDITIONS OF CONTRACT:**

In the event of any discrepancy with clauses mentioned anywhere else in the tender with the clauses mentioned within special conditions of contract, the clauses mentioned within the special conditions of contract shall supersede there mentioned elsewhere.

SAFETY CODE

Suitable scaffolds should be provided for workman for all the works that cannot safely be done from the ground or from solid construction, except in cases of short duration works, which can be done safely from ladders. When a ladder is used, an extra mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, it shall be of rigid construction made either of good quality wood or steel. The steps shall have a minimum width of 450mm and a maximum rise of 300mm. Suitable foot and hand holds of

good quality wood or steel shall be provided and the ladder shall be given an inclination not steeper than 1 in 4 (1 horizontal to 4 vertical).

Scaffolding or staging more than 300mm above the ground or floor, swung or suspended from an overhead support, shall be erected with stationery supports and shall have guard rails properly attached, bolted, braced and otherwise secured and at least 900mm high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as may necessary for the access of persons and delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.

Working platform, gangways and stairways should be so constructed that they should not sag unduly or unequally and if the height of the platform or the gangway or the stairway is more than 3-6m above ground level or floor level, they should be closely boarded, should have adequate width and should be suitably fastened, as described in (ii) above.

Every opening in the floor of a building or in a working platform be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing, whose minimum height shall be 900mm.

Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 M in length while the width between side rails in ring ladder shall be in no case be less than 300mm. For longer ladders, this width should be increased at least 6mm for each additional foot of length. Spacing of steps shall be uniform and shall not exceed 300mm.

Adequate precautions shall be taken to prevent danger from electrical equipment. At the work site, no materials shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The contractor shall also provide all necessary fencing and lights to protect the public from accident, and shall be bound to bear the expenses of defense of every suit, action or other proceedings at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay damages and costs, which may be awarded in such suit, action or proceedings to any such persons or which may with the consent of the contractor be paid to compromise any claim by any such person.

INSURANCE COVER

The contractor shall at his own expense take comprehensive all risk (C.A.R) insurance policy before starting the work at site. Such policy shall be continued till the entire work is completed by the contractor.

The C.A.R. insurance policy should cover damages to and loss of property and persons as under:

a. Building under construction – full reinstatement value against all risks during construction.

b. All types of injury including fatal to all workers belong to contractors own or sub-contractors organization to be covered under workmen compensation act.

c. All types of injury including fatal to employees of the employer and Consultant, connected with the work.

Insurance in respect of damage to persons and property:

The contractor shall be responsible for all injury to persons, animals or things and for all damages to the structural and/or decorative part of property which may arise from the operations or neglect of himself or of any sub-contractor for any of his or a sub-contractors employee, whether such injury or damage arise from carelessness, accident or any other cause whatever in any way connected with carrying out his contract. This clause shall be held to include inter alias any damage to buildings whether immediately adjacent or otherwise and any damage by frost, rain or other inclemency of the weather to roads, street, foot paths, bridges as well as all damages caused to the buildings and the works forming the subject of this contract. The contractor shall indemnify the employer and hold him harmless in respect of all and any expenses arising from any such injury or damage to persons or property as aforesaid and also in respect of any claim made in respect of injury or damage under any acts of Government or otherwise and also in respect of any award of compensation or damages consequent upon such claims.

The contractor shall reinstate all damages of every sort mentioned in this clause, so as to deliver the whole of the contract works complete and perfect in every respect and so as to make good or otherwise satisfy all claims for damages to the life/property of third parties.

The contractor shall indemnify the employer against all claims which may be made against the employer by any member of the public or other third party in respect of anything which may arise in respect of the works or in consequence thereof and shall at his own expense arrange to effect and maintain until the virtual completion of the contract, with an office approved by the Employer, a policy insurance in the joint names of the Employer and the contractor against such risks, and deposit such policy or policies with the Consultant from time to time during the currency of this contract. The contractor shall also indemnify the employer against all claims, which may be made upon the Employer whether under the workmen's compensation act or any other statures in force during the currency of this contract or any common law or under any award, decision, order, decree, finding or judgment of any labour or Industrial court or tribunal or authority or of any court of law in respect of any employee of the contractor or any sub-contractor and shall at his own expense effect and maintain until the virtual completion of the contract with an approved office a policy of insurance in the joint names of the employer and the contractor against such risks and deposit such policy/policies with the employers from time to time during the currency of this contract. The contractor shall be responsible for anything, which may be excluded from the insurance policies above referred to, and also for all other damages to any life/property arising out of and incidental to the negligence or inefficient carrying out of this contract.

He shall also indemnify the employer in respect of any costs, charges or expenses arising out of any claim or proceedings and also in respect of any award of compensation for damages arising there from. The Employer shall be at liberty and is hereby empowered to deduct the charges, the expenses, arising or occurring from or in respect of any such claim or damage from any sum or sums due or to become due to the contractor.

Fire Etc. Insurance:

The contractor shall on signing the contractor insure the works and keep them insured until the virtual completion of the contract against loss, or damage by fire and/or earthquake in an office to be approved by the Employers in the joint names of the Employer and the contractor, the name of the employer being placed first in such policy. This shall be in the form of open general policy for the full value of the works, the premium payable thereon being for the amount of work actually constructed for the time being, the premium increasing with the increase in the value of work. Such policy shall cover the property of the employer only and shall not cover any property of the contractor or of any sub-contractor or employees.

The contractor shall deposit the policy and original premium receipts with the employers within 21 days from the date of signing of the contract.

In default of the contractor insuring as provided above the employer on his behalf may so insure and may deduct the premiums paid from any sums due or which may become due to the contractor. The contractor shall as soon as the claim under the policy is settled or the work reinstated by the insurance office, should they elect to do so, proceed with all due diligence with the completion of the work in the same manner as though the fire/ rise had not occurred and in all respects under the same conditions of the contract. The contractor, in case of rebuilding or reinstatement after fire etc., shall be entitled to such extension of time for completion as the Consultants may deem fit.

LABOUR LAWS AND RULES

The Site Engineer shall ensure that the contractor maintains relevant records and fulfils all conditions and requirements in accordance with

a. The payment of Wages Act
b. Employer's Liability Act
c. Workmen's Compensation Act
d. Contract Labour (Regulations & Abolition) Act 1970 and Central Rules 1971.
e. Apprentices Act 1961.
f. Any other Act or enactment relating thereto and rules framed thereunder from time to time.

The Site Engineer shall refrain from involving himself and the supervisors under him by comments/advice/attempts at mediation in any kind of labour dispute at site. His job is only to report to his superiors any happenings of the sort in an objective manner.

EMPLOYER'S RESPONSIBILITY – CONTRACT LABOUR (REGULATIONS AND ABOLITION) ACT 1970 AND RULES 1971

With a view to ensuring that the provisions of the Act are not contravened, the Site Engineer should give particular attention to the following points and see that all the provisions of the Act are enforced:

1. Principal Employer (Employers) is registered as per the Act.

2. Contractor holds a license under the Act from the Local Labour Commissioner for the appointment of Contract labour.

3. Required notice boards, registers and records as provided in section 29 of the Act are maintained by the contractor.

4. Payment of proper wages as per the rules are effected within the prescribed time limits by the contractor.

5. Prescribed facilities and amenities are provided by the contractor.

6. Proper efforts are made by the contractor to set right contravention of law, as soon as the notice pointing out the same is received from the Labour Enforcement Officer, and reports "on action taken" are sent to the Labour Enforcement officer at the earliest with copies to the Employer.]

HVAC TECHNICAL SPECIFICATIONS

PROJECT: CDFD

BSL-3

TABLE OF CONTENT

GENERAL

1 :- BASIS OF DESIGN

It is proposed to provide the building with an effective, energy efficient and reliable air conditioning system which can not only provide the required comfort conditions in various zones of the facility but can also maintain required differential pressure levels.

Conservation of energy and water, optimization of resources and Eco-friendly systems have been the key factor in the concept of ACMV system. Additionally the latest State of Art, Technology available in India and Abroad and safe efficient and fool-proof systems with the least maintenance problems have been the major consideration for the design of the services. The ACMV system shall be designed to maintain inside design conditions as mentioned in the HVAC Design conditions, indoor air quality, air velocity and noise level.

Proper ventilation of toilets, plant and equipment rooms, achieve maximum efficiency of plant operation and conserve energy.

The system shall also be complete with all necessary fire safety measures to make the building safe and hazard-free.

Central chiller plant is proposed to give additional requirements of the Facility to meet the additional loads at BSL-03 Facility with the following main Chiller plant equipment's.

1. Water cooled Scroll/Screw Chillers
2. Primary Pumps
3. Secondary Pumps
4. Condenser Pumps
5. Cooling towers.

2. CODES & STANDARDS

The design & selection procedure for Air Conditioning Equipment is based on ASHRAE / ISHRAE Standards.

ASHRAE 2009 : SHRAE Handbook – Fundamentals – Non Residential

Cooling and Heating Load Calculations

NBC 2005 : National Building Code – Part 4 – Life Safety

IS 2062 – 2006 : Steel for General Structural Purposes

ISO 1940-1 – 2003 : Mechanical Vibration – Balance Quality Requirements of Rigid

Motors

ISO 10816-1 – 1995 : Mechanical Vibration-Evaluation of Machine Vibration by

Measurements on Non-rotating parts - Part 1: General Guidelines

AHRI 410 - 2001 : Forced Circulation Air Cooling and Air Heating Coils

3 - SCOPE OF HVAC WORKS

The central Heating, Ventilation and Air-Conditioning (HVAC) system shall comprise of Following:

HIGH SIDE EQUIPMENT

Design of the equipment based on the data furnished in the document.

Procurement of materials within the battery limits as per the schedule given by Consultants / Owner / Project Managers.

Manufacturing as per standards & details furnished in the specifications.

Assembly, Testing in Shop before delivery.

Inspection of the Equipment at site before installation.

Installation at Site as per the schedule given by Owner / PROJECT MANAGERS.

Commissioning in the presence of specialized agency (Manufacture's representative).

4 - PROJECT HVAC REQUIREMENTS

The basis of design including areas, height, occupancy & other design parameters are as per attached AC Summary sheet.

Chilled Water System:

The proposed Chiller configuration is 75 TR x 3no's. Water cooled Screw chillers (2Working+1 stand by)

Cooling towers: As per the above configuration of AC system cooling towers planned are of 75TR x 3no's).

5- HVAC EQUIPMENT DETAILS

The central Heating, Ventilation and Air-Conditioning (HVAC) system shall comprise of Following:

HIGH SIDE EQUIPMENT

Design of the equipment based on the data furnished in the document.

Procurement of materials within the battery limits as per the schedule given by Consultants / Owner / Project Managers.

Manufacturing as per standards & details furnished in the specifications.

Assembly, Testing in Shop before delivery.

Inspection of the Equipment at site before installation.

Installation at Site as per the schedule given by Owner / PROJECT MANAGERS.

Commissioning in the presence of specialized agency (Manufacture's representative).

Chilled water system:

The proposed air conditioning system shall consist of modular type; Water cooled Screw type

chilling units, primary & secondary chilled water pumps, units, chilled water piping with valves, electrical panel, wiring, control wiring and Earthing.

The chilling units along with pumps & electrical panel shall be located inside the Chiller plant area allotted besides the facility which is accepted by the Consultant & client. All motors for air- conditioning system shall be energy efficient IE2 type (earlier Eff1), suitable for 415 +/- 10% volts incoming power supply.

Central air-conditioning system shall be designed for maximizing energy conservation. Primary & secondary chilled water pumps coupled with bypass line and variable speed drive on secondary pumps shall be provided to achieve variable water flow in chilled water circuits. Chilled water flow in load circuits shall be varied but the same through chillers shall remain constant. By measuring pressure differential between chilled water supply and return header, the speed of secondary chilled water pump shall be automatically varied, thus conserving pump brake horse power. All chilled water pumps shall be insulated.

The primary design objective is to reduce building's source of energy consumption by 30% more than the recommendation by ASHRAE standard 90.1 and to design mechanical systems with minimum use of refrigerants and to design higher indoor air quantity for maximum comfort of building occupancy.

The impact of internal loads on cooling, the intensive solar conditions prevailing at summer and the need for increase ventilation set against higher relative humidity, all limit the effectiveness of many conventional methods of reducing energy, so it is proposed to incorporate the following new integrated system which uses standard equipment components and also includes other efficient and environment friendly features.

A centralized chilled water plant is proposed with water cooled Centrifugal type chillers, in the configuration mentioned above. The chiller shall have minimum two compressors with independent refrigerant circuits to handle part load conditions effectively.

CHILLED WATER SCHEMATIC

Chillers should use only R-134 a Refrigerant which is Eco friendly gas. The chilled water pumping circuit shall comprise of double pumping system. The primary chilled water pumps are meant for providing positive chilled water flow across the chiller at all times and are designed to meet the rated water flow requirement of chillers.

The secondary chilled water pumps shall work on variable speed operation based on the varying demand of the connected load and is designed to meet the same. A variable frequency drive shall be used for secondary chilled water pumps for energy saving. The condenser cooling water pumps shall be recirculating water from the chillers to the induced draft type cooling towers. Considering the plant operation at 12 hours per day, the peak demand of makeup water for total requirement will be 20 kld for AC. The chilled water plant

with chillers, chilled water pumps, cooling tower & condenser water pumps are proposed on terrace floor as per the Consultantural drawings.

GENERAL NOTES ON OPERATION OF CHILLED WATER SYSTEM.

Plant Manager for the chilled water plant is proposed. It will communicate to all the chillers, cooling tower, condenser water pump sets & chilled water pump sets to operate optimum level based on the desired set point. Chiller Plant Manager has to be preferably with MODBUS Protocol, however before supply, the Vendor has to coordinate with Building BMS Vendor related to Protocol & I/o Summary statement. Two -way valves are to be provided for the chilled water coil of the AHU. Based on the load, the chilled water flow rate in the coil will be regulated through 2-way valve. Differential Pressure Sensor (DPS) located in the farthest most point will sense the variation in flow rate in the chilled water system. The output from the DPS will vary the chilled water flow in the system through VFD (Speed variation) of the secondary chilled water pump set and will also switch ON/OFF the required number of pump sets automatically through Plant Manager. Chilled & Condenser water pipes are of Class-C MS pipes. Condenser water pipes are coated with weather-proof FRP paint with activated polyster resin. The chilled water pipe will be insulated with Polyurethane Foam (PUF) and cladded / wrapped with a layer of polythene sheet, 2 layers of FRP lining, a layer of polyshield tape over the FRP and final finish will be 2 coats of polyshield paint.
The chilled water pipe running in trench is insulated with PUF & is wrapped with 2 layers of bitumen Hexane cloth lining for weather proofing in addition to the above ground piping.

6. TECHNICAL SPECIFICATIONS

WATER SCREW CHILLERS

This part of specification covers the design, selection of materials, construction features, Manufacture, quality assurance at works, testing at works, packing, transport to site, installation, commissioning and carrying out the performance testing at site of the water cooled chillers.

APPLICABLE DESIGN STANDARDS AND CODES

The design, materials, Manufacture, inspection, testing and performance of screw water chiller shall comply with all currently applicable regulations, codes and standards in the locality where the equipment is to be installed. Nothing in this specification shall be construed to relieve the CONTRACTOR of this responsibility. In particular, the screw water chillers shall conform to the latest edition of following standards.

ANSI/ASHRAE 15 Safety Standard for Refrigeration Systems

ASHRAE 23.1 Methods of Testing for Rating the Performance of Positive Displacement Refrigerant Compressors and Condensing Units That Operate at Subcritical Temperatures

ANSI/ASHRAE 30 Methods of Testing Liquid Chilling Packages

ASME Sec VIII Rules for Construction of Pressure Vessel - Division 1

ASME B31.5 Refrigeration Piping and Heat Transfer Components

AHRI 550/590	Performance Rating of Water Chilling Packages using the Vapor Compression Cycle
AHRI 575	Method of Measuring Machinery Sound within an Equipment Space
TEMA	Standard of Tubular Exchanger Manufactures Association

GENERAL CONSTRUCTION FEATURES

The components of the water chiller shall be as per these technical specifications and as per data sheets. The unit should be factory assembled, skid mounted and shall have all components viz., open, semi hermetic or hermetically sealed screw compressor, with drive electric motor, chiller, condenser, expansion valve, interconnected refrigerant piping, lubrication system, oil cooler and protective devices. Any additional features required for safe, reliable and efficient operation of the chiller shall also be included in the scope of supply and clearly indicated in the data sheet and the cost of which shall be included in the offered price.

All rotating parts shall be statically and dynamically balanced to ISO 1940-2.

The chiller shall be dispatched to site in fully assembled condition with first fill of lubricant but without refrigerant charged. The various components of refrigerant piping system shall be nitrogen charged with minimum 0.2 bar (g) pressure while dispatching to site.

The CONTRACTOR shall include in the offered price the cost of initial charge of the refrigerant, oil and consumables till the water chiller package is handed over to the client completely in all respects.

The water chiller shall have only an eco friendly refrigerant viz., R-134a. Any alternate refrigerant provided shall be CFC / HCFC free.

Water chiller performance shall be certified in accordance with AHRI Standard 550/590. Only chillers that are listed in AHRI Certification Program for Centrifugal are acceptable.

COMPRESSOR

The compressor shall be open, semi hermetic or hermetic, direct drive, single or multiple screw type with a differential pressure lubrication system. The capacity control shall be continuous through the slide valve mechanism, positioned by hydraulic action. The capacity control shall be from 10% to 100% of the full load capacity. The compressor shall have an oil sump, equipped with an immersion oil heater provided with an auxiliary power supply from the main starter panel of the water chiller, so as to provide the power supply to the heater even if the water chiller is off during maintenance.

The lubrication system shall be designed with minimum, but not limited to, oil separator, oil level switch, oil temperature sensor, oil heater, oil cooler, 3 micron oil filter, oil flow switch, oil solenoid valve, oil sight glass and piping. An immersion oil heater shall be provided with temperature actuation. The oil separator shall be Manufactured and tested in accordance with ASME Section VIII – Division 1.

The economizer shall be integral with no moving part. The compressor shall be equipped with internal muffler, check valve, discharge shutoff valves and other accessories. External acoustic jacketing shall be provided to limit the excessive noise over the specified value.
The compressor motor shall be 2 pole, continuous duty, squirrel cage induction type, cooled by refrigerant flow. Compressor full load current at the design conditions shall not exceed motor name plate rating. The motor shall be equipped with high temperature cut out protection at each phase of the starter windings and thermistor temperature sensors built into the windings for single phasing protection and overload.
Compressor Drive Motor: Compressor motor shall be of IP55 enclosure VFD compatible squirrel cage induction type and guaranteed for continuous operation, at the name plate rating. It shall be provided with a load limit mechanism so as to give positive protection against overloading. Motor shall be oversized by at least 10% over the full load requirement. It shall be suitable for operation on 415+/- 10% volts, 3Ph, 50 Hz. The Compressor drive motor shall be high efficiency induction motor. Motor shall be suitable for the power supply system indicated above. Suitable internal RTD protection devices shall be embedded in the winding of each phase. Bearing temperature sensors with indication meter to be provided.

CONDENSER

WATER COOLED CONDENSER

The water cooled condenser shall be of horizontal shell and tube type, designed as per ASHRAE 15 standard for scheduled working pressure, single-shell or twin-shell arrangement, with the refrigerant in the shell and water flow in the tubes. The maximum water flow velocity shall not exceed 2.5 m/s (8 ft/s). Maximum water side pressure drop allowable in the condenser 25-30 ftWC.
The design pressure of the condenser shall be safe for the refrigerant being used and suitable for the actual water-side working pressure. However, the minimum working pressure of the refrigerant / water shall be 1517 kPa / 2068 kPa (220 psi / 300 psi). The test pressure shall not be less than 1.5 times of the actual working pressure or rated working pressure whichever is higher.
Unless otherwise specified in the data sheet or indicated on the drawing the condenser shall be of two-pass arrangement with compressor-end pipe connections. The shell, end covers and tube holding sheets shall be constructed of carbon steel and the tubes shall be of inner grooved seamless copper tubes shall have minimum wall thickness of 0.711 mm (0.028 inch).

AIR COOLED CONDENSER

The air cooled condenser shall be of cross-finned type with inner grooved copper tubes and aluminum fins coated with anti corrosive coating. The condenser coil shall be designed as per ASHRAE 15 standard and shall be tested at 1.5 times the design pressure or 2 times the operating pressure, whichever is maximum. Bonding of the fins to the tubes shall be by mechanical expansion to ensure a positive lasting bond and prevent thermal contact resistance.

The condenser fan shall be the propeller type, statically and dynamically balanced to AMCA 204 G 6.3 grade and shall be mounted on a solid steel shaft running in self-aligning ball bearings, amply sized for quiet operation and long life. The condenser fan shall be driven directly by resiliently mounted weather proof type squirrel cage induction motor with adequate rating suitable for outdoor duty.

COOLER / EVAPORATOR

The evaporator shall be of horizontal shell and tube type, designed as per ASHRAE 15 standard for scheduled working pressure, single-shell or twin-shell arrangement. The evaporator shall be of flooded type designed for a water velocity limited to 2.5 m/s (8 ft/s). The water side pressure drop in the evaporator shall not exceed 20 ftWC.
The design pressure of the cooler shall be safe for the refrigerant being used and suitable for the actual water-side working pressure. The test pressure shall not be less than 1.5 times of the actual working pressure or rated working pressure whichever is higher.
Unless otherwise specified in the data sheet or indicated on the drawing the cooler shall have two-pass arrangement. The shell, end covers and tube holding sheets shall be constructed of carbon steel and the tubes shall be of inner grooved seamless copper tubes shall have minimum wall thickness of 0.711 mm (0.028 inch).

REFRIGERANT PIPING

The refrigerant piping within the package shall be of seamless carbon steel or seamless copper. Isolation valves and charging port shall be provided on liquid line. The refrigerant piping shall include necessarily filter drier, sight glass, thermostatic / electronic expansion valve and solenoid valve. Liquid line between evaporator and compressor shall be insulated with CFC free and HCFC free foam insulation. Multiple compressors, if provided, shall have entirely independent refrigeration circuits.
The condenser shall have an integral sub cooling refrigerating circuit.

ELECTRICAL STARTER CUM CONTROL PANEL

The electrical starter panel shall be unit mounted, fully factory wired and tested. The panel construction shall be suitable for outdoor installation.
The electrical panel shall be designed to have a single point incoming power supply with an

integral power isolator. All power requirements of the unit shall be met by the panel wiring internally. The power distribution and electrical interlocks with safety devices and instruments shall be internally wired, within the panel.

MICRO-PROCESSOR / MICRO-COMPUTER CONTROL PANEL

The chilling package shall be equipped with micro-processor computer control panel in a locked enclosure, factory mounted, wired and tested as specified in data sheets. The control panel shall include an alpha-numeric back-lit Liquid Crystal Display (LCD) or light emitting diode (LED) display showing all system parameters in the English language with numeric data in MKS units.

The microcontroller panel and its entire wiring shall be kept isolated from the electrical starter panel, by locating in a separate enclosure or shall be separately compartmentalized.

Digital programming of essential set points through a colour coded, tactile-feel keypad shall include:

Chilled water outlet temperature

Percent current limit

Pull-down demand limiting

Seven-day time clock for starting and stopping chilling package, pumps complete with local holiday schedule

Remote re-set temperature range

All safety and cycle shut-downs shall be annunciated through the alpha-numeric display and consist of day, time; cause of shut-down and type of re-start required.

Safety shut-downs shall include:

High oil pressure

High compressor discharge pressure

Low evaporator pressure

Motor fault

Sensor malfunction

Cycling shut-downs shall include:

Low chilled water outlet temperature

Low oil temperature

Chilled water low flow or interruption or chilled water pump failure

Power fault

Internal time clock

Anti-recycle

Micro-computer controls shall provide adjustable rate at which the chiller is allowed to load from one minute to over four hours.

Controls shall be provided to avoid nuisance chiller system cycling due to transient high and low pressure conditions by not allowing compressor to load for a safe period of time. If the condition persists, the unit will be shut down automatically. During this period, the display will denote high or low pressure as the governing chiller control factor.

A four position key switch shall be furnished to provide a choice of independent control modes of operation. These include local, program, remote and service mode.

Any input that could potentially harm the machine shall be rejected and the operator immediately advised via display message.

Battery backup shall be provided to keep all set points in memory for a minimum of one month in case of power failure.

Indication of heat exchanger efficiency shall be displayed to identify tube cleaning / water treatment requirements.
Panel shall be furnished with a terminal block to accept a one to eleven second pulse width signal for continuous remote reset of leaving chilled water temperature and power demand limiting.
Field interlocks shall be provided to allow remote differentiation between cycling and safety shutdowns. Separate contact closure shall also be furnished to indicate the chiller will start (all safeties and cycling devices satisfied) when a remote start signal is received.
System temperatures and pressures shall be read directly from the alphanumeric display. These shall include evaporator / condenser refrigerant pressures, oil pressures, return / leaving chilled water temperatures, return / leaving evaporator saturation temperatures, compressor discharge temperature, and oil temperature.
Security access shall be provided to prevent unauthorized change of set points and to allow authorized local or remote control of the chilling package.
Control panel shall be interfaced with Building Management System (BMS), if called for in data sheets. Control panel shall be provided with ports compatible with the BMS offered, to output all system operating data, safety and cycling shut-down messages and a record of at least the last four safety shut-downs to a remote computer & printer. All the data available on the chiller microprocessor panel shall also be available on the BMS.
The following functions/parameters shall be continuously used / monitored in the BMS room.
Remote chiller package start / stop
Chilled water temperature reset
Current limit reset
Chilled water temperature reset
Current limit reset
Status of
Chilling package is ready to start
Chilling package is operating
Chilling package is shut down on a safety requiring re-set
Chiller is shut down on a recycling safety
All the data available on the chiller microcomputer control cabinet
Field instruments, water flow sensors and control wiring from field instruments and sensors to control panel shall be in CONTRACTOR'S scope.
Entire chiller package including solid state starter, Microprocessor control panel shall be suitable for operation in ambient temperature upto 50ºC.

