(SECTION-II)

INSTRUCTION TO BIDDERS& APPENDIX TO BID

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Section -II

Instructions to Bidders (ITB)

A. General

1. Scope of Bid

1.1 The Executing Agency (as defined in the Appendix to ITB) invites bids for "as described in these documents and referred to as "the works". The name and identification number of the works is provided in the Appendix to ITB.

1.2 The successful Bidder will be expected to complete the Works by the intended Completion Date specified in the Contract Data (Part I General Conditions of Contract).

1.3 Throughout these bidding documents, the terms "bid" and "tender" and their derivatives (bidder/tenderer, bid/tender, bidding/tendering, etc.) are synonymous.

2. Source of Funds

2.1 The expenditure on this project will be provided by Government of UT of Ladakh to the National Highways & Infrastructure Development Corporation Limited (NHIDCL).

3. Eligible Bidders

3.1 This Invitation for Bids is open to all bidders as defined in the Appendix to ITB.

3.2 Bidders shall not be under a declaration of ineligibility for corrupt and fraudulent practices by the Central Government, the State Government or any public undertaking, autonomous body, authority by whatever name called under the Central or the State Government.

4. Qualification of the Bidder

4.1 The bid is open to person/entity from India only and entity/firm/company having any share of the person resident outside India or is controlled by persons resident outside India, is not eligible for the bid.

4.2 All bidders shall include the following information and documents with their bids in Section-3, Qualification Information unless otherwise stated in the Appendix to ITB:

a) Scanned copy of original documents defining the constitution or legal status, ownership details, place of registration, and principal place of business; written power of attorney of the signatory of the Bid to commit the Bidder;
b) Total monetary value of civil Engineering construction works performed for each of the last three years;
c) Scanned copy of Experience certificate in works of a similar nature and size for each of the last Five years with certificates from the concerned officer of the minimum rank of Executive Engineer-in-Charge or equivalent;
d) Scanned copy of certificate from Charted Accountant as a proof of turnover for the past three years; (as per format enclosed Annexure-B)

e) Scanned copy of certificate from Charted Accountant as a proof of Net Worth for thelatest audited financial year;(as per format enclosed Annexure-A)
f) Scanned copy of Information regarding any litigation or arbitration during the last five years in which the Bidder is involved, the parties concerned, the disputed amount, and the matter;
g) Scanned copy of the affidavit on the Stamp Paper, duly attested from the Notary Public, that the information furnished with the bid documents is correct in all respects.
h) Scanned copy of Undertakings as mentioned in Section III Cl.2.
i) Any other information/documents required to be completed and submitted by bidders, as specified in the Appendix to ITB & Section III, and to be uploaded by bidder on e-tender portal
j) Scanned copy of proof of payment for cost of tender documents
k) Scanned copy of Bid Security Declaration
l) A detail Technical proposal of the said project which includes the following detail :
   - Detailed structural design and drawings of work.
   - Structural form, materials and structural principles.
   - Methodology of work.
   - Details of various components such as water supply, sanitary system including Sewage Disposal System
   - , flooring, Panels, finishings, Radiant Heating System, Electrical layout including plant room,transformer,DG sets etc, solar heating and lighting system,interior fitouts like doors, windows,false ceiling ,cup boards, modular kitchen, water-proofing system and other components used in the construction work, type of foundation proposed etc.

4.3 a)Bids from joint venture (JV) are allowed. Maximum numbers of JV partners permitted are 03 (three). Lead Partner to qualify 40% of criteria as per clause 4.4 (a) and clause 4.6 and each JV partner to qualify 20% of criteria as per clause 4.4 (a) and clause 4.6. Jointly the JV must qualify 100% of all criteria.

b) **The bidder including individual or any of its JV member, who are either having 2 (two) on-going EPC Project(s) in NHIDCL or on-going Project(s) worth of ₹ 500 Crore (Awarded Cost) or more in NHIDCL, as on date of financial bid opening, shall not be eligible to bid for this Project (Issuance of LOA will be considered as on-going project).**

4.4 **To qualify for award of the contract, each bidder in its name should have the following; -**

a) achieved an averageannual financial turnover (in all classes of civil Engineering construction/fabrication works only) equivalent to 20% of estimated cost mentioned in NIB during last three year ending 31st March of the previous financial yearsduly certified by Chartered Accountant and shall have a minimum Net Worth of 5% (five percent) of the Estimated Cost at the close of the preceding financial year

b) Satisfactorily completed (not less than 90% of contract value), as a prime contractor (or as a nominated subcontractor duly approved by Executing Agency, provided further that all other qualification criteria are satisfied) similar works during last **Five** years ending last day of month previous to the one in which bids are invited should be either of the following:

i. One similar completed work** costing not less than amount equals to **80% of estimated costput to tender.**

or

ii. Two similar completed works** costing not less than amount equals to **60% of estimated costput to tender**.

or

iii. Three similar completed works** costing not less than amount equals to **40% of estimated cost put to tender**.

(**The "similar work" means Construction of RCC buildings or any other RCC infrastructure work)

(Escalation factor as specified in the appendix to ITB shall be used to bring the value of such completed works at the level of financial year i.e.**2021-22)**

Year	Multiplying Factor
One (1) (2020-21)	1.00
Two(2) (2019-20)	1.05
Three(3) (2018-19)	1.10
Four(4) (2017-18)	1.15
Five(5) (2016-17)	1.20

4.5 Each bidder must produce:

(i) An affidavit on a Stamp Paper, duly attested from the Notary Public, that the information furnished with the bid documents is correct in all respects; and

(ii) Such other certificates as defined in the Appendix to ITB.

(iii)Failure to submit the certificates/documents as specified above or in Appendix to ITB shall make the bid **non-responsive.**

4.6 Bidder who meets the minimum qualification criteria will be qualified only if their available bid capacity is equal to the total estimated cost as mentioned in NIB. The available bid capacity will be calculated as under:

Assessed available Bid capacity = (A*2.5-B)

Where

A= Maximum value of civil Engineering works executed in any one year during the last **Five** years (updated to the price level of the year indicated in Appendix) taking into account the competed as well as works in progress**.**

B= Value (updated to the price level of the year indicated in table below under note) of existing commitments, works **for which Appointed Date/Commencement Date has been declared or on-going works** to be completed during the period of completion of the works for which bid is invited. For the Sake of clarification, it is mentioned that works for which LOA has been issued but Appointed Date/Commencement Date not declared as on Bid Due Date shall not be considered while calculating value of B.

***Note**: The Statement showing the value of all existing commitments, works **for which Appointed Date/Commencement Date has been declared or on-going works**as well as the stipulated period of completion remaining for each of the works listed should certified from the bidder. For any wrong certificate the bidders shall be debarred for a period of 2 years. The factors for updation of the*

value of civil Engineering works to the price level of the year are indicated as under:

Year	Year-1	Year-2	Year-3	Year-4	Year-5
Updation factor	1.00	1.05	1.10	1.15	1.20

4.7 Even though the bidders meet the above qualifying criteria, they are subject to be disqualified if they have:

(i) made misleading or false representations in the forms, statements, affidavits and attachments submitted in proof of the qualification requirements; and/or

(ii) Record of poor performance such as abandoning the works, not properly completing the contract, inordinate delays in completion, litigation history, or financial failures etc. or debarring by Government agencies.

(iii) Tampered the bid document in any manner.

5. One Bid per Bidder

5.1 Each Bidder shall submit only one Bid for the work. A Bidder who submits more than one Bid will cause the proposals with the Bidder's participation to be **disqualified.**

6. Cost of Bidding

6.1 The Bidder shall bear all costs associated with the preparation and submission of his Bid, and the Executing Agency will, in no case, be responsible or liable for those costs.

7. Site Visit and Site Location

7.1 The Bidder, at his own cost, responsibility and risk, is encouraged to visit, examine and familiarise himself with the Site of Works and its surroundings including source of earth, water, road aggregates etc. and obtain all information that may be necessary for preparing the Bid and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the Bidder's own expense. He may contact the person whose contact details are given in the Appendix to ITB.

7.2 The work includes construction of following buildings/structures:

a) Construction of 8 nos. Special T4 Staff Quarters (Four typical buildings, each building consisting of two staff quarters –one in ground floor and the other in first floor) in Geyser Palace site, Leh (G+1 floor structure) with radiant heating system, solar water heating system, cup boards, modular kitchen, false ceiling etc. Complete as per drawings

b) Construction of Staff Hostel in Geyser Palace site, Leh (G+2 floors structure).The building comprises of following:

i. Ground floor comprises entrance lobby, reception, guest lounge normal rooms (6 nos.),recreation hall and dining hall and kitchen
ii. Executive rooms(3 nos.), normal rooms(6 nos.) etc in first floor
iii. Normal rooms (12 nos.) in second floor
iv. Solar water heating etc.Services at terrace
v. Services include machine room less lift, radiant heating system, solar water heating system, solar common lighting and compound lighting, cup

boards ,false ceiling in all rooms , wall panelling and wooden flooring in Executive Room(3nos) etc. Complete as per drawings

B. Bidding Documents

8. Content of Bidding Documents

8.1 The set of bidding documents comprises the documents listed below and addenda issued in accordance with Clause 10:

Volume- I:-

i. Notice Inviting Tender
ii. Instructions to Bidders & Appendix to Bid
iii. Qualification Information
iv. Forms of Bank Guarantee, Agreement & LOA
v. Conditions of Contract & Contract Data
vi. Scope of work ,Technical specifications and Particular Specifications
vii. List of Approved Makes of Materials
viii. Tender Drawings
ix. Finishes Matrix
x. Special Conditions of Contract