HARMONIC FILTERATION

The chiller / chiller switch board shall be equipped with harmonic filtration to filter any harmonics generated from the chiller plant.

PLANT MANAGER / SEQUENCING PANEL

Apart from the unit mounted micro computer / microprocessor control on each water chiller, equipment sequencing / plant manager panel shall be provided by MANUFACTURE / CONTRACTOR, if specified in data sheet. The plant manager shall carry out following functions.
Start and stop the plant in start up and shut down sequence for optimum plant performance.
Sequence the operation of water chillers, pumps and cooling towers so as to obtain
Optimum performance of the chilling unit
Maximum overall life of the plant
Load and unload the chilling units to have optimum performance of plant based on return chilled water temperature
Provide rotation of chilling unit sequence by all modes viz.
An operator adjustable time and date

External input from BMS

An alarm shall be raised in case there is a problem in current mode of rotation
Give start and stop commands to the chilled water pumps as per plant operational requirements
Give open and close commands to motorized valves (to be supplied by CONTRACTOR) at the outlet piping of chiller and condenser connections.
Provide the operational status of the plant, which shall include all points of individual chiller.
Schedule the clock based operation of the chilling units based on loading hours of plant Vary the speed of the secondary chilled water pumps based on the analog input signal received from remotely located differential pressure sensor cum transmitter
Detect the failure of chilling unit, failure of reset
Communicate with the BMS of client having required hardware protocol supplied by chilling unit Manufacture
Communicate with individual microprocessor of each chilling unit
Record and contain the data of the plant operation, such that the history of plant operation could be retrieved through connected BMS to facilitate easy troubleshooting should have a facility of Programming all parameters that can be programmed in individual chiller Indicate all annunciations available in individual chilling unit communicate all inputs to BMS from each chiller.

NOISE & VIBRATIONS

Noise level produced by any equipment individually and combined shall not exceed the value as indicated in the data sheet. Acoustic jackets shall be provided on components causing excessive noise levels than specified.
The overall vibration level shall be as per zones A & B of ISO 10816-1.
The chillers shall be installed on the designated structure with vibration isolators installed

between structural members and equipment base. The vibration isolators shall be as per Manufacture's recommendations. The air cooled chillers shall necessarily have restrained

spring type vibration isolators, which shall be selected and supplied by Manufacture. The water cooled units shall have neoprene rubber vibration isolators if installed in ground floor or basement. Installing of water cooled chillers in any floors above ground shall require restrained spring type vibration isolators only. In all the cases, the isolation efficiency of vibration isolators shall not be less than 90%.
Rubber bellows (otherwise called as flexible rubber expansion joints) shall be installed (by CONTRACTOR) at both inlet and outlet connections of cooler (and condenser for water cooled chillers) to prevent any transmission of vibration from the chiller to the piping. Control rods shall be provided in these bellows in order to prevent their over elongation.

PAINTING

Painting shall be as per MANUFACTURE's standard, but shall be suitable for outdoor installation. Touch up painting similar to that of the factory, shall be carried out to repair any damage occurred during transport, shipping, site handling and installation.
INSTALLATION AND COMMISSIONING
The complete water chiller as a unit shall be installed on the foundation as per MANUFACTURE's recommendations. Necessary foundation bolts (other than those supplied by MANUFACTURE along with vibration isolators), leveling shims etc., shall be provided by CONTRACTOR.
Supervision of the positioning on plinths, pressure testing, evacuation, dehydration charging and the initial start up shall be by factory trained representatives of the equipment Manufacture, who have had extensive experience with the particular type of machine being installed.
This representative shall start up the equipment, adjust and calibrate controls and rectify any faults which may be found. Concurrently he shall fully instruct the personnel who will later be in charge of the operation and maintenance of the plant.
This representative shall remain on site a minimum time of 15 days consecutive working days. Should the liquid chillers be found not working satisfactorily by the end of this period, this representative shall remain on site until in the opinion of the Consultant / Client the chillers are operating satisfactorily.

The water chillers and their components shall be given the following tests and such other tests as the Consultant / Client considers necessary to bring the equipment into running order.
Evacuation of Liquid Chillers
The refrigeration system shall be evacuated by means of a suitable vacuum pump to a pressure of not greater than 0.7 kPa (0.1 psi) after which it shall be closed off and left to stand for 24 hours.

Chiller capacity

An approximate check of total refrigeration capacity of the chiller machines shall be carried out if climatic conditions permit.

Commissioning Tests

While the Manufacture's technician is on site the Contractor shall arrange the commissioning tests to be carried out and witnessed by the Consultant Engineer. The commissioning tests shall involve a complete check of the operation of all parts and safety controls associated with the chilled water machines, including associated pumps, auto start / stop controls, electrical supply and starter and any associated alarm control system.

The commissioning check of the chiller shall include check of evacuation, refrigerant and oil charge, electrical starter and associated control functions, motor windings, thermistor strips, bearings, water flow quantities, flow switch functions, purge unit functions, pump out unit functions, electrical wiring interlocks, refrigeration HP / LP controls, refrigeration low temperature thermostat, low oil pressure cut-out, oil level safety cut-out, high discharge temperature safety cut-out, leaving water thermostat and control, load limit controller, functions, recycle timer / programmer functions, and then a check of running pressures, temperatures, fluid levels, amps, motor overload trip settings to establish that proper operation is achieved.

CHILLER PERFORMANCE TESTS

To ensure quality, guaranteed efficiency and performance in compliance with the specified conditions, at least one unit of each model of the package liquid chiller shall be fully tested.
The tests shall be conducted in the presence of Client & Consultant at the Manufacture's factory or workshop where proper testing facilities are available and the test results shall be witnessed by Client & Consultant before dispatch of the chiller from manufacturing site. The design ambient condition should be simulated during the chiller performance test.
After assembly and pressure testing the chiller shall be tested on the following (in accordance with AHRI whenever applicable).

Full load capacity
Capacity control range as specified and stability of operation at minimum load

Efficiency at full load and partial load
Readings of chiller performance at 100%, 80% 70% 60% 50% and minimum loadings are required
Safety device activation
Pressure drop across evaporator and condenser
Noise levels at various points
Vibration levels at various points

The Contractor shall submit the test schedule at least one (1) month before proposed date of testing.

PUMPS

This part of specification covers the design, selection of materials, construction features, Manufacture, quality assurance and testing at works, packing, transport to site, installation, commissioning and carrying out the performance testing at site of the centrifugal pumps.

APPLICABLE DESIGN STANDARDS AND CODES

The design, materials, Manufacture, inspection, testing and performance of centrifugal pumps shall comply with all currently applicable regulations, codes and standards in the locality where the equipment is to be installed. Nothing in this specification shall be construed to relieve the CONTRACTOR of this responsibility. In particular, the centrifugal pumps shall conform to the latest edition of following Indian standards. Other international standards are also acceptable, if these are established to be equal or superior to the listed standards.

IS 1520	Horizontal Centrifugal Pumps for Clear, Cold Fresh Water
IS 5120	Technical Requirements for Rotodynamic Special Purpose Pumps
IS 6595 Part II	Horizontal Centrifugal Pumps for Clear, Cold Fresh Water
Part II	General Purposes other than Agricultural and Rural Water Supply
ISO 10816-1	Evaluation of Machine Vibrations by Measurements on Non-Rotating Parts
API 610	Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries

GENERAL DESIGN REQUIREMENTS

Performance parameters to be guaranteed by the CONTRACTOR and tolerances permitted shall be as indicated in data sheet. Signing of specifications shall be construed as CONTRACTOR's acceptance to such guarantees. Package or any portion thereof is liable for rejection, if it fails to meet any of the guaranteed performance parameters.

VARAIABLE SPEED PUMPING SYSTEM

This part of specification covers the design, selection of individual components, integration /

assembly of these components, quality assurance and testing at works (for individual components), packing, transport to site, installation, commissioning and carrying out the performance testing at site of the variable speed pumping system (hereinafter referred to as VSPS). This specification is applicable to secondary chilled water recirculation loop in HVAC system.

APPLICABLE DESIGN STANDARDS AND CODES

The design, selection of materials for individual components, manufacturing at works and integration / assembly of all these components, inspection and testing of individual components at works, and site performance testing of VSPS shall comply with all currently applicable regulations, codes and standards in the locality where the equipment is to be installed. Nothing in this specification shall be construed to relieve the CONTRACTOR of this responsibility. In particular, the VSPS shall conform to the latest edition of following standards. Other standards are also acceptable, if these are established to be equal or superior to the listed standards.

ANSI BS 6174 Specification for Differential Pressure Transmitters with Electrical Outputs

CFR Part 15.32 Test Procedures for CPU Boards and Computer Power Supplies

IEC 61508 Functional Safety of Electrical / Electronic / Programmable Electronic Safety-related Systems

NEMA 250 Enclosures for Electrical Equipment (1000 V Maximum)

NEMA ICS 61800-2 Adjustable Speed Electrical Power Drive Systems

Part 2 – General Requirements – Rating Specifications for Low Voltage Adjustable Frequency AC Power Drive Systems

PED 97/23/EC Pressure Equipment Directive

GENERAL REQUIREMENTS

The VSPS shall consist of, but not limited to, following components.

Pump Controller

Variable frequency drive (VFD)

Differential pressure sensor cum transmitter

Pump Control panel in NEMA Type 3 enclosure containing Controller, VFD and its automatic bypass

Power and control wiring between individual components and the pump control panel, as required for complete system

Any other component not listed herein but deemed necessary for system completion and its safe, reliable and efficient operation shall be included by the CONTRACTOR in his quoted price and no extra claims shall be made on this account.

PUMP CONTROLLER

The pump Controller assembly shall be listed by and bear the label of Underwriter's Laboratory (UL). The Controller shall meet Part 15.32 of FCC regulations sub-class A pertaining to CPU boards. The Controller shall be specifically designed for variable speed pumping applications.

The controller shall function to a proven program that safeguard against hydraulic conditions including.

Pump flow surges

Hunting

End of curve

System over pressure

NPSHr above NPSHa
Motor overload
The pump Controller shall be capable of receiving up to number of discrete analog inputs from zone differential pressure sensors cum transmitters as indicated in the data sheet. It shall then select the analogue signal that deviate the greatest value from its set point. This selected signal shall be used as the command feedback input for a hydraulic stabilization function to minimize hunting. Each input signal shall be capable of maintaining a different set point value. Controller shall be capable of controlling number of pumps (as indicated in data sheet) in parallel.
The pump Controller shall have an additional analog input for a flow sensor. This input shall serve as the criteria for the end of curve protection algorithm.
The hydraulic stabilization program shall utilize a proportional-integral-derivative (PID) control function. The PID values shall be user adjustable over an infinite range.
The pump Controller shall be self prompting. All messages shall be displayed in plain English. The operator interface shall have the following features.
Multi-fault memory and recall last 10 faults and related operational data
Red fault light, yellow warning light and green power on light
Soft-touch membrane keypad switches
The display shall have four lines, with 20 characters on three lines and eight large characters on one line. Actual pump information shall be displayed indicating pump status.
Controller shall be capable performing the following pressure booster function.
Low suction pressure cut-out to protect the pumps against operating with insufficient suction pressure.
High system pressure cut-out to protect the piping system against high pressure conditions.
No flow shut down to turn the pumps off automatically when system demand is low enough to be supplied by hydro pneumatic tank. No flow shutdown shall require any external flow meters, flow switches or pressure switches to determine when a No Flow condition exists.
The Controller shall provide following communication features to BAS.
System percent speed
System Start / Stop command
System operation mode
Individual KW signals
System flow, when optional flow sensor is provided
Remote system start / stop non-powered digital input
Failure of any system component
Output closes to indicate alarm condition
One 4-20 mA output with selectable output of
Frequency
Process Variable

Output Current
Output power

Individual Analog Input
Individual Zone Set Points
Individual Pump / AFD on/off status
VARIABLE FREQUENCY DRIVES (VFD)
The VFD shall be of Pulse Width Modulation (PWM) type with microprocessor controlled design.
The VFD including all factory installed option shall be tested to UL standard 508. The VFD shall also meet UL and be CE marked.
The VFD shall employ an advanced sine wave approximation and voltage vector control to allow operation at rated motor shaft output speed with no derating. This voltage vector control shall minimize harmonics to the motor to increase motor efficiency and lift. Power factor shall be near unity regardless of speed or load.
The VFD shall have balanced DC link reactors to minimize power line harmonics VFDs without a DC link reactor shall provide a 3% impedance line reactor.
Input and output power circuit switching can be done without interlocks or damage to the VFD.
The following customer editable adjustments shall be provided.
Acceleration time from 1 to 600 seconds
Deceleration time from 1 to 600 seconds
Minimum Frequency of 1 Hz
Maximum Frequency of 120 Hz
Overload protection from 70% to 100%
RS-485 communication shall be available on the VFD.
An automatic energy optimization selection feature shall be provided. This feature shall reduce voltage when lightly loaded and provide a 3% to 10% additional energy savings.
The VFD shall be suitable for upto 3300 feet elevation above sea level and upto 50ºC ambient temperature without derating. VFD shall be suitable for operation in environments upto to 95% RH non-condensing humid conditions.
The VFD shall be capable of displaying the following information in plain English via an alphanumeric display.
Frequency
Voltage
Current
Kilowatts per hour
Fault Identification
Percent Torque
Percent Power
RPM

AUTOMATIC VFD BYPASS

Variable speed pumping system shall be equipped with an automatic bypass.
Bypass shall consist of a main power disconnect with ground fault protection, a pair of interlocked Contractors and a motor overload relay.
Automatic bypass shall operate as shown in schematic drawings described in the sequence of operation.

DIFFERENTIAL PRESSURE SENSOR CUM TRANSMITTERS
Provide field mounted differential pressure sensor cum transmitters as indicated in the drawings. Unit shall transmit an isolated 4-20 mA / 0-10 V DC signal indicative of process variable to the pump Controller via standard two wire 24 DC system. Unit shall have a corrosion resistant steel body with 1/8" NPT process connection. It shall have a NEMA 1 electrical enclosure capable of withstanding 450 psi static pressure. Accuracy shall be within ±0.5% of full span. The CONTRACTOR shall ensure that these differential pressure sensor are enclosed within pilfer proof housing such as stainless steel housing with lockable access.

SEQUENCE OF OPERATION
The pumping system shall start upon the closure of customer's contact when the pump Controller mode of operation selector switch is in the REMOTE position.
When the pump Controller selector switch is in the LOCAL position, and start command on Controller is given via operator interface, the pumping system shall operate automatically.
The pump Controller shall compare each signal to the independent user defined set points.
When all set points are satisfied by the process variable, the pump speed shall remain constant at the optimum energy consumption level.
The pump Controller shall continuously scan and compare each process variable to its individual set point and control to the least satisfied zone.
If the set point cannot be satisfied by the designated lead pump, the pump Controller shall initiate a timed sequence of operation to stage a lag pump.
The lag pump shall accelerate resulting in the lead pump(s) decelerating until they equalize in speed.
Further change in process variable shall cause the pumps to change speed together.
When the set point criteria can be safely satisfied with fewer pumps, the pump Controller shall initiate a timed destage sequence and continue variable speed operation.

As the worst case zone deviates from set point, the pump Controller shall send the appropriate analog signal to the VFD to speed up or slow down the pump / motor.
In the event of a VFD fault, the pump Controller automatically initiates a time sequence of events to start the redundant pump / VFD set in the variable speed mode. The redundant variable speed system shall be started through the pump controller.
Upon VFD fault(s), the pump Controller shall display an alarm condition through a plain English message.

VFD fault indication shall be continuously displayed on the operator interface of the pump until the fault has been corrected and the controller has been manually reset.

In the event of the failure of a zone sensor / transmitter, its process variable signal shall be removed from the scan / compare program. Alternative zone sensor / transmitters, if available, shall remain in the scan / compare program for control.
Upon sensor failure a plain English warning message shall be displayed on the operator interface of the pump controller.
In the event of failure to receive all zone process variable signals, a user selectable number of VFDs shall maintain a user adjustable speed, reset shall be automatic upon correction of the zone failure.

INSPECTION AND TESTS
The PUMP MANUFACTURE shall assume "Unit Responsibility" for the complete pumping package. Unit responsibility shall be defined as responsibility for interface and successful operation of all system components supplied by the pumping system MANUFACTURE.
The MANUFACTURE shall have sufficient experience in design, application engineering, installation, commissioning and successful handing over of variable speed pumping systems. In addition to the above, the MANUFACTURE shall have sufficient after sales service backup.

All functions of the VSPS shall be tested at the factory prior to shipment. These tests shall be conducted with motors connected to VFD output and it shall test all inputs, outputs and program execution specific to the application.
MANUFACTURE shall be listed by Underwriter's Laboratories as Manufacture of packaged pumping systems and shall be ISO certified one for quality management system.
CONTRACTOR shall comply with all sections of specifications pertaining to packaged pumping systems. Any deviations from those specifications shall be clearly defined in writing

at time of bid, failing which it shall be construed that all specifications are complied with.
The pump Controller, VFDs, VFD bypass (if indicated in data sheet) and remote differential pressure sensor cum transmitters shall be shipped as individual components to site and shall be assembled at site, as per MANUFACTURE's instructions, by CONTRACTOR.
Power and low voltage control wiring shall be installed by the CONTRACTOR as shown on the field connection drawings and wiring diagrams supplied with the pumping package from the MANUFACTURE.
SUBMITTALS
The CONTRACTOR, upon finalization of order with the MANUFACTURE, shall coordinate and furnish the following documents, provided after detail engineering by the MANUFACTURE.
System summary sheet
Sequence of operation
Shop drawing indicating dimensions, required clearances and location and size of each field connection
Power and control wiring diagrams

System profile analysis including variable speed pump curves and system curve (including pump, motor and VFD efficiencies) job specific load profile, staging points, horse power and kilowatt/hour consumption
Pump documents as indicated in the pump data sheets

COOLING TOWER

This part of specification covers the design, selection of materials, construction features, Manufacture, quality assurance at works, testing at works, packing, transport to site, installation, commissioning and carrying out the performance testing at site of the induced draft cooling towers.

1.0 APPLICABLE DESIGN STANDARDS AND CODES

The design, materials, Manufacture, inspection, testing and performance of cooling towers shall comply with all currently applicable regulations, codes and standards in the locality where the equipment is to be installed. Nothing in this specification shall be construed to relieve the CONTRACTOR of this responsibility. In particular, the cooling towers shall conform to the latest edition of following standards.

IS 2312	Propeller Type AC Ventilating Fans
IS 11561	Code of Practice for Testing of Water Cooling Towers
CTI ATC 105 S	Acceptance Test Code for Closed Circuit Cooling Towers

2.0 GENERAL CONSTRUCTION FEATURES

The cooling towers shall be of induced draft, cross flow or counter flow as stated in data sheet.
The cooling towers can be of single cell or of multiple cells in modular construction.
The cooling towers shall be complete with all components viz., casing, air inlet louvers, fills, fill supports, internal supporting structure, drift eliminators, hot water piping distribution, fan, drive motor, drive set / gear box (if applicable), cold water basin and accessories.

3.0 DESIGN FEATURES

3.1 The casing could be of rectangular or circular shape as per MANUFACTURE's standard. The fan deck shall be designed to take care of the fan-motor assembly dynamic load and maintenance personnel load while in operation.
3.2 The louvers, fills and drift eliminators shall be designed to impose minimum resistance to the air flow.
Drift eliminators shall be provided to limit the drift losses to less than 0.1% of the total water flow through the cooling tower.
The propeller fan blades shall be of aerofoil, adjustable pitch type and shall be easily removable. The fan shall be statically and dynamically balanced as per AMCA 204 G 6.3 or equivalent IS standard.
Fan shall be direct driven / belt driven / gear driven. Gear box, if applicable, shall be of enclosed type with gears submerged in oil bath.

3.4 Selected drive motor shall have power margins as below

15% power margin over brake power for direct drive

15% power margin over brake power for belt drive

25% power margin over brake power for gear drive

Drive motor shall be squirrel cage induction, weather-proof, totally enclosed, fan cooled type with IP-55 degree of protection, suitable for 415 V, 3 phase, 50 Hz AC power supply. EFF1 efficiency motors shall be provided.

3.6 Cold water basin shall be water tight, without use of any sealant.

Cold water basin shall have cold water outlet, overflow, drain and make up water connections. The valves, specialties and other accessories in the piping shall be provided by CONTRACTOR during installation at site

Cold water basin design, in case of concrete basin, shall be carried out by MANUFACTURE as per the requirements of the cooling tower. However, the civil work of the same shall be carried out by others as per the drawings provided by the MANUFACTURE.

3.9 Necessary doors / windows shall be provided to have an access to internal media and water distribution system.

4.0 Material of construction

4.1 The casing, louvers and fills shall be of weather-proof fibre reinforced plastic with necessary thickness and shall be suitable for corrosive marine ambient conditions.

4.2 The internal structural frame work shall be of galvanised steel structural members.

4.3 The cold water basin shall be of concrete or FRP as indicated in the data sheets.

4.4 Internal water distribution system piping shall be of galvanized steel as per IS 1239 class C. Spray nozzles and other related fittings shall be in bronze or stainless steel.

4.5 Media for fills shall be of honeycomb type UV stabilized rigid PVC, providing maximum contact area and least resistance to air flow.

4.6 Fan blades shall be of pressure die cast aluminium.

4.7 The access ladder shall be of hot dip galvanized steel.

5.0 ACCESSORIES

Cooling tower shall have following accessories, supplied by the MANUFACTURE.

Access ladder to reach fan motor assembly on the tower deck

Fan guard of plastic coated galvanized steel wire

Stainless steel screen between casing and basin, in case of a concrete basin

6.0 INSTALLATION AND COMMISSIONING

6.1 The cooling tower shall be installed as per MANUFACTURE's general arrangement drawings, duly approved by consultant. Necessary foundation bolts (other than those supplied by MANUFACTURE), levelling shims etc., shall be provided by CONTRACTOR.

6.2 The valves and instruments as per the approved schematic drawing shall be provided and installed by the CONTRACTOR.

6.3 The cooling tower shall be performance tested as per tests indicated in data sheet.

7.0 PERFORMANCE TESTS

After installation and commissioning of the cooling tower, the performance test shall be carried out to achieve the required parameters as indicated in the section "Minimum Inspection Requirements of Induced Draft Cooling Towers".

7. PIPING, VALVES & FITTINGS

This part of the specification covers the supply and installation of the pipes, fittings, valves, strainers, test ports, etc. and their testing and balancing of all water and refrigerant piping required for the complete installation as shown in the drawings. All piping, fittings, valves and strainers shall follow the applicable standards as indicated in the corresponding data sheets.

APPLICABLE DESIGN STANDARDS AND CODES

The design, materials, Manufacture, inspection and testing of piping shall comply with all currently applicable regulations, codes and standards in the locality where it is installed. Nothing in this specification shall be construed to relieve the CONTRACTOR of this responsibility. In particular, the piping system shall conform to the latest edition of following standards.

IS 1239 – Part 1 Steel Tubes, Tubulars and Other Wrought Steel Fittings – Steel Tubes
IS 1239 – Part 2 Steel Tubes, Tubulars and Other Wrought Steel Fittings – Steel Pipe Fittings
IS 3589 Steel Pipes for Water and Sewage – Specification
IS 554 Pipe Threads Where Pressure-Tight Joints are Made on the Threads - Dimensions, Tolerances and Designation
IS 822 Code of procedure for inspection of Welds
IS 2379 Colour code for the identification of Pipelines
IS 4736 Specification for Hot-dip Zinc Coatings on Mild Steel Tubes
IS 5312 – Part 1 Swing Check Type Reflux (Non-Return] Valves for Water Works Purposes - Specification Part 1: Single-Door Pattern
IS 5312 – Part 2 Swing Check Type Reflux (Non-Return] Valves for Water Works Purposes - Specification Part 2: Double Door Pattern
IS 13095 Butterfly valves for general purposes
IS 9890 Specifications for general purpose Ball Valves
IS 6392 Steel Pipe Flanges
IS 2629 Recommended Practice for Hot-Dip Galvanizing of Iron and Steel
ANSI B 16.5 Pipe Flanges and Flanged Fittings
ASTM A 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc coated, Welded and Seamless
ASTM A 183 Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A 234 Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 449 Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A 536 Standard Specification for Ductile Iron Casting

ASTM A 1476 Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications
ASME B 16.9 Factory Made Wrought Butt Welding Fittings
ASME B 31.1 Power Piping
ASME B 31.9 Building Services Piping
AWWA C 606 Grooved and Shouldered Joints

SIZING OF PIPING SYSTEM

Pipe sizes shall be as required for the individual fluid flows. Various pipe sizes have been indicated on the drawings, these are for Contractor's guidance only and shall not relieve Contractor of responsibility for providing smooth noiseless balanced circulation of fluids.

MATERIALS AND STANDARDS.

The piping system for chilled water, hot water and condenser cooling water shall be ERW, black mild steel as per IS 1239 and IS 3589. The thickness and class shall be as stated in the data sheets.

All joining of the pipes shall be by welding, SEAMLESS unless otherwise mentioned, or as directed at site. All welding shall be done by qualified welders and shall strictly conform to BIS Code of practice for shielded metal arc welding of mild steel.

Out of three welds one butt weld of each welder shall be fully radiographed for testing purposes. Upon approval of welding joints, the concerned welder shall be allowed to carry further welding of pipes. Rest of the welds shall have 80% visual inspection.

FITTINGS

All fittings viz., elbows, caps, reducers and tees shall be fillet welded type for pipes 50 NB and higher. However pipes 40 NB and lower shall be socket welded.

Fittings for sizes 50 NB to 150 NB shall be of schedule 40 seamless mild steel as per ASTM A 234 Grade WPB with ANSI B 16.9 dimensional standard. Fittings for pipes 200 NB and above shall match the thickness of the pipe.

Fittings for sizes 40 NB and less shall be of seamless mild steel of 3000 CL as per ASTM A 105 with ANSI B 16.11 dimensional standard.

All welded joints (except pipe welded end-to-end) shall be made by use of one-piece welding flanges, caps, nozzles, elbows, branch outlets and tees of approved make. Cut samples shall be submitted for approval, if directed. All such fittings etc. shall be of a type which maintain full wall-thickness at all points, simple radius and fillets, and proper bevels or shoulders at ends. All welding shall be done by the electric shielded metal arc welding process in accordance with the following:

All joints shall have 45 degree bevel type, pipe mill-bevelled or machine-bevelled by the Contractor.

All scale and oxide shall be removed with hammer, chisel or file and bevel left smooth and clean.

Pipe lengths shall line up straight with abutting pipe ends concentric.

Both conductors from the welding machine shall be extended to locations at which welding work is being done. The leads from welding machine to location of welding work shall be held together with tape or other approved means so as to prevent induced current in structural

steel, in piping or in other metals within the building. The ground lead shall be connected to length of pipe through joints in pipe, structural steel of building or steel pipe supports.
All pipes and their steel supports shall be thoroughly cleaned and given one primary coat of red oxide paint before being installed. For vibration isolators premolded polyurethane pipe sections of 160 Kg/m3 density with adhesive shall be fixed between pipe and MS support. 8 mm thick mild steel 'U' clamp with Resistoflex shall be fixed on the pipe so that the pipe is kept in position. All welded piping shall be subject to the approval at site.
Fittings shall be malleable casting pressure rating suitable for the piping system. Fittings used on welded piping shall be of the weldable type. These shall form part of piping and are not separately identified in Schedule of Quantities.
Tee-off connections shall be through equal or reducing tees, otherwise ferrules welded to the main pipe shall be used. Drilling and tapping of the walls of the main pipe shall not be resorted to.
Flanges shall be of the type and standard as indicated in the piping data sheet. The supply of flanges shall form part of piping (not separately identified in Schedule of Quantities) and shall also include supply of fasteners and suitable asbestos fibre / rubber insertion gaskets (minimum 3 mm thick).

GROOVED PIPING SYSTEM
All grooved components (including couplings, fittings, valves and accessories) to be supplied by one Manufacture. Grooving tools shall be of the same Manufacture as the grooved components.

MATERIALS OF CONSTRUCTION
Grooved Couplings for joining carbon steel pipe shall be Manufactured in two segments of cast ductile iron conforming to ASTM A 536 grade 65-45-12. Grooved couplings shall meet the requirements of ASTM F-1476.
Rigid Type: Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity, support and hanging in accordance with ANSI B31.1, B31.9, and NFPA 11.
Flexible Type: Use in locations where vibration attenuation and stress relief are required. Flexible couplings may be used in lieu of flexible connectors at equipment connections. Three Couplings shall be placed in close proximity to the vibration source.
Gaskets shall be pressure responsive synthetic rubber grade to suit the intended service, conforming to ASTM D-2000. Gaskets for potable water application shall be UL classified in accordance with ANSI / NSF-61 for potable water service.
Mechanical Coupling bolts shall be zinc plated (ASTM B-633) heat treated carbon steel track head conforming to ASTM A-449 and ASTM A-183, minimum tensile strength 18,000 psi (758450 kPa).
Flange Adapters: For use with grooved end pipe and fittings, for mating to ANSI Class 150 flanges.
Grooved End Fittings: Fittings shall be cast of ductile iron conforming to ASTM A-536, Grade 65-45-12, forged steel conforming to ASTM A-234, Grade WPB 0.375" wall (9.53

mm wall), or fabricated from Std. Wt. Carbon Steel pipe conforming to ASTM A-53, Type F, E or S, Grade B. Fittings provided with an alkyd enamel finish or hot dip galvanized to ASTM A-153. Zinc electroplated fittings and couplings conform to ASTM B633.
Grooved Hole-Cut Branch Outlets:
Bolted Branch Outlet: Branch reductions on 2" (DN50) through 8" (DN200) header piping bolted branch outlets shall be Manufactured from ductile iron conforming to ASTM A-536, Grade 65-45-12 with synthetic rubber gasket. Heat treated carbon steel zinc plated bolts and nuts shall conform to physical properties of ASTM A-183.
Strapless Outlet: ½" (DN15) or ¾" (DN20) NPT outlet on 4" (DN80) and larger header sizes rated for 300 PSI (2065 kPa).
Strapless Thermometer Outlet: To accommodate industrial glass bulb thermometers with standard 1-1/4"-18 NEF 2B extra fine thread and 6" (152mm) nominal bulb length on 4" (DN80) and larger header sizes rated for 300 PSI (2065 kPa).

COLD WATER AND DRAIN PIPING
All pipes to be used for cold water (makeup), drain, condensate drain and fittings shall be galvanized steel class `B' (medium class) conforming to relevant BIS Codes.
All jointing in the pipe system shall be by screwed joints and/or by screwed flanges using 3 mm 3 ply rubber insertion gaskets. Pipe threads and flanges shall be as per relevant BIS Codes.
All pipes supports shall be mild steel, thoroughly cleaned and given one primary coat of red oxide paint before being installed.
Fittings shall be galvanized steel `medium class' malleable casting of pressure rating suitable for the piping system. Flanges shall be of approved make. Supply of flanges shall include bolts, nuts and gaskets as required. Sufficient number of flanges and unions shall be provided for future cleaning and servicing of piping. Tee-off connection shall be through equal or reducing tees. All equipment and valve connections or connections to any other mating pipes shall be through flanges required for the mating connections. Fittings & flanges shall form part of piping and are not separately identified in Schedule of Quantities.

Gate valves, globe valves, check valves and strainers shall be similar to those specified for chilled, condensing and hot water piping.
For proper drainage of AHU Condensate, 'U' trap shall be provided in the drain piping.
All condensate drain piping shall be insulated and painted as per the section "Insulation" as indicated in Schedule of Quantities.

REFRIGERANT PIPING
All refrigerant pipes and fittings shall be hard drawn copper tubes of Minimum 18 guage thickness (or above to suit the working pressure) and wrought copper / brass fittings suitable for connection with silver solder / phos-copper.
All joints in copper piping shall be sweat joints using low temperature brazing and / or silver solder. Before jointing any copper pipe or fittings, its interiors shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be

continuously kept clean of dirt etc. while constructing the joints. Subsequently, it shall be thoroughly blown out using carbon dioxide / nitrogen.
Refrigerant lines shall be sized to limit pressure drop between the evaporator and condensing unit to less than 0.2 kg per sq.cm.
Sight glass with moisture indicator and removable type combination dryer cum filter with MS housing and brass wire mesh / punched brass sheet shall be installed in liquid line of the refrigeration system incorporating a three valve by pass. After ninety days of operation, liquid line drier cartridges shall be replaced.
Heat exchanger shall be MS heavy duty pipe in pipe type and without any joint in the inner pipe.
Horizontal suction line shall be pitched towards the compressor and no reducers shall be provided for proper oil return.

After the refrigerant piping installation has been completed, the refrigerant piping system shall be pressure tested using Freon mixed with nitrogen / carbon dioxide at a pressure of 20 kg per sq. cm (high side) and 8 kg per sq. cm (low side). Pressure shall be maintained in the system for a minimum of 12 hours. The system shall then be evacuated to a minimum vacuum of 70 cm (500 microns) of mercury and held for 24 hours. Vacuum shall be checked with a calibrated vacuum gage.
All refrigeration piping shall be installed strictly as per the instructions and recommendations of air conditioning equipment Manufacture.

VALVES
All valves shall be provided as indicated in the drawings.
All valves shall be located in the accessible position for ease of operation. The orientation of the operating handles, levers or gear wheels shall kept into consideration while installing the valves.
The valves embedded under the insulation shall be provided with extended stems to enable their easy operation.
Ball valves shall be used for isolation purpose for line size upto 40 NB. The ball valves shall be female threaded in 2 piece or 3 piece connection. The material of construction shall be as below.

Body & ball	:	Nickel or chrome plated brass
Seat and stem packing:	PTFE or EPDM	
Stem / shaft	:	Brass
Lever / handle	:	Steel

Wafer type butterfly valves shall be used for isolation purpose for line sizes 50 NB or higher. Lever operated valves shall be used for sizes upto 200 NB and gear operated valves shall be used for sizes 250 NB and higher. The material of construction shall be as below.

Body	:	Cast Iron as per IS 210 Gr FG 260

Disc	:	SG Iron to IS 1865 Gr 450
Liner / seal	:	EPDM / Buna-N
Shaft / stem	:	Stainless steel 410
Lever / Gear	:	Carbon steel

Non return valves shall be wafer type dual plate check valves. The material of construction shall be as below.

Body	:	Cast Iron as per IS 210 Gr FG 260 / ASTM A 126 Class B
Discs / plates	:	Stainless steel 316
Liner / seal	:	EPDM
Shaft / stem	:	Stainless steel 410
Springs	:	Stainless steel 316

Balancing valves shall be double regulating type with raised face flanges drilled as per ANSI B 16.5 or female threaded. The material of construction shall be as below.

Sizes upto 40 NB

Body	:	Brass / Bronze / Gun metal
Seat and stem / shaft	:	Bronze / Gun metal
Seat seal and stem seal	:	Teflon
Handle	:	Polyamide plastic

Sizes 50 NB and above

Body	:	Cast Iron as per IS 210 Gr FG 260
Seat and stem / shaft	:	Stainless steel 410
Seat seal and stem seal	:	EPDM
Handle	:	Mild steel

Suction strainers shall be Y type with raised face flanges drilled as per ANSI B 16.5 or female threaded. The body shall possess an integral permanent magnet to arrest the iron particles. The material of construction shall be as below.

Sizes upto 40 NB

Body and screw	:	Brass / Bronze / Gun metal
Screen	:	0.6 mm thick mesh of SS-304 with 1.2 mm thick wire of SS-304

Sizes 50 NB and above

Body and bonnet	:	Cast Iron / Mild steel
Basket	:	1.2 mm thick Brass / Bronze / SS-304 With 3 mm perforations

VALVE IDENTIFICATION

Provide 30 mm dia brass valve tag, with embossed letters and number for each valve and attach the tag to valve handle by “S” hook or by suitable means. Contractor shall provide

valve tag schedule and valve chart for each piping system, consisting of schematic drawing of piping layout, along with a valve list, showing and identifying each valve by number, service and location and describing its function.
The Contractor shall frame under glass in the air conditioning plant room or as directed by Owner's site representative two copies of valve chart. Two additional uncounted copies shall be supplied to the Owner's site representative.
Tags shall correspond with the valve schedule and record drawings. In back of house areas, where ceilings are installed and the valve or valve tag is not visible, a self adhering tag with the valve number shall be installed on the wall or directly under the ceiling. For public area ceiling valves, these tags are to be installed in the service corridor, leading to the public areas.

PIPING INSTALLATION
Design Drawings indicate schematically the size and location of pipes. The Contractor, on

award of the work, shall prepare detailed shop drawings, showing the cross-section, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves, and all pipe supports. He must keep in view the specific openings in the building through which pipes are designed to pass.
Piping shall be properly supported on, or suspended from, stands, clamps, and hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency. All support hangers shall be provided with double nuts.
Continuous threaded rods shall be used as hangers from the anchors. Intermediate threaded couplings for the support hangers shall not be acceptable (except where the hanger lengths exceed 6 m, for which there are special instructions).
All pipes in HVAC plant room shall be supported with pipes and channels from floor only with necessary PUF pipe supports and resistoflex sheet.
Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint and finish coated black. Where pipe and clamps are of dissimilar materials, a gasket shall be provided in between. Spacing of pipe supports shall not exceed the following.

Pipe size	Spacing between supports	Rod Size
Upto 12 NB	1.5 m	8 mm
15 NB to 25 NB	2.0 m	10 mm
32 NB to 100 NB	2.0 m	12 mm
125 NB & 150 NB	3.0 m	16 mm
200 NB and above	2.4 m	16 mm

Vertical pipes passing through floors shall be plumb and parallel to wall. Pipes shall be supported on alternate floor. MS cleats shall be welded on pipes and rest on MS channel placed on the floor with 15 mm thick resistoflex pads between the cleat and channel. U

clamps with resistoflex sheet shall be provided to keep the pipe in position. Bull heading in water/refrigerant piping shall be avoided.

Pipe sleeves at least 3 mm thick, 50 mm / 80 mm larger in diameter than condenser / chilled water pipes respectively shall be provided wherever pipes pass through retaining wall and slab. Annular space shall be filled with fiberglass / nitrile rubber and finished with retainer rings welded on the ends of the sleeve.
Wherever pipes pass through the brick or masonry / slab openings, the gaps shall be sealed with Low VOC fire sealant such as fire barrier caulks.
Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. 20 gage metal sheets shall be provided between the insulation and the clamp, saddle or roller, extending atleast 15 cm on both sides of the clamp, saddles or roller.

All piping work shall be carried out in workmen like manner, causing minimum disturbance to the existing services, buildings and structure. The entire piping work shall be organized, in consultation with other agencies work, so that laying of pipes, supports, and pressure testing for each area shall be carried out in one stretch.
Cut-outs in the floor slabs for installing the various pipes are indicated in the Drawings. Contractor shall carefully examine the cut-outs provided and clearly point out where the cut-outs shown in the Drawings do not meet with the requirements.
The Contractor shall make sure that the clamps, brackets, clamp saddles and hangers provided for pipe supports are adequate. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required.
All pipes shall be accurately cut to the required size in accordance with relevant BIS Codes, edges beveled and burrs removed before lying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reducers shall be used for the piping to drain freely. In other locations, concentric reducers may be used.
Flanged inspection pieces 1.5 meters long, with bolted flanges on both ends, shall be provided no more than 30 meters centres, or where-ever shown in Approved-for-Construction shop drawings, to facilitate future cleaning of all welded pipes.

Flexible metallic expansion joints shall be provided wherever the piping is crossing a building structural expansion joint to prevent stress development in the piping network.

BURIED PIPES
All buried pipes shall be cleaned and coated with zinc chromate primer and bitumen paint, and placed on concrete blocks with PUF saddles, on a sand bed of minimum 80 mm underneath. The concrete block supports shall be placed at not more than two meter (2 m) intervals. The pipes shall then be wrapped with three layers of fibre glass felt, each layer laid in bitumen. The underground piping shall be covered after above finishing 200 mm thick sand bed.

Insulated buried pipes shall be cleaned, derusted, then coated with rust-resistant primer and placed on concrete blocks with PUF saddles dipped in bitumen at every 2 meters. Insulation shall be applied as per the section "Insulation", wrapped with GI wire and covered with polyethylene sheet. Two coats (each 6 mm thick) of cement plaster shall be applied over chicken wire mesh lath. Where indicated in Schedule of Quantities, buried insulated pipes shall be water-proofed using coat of Shalibond, or approved adhesive, over the plastered surface; wrapping one layer of fibre glass RP tissue and one layer of roofing tar felt with sufficient overlaps, set and sealed with the adhesive, held in position by 16 gage G.I wire tied at 15 cm intervals.

AIR VENTS AND DRAINS

All piping work shall be provided with vents at the top most points and drains in the lowest points, in general.

Air valves shall be 15 mm pipe size with screwed joints.

Discharge from the automatic air valves / automatic air vents shall be piped through an equal sized mild steel or galvanized steel pipe to the nearest drain or sump. These pipes shall be pitched towards drain points.

Drains shall be provided at all low points in the piping system and shall have following sizes.

Main pipe size	Drain point size
Upto 100 NB	20 NB
125 NB to 250 NB	25 NB
300 NB and above	40 NB

Drain shall be provided with an isolation valve (preferably a gate valve) of the same size as that of the drain itself. The drains shall have the interconnecting piping upto nearest drain points (floor drains / roof drains) with a union coupling close to drain to enable the connection of a flexible hose as and when required.

PRESSURE GAUGES AND THERMOMETERS

Pressure gauges as specified under section "Automatic Controls and Instruments" shall be provided at suction and at discharge of each pump, at chilled water supply and return at each air handling unit, at each chillers and condenser, and as shown on the Drawings and included in Schedule of Quantities. Care shall be taken to protect pressure gauges during testing. Pressure gage sockets on insulated pipes and accessories shall be extended upto insulation to avoid damage of insulation for replacement of gauges.

Pressure gauges dial shall be not less than 100 mm diameter for dial type. Digital pressure gauges shall be provided if stated in the bill of quantities. The dial type pressure gauges shall

be of bourdon tube type suitable for outdoor installation. Complete case, internal movement and bourdon shall be in stainless steel construction.
Thermometers as specified under section "Automatic Controls and Instruments" shall be provided at chilled water supply and return at each air handling unit, at each chiller and condenser, and as shown on Drawings and included in Schedule of Quantities.
Thermometers shall be stem type. Digital thermometers shall be provided if stated in bill of quantities. The thermometers shall be of mercury in glass type.
Pressure gauges and thermometers shall be oriented and angles in such a way that they are clearly readable from the floor level without any ladder or elevating equipment.
Pressure gauges and thermometers shall be installed after completing of all works at site. The same shall be inspected by Consultants / Owners for their correct operation.
Thermometers on CHW lines shall be with long stem. Thermometer socket shall be extended upto insulation thickness so that the thermometer shall be removable without damaging the insulation.

The pressure gauges and thermometers shall be selected for an appropriate range such that the operating values shall be approximately in the middle of the range of the instruments.
The pressure gauges and thermometers shall be supplied along with their calibration certificates.
Test ports shall be provided in the piping near the equipment to take measurements of pressure and temperature.

TESTING
During construction, the Contractor shall properly cap all lines, so as to prevent the entrance of sand, dirt, etc. Each system of piping shall be flushed thoroughly after completion (for the purpose of removing dirt, grit, sand etc. from the piping and fittings) for as long a time as is required to thoroughly clean the system.
All piping shall be tested to hydrostatic test pressure of atleast two times the maximum operating pressure, but not less than 8 Kg/cm2(g) for not less than 48 hours. All leaks and defects in joints revealed during the testing shall be rectified, retested and gotten approved.
Piping may be tested in sections and such sections shall be securely capped, then re-tested for the entire system.
The Contractor shall give sufficient notice to all other agencies at site, of his intention to test a section or sections of piping and all testing shall be witnessed and recorded by Owner's site representative.
The Contractors shall provide temporary pipe connections to initially by-pass condenser / chiller and circulate water through condenser / chilled water pipe lines for minimum 8 hours of pre-commissioning flushing process. Water should be drained out from the lowest point. The temporary lines shall be removed and blanked with blind flanges. Strainers shall be cleaned and fresh water filled in the circuits before the water is allowed into the condensers, cooler and AHU coils.
The Contractor shall make sure that proper noiseless circulation of fluid is achieved through all coils and other heat exchange equipment in the system concerned. If proper circulation is

not achieved due to air bound connection, the Contractor shall rectify the defective connections. He shall bear all expenses for carrying out the above rectifications including the tearing up and re-finishing of floors and walls if required.
After the piping has been installed, tested and run for atleast three days of eight hours each, all insulated exposed piping in plant room shall be given two finish coats, 3 mils each of approved colour, conforming to relevant BIS Codes. The direction of flow of fluid in the pipes shall be visibly marked with identifying arrows. For painting of insulated and clad pipes refer to Insulation section.
After testing, all systems shall be chemically cleaned. After cleaning, the pipe work should be rinsed multiples times until the system is neutral.
Before handover Owner's site representative shall be provided with certificate of cleaning of pipe systems, signed by the Contractor.

The Contractor shall provide all materials, tools, equipment, instruments, services and labour required to perform the test and to remove water resulting from cleaning and after testing.

BALANCING
After completion of the installation, all water system shall be adjusted and balanced to deliver the water quantities as specified, quoted, or as directed.
All balancing valves, Automatic control valves and two-way diverting valves shall be set for full flow condition during balancing procedure. Each water circuit shall be adjusted thru balancing valves provided for this purpose; these shall be permanently marked after balancing is completed, so that they can be restored to their correct positions, if disturbed.
Complete certified balancing report shall be submitted for evaluation and approval by Owner's site representative. Upon approval, four copies of the balancing report shall be submitted with the as-installed drawings and completion documents.

HYDRONIC BALANCING
Automatic balancing valves shall automatically control flow rates with + 5% accuracy.

Valve control mechanism shall consist of a stainless steel cartridge with a ported cup and coil / helical spring to avoid corrosion. Four operating ranges shall be available with the minimum range requiring less than 14 kPa to actuate the mechanism. Manufacture shall provide independent laboratory tests verifying assurance of performance
Manual double regulating balancing valves shall be provided at chiller, condenser, various tap-offs and each AHU outlet line as indicated in schedule of quantities. These valves shall have built-in pressure drop measuring facility to compute flow rate across the valve. The test cocks shall be long enough to protrude out of pipe insulation. To enable accurate and practical operation, measurement of flow and differential pressure shall be made with a computerized balancing instrument which shall enable the operator to read the flow directly without the use of diagrams or tables. In addition to measuring flow rate, differential pressure

and temperature, computerized balancing instrument shall have a computer program to provide the following functions.
To balance the HVAC installation and calculate the necessary valve settings, based on system measurements
To store the results of balancing
To log measured values from a valve (differential pressure, flow rate or temperature)
To printout saved data in computerized measurement protocol (CMP) consisting of
Name and size of Balancing Valve (BV)
Pre-setting position of BV
Pressure difference at BV
Flow at BV
Design Flow

MEASUREMENT FOR PIPING
Unless specified otherwise, measurement for piping for the project shall be on the basis of center line measurements described herewith.
Piping shall be measured in units of length along the center line of installed pipes including all pipe fittings, flanges (with gaskets, nuts, and bolts for jointing), unions, bends, elbows, tees, concentric and / or eccentric reducers, inspection pieces, expansion loops etc. The above accessories shall be measured as part of piping length along the center line of installed pipes, and no special multiples of pipe lengths for accessories shall be permitted.
The quoted rates for centre line linear measurements of piping shall include all wastage allowances, pipe supports including hangers, MS channel, PUF supports, nuts, check nuts, vibration isolator suspension where specified or required, and any other item required to complete the piping installation as per the specifications. None of these items will be separately measured nor paid for.
However, all valves (gate / globe / check / balancing / purge / butterfly / drain etc), strainers, thermometers, pressure gages shall be separately counted and paid as per their individual unit rates, which shall also include their insulation as per specifications. Piping measurements shall be taken before application of the insulation.

Contractor shall get pressure testing of pipes / measurements etc verified by the Owners representative at site.

IDENTIFICATION OF PIPING SYSTEMS:
Abbreviation and letter - label coloring based on ASME A13.1 - 2007 Scheme for the Identification of Piping Systems:

Label Abbreviation	System, Pipe Contents	Label Colors (Background - Text)
CHWR	Chilled Water Return	Green - White
CHWS	Chilled Water Supply	Green - White

CWR	Condenser Water Return	Green - White
CWS	Condenser Water Supply	Green - White
FIRE	Fire Suppression Water	Red - White
HAZ	Hazardous Waste	Orange - Black
DI or RO	High Purity Water	Green - White
DCW	Potable Cold Water	Green - White
DHW	Potable Hot Water Supply	Green - White
DHWR	Potable Hot Water Return	Green - White
NG	Natural Gas	Yellow - Black
LN2	Nitrogen (liquid)	Black - White
Med Air	Medical air	Yellow - Black
CO2	Carbon dioxide	Gray - White
He	Helium	Brown - White
N2	Nitrogen	Black - White
N2O	Nitrous oxide	Blue - White
O2	Oxygen	Green - White
Med Vac	Medical/surgical vacuum	White - Black
WAGD	Waste anesthetic gas disposal	Violet - White
Lab Air	Laboratory air	Yellow and White checkerboard - Black
Lab Vac	Laboratory vacuum	White and Black checkerboard - Black boxed
IA	Instrument air	Red - White

CFHE	Chemical Fume Hood Exhaust	Purple - White
BCE	Biosafety Cabinet Exhaust	Purple - White
RE	Radioisotope Exhaust	Yellow - magenta
ETOE	ETO Exhaust	Purple - white

ASME A13.1 - 2007 Scheme for the Identification of Piping Systems - is intended to establish a common system to assist in identification of hazardous materials conveyed in piping systems and their hazards when released in the environment -concerns identification of contents of piping systems in industrial and power plants - recommended for the identification of piping systems used in commercial and institutional installations and in buildings used for public assembly.

Size of Letters

Outside Pipe or Covering Size (in)	Width of Color Band (in)	Size of Letters (in)
3/4" to 1 1/4"	8	1/2"
1 1/2" to 2"	8	3/4"
2 1/2" to 6"	12	1 1/4"
8" to 10"	24	2 1/2
> 10"	32	1/2"

8. DATA SHEETS AND EQUIPMENT SCHEDULES

WATER CHILLERS		
Sl. No.	Parameters	Values
1.0	GENERAL	
1.1	Actual minimum cooling capacity	75 TR
1.2	Make, model and place of Manufacture	*
1.3	Quantity	1W + 1S
1.4	Overall dimensions (LXWXH)	* mm X * mm X * mm
1.5	Weight of the unit	
1.5.1	Gross weight	*

WATER CHILLERS			
Sl. No.	Parameters	Values	
1.5.2	Shipping weight	*	
1.5.3	Operating weight	*	
1.6	Refrigerant used	R-134a / R-407c / R-410a	
1.7	Painting and coating	Anti-corrosive	
1.8	Unit power consumption	Percentage load	IkW / TR
		100%	*
		75%	*
		50%	*
		25%	*
1.9	Extent of sub cooling	* oC	
1.10	Extent of super heating	* oC	
1.11	Noise level at 3.0 m from unit	Not to exceed 70 dB(A)	
1.12	Whether the chiller is ARI certified	Yes / No	
1.13	Required COP	5.5	
2.0	COMPRESSOR		
2.1	Type	Screw	
2.2	Sealing	Hermetic / Semi hermetic	
2.3	Lubrication system	Differential pressure	
2.4	Capacity control	10%-100%	
2.5	Balancing requirement	As per ISO 1940	
2.6	Brake power and drive motor rating	kW / kW	
2.7	Suction pressure / temperature	* Kg/cm2 (g) / * oC	
2.8	Discharge pressure / temperature	* Kg/cm2 (g) / * oC	
2.9	Condensing pressure / temperature	* Kg/cm2 (g) / * oC	
2.10	Operating speed	Not to exceed 2950 RPM	
3.0	EVAPORATOR		
3.0	Type	Shell and tube, Flooded	
3.1	Chilled water inlet temperature	54 **^{0} F**	
3.2	Chilled water outlet temperature	44**^{0} F**	
3.3	Chilled water flow rate for actual required cooling capacity	xxx US GPM	
3.4	Fouling factor	0.0001 hr-ft2-oF / BTU	
3.5	Maximum permissible pressure drop	20 ftWC	
3.6	Maximum Inlet pressure allowed	* Bar (g)	
3.7	Material of construction		
3.7.1	Shell, end covers, tube holding sheets	Carbon steel	
3.7.2	Tubes	Internally grooved seamless copper	
3.8	Insulation on refri. piping and evaporator	HCFC free insulation	
3.8.1	Material		

WATER CHILLERS		
Sl. No.	Parameters	Values
3.8.2	Density	* Kg/m3
3.8.3	Thickness	* mm
3.8.4	K value	* W / m - oC
4.0	CONDENSER	
4.1	Type	Water cooled
4.2	Water cooled condenser	
4.2.1	Cooling water inlet temperature	88^{0} **F**
4.2.2	Cooling water outlet temperature	95.5^{0} **F**
4.2.3	Cooling water flow rate for actual required heat rejection	xxx US GPM
4.2.4	Condenser fouling factor	0.00025 hr-ft2-oF / BTU
4.2.5	Maximum permissible pressure drop	20 ft WC
4.2.6	Maximum Inlet pressure allowed	* Bar (g)
4.2.7	Material of construction	
	a) Shell, end covers, tube holding sheets	Carbon steel
	b) Tubes	Internally grooved seamless copper
5.0	ELECTRICAL AND CONTROL PANEL	
5.1	Type of starter	Soft starter
5.2	Suggested electrical feeder at mains	* Amps
5.3	Suggested cable size to be brought to integral power isolator	* mm2 Copper * mm2 Aluminum
5.4	Unit power supply	415 V, 3 phase, 50 Hz
5.5	Oil heater power supply within unit	* V, * Ø, 50 Hz
5.6	Type of controller	Microprocessor / microcontroller based
5.7	Protocol required for interfacing with BMS	Modbus / BACNet
6.0	ACCESSORIES REQUIRED	
6.1	Vibration isolators	Required /
6.2	External flow switches	Required /
6.3	Condenser coil and fan guard (plastic coated)	/ Not Applicable
6.4	Acoustic jacketing for moving parts	Required / Not required
6.5	External flexible connections	Required /
6.6	Companion flanges / Grooved couplings with fasteners and gaskets	Required
6.7	Unit mounted integral power isolator	Required
6.8	Motorized valve at outlet of evaporator	Required /
6.9	Motorized valve at outlet of condenser	Required /
6.10	Plant Manager	Required /
7.0	TESTING AND INSPECTION	
7.1	Factory testing for chillers	☐ As per ARI 550/590 at full load / full

WATER CHILLERS		
Sl. No.	Parameters	Values
		and part loads ☑ As per design conditions at full load / full and part loads
7.2	Factory test witness	By client / consultant
7.3	Evaporator test pressures Water side Refrigerant side	 * Kg/cm2 (g) * Kg/cm2 (g)
7.4	Condenser test pressures Water side Refrigerant side	 * Kg/cm2 (g) * Kg/cm2 (g)
8.0	**PERFORMANCE GUARANTEES**	
8.1	Cooling capacity	150 ± 5 TR
8.2	Power consumption by the unit	105 ± 5 kW
8.3	Chilled water outlet temperature	12 ±1 ^{o}C
8.4	Cooling water outlet temperature	28 ± 2 ^{o}C
8.5	Evaporator pressure drop	- ± mWC
8.6	Condenser pressure drop	- ± mWC

Notes:
The spaces marked (*) shall be filled up by the CONTRACTOR. The data already filled in shall be adhered to. In case of any deviation, the same shall be brought to the notice in schedule of technical deviations, failing which it shall be construed that the bidder complies with the data indicated.
Quality of cooling water in case of water cooled condenser would be hardness less than 5 ppm and turbidity less than 1.0 NTU.
Data required from Manufacture:
GA drawing of the chiller indicating piping connections
Foundation plan marking clearances required and point load details
Power and control wiring diagram indicating all internal interlocks

Internal piping and instrumentation diagram indicating refrigerant piping and lubrication piping schematic
Motor termination drawing
Manufacturing quality assurance plan
Installation and pre commissioning checklist
Installation, operation and maintenance manual indicating unloading, handling and storage instructions
Dimensioned cross-section drawings of compressors and other proprietary items with part list and materials of construction

PUMPS

Sl. No.	Parameters	Values		
		CHW Prim. pumps	CHW Sec. pumps	CW pumps
1.0	GENERAL			
1.1	Tags			
1.2	Make and place of Manufacture	*		
1.3	Model offered	*	*	*
1.4	Quantity	2 (1W+1S)	2 (1W+1S)	2 (1W+1S)
1.5	Overall dimensions (LXWXH)	*	*	*
1.6	Operating weights	*	*	*
1.7	Liquid handled	Chilled water	Chilled water	Cooling Tower water
1.8	Painting and coating	As per Manufacture's standard		
1.9	Noise level at 1.0 m from unit	70 dB(A)		
2.0	DESIGN PARAMETERS			
2.1	Volume flow rate	180 GPM	180 GPM	225 GPM
2.2	Differential head			
	Shut off head	*	*	*
	Pump efficiency	*	*	*
2.3	NPSH available	Flooded suction		
2.4	NPSH required	*	*	*
2.5	Operating speed	*	*	*
2.6	Minimum flow for continuous operation	*	*	*
2.7	Limiting suction pressure	*	*	*
2.8	Moment of Inertia of rotating elements	*	*	*
3.0	CONSTRUCTIONAL FEATURES			
3.0	Type	Centrifugal end		
3.1	Impeller	Enclosed		
3.2	Coupling type	Flexible		
3.3	Shaft sealing	Mechanical seal		
3.4	Lubrication	Grease / oil		
3.5	Nozzle orientation	End suction and top discharge		
3.6	Nozzle sizes suction / discharge	* NB / * NB		
3.7	Flange drilling standard	ANSI B 16.5 / Manufacture's standard		
3.8	Whether the pump require external water for cooling of seal and bearings	Required (* flow required) / Not required		
4.0	MATERIAL OF CONSTRUCTION			
4.1	Casing	Cast Iron as per IS 210 FG 260		
4.2	Impeller	Bronze as per IS 318 LTB Grade 2		

PUMPS				
Sl. No.	Parameters	Values		
		CHW Prim. pumps	CHW Sec. pumps	CW pumps
4.3	Shaft	EN 8 or SS-410		
4.4	Shaft sleeve	*		
4.5	Wearing rings	*		
4.6	Base plate	Carbon steel as per IS 2062 Grade B		
5.0	DRIVE MOTOR			
5.1	Type	TEFC, squirrel cage induction motor		
5.2	Degree of protection	IP 55		
5.3	Brake power at duty conditions	*	*	*
5.4	Maximum power required along operating range	*	*	*
5.5	Selected name plate rating	*	*	*
6.0	ACCESSORIES REQUIRED			
6.1	Companion flanges with gaskets and fasteners	Required /		
6.2	Common base plate	Required /		
6.3	Floating foundation	Required /		
6.4	Foundation bolts	Required /		
6.5	Coupling with guard	Required /		
7.0	TESTING AND INSPECTION			
7.1	Factory testing for pumps	Performance testing as per IS 5120		
7.2	Hydro test pressure for casing	1.5 times the design pressure for 30 minutes		
7.3	Static and dynamic balancing of rotating assembly	As per ISO 1940 / VDI 2060		
8.0	PERFORMANCE GUARANTEES			
8.1	Volume flow rate	87 ± 3 m3/hr		
8.2	Differential head	15 mWc for Primary/25 mWc for Secondary/18 mWc for Condenser		
8.3	Power input at motor terminals			

Notes:

The spaces marked (*) shall be filled up by the CONTRACTOR. The data already filled in shall be adhered to. In case of any deviation, the same shall be brought to the notice in schedule of technical deviations, failing which it shall be construed that the bidder complies with the data indicated.

The differential heads indicated herein are indicative and shall be verified by the bidder after final piping layout before procurement.

The secondary chilled water pumps are operated on VFD and hence its drive motor shall be suitable for the same.

CONTRACTOR shall furnish following data.

Pump set general arrangement drawing indicating outline dimensions
Foundation drawings indicating static and dynamic loads and forces and moments acting on the nozzles
Cross sectional drawing of the pumps indicating the part list with material of construction
Performance curves of pumps indicating Flow rate Vs Head, brake power, efficiency and NPSH required
Torque speed curve of the pump
Drive motor termination drawing
Manufacturing quality assurance plan
Installation and pre commissioning checklist
Installation, operation and maintenance manual indicating unloading, handling and storage instructions

COOLING TOWERS		
Sl. No.	Parameters	Values
1.0	GENERAL	
1.1	Equipment tag	CT – 1, 2, ...
1.2	Make, model and place of Manufacture	*
1.3	Quantity	1W + 1S
1.4	Cooling tower type	counter flow
1.5	Fill arrangement	Splash / film
1.6	Drift eliminator	/ Honey comb
1.7	Number of cells	1 / 2 / 3 / 4
1.8	Overall dimensions (LXWXH)	* mm X * mm X * mm
1.9	Operating weight of cooling tower	*
1.10	Dry weight of cooling tower	*
1.11	Noise level at 1.0 m from unit	Not to exceed 70 dB(A)
2.0	DESIGN DATA	
2.1	Actual minimum heat rejection capacity	75 TR
2.2	Cooling water inlet temperature	95.5 **ºF**
2.3	Cooling water outlet temperature	88 **ºF**
2.4	Cooling water flow rate	225 US GPM
2.5	Design ambient wet bulb temperature	78 **ºF**
2.6	Flow velocity in hot water piping	Not to exceed 2 m/s
2.7	Required pressure at hot water inlet	* mWC
2.8	Basin water holding capacity	* m3
2.9	Drift loss per cell	* m3/hr
2.10	Air flow rate per cell	* m3/hr
2.11	Fan drive	Direct / gear / belt
2.12	Fan nominal diameter	* mm
2.13	Fan static pressure	* mmWC
2.14	Fan static efficiency	%
2.15	Fan operating speed	* RPM

COOLING TOWERS		
Sl. No.	Parameters	Values
2.16	Drive motor speed	* RPM
2.17	Fan brake power	* kW
2.18	Selected motor rating	* kW
2.19	Details of gear box if gear driven	*
2.20	Details of drive set if belt driven	*
3.0	MATERIAL OF CONSTRUCTION	
3.1	Casing	FRP /
3.2	Air inlet louvers	FRP
3.3	Fills	PVC
3.4	Fill supports	Hot dip GS
3.5	Drift eliminators	PVC
3.6	Fan deck	FRP
3.7	Fan blades	FRP / Cast aluminum alloy
3.8	Fan guard	Hot dip GS /
3.9	Orifices, nozzles	Bronze / Stainless steel / Polypropylene
3.10	Access ladder	Powder coated mild steel /
3.11	Water holding basin	FRP /
3.12	Hardware	/ Hot dip GS
4.0	ACCESSORIES REQUIRED	
4.1	Companion flanges	Required /
4.2	Foundation bolts	Required /
4.3	Fan guard (plastic coated)	Required /
4.4	Drive motor	Required /
4.5	Interconnecting equalizer line	Required /
4.6	Drain line till nearest drain point	Required /
5.0	TESTING AND INSPECTION	
5.1	Performance test	As per CTI ATC 105 S
5.2	Fan static and dynamic balancing	As per AMCA 204 G 6.3
5.3	Fan performance testing	As per AMCA 210
6.0	PERFORMANCE GUARANTEES	
6.1	Cooling capacity	80 ± 5 TR
6.2	Power consumption by the unit	XXX ± * kW
6.3	Chilled water outlet temperature	XXX ± * oC
6.4	Cooling water outlet temperature	XXX ± * oC
6.5	Evaporator pressure drop	XXX ± * mWC
6.6	Condenser pressure drop	XXX ± * mWC

Notes:

The spaces marked (*) shall be filled up by the CONTRACTOR. The data already filled in shall be adhered to. In case of any deviation, the same shall be brought to the notice in

schedule of technical deviations, failing which it shall be construed that the bidder complies with the data indicated.
Quality of cooling water would be hardness less than 5 ppm and turbidity less than 1.0 NTU.
Data required from Manufacture:
GA drawing of the cooling tower indicating piping connections
Foundation plan indicating static and dynamic loads

Part list with material of construction
Thermal performance curves
Fan motor data sheet, GA drawing and torque speed curve
Fan performance curves
Motor termination drawing
Manufacturing quality assurance plan
Installation and pre commissioning checklist
Installation, operation and maintenance manual indicating unloading, handling and storage instructions

9. ELECTRICAL SYSTEM FOR HVAC SERVICES

I. MV CABLES

This specification covers supply, delivery, installation, testing, and commissioning of cables and accessories, as detailed under Bill of Quantities.

1.1 CABLES

1.1.1 POWER CABLES

The M.V. power cables shall conform to I.S.7098 (Part-I). The conductor shall be of aluminium / copper XLPE insulated, PVC sheathed steel armoured. The cables shall be suitable for grounded neutral system, and shall be of 1100 volts grade. The conductor size and number of cores shall be as specified in the Bill of Quantities.

1.1.2 PVC Control Cables.

The cables should conform to I.S.1554 (Part-I). The conductors shall be of copper, PVC insulated, PVC sheathed, 1100 volts grade. The conductor size shall not be less than 2.5 sq.mm., unless otherwise specified- The number of cores shall be as specified.

1. 2 CABLE ACCESSORIES

1.2.1 Cable glands (Non Flameproof)

The cable glands shall be compression type plated - brass. They shall be complete with neoprene rubber rings, two nos . galvanised M.S. washers, lock nut etc.

1.2.2 Cable Glands (For Flame proof area), if applicable

The cable glands shall be flameproof double compression type plated - brass. They shall be complete with neoprene rubber rings, two nos. galvanised M.S. washers, lock nut etc

1.2.3 Cable Terminations

Cable lugs shall be used for stranded conductors. Cable lugs shall be fitted by crimping method only. The oxide inhibiting compound shall be used for removal of oxide film on the conductor. Tinned copper lugs shall be used for cables upto 35 sq.mm and aluminium lugs shall be used for higher sizes.

1.2.4 Holes of appropriate sizes shall be drilled on cable gland plates' of MCC/Main M.V.

Panel / P.D.B / L.D.B. for cables / conduit entry and exit. The paint around the holes shall be scrapped before fixing the cable glands. The armour strands shall be cut, bent and clamped between the G.I. washers. After glanding, the cable shall be clamped using G.I.clamps.

CABLE ERECTION

Before cable erection, phase to phase and phase to earth insulation and continuity of the conductors shall be ascertained. Sharp bends in cable shall be avoided. The bending radius shall not be less than 12 x diameter of the cables for M.V. cables. Wherever possible 25% larger radius than specified above shall be used. The cables shall be clamped at every 600mm intervals in vertical runs and 1000mm interval on horizontal runs, and clamp shall be fixed on both the sides of bends. The cable tag markers shall be fixed at every 10 Mtrs. and at strategic locations. Solid conductors shall be tinned before termination. The workmanship in end termination and glanding shall be excellent. Cable layout drawings shall be followed for routing of the cables. The unit rate for power and control cables installation shall include the following:

Fixing accessories such as G.I. clamps, spacers, rawl plugs, screws etc. M.S. angle iron brackets (Painted) G.I. Cable route marker, G.I. Nut bolts and washers, etc. Anodised aluminium Cable tag markers shall be used for identification of the cable. The cable number and size shall be punched on the tag markers. 16 SWG G.I. wires shall be used for fixing the cable tag markers.

UNDER GROUND CABLES:-

Cables shall be so laid that they will not interfere with other underground structure / services. L.T. Cables shall be laid after excavating a trench of uniform depth of 900mm and wide enough for laying the number of cables. For 11KV cables the depth of laying shall be 1.05M. Backfilling, with sand, shall be done, before and after cable laying, for a depth of 150mm. A layer of Tiles / Bricks shall be laidon three sides of the cable and then the trench shall be refilled with sand and earth. 6mm thick cast iron galvanized cable markers shall be provided along the cable route at every 15M. For road crossing a R.C.C., pipe of 100 / 150mm dia. shall be provided. Pipe shall be laid to a depth of 1.0 M below the surface of the road. The pipe shall be plugged to prevent choking.

1.5 Site Tests

The following test shall be carried out at site:

1.5.1 Continuity Test

The continuity shall be established with a multi meter.

1.5.2 Insulation Resistance Test

The insulation resistance shall be measured between phases and phases to earth both before and after the high voltage power frequency test. For M.V. and Control cables the insulation resistance shall be more than one mega ohm.

1.5.3 High Voltage Power Frequency test:

This test shall be carried out only for 11 KV cables for providing phase to phase insulation and phase to earth insulation. The cables withstand the appropriate voltage for one minute.

1.5.4 The earthing system earth resistance as well as the individual earth electrode resistance shall be measured. The system earth resistance shall be less than one ohm.

1.6 INSPECTION / HANDLING OF CABLES INCLUDING PREPARATION 0F RECORD

1.6.1 Immediately after the work starts, both ends of every length of XLPE or paper insulated cable shall be sealed against ingress of moisture by means of metal cap fitting over the end plumbed to the sheath. The cable shall be wound on drums in convenient lengths as may be specified with due regard to transport.

While unloading drum from a lorry or railway wagon, a crane should be used if available and the drums carefully lifted and deposited on the ground. If a crane is not available, then the drums should be carefully rolled down by a suitable arranged ramp or rails. Under no circumstances should a drum be dropped to the ground as the shock may cause serious damage to the inner layers of cable.

In no case shall the drum be stored 'on the flat' that is with flange horizontal.

1.7 MOVEMENT OF CABLE DRUMS

Rolling cable should be rolled in the direction of the arrow.

Transport over long distance from storage site to work spots, shall be as under:

The drum should be mounted on cable drum wheels strong enough to carry the weight of the drum, which are pulled by means of ropes, or alternatively, they may be mounted on a trailer or a vehicle, with a low loading platform for transport to the destination.

1.8 REMOVING CABLE FROM DRUMS

The drum should be properly mounted on a cable wheel making sure that the spindle is strong enough to carry the weight without bending and that is laying horizontally in the bearings so as to prevent the drum creeping to one side or the other and protection box

attached to the flanges of the drum and cut the securing ropes so as to leave the cable end free to move.

1.9 BENDING RADIUS

XLPE cables should always be bent or straightened slowly, they should never be bent to a small radius. The maximum safe bending radius for XLPE cables upto and including 11KV shall be taken as per Manufacture's recommendation but wherever possible larger radius shall be used.

1.10 BOTTOM OF THE TRENCH

The bottom of the trench should be carefully levelled and free from stones, but if gradients and changes of depth are unavoidable, they should be gradual. If the soil is chemically charged it may even be necessary to transport a sufficient quantity of insert soil from elsewhere to the site to form good bedding and cover for the cable.

All excavated materials should be stored such that there is no obstruction to main all facilities around the excavated area. The excavated materials should be stored within a pre-determined area so that it may not fall back in trench, block up gutters, roads etc.

The necessary red lamps and red flags should be displayed to avoid any accidents.

1.11 SUPERVISION

The Contractor shall keep a competent, qualified experienced and approved electrical engineer at the works who will be responsible for carrying out all the work in accordance with the drawings, specifications and instructions. All workmen employed shall be duly qualified and skilled.

1.12 PARTICULARS OF WORK

The work comprises of laying, erection, fixing, connection jointing and testing of all cables and supply of cable accessories as listed in the Bill of Quantities.

1.13 GENERAL RULES FOR CABLE LAYING

Installation shall be carried out in neat, workman like manner by skilled, experienced and

competent workmen in accordance with the standard practices. Cable shall be laid preferably in one piece length to avoid mid-span joints. If straight joints are found necessary these can be introduced with prior approval of Engineer-in-charge. Method of installation, routing of cables etc., shall in every case be subject to the approval and the Contractor shall modify or rectify at no extra cost. All damages to the civil and other works on this account shall be made good by the Contractor at no extra cost. Where cables pass through hume pipes, Contractor shall fix hard wooden bushes round the cable at the ends of the hume pipes. Where the cables pass through floors or chambers and in such other situations as the Engineer shall require, the Contractor shall seal holes in a manner approved by the Engineer-in charge. Where cables pass through road nallas, etc. cables must be protected by Class 'A" RCC hume pipes of diameter as shown in the Bill of Quantities.

The cable route shall be short and there shall be minimum interference with built up areas.
Excavation of the trenches shall be executed and the vertical sides of the trenches are kept as straight as possible. The exact location of each trench shall be settled by the Engineer-in - charge on site when the Contractor is in a position to commence each portion of the work.
Contractors shall provide all necessary labour, tools, plants, and other requisites at his own cost for making trenches.
After the cables are laid, the trench shall be filled in the earth in each layer being well rammed by spraying water and sufficient allowances made for settlement. The extra earth

over the trench should be removed from the place of trench to a place as decided by the Engineer-in-charge at site.
The cables and joint; boxes, as well as straight joint boxes, suitable loops of at least 2 metres length shall be kept for future requirement. In case of cable laid in ground, cable markers at convenient intervals and crossing of roads etc. shall be fixed along the route of the cable in an approved manner.
Ends of cables shall be properly sealed to prevent entry of moisture prior to installation.

For all multi core cables each core and coils shall be brought out marked and colored in an approved manner.

Where cables are laid in buildup trench they shall be fixed with angle iron frame to be furnished by the Contractor.

The electrical Contractor shall be completely responsible for the testing and commissioning of the entire installation covered by these specifications.

1.14 DRAWINGS

The Contractor shall submit drawings, before commencement of work, showing details of cable joint boxes, clamps or other accessories proposed to be used by him. He shall also submit before commencement of work all drawings or samples etc. that may be required by the Engineer-in-Charge and in sufficient time to admit modification being made if such are deemed necessary by the Engineer-in-charge.

1 .15 MEASUREMENT

All measurements for purpose of payment as well as mutual forming up of quantities to be procured shall be done by the Contractor at his own cost in the presence of Engineer-in-Charge or his authorized representative who will certify the routes, lengths and quantities. Contractor shall be paid on running metre basis.

1.16 CABLE RACKS

The cable racks shall be of ladder type construction, it shall be fabricated from rolled sections 50x50x6mm angles and 25mmx3mm flats by keeping 6mm gap between 2 flats of 25mmx3mm, the flats being welded to the angle iron at an interval of 500mm.

Additional support of size 50x50x6mm angle iron shall be provided at every 2.00 to 2.5 0 mtrs. Interval to support cable rack. The width of cable rack shall be designed as per number of cable running on it and it should cater for some future cables.
The cable rack shall be earthed by providing earthing continuity conductor, preferably
32 x 6 mm G.I. strip as specified along the entire route of cable racks. All necessary materials for fixing cable rack like nuts, bolts, washers, grouting, welding, inserts in the wall, etc. shall be included. The cable rack shall be painted two coats of red oxide primer and two coats of final approved paint.

II. POWER CONTROL CENTRES

1.0 Scope:

This specification is to cover the requirement of design, supply, installation, testing and commissioning of LT power control centers / main switch boards with all components, Instruments, fittings and accessories for efficient operation without any trouble.

2.0 Standards:

The PCC specified herein, unless otherwise stated shall conform to the relevant and latest revisions of Indian standards and Indian Electricity Rules.

3.0 Design and construction:

3.1 Design requirements : The power control centers shall be suitable for operation on 440volt, 3 phase,4wire 50HZ system to withstand a short circuit level of 50 KA RMS symmetrical.
The PCC shall be designed for operation in high ambient temperature up to 45 degrees centigrade and high humidity up to 95% and tropical atmospheric conditions. Means shall be provided to facilitate ease of inspection, Maintenance and Servicing.

3.2 Constructional requirements:

i) The power control center shall be of Metal clad, cubicle, indoor, free standing type suitable for Mounting on Built up Trenches with U Channels of adequate size.

ii) Made up of the requisite vertical sections, which when coupled together shall form continuous dead front switch board.

iii) Dust and damp protected, the degree of protection shall be better than IP - 54 as specified in IS-2147, if specified in schedule

iv) Readily extendable on both sides by the addition of vertical sections after removal of the end covers.

v) Single front construction with the circuit breaker feeder and switch fuse feeders suitable for operation from the front of the panel.

The PCC shall have the feeder ratings as per the schematic diagrams enclosed with the schedule and constructed only of materials capable of withstanding the mechanical, electrical

and thermal stresses as well as the effects of humidity, which are likely to be encountered in normal service.

3.3 Vertical Sections: Each vertical section shall comprise a front framed structure rolled folded sheet steel channel section of minimum 2 mm thickness rigidly bolted together. This structure shall house the components contributing the major weight of the equipment such as circuit breaker, switch fuse units, main horizontal bus bars, vertical risers and other front mounted accessories. The structure shall be mounted on a rigid base frame of folded sheet steel of minimum of 2.5mm thickness and 100mm height. The design shall ensure

Structural stability during Transit and also during Operation after Commissioning Suitable cable chamber housing the cable end connections and power / control cable terminations shall be provided. The design shall ensure generous availability of space for ease of installation and maintenance of cabling and adequate safety for working in one vertical section without coming into accidental contact with live parts in the adjacent section.

A cover plate at the top of the vertical section shall be provided with necessary ventilating arrangements. Any aperture for ventilation shall be covered with a perforated sheet having less than 1 mm diameter perforations to prevent entry of vermin.

Sheet Steel Cubicle:

3.4.1 The sheet steel cubicle shall be designed in fully segregated multi tier formation. Each cubicle shall have hinged front access door with easy operating fasteners. All the doors and covers shall be heavily gasketted to make the compartment dust tight.

Each cubicle shall have a covering at the bottom to make a dust and vermin proof construction. Door hinges shall be of concealed type.

The cubicle shall be of minimum 2 mm thick sheet steel. Sheet steel shrouds and partitions shall be of minimum 1.6 mm thickness. All sheet steel work forming the exterior of switch boards shall be smoothly finished, levelled and free from flaws. The corners shall be rounded. The minimum Thickness of Gland plates shall be 3mm.

3.4.2 The apparatus and circuits in the power control centers shall be so arranged as to facilitate their operation and maintenance at the same time to ensure the necessary degree of safety.

Apparatus forming part of the control centers shall have the following minimum clearance.

i) Between phases - 25 mm,
ii) Between phase and neutral - 25 mm,
iii) Between phases and earth - 25 mm,
iv) Between neutral and earth - 19 mm,

When, for any reason, the above clearances are not available suitable insulation shall be provided. Clearance shall be maintained during normal service conditions. Creepage distances shall comply with those specified in relevant standards.

3.4.3 All insulating materials used in the construction of the equipment shall be non hygroscopic duly treated to withstand the effect of high humidity, high temperature and tropical ambient service conditions.

3.4.4 Functional units such as circuit beakers and fuse switches shall be arranged in multitier formation, except that not more than one air circuit breaker housed in a single vertical section.

3.4.5 Metallic / insulated barriers shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with:
i) Main busbars and vertical risers during operation, inspection or maintenance of functional units and front connected accessories.
ii) Cable terminations of one functional unit, when working on those of adjacent unit / units.

3.4.6. All doors / covers providing access to live power equipment / circuits shall be provided with tool operated fasteners to prevent unauthorized access.

3.4.7 Provisions shall be made for permanently earthing the frames and other metal parts of the switchgear by two independent connections. The earth connections shall be extended to the bases of SFUs
Metal treatment and finish:
All steel works used in the construction of the switch boards shall have undergone a suitable rigorous metal treatment process so as to remove oxide scales and rust formation and to facilitate a durable coating of the paint on the metal surfaces and also to prevent the spreading of rust, in the event of the paint film being mechanically damaged.
Two coats of Anti Corrosive primer followed by a finishing coat of Epoxy powder coating of the shade 631 of IS:5 (ie Siemens grey) shall be given. The total thickness of paint shall not be less than 25 micron.

3.6 Bus Bars:
3.6.1 The busbars shall be housed in non-segregated sheet steel compartments in the cubicle at convenient locations with provision for access to the buses from the front of the panel. The busbar shall be suitably braced with DMC / SMC supports to provide a through fault withstand capacity of 50 KA RMS symmetrical for one second and a peak short circuit withstand capacity 150 KA minimum. The neutral as well as the earth bus shall be capable of withstanding the above fault level.

3.6.2 Large clearance and creeping distance shall be provided on the busbar system to minimize the possibility of a fault.

3.6.3 High tension bolts, nuts and spring washers shall be provided at all busbar joints.

3.6.4 The continuous rating of the bus bar shall be 0.8A/sq.mm. Maximum temperature of the bus and the connections shall not exceed 85 degrees centigrade. The bus bars shall be of liberal design The main phase busbars shall have continuous current rating throughout the length of each power control center and the neutral busbars shall have continuous rating of at least 50% of phase busbars.

3.6.5 Connections from the main busbars to functional circuits shall be arranged and supported so as to withstand without any damage or deformation, the thermal and dynamic stresses due to short circuit currents.
All busbars and tappings shall be provided with colour coded heat shrinkable sleeves for phase identification.
All joints / tapping points of the buses shall be suitably shrouded to prevent accidental contact.

4.0 Air Circuit Breakers:
4.1 General:

4.1.1 Circuit breakers shall be of triple pole / four pole, air break, horizontal draw out / Fixed type, as given in the schedule of work and comply with the requirements of relevant IS with latest amendments confirming to IS- 13947/1&2 and shall have conform to Isolation standard and shall have the following:

i) A short circuit breaking capacity (Ics r.m.s of not less than 50 KA RMS at 500volts, 50Hz AC.

ii) A short circuit making capacity (Icm peak) of 105 KA.

iii) Rated ultimate short circuit breaking capacity, (Icu r.m.s) of 105 kA

iv) A short time withstand capacity (Icw of 150 KA for one second.

v) Electrical overload performance at 6 times the rated current, 100% of the rated voltage as recovery voltage at 0.5 power factor.

vi) Dielectric test of 2.5 KV applied for one minute on main circuits.

4.1.2 The circuit breakers shall be fitted with detachable arc chutes on each pole designed to permit rapid dispersion, cooling and extinction of the arc. Inter phase barriers shall be provided to prevent flash over between phases.

4.1.3 Arcing contacts shall be of hard wearing material copper tungsten or silver tungsten and shall be easily replaceable. Main contacts shall be of silver plated copper of high pressure type and generous cross section.

4.2 Operating Mechanism:

The operating mechanism shall be of robust design, with minimum number of linkages to ensure maximum reliability. Manually operated circuit breakers shall be provided with spring operated closing mechanism which are independent of speed of manual operation. Electrically shall be independent of the motor which shall be used slowly for charging the closing spring.

The operating mechanism shall be such that the breaker is at all times free to open immediately when the trip coil is energized.

Mechanical operation indicators shall be provided to show open and close positions of the

breaker. Electrically operated breakers shall be additionally provided with mechanical indications to show charged and discharged conditions of the charging spring.

Means shall be provided for slow closing and opening of the breaker for maintenance purposes, and for manual changing and closing of electrically operated breakers during emergencies,

4.3 Protection:

Provisions shall be available for fitting a minimum of five trip devices - three over current, as shunt trip and an under voltage release or two over current and earth fault release, a shunt trip and one under voltage release. The breakers shall be of the shunt or series trip type as specified in the schedule.

The protection release must be Electronic / Micro Processor based as specified in Schedule, True RMS sensing compatible to EMC and with a provision of malfunctioning indications.

Following setting must be available on the relay:

i) Over current setting (Ir) 70% to 100% of In

ii) Short circuit setting (Id) 1.25 to 10 of Ir

4.4 Housing of Circuit Breaker:

Circuit breakers shall be individually housed in sheet metal castle provided with hinged doors. The breaker along with its operating mechanism shall be mounted on a robust carriage moving on guide rollers with in the castle. Isolating contacts for both power and control

circuits shall be of robust design and fully self aligning. The assembly shall be designed to allow smooth and easy movement of the breakers within its castle.

The breaker shall have three distinct positions within the castle as follows:

i) ` Service' position: With main and auxiliary contacts connected.

ii) `Test' position: with power contacts fully disconnected and control circuit contacts connected.

iii) `Isolated' position: with both power and control circuit contacts fully disconnected.

It shall be possible to achieve any of the above positions with the castle doors closed. Mechanical position indicators shall be provided for the three positions of the breakers.

4.5 Interlocking:

4.5.1. The moving portion of the circuit breaker shall be interlocked so that:

i) It shall not be possible either to isolate it from the connected position, or to plug it in from the isolated position with the breaker closed.
ii) The circuit breaker can be closed only when it is in one of the three positions or when it is fully out of the castle.

iii) It shall not be possible to open the hinged door of the castle unless the breaker is drawn to the isolated position.
iv) In advertent withdrawal of the circuit breaker too far beyond the supporters is prevented by the suitable stops.

4.5.2 Provisions shall be available for the padlocking of the circuit breaker accessible in any of the three positions.

4.5.3 Automatically operated safety shutters shall be provided to screen the fixed isolating contacts when the breaker is drawn out from the castle.

4.5.4 The moving portion of the circuit breaker shall be provided with a heavy duty, self aligning earth contact, which shall make before and break after the main isolating contacts during insertion into withdrawal from the service position of the breaker. Even in the isolated position positive earthing contact should exist.

4.5.5 Auxiliary switches directly operated by the breaker operating mechanism and having 4 `NO' and 4 `NC' contacts shall be provided on each breaker. The auxiliary switch contacts shall have a minimum rated thermal current of 10 amps.

5.0 Moulded Case Circuit Breakers (MCCBs)
5.1 If specified in the BOQ, MCCB's shall be provided in the switchboards for the circuit protection. MCCBs rating shall be as indicated in the switchboard data sheet.

5.2 MCCB shall be of triple pole / four pole as given in the schedule of work and comply with the requirements of relevant IS with latest amendments confirming to IS 13947/1&2 and shall confirm to isolation standard and shall have the following Rated ultimate short circuit breaking capacity (Icu r.m.s) of not less than 20 KA RMS at 415 volts, 50 Hz Ac.
Rated short circuit breaking capacity upto 600V DC (Ics) of 20KA.

5.3 MCCB shall be provided with adjustable type overload (70-100% of In) and S.C. setting of 2 to 10times of Ir tripping device with inverse time characteristics for over load protection and instantaneous characteristics for short circuit protection.
The protection release must be Electronic / Microprocessor based, True RMS sensing, inbuilt with adjustable threshold and time delay, compatible to EMC and with a provision of malfunctioning indications, if specified in schedule

MCCBs shall be provided with spring assisted quick make / break manually operated trip mechanism. Wherever specified, MCCB shall be suitable for remote tripping operation and the tripping device shall be suitable fotr the specified control supply voltage.

5.5 'ON' and 'OFF' position of the operating handle of MCCB shall be displayed and

5.6 MCCB shall be provided with minimum 1 NO + 1NC auxiliary contacts.

If specified in the Schedule, the MCCBs shall be provided with solenoid / Motorised closing solenoid / motor shall be suitable for specified control supply voltage.

Wherever specified in the schedule, the MCCB shall be provided with Earth leakage relays. However all MCCBs whether specified or not shall have shout trip device.

6.0 Earth Leakage Relays:

The Earth Leakage relays shall be static type.
The ELR shall have variable Current sensitivity and Tripping time to 0.15-3.0 seconds
The unit shall be flush mounting type
The unit shall have an LED for visual fault indication
The input voltage shall be 440V AC 50Hz
The core Balance CT shall be of cast Resin type size as required
The unit shall have built in 1NO +1NC potential free contacts.
The contact rating shall be 6A/230V AC
The current rating shall be suitable for Temp range of 0-50DegC
The Breakdown Voltage of the unit shall be 2KV for one Minute
The Unit shall be of 96X96 mm size

7.0 Current Transformers.

Current transformers shall comply with the requirements of relevant latest IS. They shall have ratios, outputs and accuracy as specified in the schedule.

8.0 Indicating / Integrating Meters:

All indicating instruments shall be of flush mounted industrial pattern conforming to the relevant latest amended IS. The instrument shall have nonreflecting bezels, clearly, divided and indelibly marked scales, and shall be provided with zero adjusting devices in the front. Integrating instruments shall be of flush mounted switch board pattern complying with the requirements of relevant latest IS.

9.0 Control switches / Selector switches: Control switches / Selector switches shall be of the heavy duty rotary type, with plates clearly marked to show the operating position.

They shall be of semi-flush mounted type with only the front plate and the operating handle projected.

Circuit breakers control switches shall be of the spring return to neutral type.

10.0 Indicating lamps and push buttons:

Indicating lamps shall be of the LED type of low watt consumption, provided with series resistors where necessary and with translucent lamp covers. Bulbs and lenses shall be easily replaceable from the front.

Push buttons shall be of the momentary contact, push to actuate type fitted with self-reset contacts and provided with plates marked with its junctions.

11.0 Cable terminations:

Cable entries and terminals shall be provided in the switch board to suit the number, type and size of aluminum conductor power cables and copper conductor control cables as indicated in the schematic diagram.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable glands and terminals such that cables can be easily and safely terminated. Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit. Cable riser shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults. Cable sockets shall be of Bimetallic crimping type.

12.0 Control wiring : All control wiring shall be carried out with 1100/650 V grade single core Copper cable conforming to relevant IS having stranded copper conductors of minimum 2.5 sq.mm section for CT Circuit and 1.5sq.mm for other Control wiring.

Wiring shall be neatly bunched, adequately supported and properly routed to allow easy access and maintenance.

Wires shall be identified by numbered ferrules at each end. The ferrules shall be of the ring type of non-deteriorating material. They shall be firmly located on each wire so as to prevent free movement.

All control circuit fuses shall be mounted in front of the panel and shall be easily accessible.

13.0 Terminal blocks and labels:

Terminal block shall be of 500 volts grade of the stud type.

Insulating barriers shall be provided between adjacent terminals.

Terminal block shall have minimum current rating of 10 amps and shall be shrouded.

Provisions shall be made for label inscriptions.

Labels shall be made of anodized aluminum, with white engraving on black background. They shall be properly secured with fasteners. Danger plate of size and descriptions as recommended in the relevant IS shall be provided on the PCC.

14.0 Tests:

i) The power control center shall be completely assembled, wired, adjusted and tested for operation under simulated conditions to ensure correctness of wiring and interlocking and proper functioning of all components.
ii) Each power control center and components shall be subjected to standard routine tests as per applicable clauses of relevant standards.
All current carrying parts and wiring of power control center shall be subjected to power frequency voltage withstand test.
15.0 Drawings: After the award of the contract, the Contractor Shall submit three copies of the following drawings for approval of the Department.

i) Outline dimensional drawing of the PCC showing the general arrangement indicating the following:
Busbar clearances;
power and control cable entry points;
Configuration of busbars;
Details of support insulations and spacings;
Outgoing power cable termination arrangements.
ii) Single line diagram of power control centre showing Protection, Metering etc.
iii) Cubicle wiring diagram.
List of Fitments with Ratings & makes / Models

16.0 Installation Testing and commissioning: The power control centre shall be installed over the cable trench / cable pit using suitable size of MS channel including grouting of the channel with necessary bolts and nuts. Proper earthing of PCC shall be done using two independent copper / GI strips of sizes as indicated in the schedule. The channel shall be painted with one coat of red oxide primer and two coats of anticorrosive enamel paint of proper shade as directed by the Engineer-in-charge.

The pre-commissioning tests as required shall be done and the PCC shall be commissioned.

10- INSPECTION AND QUALITY ASSURANCE REQUIREMENTS

WATER COOLED CHILLERS

Sl. No.	Process Description	Test	Quantum of Check	Inspection Agency
	RAW MATERIAL			
1.1	Plates, pipes, forgings and castings,	Visual inspection Review of material TC	Random	Mfr Mfr
1.2	Forgings	Ultrasonic / Magnetic particle test	100%	Mfr
1.3	Castings	Magnetic particle test	100%	Mfr
1.4	Tube plates	Ultrasonic test	100%	Mfr
2.0	IN PROCESS			

Sl. No.	Process Description	Test	Quantum of Check	Inspection Agency
2.1	Welding	Welding procedure qualifications and welder's performance record Butt welded joints (radiography) Fillet welded joints (magnetic particle test)	100% 100%	Mfr
2.2	Heat exchangers	Hydrotest	100%	Mfr
2.3	Compressors assembly	No load performance test Refrigerant leak test Loading and unloading test Vibration, noise, temperature rise on bearings	100%	OEM
2.3	Rotating components	Static and dynamic balancing	100%	Mfr
2.4	Electrical and control panel	Electrical interlocks	100%	Mfr
3.0	ASSEMBLY			
3.1	Package assembly	Dimensional check	100%	Note 3
3.2	Refrigerant piping	Leak testing	100%	Note 3
3.3	Performance test	Cooling capacity Power input Outlet temperatures on condenser and cooler Pressure drops in condenser and cooler Noise level	100%	Note 3

Notes:

The CONTRACTOR should liaison with the chiller MANUFACTURE and should ensure the above minimum inspection and testing in works.

The CLIENT / CONSULTANT reserves the right to seek the witness of any of the inspections carried out at works.

The performance tests shall be witnessed by the CLIENT / CONSULTANT, if indicated in data sheet, to their fullest satisfaction, before the dispatch of the first chiller from the works. CONTRACTOR should furnish the factory test reports (including those of the outsourced items) along with the inspection call for the chiller.

The chiller performance test conditions shall be as indicated in the data sheet.

The acceptance norms of the above tests shall be as mentioned below.

Materials : As per applicable material specifications

Welding : As per ASME Section IX

Nondestructive testing : As per ASME Section V / VIII Div. 1

requirements
Dynamic balancing : As per ISO 1940 / VDI 2060
Vibration level : VDI 2056 – 'Good zone'
Performance test : As per procedures laid down in AHRI 550/590

CENTRIFUGAL PUMPS

Sl. No.	Process Description	Test	Quantum of Check	Inspection Agency
	RAW MATERIAL			
1.1	Castings, forgings and structural members	Visual inspection Review of material TC Review of heat treatment chart	Random	Mfr Mfr
1.2	Forgings	Ultrasonic / Magnetic particle test	100%	Mfr
1.3	Castings	Magnetic particle test	100%	Mfr
2.0	IN PROCESS			
2.1	Casing	Liquid penetration test on machined surfaces		
2.0	IN PROCESS			
2.1	Casing	Liquid penetrant test on machined surfaces Hydrotest for minimum 30 mins.	100%	Mfr
2.2	Impeller	Liquid penetrant test on machined surfaces Static and dynamic balancing of impellers Hardness test of impeller wearing ring	100%	Mfr
2.3	Shaft	Liquid penetrant test after machining	100%	Mfr
2.4	Rotating assembly	Static and dynamic balancing Run out check	100%	Mfr
2.5	Electrical motor	Routine tests	100%	Mfr
3.0	ASSEMBLY			
3.1	Assembled pump set	Dimensional check	100%	Note 3
3.2	Performance test	Flow Differential head Power input Efficiency NPSH test, if indicated in data sheet Noise level and vibrations Strip down test	100%	Note 3

Notes:

The CONTRACTOR should liaison with pumps' MANUFACTURE and should ensure the above minimum inspection and testing in works.

The CLIENT / CONSULTANT reserves the right to seek the witness of any of the inspections carried out at works.

The performance tests shall be witnessed by the CLIENT / CONSULTANT, if indicated in data sheet, to their fullest satisfaction, before the dispatch of the first pump set from the works. CONTRACTOR should furnish the factory test reports (including those of the outsourced items) along with the inspection call for the pump set.

The acceptance norms of the above tests shall be as mentioned below.

Materials	:	As per applicable material specifications
Welding	:	As per ASME Section IX
Nondestructive testing	:	As per ASME Section V requirements
Dynamic balancing	:	As per ISO 1940 / VDI 2060
Vibration level	:	VDI 2056 – 'Good zone'
Performance test	:	As per IS 5120

COOLING TOWERS

Sl. No.	Process Description	Test	Quantum of Check	Inspection Agency
1.0	RAW MATERIAL			
1.1	Fan blades, shafts, gear boxes, pulleys, bushes / hubs, FRP components, piping, fills and nozzles	Visual inspection Dimensional check Review of material TC Mechanical properties	Random	Mfr Mfr
1.2	Shafts and hubs	Ultrasonic / Magnetic particle test	100%	Mfr
1.3	Castings	Magnetic particle test	100%	Mfr
2.0	IN PROCESS			
2.1	Various components of cooling tower	Liquid penetrant test on machines surfaces		
2.2	Fan assembly	Dimensional check Static and dynamic balancing Performance test	100%	Mfr
2.3	Gear box, if applicable	Dimensional check Back lash and gear ratio No load and full load run test	100%	Mfr
2.4	Electrical motor	Routine tests	100%	Mfr
3.0	ASSEMBLY			
3.1	Assembled cooling tower	Dimensional check	100%	Note 3
3.2	Performance test	Air flow, static pressure, power input and efficiency of the fan	100%	Note 3

Sl. No.	Process Description	Test	Quantum of Check	Inspection Agency
		Cooling water outlet temperature Cooling water flow rate Noise and vibration		

Notes:

The CONTRACTOR should liaison with the cooling towers' MANUFACTURE and should ensure the above minimum inspection and testing in works.

The CLIENT / CONSULTANT reserves the right to seek the witness of any of the inspections carried out at works.

The performance tests shall be witnessed by the CLIENT / CONSULTANT, at site.

CONTRACTOR should furnish the factory test reports of raw material and in process quality assurance (including those of the outsourced items) before the dispatch of the cooling tower.

The acceptance norms of the above tests shall be as mentioned below.

Materials	:	As per applicable material specifications
Nondestructive testing	:	As per ASME Section V requirements
Dynamic balancing	:	As per ISO 1940 / VDI 2060
Vibration level	:	VDI 2056 – 'Good zone'
Performance test	:	As per CTI ATC 105 S

RECOMMENDED MAKES OF MATERIALS

11. **LIST OF APPROVED MAKE & CATEGORY FOR TEST / INSPECTION**		
S. N.	**DETAIL OF MATERIAL / EQUIPMENT**	**APPROVED MAKES**
1	WATER COOLED SCREW/SCROLL CHILLERS	CARRIER /YORK/DAIKIN/ETA/BLUESTAR
2	PUMPS	KIRLOSKER/ ARMSTRONG /XYLEM
3	COOLING TOWER	ADVANCE/BELL/EDGETECH
4	VARIABLE FREQUENCY DRIVE (VFD)	DANFOSS / SIEMENS / ABB
5	EXPANSION TANK AND AIR SEPARATOR	ANERGY / SPIROTECH / DS ENGINEERING
6	DUCT / PIPE SUPPORT SYSTEM	MUPRO/ GRIPPLE/HILTI

7	FLEXIBLE CONNECTORS /VIBRATION ISOLATION	DUNLOP / CORI / BDK / RESISTOFEX
8	NITRILE RUBBER & ADHESIVES	ARMACELL / A-FLEX / K- FLEX
9	FIBERGLASS	UP TWIGA/ OWENS CORNING
10	EPS PIPE SECTIONS	BEARDSELL/HYDERABAD EPS/STY PACK
11	INSULATION PROTECTIVE COATING	PIDILITE / FOSTER/ARMACELL
12	DRAIN PIPE	PRECISION / NIHIR / AKG / BEC
13	L.T. CABLES/ CONTROL CABLES	FINOLEX / POLYCAB / HAVELL'S / RR KABEL /GLOSTER / TORRENT
14	PLC / DDC CONTROLLERS AND CO SENSORS	SIEMENS / HONEYWELL / MITSHUBISHI / ALLEN BRADLY / JOHNSON CONTROLS
15	L.T.PANEL BUILDERS	ONLY CPRI /ERDA APPROVED AND ISO CERTIFIED PANEL BUILDERS
16	C.T/P.T METRING UNIT	PRAGATI / KAPPA / SILKANS / ABB / L & T / GILBERT /CROMPTON / AE /ASHMORE
17	ACB / MCCB/ ON-LOAD CHANGE OVER SWITCH/SFU	L&T / SIEMENS / ABB / LEGRAND / SCHNEIDER-MG
18	MCB, RCCB / ELCB, MCB ISOLATOR	SIEMENS / LEGRAND / CRABTREE / SCHNEIDER / ABB / HAGER
19	CONTACTORS (POWER & CONTROL /CAPACITIVE DUTY)	SIEMENS / L & T / ABB / SCHNEIDER –MG / LEGRAND / CROMPTON / GE
20	PANEL INDICATING METERS (ANALOG & DIGITAL)	SCHNEIDER (CONZERV) / L&T / TRINITY / NEPTUNE / SECURE / IMP/SIEMENS/ ABB /ELMEASURE
21	EARTH LEAKAGE RELAY	IMP / PROKDVS / NAGOBA / NEPTUNE / SIEMENS/ ABB / SCHNEIDER / L & T
22	INDICATING LAMP /PUSH BUTTON	L & T / C & S / SCHNEIDER /TEKNIC / BCH/SALZER /BINAY / RAAS
23	SELECTOR SWITCHES	L&T / SCHNEIDER / SIEMENS / SALZER
24	ELECTRICAL CONNECTORS / TERMINAL BLOCK	PHOENIX / WAGO / ELMEX / CONNECTWELL

25	CABLE LUGS	DOWELLS / 3D / JAINSON / HEX
26	CABLE GLAND	COMET(COSMOS) / DOWELLS / HMI / JAINSON / SIEMENS
27	FLEXIBLE CU. WIRES-	FINOLEX / POLYCAB / RRKABLE / ANCHOR / LAPP
28	COPPER PIPES	RAJCO / MANDEV / TOTALLINE
29	CABLE TRAY	INDIANA / KEW / LEGRAND / OBO BETTERMAN
30	**VALVES**	
31	CONTROL VALVES	SIEMENS/JOHNSON CONTROLS / HONEYWELL/DANFOSS
32	BUTTERFLY VALVES	AUDCO/ HONEYWELL/KIRLOSKER/L & T
33	BALANCING VALVES	DANFOSS/HONEYWELL/FLOWCORN/GIACOMINI/DANFOSS
34	NON-RETURN VALVES	HONEYWELL/SANT/KIRLOSKER/DANFOSS
35	GLOBE VALVES	LEADER/SAINT/AUDCO/HONEYWELL
36	BALL VALVES	RB/GIACOMINI/L & T/ HONEYWELL
37	REFREIGERANT VALVES	BRASSOMATIC/DANFOSS
38	Y STRAINER	SANT/HONEYWELL/KIRLOSKER/L & T/TRISHUL
39	TEMPARATURE AND PRESSURE GAUGES	H GURU / FORBES MARSHALL/ WAREE
40	AUTOMATIC AIR VENT	AMTROL/ENERGY/FLAMMCO

Note: Before use of any of the above brands for the Project, Prior Written permission shall be taken from client. The Client shall have choice to select any of the above approved brands.

Note: Before supply the material, TDS (Technical Data Sheets) should be approved by client.

TENDER FOR ELECTRICAL WORKS

TECHNICAL SPECIFICATIONS

INTERNAL ELECTRICAL WORKS
CHAPTER-1

1. SCOPE OF WORK

The scope of work shall include all the internal electrical works required for the proposed project. The scope of work shall include supply, installation, testing and commissioning of all internal electrical works as per Specifications, bill of quantities (BOQ), Drawings and latest IS codes:

- Internal wiring shall be run through surface /concealed MS conduits in Ground and upto Second floor and with FR PVC conduits in all other floors for all the Light points, Ceiling / Exhaust Fan points, Power Socket outlets, Switches with accessories etc.

- The scope shall also include supply, installation, testing and commissioning of required internal Light fixtures, Ceiling/ Exhaust Fans, Power Socket outlets, Switches along with all fixing accessories required to complete the job as per requirement.

- FRLS insulated Copper conductor multi stranded flexible wires/ cables sizes for various usages shall be as follows.

Purpose	**Size of wire**
Light Points from Switch board to point	3Runs 1.5sq.mm
Lighting circuit from DB to switch board	3runs of 2.5sq.mm
6A socket from DB to socket / looping from socket to socket	3runs of 2.5sq.mm
16A socket from DB to socket / looping from socket to socket	3runs of 4sq.mm
20A/ 32 socket from DB to socket	3runs of 6sq.mm
LDB	4runs of 6sq.mm & 2runs of 6sq.mm
PDB & RDB's	4runs of 10sq.mm & 2runs of 6sq.mm
UDB&MDB's	5runs of 10sq.mm & 2runs of 6sq.mm

- Conduiting and Wiring for UPS powered socket outlets for medical and IT usage.

- Conduiting and wiring for 3phase sockets outlets from floor electrical rooms.

- Providing Distribution boards (DB's) in floor electrical rooms to facilitate power for lights, fans, sockets outlets of UPS and normal supply. UPS power supply wiring shall be routed separately.
- Isolated Power supply shall be extended to all points in Operation theaters and ICCUs as per schematic drawing

- Supply for Isolation panels are extended directly from UPS floor Panel (Medical) located at floor electrical room.

- UPS supply for DBs of IT usage shall be extended from UPS output panel (IT).

- Contractor has to submit the following before proceeding with work
    - The working/ shop drawings of internal electrification based on tender / working drawings for approval before commencement of work. The works shall be commenced at site only after obtaining approvals

    - Contractor has to obtain approvals for the makes of materials, before procurement

    - Installation working drawings (indicating details of bracket fabrication, requirements of inserts / fan hooks / opening in the civil works, junction boxes, fabrication and erection, fixing details of DBs ,hooks/ bracket for fittings, etc.)

    - Technical details of the lighting fixtures (catalogues, test certificates, etc.).

- **The Complete Wiring shall be tested before energizing and all test certificates shall be submitted for approval**

- Before commissioning, the contractor shall hand over the original tracing along with one reproducible tracing "As Built Drawing" incorporating all the modification / deviations made at site from the original approved plan

TECHNICAL SPECIFICATIONS
CHAPTER-2

INTERNAL ELECTRIFICATION

WIRING

1. GENERAL

Technical Specifications in this section cover the Internal Wiring Installations comprising of:

- Wiring for lights and convenience socket outlets etc. in conduits
- Sub main wiring.
- MCB Distribution Boards

2. STANDARDS AND CODES

The following Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

BIS certified equipment shall be used as a part of the Contract in line with Government regulations. Necessary test certificates in support of the certification shall be submitted prior to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

• 650/1100 V grade FRLS insulated wires.	IS	694 : 1990
• Rigid Non metal conduits for electrical wiring.	IS	9537 : Part I 1980
	IS	9537 : Part II 1981
• Accessories for rigid steel conduits	IS	3837 : 1990
• Flexible steel conduits for electrical wiring	IS	3480 : 1990
• Switch socket outlets	IS	4615 : 1990
• Switches for domestic and similar purposes	IS	3854 : 1997
• Boxes for the enclosure of electrical accessories	IS	5133 : Parts I &II 1969
• Code of practice for personal hazard fire safety of Buildings	IS	1644: 1998
• Code of practice for electrical installation fire safety of		
• buildings	IS	1646 : 1997

- Code of practice for electrical wiring installations IS 732 : 1989
- Miniature Air Circuit Breakers for AC circuits IS8828:1978
- Residual Current Circuit Breakers IS 12740
- Degrees of Protection provided by enclosures for low voltage switchgear IS 2147 : 1962
- Code of Practice for installation and maintenance of switchgear not exceeding 1000 volts IS 10118 : 1982
- General requirements for switchgear and control gear for voltages not exceeding 1000 volts IS 4237 : 1982

3. CONDUITS/ RACEWAYS

3.1 Non-Metal Rigid Conduits

These shall be of FR PVC heavy gauge type having perfectly circular tubing.

3.2 PVC Conduit Connections

Connections between PVC conduits shall be with proper sealing compound of approved quality and finish. Conduits shall be connected to outlet boxes by means of check-nuts fixed both inside and outside the box. Conduit edges shall be free of burrs and provided with screwed PVC bushes to avoid damage to insulation of conductors while pulling them through the conduits. Connections between M.S. and PVC conduits, if required, shall be through a junction box and never directly.

3.3 Bends

Large right angle bends (more than 75 mm radius) or non right angle bends in conduit runs shall be made by means of conduits bending machines carefully so as not to cause any crack in the conduit. Small right angle bends in conduits runs can be made by standard conduit accessories (solid/inspection bends/elbows) no run of conduits shall have more than four right angle bends from outlet to outlet. Bends in multi runs of conduits shall be parallel to each other and neat in appearance, maintaining the same distance as between straight runs of conduits.

3.4 Conduit Accessories.

3.4.1 Standard accessories

Heavy duty black standard conduit fittings and accessories like standard/extra-deep circular boxes, looping in boxes, junction boxes, normal/ inspection bends, solid/inspection elbows, solid/inspection tees, couplers, nipples, saddles, check nuts, earth clips, ball socket joints etc. shall be of superior quality and of approved makes. Heavy duty covers screwed with approved quality screws shall be used. Superior quality screwed PVC bushes shall be used Samples of all

conduits fittings and accessories shall be got approved by Development Manager before use.

3.4.2 **Fabricated accessories**

Wherever required, outlet/junction boxes of required sizes shall be fabricated from 1.6 mm thick MS sheets excepting ceiling fan outlet boxes, which shall be fabricated from minimum 2 mm thick sheets. The outlet boxes shall be of approved quality, finish and manufacture. Suitable means of fixing connectors etc., if required, shall be provided in the boxes. The boxes shall be protected from rust by zinc phosphate primer process. Boxes shall be finished with minimum 2 coats of enamel paint of approved colour. A screwed brass stud shall be provided in all boxes as earthing terminal.

3.4.2.1 **Outlet Boxes For Light Fittings.**

These shall be minimum 75mm x 75mm x 50mm deep and provided with required number of threaded collars for conduit entry. For ceiling mounted florescent fittings, the boxes shall be provided 300 mm off centre for a 1200 mm fitting and 150 mm off centre for a 600 mm fitting so that the wiring is taken directly to the down rod. 3 mm thick Perspex /hylamn sheet cover of matching colour shall be provided.

3.4.2.2 **Outlet Boxes For Ceiling**

Outlet boxes for ceiling fans shall be fabricated from minimum 2 mm thick MS sheet steel. The boxes shall be hexagonal in shape of minimum 100 mm depth and 60 mm sides. Each box shall be provided with a recessed fan hook in the form of one 'U' shaped 15 mm dia rod welded to the box and securely tied to the top reinforcement of the concrete slab for a length of minimum 150 mm on either side. 3 mm thick Perspex /hylamn sheet cover of matching colour shall be provided.

4. **Metal Rigid Conduit** wiring system:

4.1 All conduit pipes shall be black enameled M.S. conduits with uniform wall thickness.

All conduit accessories shall be threaded type in metric system as per IS 2667-1976. No steel conduit less than *20* mm dia shall be used. The thickness shall be 1.6mm upto 32 mm dia. pipes and 2 mm for conduit above 32 mm dia. Separate conduits shall be used for power and lighting circuits.

4.2 Conduit pipes shall be jointed by means of screwed couplers and screwed accessories like junction boxes of depth not less than 65 mm in case of concealed conduits and 50 mm in case of surface conduits. In long distance straight runs of conduit, inspection type couplers at reasonable 8 mtrs. Intervals shall be provided. Threads on conduit pipes in all cases shall be between 20mm to 24mm long sufficient to accommodate pipes to full threaded portion of couplers or accessories. Cut ends of conduit pipes shall have no sharp edges nor any burrs left to avoid any damage to the insulation of conductors while pulling them through. Field made threads' are to be protected by applying zinc rich paint-epoxy zinc rich primer (Product of Asian / Garware paints).

4.3 Ebonite bushes shall be used wherever steel conduits are terminated to either junction box, switch socket or any fixture to prevent cuts on wire insulation on any junction box socket outlet or any fixture.

4.4 The outer surface of the conduit pipes including all bends, union', tees, junction boxes etc. forming part of the conduit system shall be adequately protected against rust. In no case bare threaded portion of conduit pipe shall be allowed unless such bare threaded portion is treated with anti-corrosive preservative paint.

4.5 At least 8 SWG G.I. wire shall be laid through the conduit to enable to pull the wires through the conduit.

4.6 For surface conduit wiring, conduit pipes shall be fixed by heavy gauge galvanized M.S. saddles, secured to M.S. galvanized flats of 3 mm thick. The width of flats shall suit the total number of conduits to be run. The conduit pipes shall be individually fixed using galvanized screws, at every 600 mm.

4.7 The junction boxes, and inspection boxes and switchboxes shall be temporarily blocked by jute before the concreting is done and shall be co-ordinated with Consultants. After concreting is over, the shuttering is removed, the jute shall be removed and boxes shall be cleaned if they are blocked up by concrete.

4.8 All necessary bends in the system including diversion shall be done bending pipes or by inserting normal or inspection type normal bends or by fixing M.S. Painted inspection boxes whichever is more suitable.

Conduits fittings shall not be used on conduit system exposed to weather. Radius of such bends in conduit pipes shall not be less than 7.5 cm. No length of conduit shall have more than the equivalent of two quarter bends from outlet to outlet Additional bends shall be inspection bends / boxes.

4.9 Junction boxes and down rods for lighting fixtures, shall be of approved make. The boxes shall be complete with covers to be fixed with screws.

4.10 The conduits for concealed wiring in slab or R.C.C. shall be tied to the reinforcement bars by M.S. galvanized wires at every 600 mm apart to give the conduits rigidity. Before installing conduits, junction boxes and inspection boxes in the brick wall, a chase shall be done and shall be co-ordinated with plastering of the walls is done and shall be coordinated with the other Agency. After installing the conduits, the chase shall be closed and shall be finished with the wall.

4.11 The conduit of each circuit or section shall be completed before conductors are drawn in. The entire system of conduit after erection shall be tested for Mechanical and electrical continuity throughout and permanently connected

to earth. Conduit shall not be used as a earth medium. A separate earth wire of 14 SWG / 2mm copper wire shall run along with each conduit for earthing. Alternatively PVC insulated copper conductor of same size as that of the phase conductor shall run inside the conduit pipe. If conduit pipes are liable to mechanical damage, they shall be adequately protected.

4.12 Inspection Boxes

Suitable inspection boxes, fabricated out of 2 mm M.S. sheet shall be provided to permit periodical inspection and to facilitate removal of wires, if required. Every box should be provided with a suitable brass earthing screw in tapped holes to facilitate connection to earth continuity conductor.

4.13 Fixing of Conduits in Chase

4.13.1 The conduit shall be fixed by means of staples at not more than 600 mm apart. The conduits shall be embedded in brick work before plastering.

4.13.2 For installation of conduit, switchbox, pull box, panel, switches wherever masonry or slab or brick wall is chipped after plastering the chipped portion shall be finished neatly in a manner acceptable to Engineer-in-charge by contractor doing electrical installation work.

4.13.3 In case of conduits to be fixed in 150 mm or less thick brick work, the conduit along with all accessories switchboxes, etc. should be fixed simultaneously along with construction of brick work.

If required conduit layout shall be installed before construction of brick work with necessary supporting arrangement for the conduit layout to stay in position. Conduits to be embedded in RCC structure shall be put in position, and securely bound to reinforcement before the concrete is poured.

The contractor shall ensure that there is proper coordination and supervision to avoid displacement of such conduits.

4.13.4 Except inside false ceiling and other places indicated in drawing and schedule of quantities, at all other areas concealed conduit installation has to be executed. Maximum size of conduit allowed to be concealed in the slab will be 32 mm. Wherever bigger size of conduit is required a row of small size conduit may be used all terminating in the same box.

5. Boxes For Modular Wiring Accessories

5.1 SWITCH BOXES - MODULAR TYPE

Switch boxes suitable to house modular type switches of required ratings, and fan regulators as required shall be provided. In case the number of switches in one box is not tallying with that available in standard manufacture, the box

accommodating the next higher number of switches shall be provided without any extra cost. In case fan regulator/regulators is /are to be provided at a later dated, suitable provision for accommodating such regulators shall be made in the switch boxes and blank off covers shall be provided without any extra cost.
Switch boxes shall be so designed that accessories are mounted on a grid plate with tapped holes for brass machine screws leaving ample space at the back and on the sides for accommodating conductors, check-nuts and screwed bushes at conduit entries etc... The grid plates and M.S. boxes shall be fitted with a brass earth terminal. Boxes shall be attached to conduits by means of check-nuts on either sides of their walls. Moulded front covers made from high impact resistant, flame retardant and ultra violet stabilized engineering plastics shall be fixed by means of counter sunk chromium plated brass machine screws. No timber shall be used for any supports. Switch boxes shall be located with bottom at 1200 mm above floor level unless otherwise indicated.

5.2 MODULAR TYPE BOXES FOR SOCKET OUTLETS

Outlet boxes shall be suitable for housing modular type switched socket outlets/ telephone outlets/ buzzers and any other outlet as required. These shall be so designed that accessories are mounted on a grid plate with tapped holes for brass machine screws leaving ample space at the back and on the sides for accommodating conductors, checknuts and screwed bushes at conduit entries etc. The grid plates and M.S. boxes shall be fitted with a brass earth terminal. These shall be attached to conduits by means of check nuts on either sides of their walls. Moulded front covers made from high impact resistant, flame retardant and ultra violet stabilized engineering plastics shall be used to mount the outlets and shall be fixed to the outlet M.S. boxes by means of counter sunk chromium plated brass machine screws. No timber supports shall be used. Boxes shall be located at skirting level or bottom at 1200 mm from floor or inside raceways on laboratory work tables., as indicated in drawings and/or as directed.

5.3.1 Construction :

5.3.1 Control at the point of commencement of supply.

1.1 The main switch shall be located near the termination of service line and it shall be easily accessible without the use of any external aid and the main switch shall be installed at a height of 1.8m from finished floor level. The exact location shall be finalised by the Engineer - in - charge.

1.2 A circuit beaker or switch fuse unit shall be provided at the point of entry. There shall not be any break in the neutral wire in the form of fuse or switch unit. The neutral shall also be marked clearly.

5.3.2 Location of the switch boards.

2.1 Switch boards shall be placed only in dry locations and in ventilated rooms and they shall not be placed in the vicinity of storage batteries or

exposed to chemical fumes.

2.2 In a damp situation or where flammable or explosive dust, vapor or gas is likely to be present, the switch board shall be totally enclosed or made flame proof as may be necessitated by the particular circumstances.

2.3 Main board location shall be such that it is easily accessible for firemen and other personnel to quickly disconnect the supply in case of emergencies.

2.4 Care shall be taken not to erect switch boards above gas stoves or sinks within 2.5m of any washing unit in the washing rooms.

2.5 Main switch boards shall be installed in rooms or cupboards having provisions for locking arrangement so as to safeguard against operation by unauthorised personnel.

2.6 Adequate Illumination shall be provided for all working spaces around the switch boards when installed indoors.

2.7 In case of switch boards fixed in places likely to be exposed to weather or to abnormal moist atmosphere, the outer casing shall be weather proof and shall be provided with glands or bushing or adopted to receive screwed conduit, according to the manner in which the cables are run.

2.8 When the switch boards are recessed in wall, the front shall be fitted with a hinged panel of teakwood or other suitable material such as hylam, or with unbreakable glass doors in teak wood frame with locking arrangement, the outer surface of the doors being flush with the walls. Sufficient space shall be provided at the back for connection and at the front between switchgear mountings and the door.

2.9 Wall mounted switch boards shall be installed such that the bottom is at a minimum height of 1.20 m above finished floor level wherever applicable, as indicated in the drawing.

The various live parts, unless they are effectively screened by substantial barriers of non hygroscopic, Non flammable insulating material, shall be so spaced that an arc cannot maintain between such parts and earth.

2.11 No, apparatus shall project beyond any edge of the panel. No fuse body shall be mounted within 2.5cm of any edge of the panel and no holes by means of which the panel is fixed shall be drilled closer than 1.3cm from any edge of the panel.

2.12 Equipment which is on the front of a switch board shall be so arranged that inadvertent personnel contact with live parts is unlikely during the manipulation of switches, changing of fuses or similar operation.
In every case in which switches and fuses are fitted on the same pole, these fuses, shall be so arranged that the fuses are not live when their respective switches are in 'OFF' position.

2.13 No fuses other than fuses in instrument circuit shall be fixed on the back or behind a switch board panel or frame.

2.14 The arrangement of the gear shall be such that they shall be readily accessible and their connections to all instruments and apparatus easily traceable.

6. **Cross Section**

The conduits shall be of ample sectional area to facilitate simultaneous drawing of wires and permit future provision also. Total cross section of wires measured overall shall not normally be more than half the area of the conduit. Maximum number of FRLS insulated 660/1100 Voltage grade copper conductor cable conforming to IS - 694 - 1990 as per table give below.

- Maximum no of FRLS insulated 660/1100 V grade a copper
- Conductor cable conforming to IS : 694 - 1990

Normal Cross Sectional area of conductor in sq. mm	20 mm		25 mm		32 mm		38 mm		51 mm		64 mm	
	S	B	S	B	S	B	S	B	S	B	S	B
1	2	3	4	5	6	7	8	9	10	11	12	13
1.50	5	4	10	8	18	12	-	-	-	-	-	-
2.50	5	3	8	6	12	10	-	-	-	-	-	-
4	3	2	6	5	10	8	-	-	-	-	-	-
6	2	-	5	3	4	8	7	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	2	3	3	6	5	10	7	12	8
25					3	2	5	3	8	6	9	7
35							3	2	6	5	8	6
50									5	3	6	5
70									4	3	5	4

Note :

1. The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.
2. The columns headed 'S' apply to runs of conduits which have distance not exceeding 4.25 m between draw boxes and which do not deflect form the straight by an angle of more than 15 degrees. The columns headed 'B' apply to runs of conduit which deflect form the straight by an angle of more than 15 degrees.
3. Conduits sizes are the nominal external diameters.

7. WIRES

Wiring shall be carried out with FRLS insulated Fire Retardant 660/1100 volt grade unsheathed single core wires with electrolytic annealed stranded copper (unless otherwise stated) conductors and conforming to IS 694/1990. All wire rolls shall be ISI marked. All wires shall bear manufacturer's label and shall be brought to site in new and original packages. Manufacturer's certificate, certifying that wires brought to site are of their manufacture shall be furnished as required.

8. LAYING OF CONDUITS

- Conduits shall be laid either recessed in walls and ceilings or on surface on walls and ceilings or partly recessed and partly on surface, as required.
- Same rate shall apply for recessed and surface conduiting in this contract.
- Stranded copper conductor insulated wire of size as per schedule of quantities shall be provided in entire conduiting for loop earthing.
- GI wire of suitable size to serve as a fish wire shall be left in all conduit runs to facilitate drawing of wires after completion of conduiting.

9. Laying of Conduits

9.1 Recessed Conduiting

Conduits recessed in concrete members shall be laid before casting, in the upper portion of slabs or otherwise as may be instructed, so as to embedd the entire run of conduits and ceiling outlet boxes with a cover of minimum 12 mm concrete. Conduits shall be adequately tied to the reinforcement to prevent displacement during casting at intervals of maximum 1 meter. No reinforcement bars shall be cut to fix the conduits. Suitable flexible joints shall be provided at all locations where conduits cross expansion joints in the building.

Conduits recessed in brick work shall be laid in chases to be cut by electrical Contractor in brick work before plastering. The chases shall be cut by a chase cutting electric machine. The chases shall be of sufficient width to accommodate the required number of conduits and of sufficient depth to permit full thickness of plaster over conduits. The conduits shall be secured in the chase by means of heavy duty pressed steel clamps screwed to MS flat strip saddles at intervals of maximum 1 meter. The chases shall then be filled with cement and coarse sand mortar (1:3) and properly cured by watering.

Entire recessed conduit work in concrete members and in brick work shall be carried out in close coordination with progress of civil works. Conduits in concrete members shall be laid before casting and conduits in brick work shall be laid before plastering. Should it become necessary to embed conduits in already cast concrete members, suitable chase shall be cut in concrete for the purpose. For minimising this cutting, conduits of lesser diameter than 25 mm and outlet boxes of lesser depth than 50 mm could be used by the Contractor for such extensions only after obtaining specific approval from Project Managers. For embedding conduits in finished and plastered brick work, the chase would have to be made in

the finished brick work. After fixing conduit in chases, chases shall be made good in most workmanlike manner to match with the original finish.

Cutting chases in finished concrete or finished plastered brick work for recessing conduits and outlet boxes etc shall be done by the Contractors without any extra cost.

9.2 **Surface Conduiting**

Wherever so desired, conduit shall be laid in surface over finished concrete and/or plastered brickwork. Suitable spacer saddles of approved make and finish shall be fixed to the finished structural surface along the conduit route at intervals not exceeding 600 mm. Holes in concrete or brick work for fixing the saddles shall be made neatly by electric drills using masonry drill bits. Conduits shall be fixed on the saddles by means of good quality heavy duty MS clamps screwed to the saddles by counter sunk screws. Neat appearance and good workmanship of surface conduiting work is of particular importance. The entire conduit work shall be in absolute line and plumb.

9.3 **Fixing of conduit fittings and accessories**

For concealed conduiting work, the fittings and accessories shall be completely embedded in walls/ceilings leaving top surface flush with finished wall/ceiling surface in a workman like manner.

Loop earthing wire shall be connected to a screwed earthstead inside outlet boxes to make an effective contact with the metal body.

9.4 **Protection of Conduits**

To safeguard against filling up with mortar/plaster etc. all the outlet and switch boxes shall be provided with temporary covers and plugs which shall be replaced by sheet/plate covers as required. All screwed and socketed joints shall be made fully water tight with white lead paste.

9.5 **Cleaning of Conduit Runs**

The entire conduit system including outlets and boxes shall be thoroughly cleaned after completion of erection and before drawing in of cables.

9.6 **Protection Against Dampness**

All outlets in conduit system shall be properly drain and ventilated to minimise chances of condensation/sweating.

9.7 **Expansion Joints**

When crossing through expansion joints in buildings, the conduit sections across

the joint shall be through approved quality heavy duty metal flexible conduits of the same size as the rigid conduit.

9.8 Loop Earthing

Loop earthing shall be provided by means of insulated stranded copper conductor wires of sizes as per Schedule of Quantity laid along with wiring inside conduits for all wiring outlets and sub-mains. Earthing terminals shall be provided inside all switch boxes, outlet boxes and draw boxes etc.

10. LAYING AND DRAWING OF WIRES

10.1 Bunching of Wires

Wires carrying current shall be so bunched in conduits that the outgoing and return wires are drawn into the same conduit. Wires originating from two different phases shall not be run in the same conduit.

10.2 Drawing of Wires

The drawing of wires shall be done with due regard to the following precautions:-

No wire shall be drawn into any conduit, until all work of any nature, that may cause injury to wire is completed. Burrs in cut conduits shall be smoothen before erection of conduits. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire. Approved type bushes shall be provided at conduit terminations.

Before the wires are drawn into the conduits, conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction by forcing compressed air through the conduits if necessary.

While drawing insulated wires into the conduits, care shall be taken to avoid scratches and kinks which cause breakage of conductors.

There shall be no sharp bends.

The Contractor shall, after wiring is completed, provide a blank metal/sunmica plate on all switch / outlet / junction boxes for security and to ensure that wires are not stolen till switches / outlets etc.. are fixed at no extra cost the contractor shall be responsible to ensure that wires and loop earthing conductors are not broken and stolen. In the event of the wire been partly / fully stolen, the contractor shall replace the entire wiring along with loop earthing at no extra cost to the Client. No joint of any nature whatsoever shall be permitted in wiring and loop earthing .

10.3 **Termination /Jointing of Wires**

Sub-circuit wiring shall be carried out in looping system. Joints shall be made only at distribution board terminals, switches/buzzers and at ceiling roses/connectors/lamp holders terminals for lights/fans/socket outlets. No joints shall be made inside conduits or junction/draw/inspection boxes.

Switches controlling lights, fans or socket outlets shall be connected in the phase wire of the final sub circuit only. Switches shall never be connected in the neutral wire.

Wiring conductors shall be continuous from outlet to outlet. Joints where unavoidable, due to any special reason shall be made by approved connectors. Specific prior permission from Project Manager in writing shall be obtained before making such joint.

Insulation shall be shaved off for a length of 15 mm at the end of wire like sharpening of a pencil and it shall not be removed by cutting it square or wringing.

Strands of wires shall not be cut for connecting terminals. All strands of wires shall be twisted round at the end before connection..

Conductors having nominal cross sectional area exceeding 4 sq. mm shall always be provided with crimping sockets.

At all bolted terminals, brass flat washer of large area and approved steel spring washers shall be used.

Brass nuts and bolts shall be used for all connections.

The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less.

Switches controlling lights, fans, socket outlets etc. shall be connected to the phase wire of circuits only.

Only certified valid license holder wiremen shall be employed to do wiring / jointing work.

10.4 **Load Balancing**

Balancing of circuits in three phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

10.5 **Color Code of Conductors**

Color code shall be maintained for the entire wiring installation - red, yellow, blue for three phases, black for neutral and green for earth.

11. MCBs/ MCB DISTRIBUTION BOARDS

11.1 Miniature Circuit Breakers

- The MCB's shall be of the completely moulded design suitable for operation at 240/415 Volts 50 Hz system.

- The MCB's shall have a rupturing capacity of 10 KA at 0.5 p.f.

- The MCB's shall have inverse time delayed thermal overload and instantaneous magnetic short circuit protection. The MCB time current characteristic shall coordinate with FRLS cable characteristic.

11.2 MCB Distribution Boards

- All the distribution boards shall be with MCBs as described in the respective schedule.
- All MCB DBs shall be factory made

- Each outgoing circuit shall be provided either with MCB.
- The neutral shall be connected to a common link and be capable of being disconnected individually for testing purposes.

- The distribution board shall comply with the specifications as given in Schedule and covered with Poly propylene front cover and supplied by the Standard Companies as given in the Recommended Makes.

- The distribution board shall be fixed at 1.5m from F F L or as specified in Drawing and shall be installed in flush with wall/ niche as indicated in Drawing

- They shall be weather proof if exposed to weather or damp situations.

- The following shall be marked on the distribution boards :
  a) Danger 415 volts.
  b) Accessible only to authorised persons.
  c) Shall be provided with circuits list giving details of each circuit which it controls along with circuit rating and MCB size
  d) The panel from where power is tapped to D.B.

  All marking shall be clear and legible.

- The total load of the consuming devices shall be evenly distributed between the number of ways of distribution board and the Details of Circuits indicated shall be followed.

- The consuming devices circuit shall be connected to distribution board in proper sequence, so as to avoid unnecessary crossing of wires.

- Cables shall be connected to a terminal only by soldered or crimped lugs.

- Cables shall be rigidly fixed in such a manner that a clearance of at least 2.5cm is maintained between conductors of opposite polarity or phase and between the conductors and any material other than insulating material.

- The incoming and outgoing cables shall be neatly bunched.

12. MEASUREMENT AND PAYMENT OF WIRING

Wiring for lights, fans, convenience socket outlets and telephone outlets etc. shall be measured and paid for on POINT BASIS as itemized schedule of quantities and as elaborated as below unless otherwise stated.

12.1 Primary and Secondary light point wiring

In respect of group control of lights (more than one light controlled by one switch or MCB), wiring upto the first light in the group shall be measured and paid for as a primary light point. Wiring for other lights looped in one group for switch controlled as also MCB controlled lights shall be measured and paid for as secondary light points. Primary light points for switch controlled lights shall include the cost of control switch whereas primary light points controlled by MCBs shall not include the switch cost. The cost of MCB controlling such lights shall not be included in the primary light point rate since the MCB shall be paid for in the item of DB.

The point wiring basis shall assume average wiring length and average conduit length per point based on parameters. The average wiring length and average conducting length forming the basis of point wiring payment, shall take the electrical layouts of the entire project into consideration. Tenderers are advised to seek clarifications, if they so desire, on this aspect before submitting their tenders. No claim for extra payment on account of electrical layouts in part or whole of the project requiring larger average wiring and conduit length per point, whether specifically shown in tender drawings or not, shall be entertained after the award of contract.

ROUTINE AND COMPLETION TESTS

13.1 Installation Completion Tests

At the completion of the work, the entire installation shall be subject to the following tests:

1. Wiring continuity test
2. Insulation resistance test
3. Earth continuity test
4. Earth resistivity test

Besides the above, any other test specified by the local authority shall also be carried out. All tested and calibrated instruments for testing, labour, materials and incidentals necessary to conduct the above tests shall be provided by the contractor at his own cost.

13.2 Wiring Continuity Test

All wiring systems shall be tested for continuity of circuits, short circuits, and earthing after wiring is completed and before installation is energised.

13.3 Insulation Resistance Test

The insulation resistance shall be measured between earth and the whole system conductors, or any section thereof with all fuses in place and all switches closed and except in concentric wiring all lamps in position of both poles of the installation otherwise electrically connected together, a direct current pressure of not less than twice the working pressure provided that it does not exceed 1100 volts for medium voltage circuits. Where the supply is derived from AC three phase system, the neutral pole of which is connected to earth, either direct or through added resistance, pressure shall be deemed to be that which is maintained between the phase conductor and the neutral. The insulation resistance measured as above shall not be less than 50 megohms divided by the number of points provided on the circuit the whole installation shall not have an insulation resistance lower than one megohm.

The insulation resistance shall also be measured between all conductors connected to one phase conductor of the supply and shall be carried out after removing all metallic connections between he two poles of the installation and in those circumstances the insulation shall not be less than that specified above.

The insulation resistance between the frame work of housing of power appliances and all live parts of each appliance shall not be less than that specified in the relevant Standard specification or where there is no such specification, shall not be less than half a megohm or when PVC insulated cables are used for wiring

12.5 megohms divided by the number of outlets. Where a whole installation is being tested a lower value than that given by the above formula subject to a minimum of 1 Megohms is acceptable.

13.4 Testing Of Earth Continuity Path

The earth continuity conductor including metal conduits and metallic envelopes

of cable in all cases shall be tested for electric continuity and the electrical resistance of the same alongwith the earthing lead but excluding any added resistance of earth leakage circuit breaker measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

13.5 Testing Of Polarity Of Non-Linked Single Pole Switches

In a two wire installation a test shall be made to verify that all non-linked single pole switches have been connected to the same conductor throughout, and such conductor shall be labeled or marked for connection to an outer or phase conductor or to the non-earthed conductor of the supply. In the three of four wire installation, a test shall be made to verify that every non-linked single pole switch is fitted to one of the outer or phase conductor of the supply. The entire electrical installation shall be subject to the final acceptance of the Development Manager as well as the local authorities.

13.6 Earth Resistivity Test

Earth resistivity test shall be carried out in accordance with IS Code of Practice for earthing IS 3043.

13.7 Performance

Should the above tests not comply with the limits and requirements as above the contractor shall rectify the faults until the required results are obtained. The contractor shall be responsible for providing the necessary instruments and subsidiary earths for carrying out the tests. The above tests are to be carried out by the contractor without any extra charge.

13.8 Tests And Test Reports

The Contractor shall furnish test reports and preliminary drawings for the equipment to the Project Managers/consultants for approval before commencing supply of the equipment. The Contractor should intimate with the tender the equipment intended to be supplied with its technical particulars. Any test certificates etc., required by the local Inspectors or any other Authorities would be supplied by the Contractor without any extra charge.

RECOMMENDED MAKES OF MATERIALS

ELECTRICAL WORKS

1.	MCBs/MCB Distribution boards	: Legrand/Hager/Schneider/ABB/Siemens
2.	MCCBs	: Schneider/L&T/Siemens/ABB
3.	Underground LT Cables	: Universal/Finolex/KEI/Havells
4.	Cable Glands	: HMI/Comet/Bracco
5.	Cable Lugs	: Dowell's/3D
6.	MV Panels (PCCs) since	: Manufacturers with CPRI Test Certificate at least past 2 years
7.	Earth Leakage relay	: Prok Dvs/Nagoba/Eqvt.
8.	Indicating Meters	: Conzerv/AE/ Prok DVsEqvt.
9.	Selector switches	: Vaishno/Salzer/Kaycee/Eqvt
10.	Indication Lamps LED (protected type)	: Siemens/ Vaishno/ Binay
11.	Alternator	: Kirloskar/Stamford/ Leroy Somer/Mutsubishi
12.	Engine	: Cummins/ Cater Pillar/Mitsubishi/Kirloskar
13.	Digital Meters	: Conzerv/ Meco/ HPL/Prok DVs
14.	GCU/Relays	: Cummins/ Cater Pillar/Woodward/DIEF
15.	MV Cables	: Asian/ Gloster/ Nicco/Unistar/Havells
16.	Control Cables	: Lapp/RRKable/Finolex
17.	Batteries	: Amaron/Nife/Exide

18. Control panel/BusDuct	: CPRI ceritified
19. Voltage Transformer	: AE/Kappa/Poweronics/Kalpa
20. Push Buttons	: L&T/Seimens/BCH
21. Timer	: L&T/Seimens
22. Cable end Terminations	: Dowells/3D
23. M.S/G.I Pipes	: Tata/Jindal
24. FRLS Insulated Copper Conductor wires	: Lapp /Finolex/ RR Kabel/ Bonton

Note: Before use of any of the above brands for the Project, Prior Written permission shall be taken from client/Consultant. The Client shall have choice to select any of the above approved brands.

Note: Before supply the material, TDS (Technical Data Sheets) should be approved by client.

PROJECT : BSL-3 BLDG , CDFD UPPAL
MEP WORKS BILL OF QUANTITY FOR CHILLER PLANT

SL NO.	DESCRIPTION	AMOUNT IN RS.
1.0	HVAC,FIRE & CCTV WORKS	
2.0	INTERNAL ELECTRIFICATION	
3.0	EXTERNAL ELECTRIFICATION	
4.0	SHED FOR PUMP ROOM	
	GRAND TOTAL	

		PROJECT : BSL-3 BLDG , CDFD UPPAL				
		MEP WORKS BILL OF QUANTITY FOR CHILLER PLANT				
SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
A		**AIR CONDITIONING WORKS**				
I		**WATER COOLED CHILLERS**				
1.1	NSR	Supply, installation, testing and commissioning of **WATER COOLED SCREW CHILLERS** with the following capacities hermetic/semi hermetic, multiple screw type compressors - each with step less capacity control of 10 % to 100 % of the rated capacity, with microprocessor based control panel, motor, starter panel, machine mounted, air- cooled condensers, insulated chiller, water flow switch , vibration spring isolators, integral refrigerant piping and wiring with 2 circuits,automatic and safety controls mounted in central console panel and all mounted on a steel frame (complete as per specifications). Motor shall be suitable for 415±10% 50 cycles. 3 phase AC supply. Factory Supplied Electrical starter panel with unit mounted power isolator and BMS ready Microprocessor Panel.				
		The scope includes first charge of Refrigerant and oil, suction and discharge shut off valves and HP/LP cutouts, oil pressure failure switch, gague panel, cranckcase heater, automatic capacity control,microprocessor based control for chiller control, watercooled condenser, strainer, sight glass isolating valves, suction line and chiller insulation. Acoustic jacketing of the chiller to meet the noise level of less than 60 dB(A) at 3 m from unit.				
		The quoted price should also be inclusive of PVC Mesh / Frame for protecting Condenser Fins from Factory, Victolic Couplings, PCC/RCC Foundation .etc., Refrigerant gas used shall be R 134a. Water cooled chillers shall be installed under a Metallic roof with Rain water protection **(Metallic roof shall be in clients scope)**				
		All the above Chillers shall meet minimum COP,EER,IPLV as per ECBC 2009 & ASHRAE90.1-2010(5).				
1.1.1		**Water cooled screw chiller** of 75 TR with HFC 134a Refrigerant	Nos	3		
		Evaporator LWT/EWT :54/44 Deg F , Evaporator Fouling factor :0.0001 hr-sft/deg F/Btu Condenser EWT/LWT :88/98 Deg C , Condenser Fouling factor :0.0005 hr-sft/deg F/Btu				

		PROJECT : BSL-3 BLDG , CDFD UPPAL				
		MEP WORKS BILL OF QUANTITY FOR CHILLER PLANT				
SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
1.2	NSR	Supply and installation of Power and control cables on wall/cable tray including clamps, spacers, saddles, terminating identification etc.for chillers, pumps, condenser water coolers, air-handling units and interlocking control wiring including earthing and cable -trays of following size : (All cables shall be of 1100 volts grade, PVC insulated Sheathed aluminium conductor armoured cables XLPE)				
1.2.1		2 Core 1.0 SQ. MM	Rmt	96		
1.2.2		3 Core 1.0 SQ. MM	Rmt	100		
1.2.3		4 Core 1.0 SQ. MM	Rmt	100		
1.2.4		25 mm PVC Conduit with all accessories	Rmt	153		
1.3	NSR	Supply, installation of perforated cable trays with threaded rod supports, anchor fastners etc.,Tray shall be of the following mentioned width.				
1.3.1	4.1.4	300 mm width X 50 mm depth X 1.6 mm thickness	Rmt	50		
1.3.2	4.1.2	150 mm width X 50 mm depth X 1.6 mm thickness	Rmt	50		
1.4	NSR	Supply Installation Testing & Commissioing of Standalone Chiller Plant Manager with Visual Display Console and with complete connectivity to Client's BMS on OPEN protocol included.	Nos	1		
I		**TOTAL FOR CHILLERS & PLANT MANAGER**				
II		**PUMPS & COOLING TOWERS**				
		Primary Chilled Water pump				
2.1	NSR	Supply, installation, testing and commissioning of centrifugal coupled horizontal type pumpset with axial suction port and radial discharge port,with EFF1 IE2 drive motor, bronze impeller mechnical seal, three phase TEFC squirrel cage motor with IP55 protection, class F insulation having a speed of 1440 rpm with inertia base, vibration isolation springs, rubber isolation bellows, flexible coupling, PCC Foundations for chilled water circulation having the following duty conditions as per specifications.				
2.1.1		**180 GPM** against a head of **15 m** with EFF1 IE2 motors (2w+1s)	Nos	3		

		PROJECT : BSL-3 BLDG , CDFD UPPAL				
		MEP WORKS BILL OF QUANTITY FOR CHILLER PLANT				
SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
		Secondary Chilled Water pump,				
2.2	NSR	Supply, installation, testing and commissioning of centrifugal coupled horizontal type pumpset with axial suction port and radial discharge port,with EFF1 IE2 drive motor, bronze impeller mechnical seal, three phase TEFC squirrel cage motor with IP55 protection, class F insulation having a speed of 1440 rpm with inertia base, vibration isolation springs, rubber isolation bellows, flexible coupling, PCC Foundations for chilled water circulation having the following duty conditions as per specifications. The scope includes Suitable Independent VFD's for all Secondary pumps.				
2.2.1		**180 GPM** against a head of **25 m** with EFF1 IE2 motors (2w+1s)	Nos	3		
2.3	NSR	Supply, installation, testing and commissioning of Microprocessor based pump logic controller with Individual Variable frequency drives for all seconadry pumps,2 DP Transmitters complete by pass starter with IP 55 Enclosure, Required quantity of differential pressure / temperature transmitter, incoming MCCB / ACB with control wirng 300Rmt for software integration, built in Software integrator suitable for BAS as per specifications.				
		Incoming : 120A 35KA TP MCCB with Neutral link- 1no				
		Bus bars : 120A TPN Aluminium Bus bars – 1Set				
		Outgoings:				
		Byepass star delta starter suitable for Secondary Pumps (VFD's considered in Secondary pumps) - 2Nos				
		Metering :				
		i) 0 - 500V Digital Voltmeter with Selector switch -1set				
		ii) 0 – 160A Digital Ammeter with Resin cast Cts				
		and selector switch-1set				
		iii) CT operated Multi function Meter with RS 485 connectivity-1set				
		iv) LED type Phase indication lamps with				
		individual MCB control and toggle switches - 1set	No's	1		
		Condenser Water pump,				

		PROJECT : BSL-3 BLDG , CDFD UPPAL				
		MEP WORKS BILL OF QUANTITY FOR CHILLER PLANT				
SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
2.4	NSR	Supply, installation, testing and commissioning of centrifugal coupled horizontal type pumpset with axial suction port and radial discharge port,with EFF1 IE2 drive motor, bronze impeller mechnical seal, three phase TEFC squirrel cage motor with IP55 protection, class F insulation having a speed of 1440 rpm with inertia base, vibration isolation springs, rubber isolation bellows, flexible coupling, PCC Foundations for chilled water circulation having the following duty conditions as per specifications.				
2.4.1		**225 GPM** against a head of **18 m** with EFF1 IE2 motors (2w+1s)	Nos	3		
2.5	NSR	Supply Installation Testing & Commissioing of Single or multiple cell Induced draft FRP type cooling towers with FRP fans and sump, Galvanised steel ladder,complete to suit heat rejection of below specified Chiller heat rejection while working at 98.0 °F inlet water and 88 °F outlet water designed at an ambient wet bulb temperature of 83 °F. The scope shall include complete FRP casing louvers for intake air with required internal structural supports in galvanized steel, internal piping distribution, axial flow propeller fan with FRP or die pressure die cast aluminum blades, driven by TEFC, Sq. cage, outdoor application Eff1 IE 2motor. the scope includes all civil foundations for CT mounting				
a.		Each Cooling Tower suitable for 150 TR Chiller & Flow rate of **225 USGPM (2w+1s)**	Nos	3		
II		**TOTAL FOR PUMPS & COOLING TOWERS**				
III		**Chilled water piping & valves**				
3.1	16.3	Supplying, laying/ fixing, testing and commissioning of following nominal sizes of chilled water piping plumbing inside the building (with necessary clamps, vibration isolators and fittings but excluding valves, strainers, gauges etc.) duly insulated with fire retardant quality expanded polystrene moulded pipe section of density 20 kg/cu.m after a thick coat of cold setting adhesive (CPRX compound) wrapping with 500g polythene faced hessain and finally applying 0.63mm aluminium sheet cladding complete with type3 , grade 1 roofing feltstrip(as per IS:1322 as amended up to date) at joints repairing of damage to building etc. as per specifications and as required complete in all respect.				

		PROJECT : BSL-3 BLDG , CDFD UPPAL				
		MEP WORKS BILL OF QUANTITY FOR CHILLER PLANT				
SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
		Note:- The Pipes of sizes 150mm & below shall be M.S. 'C' class as per IS : 1239 and pipes size above 150mm shall be welded black steel pipe heavy class as per IS: 3589, from minimum 6.35mm thick M.S. Sheet for pipes upto 350 mm dia. and from minimum 7mm thick MS sheet for pipes of 400 mm dia and above.				
		MS 'C' Class pipe with insulation as per specifications,				
3.1.1	16.3.6	150mm dia. (75 mm thick insulation)	Metre			
3.1.2	16.3.7	125mm dia.(75mm thick insulation)	Metre	190		
3.1.3	16.3.8	100mm dia.(75mm thick insulation)	Metre	40		
				230		
		INSULATED VALVES				
	16.7	Supplying, fixing, testing and commissioning of following valves, strainers, gauges in the chilled water plumbing duly insulated to the same specifications as the connected piping and adequately supported as per specifications.				
3.2	16.7.1	BUTTERFLY VALVE (MANUAL) with C I body SS Disc, Nitrile Rubber Seal & O- Ring PN 16 pressure rating for chilled water/hot eater circulation as specified .				
3.2.1	16.7.1.4	125 mm dia	Each	2		
3.2.2	16.7.1.4	100 mm dia	Each	18		
				20		
3.3	16.7.2	BALANCING VALVE WITH BUILT IN MEASURING FACILITY with C I body flanged construction with EPDM coated disc with long pitch with protected out pipe insulation & PN 16 pressure rating for chilled / hot water circulation as specified.				
3.3.1	16.7.2.3	125mm dia	Each			
3.3.2	16.7.2.4	100 mm dia	Each	3		
3.4	16.7.3	NON - RETURN VALVE with duel plate of C I body SS plates vulcanized NBR seal flanged end & PN 16 pressure rating for chilled / hot water circulation including insulation as specified.				
3.4.1	16.7.3.3	125 mm dia	Each			
3.4.2	16.7.3.4	100 mm dia	Each	6		
3.5	16.7.4	Y - STRAINER of Ductile CI Body flanged ends with stainless steel strainer for chilled / hot water circulation including insulation as specified.				
3.5.1	16.7.4.3	125 mm dia	Each			
3.5.2	16.7.4.4	100 mm dia	Each	6		

		PROJECT : BSL-3 BLDG , CDFD UPPAL				
		MEP WORKS BILL OF QUANTITY FOR CHILLER PLANT				
SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
3.6	NSR	Supply Installation Testing & Commissioing of Motorized ON/OFF butterfly valves with Actuators with ON / OFF Feedback for following sizes with Extended Stem, matching bolts, supports etc. complete with required 240 / 12 V transformers, control wiring from chillers etc. as per specifications. The valves shall be suitable for BMS integration on Open / MODBus BACnet protocol. The valves shall be insulated with loose TF quality thermocole for a layer of 50mm thickness and finished as per chilled water insulation specifications.				
3.6.1		125 mm dia	Each			
3.6.2		100 mm dia	Each	4		
		CONDENSER WATER PIPE				
3.7	16.10	Supplying, fixing, testing and commissioning of condenser water pipes of following sizes of MS 'C' class along with necessary clamps, vibration isolators and fittings such as bends,tees etc.but excluding valves, strainers, gauges etc. adequately supported on rigid supports duly painted/buried in ground excavation and refilling etc. as per specification and as required complete in all respect.				
		Note:-The Pipes size 150mm & below shall be M.S. 'C' class as per IS : 1239 and pipes size above 150mm shall be welded black steel pipe heavy class as per IS: 3589, from minimum 6.35mm thick M.S. Sheet for pipes upto 350 mm dia. And from minimum 7mm thick MS sheet for pipes of 400 mm dia and above.				
3.7.1	16.10.4	150mm dia	Metre	80		
3.7.2	16.10.5	125mm dia	Metre	20		
3.7.3	16.10.6	100mm dia	Metre	50		
3.7.4		65mm dia	Metre	112		
3.7.5		50mm dia	Metre	200		
3.7.6		32mm dia	Metre	15		
3.7.7		25mm dia	Metre	10		
				462		
		VALVES WITHOUT INSULATION				
	16.11	Supplying, fixing, testing and commissioning of following valves, gauges and strainers for condenser water circulation as per specifications.				
3.8	16.11.1	BUTTERFLY VALVE (MANUAL) with C I body SS disc nitrile sheet & O - ring & PN 16 pressure rating as specified.				
3.8.1	16.11.1.3	125mm dia	Each	18		

		PROJECT : BSL-3 BLDG , CDFD UPPAL				
		MEP WORKS BILL OF QUANTITY FOR CHILLER PLANT				
SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
3.8.2	16.11.1.4	100mm dia	Each	3		
3.8.3	16.11.1.8	40mm dia	Each	6		
		25mm dia	Each	9		
3.9	16.11.2	NON - RETURN VALVE with dual plate of C I body SS plates vulcanized NBR seal flanged end & PN 16 pressure rating as specified.				
3.9.1	16.11.2.2	125mm dia.	Each	3		
3.9.2	16.11.2.3	100mm dia.	Each			
3.10	16.11.3	Supplying, fixing, testing and commissioning of following sizes Motorized Butter fly Valve with CI Body, SS Disc,O - ring and minimum PN-16 pressure rating , conforming to BS 5155, IS 13095, with IP-55 actuator, capable of accepting upto 10V DC , and upto 20mA electric signal and providing similar transduced feedback output to control system as required.				
3.10.1	16.11.3.5	125mm dia.	Each	3		
3.11	NSR	BALANCING VALVE WITH BUILT IN MEASURING FACILITY with C I body flanged construction with EPDM coated disc with long pitch with protected out pipe insulation & PN 16 pressure rating for chilled / hot water circulation as specified.				
3.11.1		125mm dia.	Each	3		
3.12	NSR	Y - STRAINER of Ductile CI Body flanged ends with stainless steel strainer for chilled / hot water circulation including insulation as specified.				
3.12.1		125 mm dia	Each	3		
3.13	NSR	Supply Installation Testing & Commissioing **Closed Water Expansion Tank of CIMM** or equal make of MS construction with interchangeable EPDM Butyl rubber membrane bladder complete with 25mm thick SE quality expanded polystyrene insulation, set in a frame work of treated teak wood and finished with 20G aluminium sheet duly powder coated to match external elevation. Tank to be minimum **500 Ltrs capacity** and tank shall be mounted on FRP coated steel stands	Each	1		

		PROJECT : BSL-3 BLDG , CDFD UPPAL				
		MEP WORKS BILL OF QUANTITY FOR CHILLER PLANT				
SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
		The tank shall have 50mm system connection and 40mm drain and over flow and 40mm quick fill and makeup connection, provision for pressure gauge and switches etc. Tank shall be insulated as per specifications and provided with pressure switches. The expansion tank shall be supplied and installed with all accessories required for proper functioning of the system.				
		Tank shall be complete with Pumps (Flow rate of 2.0CMH, 5 mts head)required in the configuration of N + 1 (1 working + 1 Stand By). The cost shall include necessary valve package & control logic panel.				
		Air Seperator				
3.14	NSR	Supply, installation, testing and commissioning of air seperator with Dirt seperator fabricated with Steel finished with dirt chamber, air chamber, vent units, automatic valve, drain valve, suitable for flushing even when in operation, suitable for threaded or flanged connections as per specifications of the following size.				
3.14.1		125 mm dia	Nos	1		
3.15	NSR	Supply, installation, testing & commissioing of flexible bellows for the chillers & Pumps				
3.15.1		125 mm dia	Nos	12		
3.15.2		100 mm dia	Nos	18		
3.16	NSR	Supply Installation Testing & Commissioing of Automatic Air Vents on extended nipples with isolation valves	Nos	10		
3.17	16.8	Providing and fixing in position the industrial type pressure gauges with gun metal / brass valves complete as required	Nos	24		
3.18	16.9	Providing & fixing in position the mercury in glass industrial type thermometers.	Nos	12		
3.19	NSR	Supply Installation Testing & Commissioing of Paddle type water flow switches for chiller side	Sets	6		

		PROJECT : BSL-3 BLDG , CDFD UPPAL				
		MEP WORKS BILL OF QUANTITY FOR CHILLER PLANT				
SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
3.20	NSR	Supply Installation Testing & Commissioing of Digital Display Pressure Guages for Chillers & Condensers	Sets	6		
3.21	NSR	Supply Installation Testing & Commissioing of Digital display Water flow meter suitable for BMS connectivity with necessary accessories for 125mm dia	Sets	1		
3.22	NSR	Supply, installation, testing and commissioning of Drain piping using CPVC pipe SDR11 with CPVC fittngs. The pipe goes below ground should be rapped with polythene sheet as follows:				
3.22.1		50 mm dia	Rmt	150		
3.22.2		40 mm dia	Rmt	40		
3.22.3		32 mm dia	Rmt	80		
3.22.4		25 mm dia	Rmt	58		
		TOTAL FOR LOW SIDE WORKS				
		Grand Total for Air Conditioning works				
B		**Fire Extinguishers**				
2.1	NSR	Supply, installation, testing & commissioning of CO2 type Fire Extinguisher of 4.5 kgs capacity made from brand new seamless drawn steel cylinder with ISI mark fitted with wheel valve, with discharge hose and horn and supplied complete with initial charge and wall bracket. Fire Rating 21B	Nos	10		
2.2	NSR	Supply of ABC powder type fire extinguisher of capacity 4.0 kgs, stored pressure type, pressure guage, controllable discharge mechanism with Hose & Nozzle, ISI mark, supplied along with wall bracket & initial filling (Fire Rating 2A:34B)	Nos	10		
		TOTAL FOR FIRE EXTINGUISHERS				
C		**CONVENTIONAL CCTV SYSTEM**				
		CAMERAS				

		PROJECT : BSL-3 BLDG , CDFD UPPAL				
		MEP WORKS BILL OF QUANTITY FOR CHILLER PLANT				
SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
3.1	NSR	Supply, installation, testing & commissioning of 1/2.8" Progressive Scan CMOS lens, 1080P full HD 2 MP AHD Dome Camera with 30 Mtr IR lens, uitable for Day & Night contions. Focal Length: 2.8 mm.	No's	5		
3.2	NSR	Supply, installation, testing & commissioning of 8 Channel DVR suitable High definetion Cameras including storage upto 30 days	No's	1		
3.3	NSR	Supply installation testing and commissioning of 50” and above professional LFD Monitors for 24/7 continuous operational including all required mounting and connecting accessories in complete. Note: Sufficient Connecting cables, connectors and mounting accessories shall be included	No's	1		
3.4	NSR	Supply & Installation of 12U/6U Floor mount Closed type Rack including Power manager and cooling fans with all required accessories in complete.	No's	1		
3.5	NSR	Supply, Laying of 3+1 CCTV Cable with required connectors in medium guage pvc conduit	Mtrs	100		
3.6	NSR	Supply, Installation, testing and commissioning of Power supply units	Nos	6		
		TOTAL FOR CONVENTIONAL CCTV SYSTEM				
		GRAND TOTAL				
		SCHEDULE OF INTERNAL ELECTRICAL WORKS				
-	-	-	-	-	-	-
S.NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
-	-	-	-	-	-	-
I		**INTERNAL ELECTRIFICATION**				
1		**Point wiring:**				
	1.10	Wiring for light point/ fan point/ exhaust fan point/ call bell point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable in surface / recessed medium class PVC conduit, with modular switch, modular plate, suitable GI box and earthing the point with 1.5 sq.mm FRLS PVC insulated copper conductor				

		PROJECT : BSL-3 BLDG , CDFD UPPAL				
		MEP WORKS BILL OF QUANTITY FOR CHILLER PLANT				
SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
		single core cable etc. as required.				
	1.10.3	Group C	Point	15		
3	1.31	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 3 pin 5/6 A modular socket outlet and 5/6 A modular switch, connections etc. as required.	Each	5		
4	NSR	Supply and fixing of One 5A 5 Pin socket, controlled with one 5A switch in Lighting switch board. (Dependant type) including interconnections	Nos	5		
5	1.30	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 6 pin 5/6 & 15/16 A modular socket outlet and 15/16 A modular switch, connections etc. as required.	Nos	2		
6	NSR	Supply and Installation of Single phase 20A Metalclad Socket with MCB control box including all fixing accessories.	Nos	2		
7	NSR	Supply and Installation of single phase 16A 3pin Switch operated Socket with Plug (IP66) including all fixing accessories	Nos	8		
8	NSR	Supply and Installation of three phase 16A 5pin Switch operated Socket with Plug (IP66) including all fixing accessories	Nos	8		
9	NSR	Supply and Wiring with the following size 1100V grade FRLS insulated multistranded Copper conductor wires in & including suitable size heavy gauge FR PVC conduit concealed in wall / Ceiling including all accessories such as junction boxes, bends, elbo				
b)		4runs of 6 Sq.mm wires with 2 runs of 6 Sq.mm in 32mm dia MS Conduit. (for LDB's & 32A 3Phase sockets)	Rmt	40		
c)		4 runs of 10 Sq.mm wires with 2 runs of 6 Sq.mm in 40mm dia MS Conduit. (for 63A 3phase sockets,PDBs& RDBs)	Rmt	40		

		PROJECT : BSL-3 BLDG , CDFD UPPAL				
		MEP WORKS BILL OF QUANTITY FOR CHILLER PLANT				
SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
d)	1.14	Wiring for circuit/ submain wiring alongwith earth wire with the following sizes of FRLS PVC insulated copper conductor, single core cable in surface/ recessed medium class PVC conduit as required.				
	1.14.1	2 X 1.5 sq. mm + 1 X 1.5 sq. mm earth wire	Rmt	125		
	1.14.2	2 X 2.5 sq. mm + 1 X 2.5 sq. mm earth wire	Rmt	125		
	1.14.3	2 X 4 sq. mm + 1 X 4 sq. mm earth wire	Rmt	200		
10	2.3	Supplying and fixing following way, single pole and neutral, sheet steel, MCB distribution board, 240 V, on surface/ recess, complete with tinned copper bus bar, neutral bus bar, earth bar, din bar, interconnections, powder painted including earthing etc. as required. (But without MCB/RCCB/Isolator)				
a)	2.3.3	12 way , Double door	Nos	1		
	2.14	Supplying and fixing following rating, double pole, (single phase and neutral), 240 V, residual current circuit breaker (RCCB), having a sensitivity current 30 mA in the existing MCB DB complete with connections, testing and commissioning etc. as required.				
	2.14.3	63A RCCB 30mA	Nos	1		
	2.10	Supplying and fixing 5 A to 32 A rating, 240/415 V, 10 kA, "C" curve, miniature circuit breaker suitable for inductive load of following poles in the existing MCB DB complete with connections, testing and commissioning etc. as required.				
	2.10.1	5A to 32A 10kA MCB Breaker	Nos	10		
12	NSR	63A TPN MCB RCBO with Weather Proof Enclosure for Lifts	Nos	6		
13	NSR	Light fixtures				
		Supply, Installation & testing of following type Fluorescent/ Compact fluorescent/ Incandescent light fixtures on wall/ Ceiling including all fixing accesssories, etc complete as required. The Fluorescent/CFL fixtures shall be complete with Low loss cop				
a)		1x36W LED Industrial type Light fixture-IP65	Nos	12		

		PROJECT : BSL-3 BLDG , CDFD UPPAL				
		MEP WORKS BILL OF QUANTITY FOR CHILLER PLANT				
SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
14	NSR	Supply and Fixing of 1200 mm sweep Ceiling fan including down rod, blades with all accessories excluding regulator.				
a)		Ceiling Fans- 1200mm sweep	Nos	0		
b)		Exhaust Fans	Nos	2		
15	NSR	Supply and laying of following size earth wires/strips including all fixing accessories when laid in trench or cable tray with necessary interconnections with earth station and equipments.				
b)		8 SWG GI wire	Rmt	100		
		TOTAL				
II		**TELEPHONE**				
		Note:				
1	1.24	Supplying and fixing following modular switch/socket on the existing modular plate & switch box including connections but excluding modular plate etc. as required.				
2	1.24.6	Telephone socket outlet	Nos	2		
3	1.18	Supplying and drawing following pair 0.5 mm dia FRLS PVC insulated annealed copper conductor, unarmored telephone cable in the existing surface/ recessed steel/ PVC conduit as required.				
	1.18.2	2 Pair	Mtrs	60		
	1.27	Supplying and fixing following size/ modules, GI box along with modular base & cover plate for modular switches in recess etc. as required.				
	1.27.1	1 or 2 Module (75mmX75mm)	Nos	2		
	1.27.2	3 Module (100mmX75mm)	Nos	10		
	1.27.6	12 Module (200mmX150mm)	Nos	3		
3	1.21	Supplying and fixing of following sizes of medium class PVC conduit along with accessories in surface/recess including cutting the wall and making good the same in case of recessed conduit as required.				
a.	1.21.3	32mm	Rmt	75		
b.	2.21.2	25mm	Rmt	75		

		PROJECT : BSL-3 BLDG , CDFD UPPAL				
		MEP WORKS BILL OF QUANTITY FOR CHILLER PLANT				
SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
4		Supply and fabrication and installation of following size perforate GI Tray 2mm thick GI Sheet and supported with Screw type road anchored from ceiling with 10mm dia suitable length anchor bolts including supply of necessary bends/ elbows etc				
a.	4.6.6	450mm wide	Rmt	0		
b.	4.6.4	300mm wide	Rmt	0		
c.	4.6.2	150mm x 50mm	Rmt	25		
		TOTAL				
		SCHEDULE OF EXTERNAL ELECTRICAL WORKS				
Sl.No.	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
A		**Part-I- Panels**				
1	NSR	**L.T. Switchgear**				
		Supply, installation, Testing and Commissioning of 3 phase415V 4 wire Free Standing Floor mounted MV panel made out of 2mm thick MS sheet after seven tank process and painting with Epoxy powder coating including all switchgear as detailed below.				
		The panel shall have Short circuit withstanding capacity of minimum 50kA and consist of the switchgear as mentioned below. The panel shall be mounted on channels grouted to the floor including all materials. The panel shall be got fabricated from manufacturers with CPRI Test certificate only and shall be as per detailed specifications.				
		The Panels shall be mounted on U channels including supply and fixing of the same. Every ACB shall be provided with ON/OFF /Trip Indication lamps of LED type, The panels shall be floor mounting cubicle compartmentalized type switch boards confirming to enginnering specifications.				
		All MCCB/ACBs of rating 160A and above shall be with Micro processor releases and All MCCBs below 160A shall be with adjustable thermal and magnetic based releases. All MCCBs shall be with spreader links and rotary handle. All breakers shall be over load & short circuit releases with Icu=100% Ics. All CTs/CBCT shall be resin cast type. All Controlling wiring shall be with FRLS cables/wires, all bus bar sleeves shall be with Heat shrinkable kits. Bus Bar current density shall be 0.8A/Sq.mm for Aluminium and				

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SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
		1.2A/Sq.mm for Copper.				
		All ACBs & MCCBs shall be provided with auxiliary '1 NO + 1 NC' Contacts and wired to a common terminal block for BMS Connectivity.				
		Chiller Panel @ Terrace floor (Indoor type)				
		Incoming : 630A 50KA TPN EDO ACB with Micro process based				
		releases-O/C, S/C, E/F- 2Nos				
		Bus bars :630A TPN Aluminium Bus bars – 1Set				
		Outgoings:				
		Fully automatic Star Delta Starter along with suitable rated MCCB suitable for 3.7kw -4Nos for Primary Pumps				
		Fully automatic Star Delta Starter along with suitable rated MCCB suitable for 5.5kw -4Nos for Condenser Pumps				
		Fully automatic Star Delta Starter along with suitable rated MCCB suitable for 4kw -4Nos for Cooling towers				
		160A 35KA TPN MCCB with releases -4No's for chillers				
		100A 35 kA TPN MCCB with releases for Secondary Pumps -1 No				
		Spares-10Nos				
		Metering :				
		i) 0 - 500V Digital Voltmeter with Selector switch -1set				
		ii) 0 – 630A Digital Ammeter with Resin cast Cts				
		and selector switch-2sets				
		iii) CT operated Multi function Meter with RS 485 connectivity-2sets				
		iv) LED type Phase indication lamps with				
		individual MCB control and toggle switches - 2sets				

		PROJECT : BSL-3 BLDG , CDFD UPPAL				
		MEP WORKS BILL OF QUANTITY FOR CHILLER PLANT				
SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
		Every motor in MCC shall be provided with required Contactors, Overload relay, On/Off Push buttons, On/Off/trip indications in manual mode and Auto/ manual selector switch.				
		Supply	Nos	1		
B		**Part II - MV Cables**				
	7.1.4	Supply,laying of one number PVC insulated and PVC sheathed / XLPE power cable of 1.1 KV grade of following size direct in ground including excavation, sand cushioning, protective covering and refilling the trench etc as required.				
	7.1.4	Above 185 sq. mm and upto 400 sq. mm	mts	300		
	7.5	Supply,laying of one number PVC insulated and PVC sheathed / XLPE power cable of 1.1 KV grade of following size in the existing RCC/ HUME/ METAL pipe as required.				
	7.5.4	Above 185 sq. mm and upto 400 sq. mm	mts	0		
1.1		**LT Cables**				
	NSR	Supply and laying dressing and clamping of 1.1kV grade, XLPE insulated Aluminium/Copper conductor armoured cables including all fixing accessories suchas clamps for fixing the cable				
1.2		3.5 C x 240 Sq.mm A2XFY, Armoured PVC sheathed cable	M	70		
1.3		3.5 C x 95 Sq.mm A2XFY, Armoured PVC sheathed cable	M	70		
1.7		3.5C x 35 Sq.mm A2XFY, Armoured PVC sheathed cable	M	35		
1.8		4 C x 16 Sq.mm A2XFY, Armoured PVC sheathed cable	M	35		

		PROJECT : BSL-3 BLDG , CDFD UPPAL				
		MEP WORKS BILL OF QUANTITY FOR CHILLER PLANT				
SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
1.9		3 C x 10 Sq.mm Cu.2XFY, Armoured PVC sheathed cable	M	250		
2.0	NSR	**Control Cables.**				
		2XFY insulated, steel armoured PVC sheathed 1100V Grade Copper Conductor cables.				
2.1		4C x 6 sq.mm. (YWY)	M			
2.2		4C x 4 sq.mm. (YWY)	M			
2.3		14C x 2.5 sq.mm. (YWY)	M	35		
2.4		12C x 2.5 sq.mm. (YWY)	M	35		
2.5		4C x 2.5 sq.mm. (YWY)	M			
3.0	NSR	**XLPE insulated, Sheathed, un-armoured copper conductor cables.**				
3.1		16 Sq.mm x 1 C (YY)	M	35		
3.2		3CX10 Sq.mm x 1 C (YY) Armoured PVC sheathed cable	M	70		
3.3		6 Sq.mm x 1 C (YY)	M	35		
3.4		3C x 2.5 sq.mm. (YY)	M	70		
4.0	NSR	**End Terminations.**				
		Providing Indoor type end terminations for the cable specified under above item with compression type gland, Bi-metallic lugs using crimping tool, Insulation tape, Identification tags etc., including end termination and Earthing of Gland.				

		PROJECT : BSL-3 BLDG , CDFD UPPAL				
		MEP WORKS BILL OF QUANTITY FOR CHILLER PLANT				
SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
		For Aluminium Conductor Cables, DOUBLE compression glands				
4.1		3.5 C x 240 Sq.mm A2XFY, Armoured PVC sheathed cable	Nos	8		
4.2		3.5 C x 95 Sq.mm A2XFY, Armoured PVC sheathed cable	Nos	6		
4.6		3.5C x 35 Sq.mm A2XFY, Armoured PVC sheathed cable	Nos	2		
4.7		4 C x 16 Sq.mm A2XFY, Armoured PVC sheathed cable	Nos	2		
4.80		3 C x 10 Sq.mm Cu.2XFY, Armoured PVC sheathed cable	Nos	36		
5.0	NSR	**Control Cables.**				
		2XFY insulated, steel armoured PVC sheathed 1100V Grade Copper Conductor cables.				
5.1		4C x 6 sq.mm. (YWY)	Nos	0		
5.2		4C x 4 sq.mm. (YWY)	Nos	0		
5.3		14C x 2.5 sq.mm. (YWY)	Nos	4		
5.4		12C x 2.5 sq.mm. (YWY)	Nos	6		
5.5		4C x 2.5 sq.mm. (YWY)	Nos	0		
6.0	NSR	**XLPE insulated, Sheathed, un-armoured copper conductor cables.**				
6.1		16 Sq.mm x 1 C (YY)	Nos	25		

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SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
6.2		3CX10 Sq.mm x 1 C (YY) Armoured PVC sheathed cable	Nos	25		
6.3		6 Sq.mm x 1 C (YY)	Nos	4		
6.4		3C x 2.5 sq.mm. (YY)	Nos	10		
C		**Part III-EARTH ELECTRODES AND EARTH STRIPS**				
1.0	NSR	Supply,laying and testing of earth conductor with 25mm dia MS rods in ground as per the drawing at 300mm below ground level in a grid of 1000X1000mm including cutting, welding etc as required. Including Back filling of earth enhance material /Black cotton.	Mtrs.	4		
2.0	NSR	Providing standard G.I. Pipe Earth station, with 38mm dia. G.I. pipe including construction of brick pedestal, providing meshed funnel, CI cover and other civil Engineering works, spreading a homogeneous mixture of salt charcoal around the pipe etc, complete.	Nos	2		
3.0	NSR	Providing standard Copper Plate Earth station, with 600X600X3.15mm thick copper plate including construction of brick pedestal, providing meshed funnel, CI cover and other civil Engineering works, spreading a homogeneous mixture of salt charcoal around the plate etc, completely as per IS 3043,1987 or latest revision.	Nos	2		
4.0		**EARTH STRIPS**				
		GI/Copper Strips				
	NSR	Supply and laying of following size earth strips including excavation and refilling of earth when laid in ground and with all fixing accessories when laid inside the building including all necessary interconnections with earth station and Panels				
4.2		50 x 5 mm GI strip	M	100		

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SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
4.3		32x 5 mm GI strip	M	70		
4.4		25 x 5 mm GI strip	M	70		
4.6		32 x 5mm copper earth strip with PVC sleeves	M	35		
4.7		25 x 5mm copper earth strip with PVC sleeves	M	70		
4.8		8SWG Copper wire	M	125		
4.9		Bus bar of 0.5 mtr length made out of 50 x 6 mm copper strip with drill of				
		M8 at every 25 mm interval mounted on insulators.	Nos	10		
		Part III Total -EARTH ELECTRODES AND EARTH STRIPS				
D		**Part IV-Miscellaneous, Safety Eqpts., & Approvals**				
1.0	NSR	Class 'B' GI Pipe - 50 mm dia.	M	35		
2.0	NSR	Supply and installation of Shock treatment chart laminated display boards.	Nos	2		
3.0	NSR	Supply and installation of A1 size laminated drawings(SLD)	Sets	2		
4.0	NSR	Supply and laying of Rubber mat 1100V grade 2MM as per IS-15652 of 2 m x 1m	Nos	5		
5.0	NSR	First aid kit	Nos	2		
6.0	NSR	Supply, fabrication and installation of steel for supporting electrical works.				
		The quoted rate shall include - 2 coats of Red oxide and 2 coats of Enamel paint.	Tons	2		

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SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
7.0	NSR	Providing and fixing M.V. danger notice plate of 200 mm X 150 mm, made of mild steel, at least 2 mm thick, and vitreous enameled white on both sides, and with inscription in single red colour on front side as required.	Nos	2		
		GRAND TOTAL				
		SHED FOR MACHINE ROOM AT CDFD UPPAL				
S.No	**DSR 2018 Civil**	**Description**	**Unit**	**Qty**	**RATE (Rs.)**	**AMOUNT (Rs.)**
1	2.28	Surface dressing of the ground including removing vegetation and inequalities not exceeding 15 cm deep and disposal of rubbish, lead up to 50 m and lift up to 1.5 m.				
	2.28.1	All kinds of soil	sqm	250		
2	4.1	Providing and laying in position cement concrete of specified grade 4.1 Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level :				
	4.1.8	1:4:8 (1 Cement : 4 coarse sand (zone-III) : 8 graded stone aggregate 40 mm nominal size)				
		cum 5789.60	cum	43		
3	5.2	Reinforced cement concrete work in walls (any thickness), including attached pilasters, buttresses, plinth and string courses, fillets, columns, pillars, piers, abutments, posts and struts etc. above plinth level up to floor five level, excluding cost of centering, shuttering, finishing and reinforcement :				
	5.2.2	1:1.5:3 (1 cement : 1.5 coarse sand(zone-III) : 3 graded stone aggregate 20 mm nominal size) cum 9306.00	cum	4		
4	6.4	Brick work with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in superstructure above plinth level up to floor V level in all shapes and sizes in :				
	6.4.1	Cement mortar 1:4 (1 cement : 4 coarse sand)	cum	15		
	10.2	Structural steel work riveted, bolted or welded in built up sections, trusses and framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer all complete.	kg	4150		

		PROJECT : BSL-3 BLDG , CDFD UPPAL				
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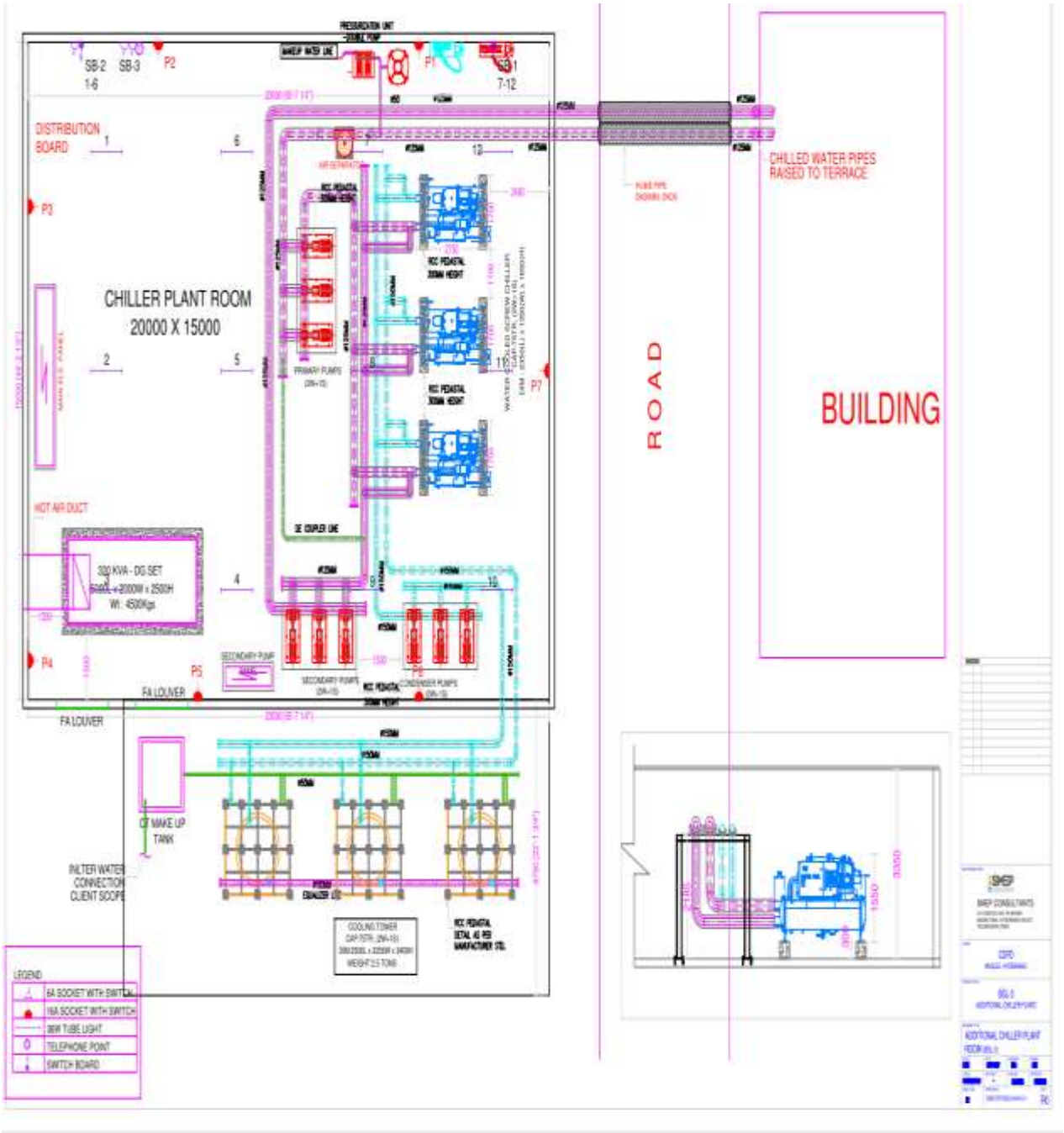
SL NO	**DSR CODE**	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (Rs.)**	**AMOUNT (Rs.)**
6	10.25	Steel work welded in built up sections/ framed work, including cutting,hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required.				
	10.25.2	In gratings, frames, guard bar, ladder, railings, brackets, gates and similar works	kg	500		
7	12.1	Providing corrugated G.S. sheet roofing including vertical / curved surface fixed with polymer coated J or L hooks, bolts and nuts 8 mm diameter with bitumen and G.I. limpet washers or with G.I. Limpet washers filled with white lead, including a coat of approved steel primer and two coats of approved paint on overlapping of sheets complete (up to any pitch in horizontal/ vertical or curved surfaces), excluding the cost of purlins, rafters and trusses and including cutting to size and shape wherever required.				
	12.1.1	1.00 mm thick with zinc coating not less than 275 gm/m²	sqm	300		
8	12.4	Providing ridges or hips of width 60 cm overall width plain G.S. Sheet fixed with polymer coated J or L hooks, bolts and nuts 8 mm dia G.I. limpet and bitumen washers complete.				
	12.4.1	0.80 mm thick with zinc coating not less than 275 gm/m²	metre	20		
9	12.7	Providing and fixing 15 cm wide, 45 cm overall semi-circular plain G.S. sheet gutter with iron brackets 40x3mm size, bolts, nuts and washers etc., including making necessary connections with rain water pipes complete.				
	12.7.1	0.80 mm thick with zinc coating not less than 275 gm/m²	metre	40		
10	13.1	12 mm cement plaster of mix :				
	13.1.1	1:4 (1 cement: 4 fine sand)	sqm	275		
11	13.81	Distempering with 1st quality acrylic distemper, having VOC (Volatile Organic Compound) content less than 50 grams/ litre, of approved brand and manufacture, including applying additional coats wherever required, to achieve even shade and colour.				
	13.81.2	Two coats	sqm	220		
12	13.85	Applying priming coats with primer of approved brand and manufacture, having low VOC (Volatile Organic Compound) content.				
	13.85.3	With water thinnable cement primer on wall surface having VOC content less than 50 grams/litre	sqm	220		
		TOTAL				
		Taxes				
		GRAND TOTAL				

DRAWINGS:

CHILLER PLANT ROOM



CHILELR PLANT ROOM SHED