Volume - II:-

Bill of Quantities

8.2 The bidder is expected to examine the bill of quantities enclosed with bid document, tender drawings, Technical and Particular specifications, Finishes Matrix ,contract conditions and special conditions of contract and access the site locations and include all transportation and miscellaneous cost while quoting the bid. The bill of quantities enclosed is indicative and it is the responsibility of the bidders to work out all quantities and their costs involved in the project and quote for the bid.As the contract is on EPC mode , the selected contractor is required to deliver the project as per approved drawings in all respects and nothing extra shall be payable beyond the quoted amount.

8.3 The bidder is expected to examine carefully all instructions, conditions of contract, contract data, forms, terms, and specifications, bill of quantities, forms and drawings in the Bid Document. Failure to comply with the requirements of Bid Documents shall be at the bidder's own risk. Pursuant to clause 26 hereof, bids, which are not substantially responsive to the requirements of the Bid Documents, shall be **rejected.**

9. Clarification of Bidding Documents

9.1 A prospective Bidder requiring any clarification on the bid document may notify the Executing Agency in writing or by e-mail (scanned copy) at the Executing Agency's address indicated in the Notice Inviting Tender. The Executing Agency will respond to any request for clarification received earlier than 7 days prior to the deadline for submission of bids. Copies of the Executing Agency's response will be hosted on website or which are required in the opinion of the Executing Agency including a description of the enquiry, but without identifying its source.

10. Amendment of Bidding Documents

10.1 Before the deadline for submission of bids, the Executing Agency may modify the bidding documents by issuing addenda.

10.2 Any addendum thus issued shall be part of the bidding documents and shall be hosted on the NHIDCL website/e-procurement portal only.

10.3 To give prospective bidders reasonable time in which to take an addendum into account in preparing their bids, the Executing Agency shall extend, as necessary, the deadline for submission of bids, in accordance with Clause 20.2.

C. Preparation of Bids

11. Language of Bid

11.1 All documents relating to the Bid shall be in the language specified in the Appendix to ITB.

12. Documents Comprising the Bid

12.1 The e-bid submitted by the bidder shall be in two separate parts. Part-I This shall be named Technical Bid and shall comprise of information submitted online as per Cl. 4.2 in Sec-II. Part-II It shall be named Financial Bid and shall comprise of (i) Priced bill of quantities.

12.2 **Documents comprising Technical and Financial BID**

The Bidder shall first upload all the project details, net worth details, turnover details and all other details required in this RFP for technical qualification. The Bidder shall ensure that all the details are updated as on the due date of submission of this bid.
The Bidder shall then apply for the RFP on the CPPP website https:// eprocure.gov.in/eprocure/app by submitting the documents mentioned below along with the supporting documents which shall comprise of the Technical BID on the CPPP portal :

Technical Bid

(a) Power of Attorney of the signatory of the bidder to commit BID;

(b) Copy of online receipt towards payment of Bid Security Declaration;

(c) Copy of online receipt towards payment of cost of Bid document of required amount;

(d) Affidavit duly notarized and undertakings as per Section III;

(e) Annual financial turnover (in all classes of civil Engineering construction & fabrication works only) during last three years ending 31st March of the previous financial year duly certified by Chartered Accountant. (as per Format Annexure-B);

(f) Net worth certificate duly certified by Chartered Accountant. (as per Format Annexure-A);

(g) Scanned copy of Experience certificate in works of a similar nature and size for each of the last Five years with certificates from the concerned officer of the minimum rank of Executive Engineer-in-Charge or equivalent;

(h) Scanned copy of Information regarding any litigation or arbitration during the last five years in which the Bidder is involved, the parties concerned, the disputed amount, and the matter;

(i) A detailed Technical proposal of the project as specified in RFP.

Financial Bid

(g) To be submitted online on GoI e-tendering portal (https://eprocure.gov.in/cppp) on or before Schedule time given in Data Sheet.

12.2.2 The Bidder shall submit the following documents physically by date and time given in Appendix to ITB:

(a) Original Power of Attorney of the signatory of the bidder to commit BID;

(b)Copy of online receipt towards payment of Bid Security Declaration;

(c) Copy of online receipt towards payment of cost of Bid document of required amount;

(d) Original Affidavit duly notarized and undertakings as per Section III;

(e) Annual financial turnover (in all classes of civil Engineering construction and fabrication works only) during last three years ending 31st March of the previous financial year duly certified by Chartered Accountant. (as per Format Annexure-B);

(f) Net worth certificate duly certified by Chartered Accountant. (as per Format Annexure-A);

(g) Scanned copy of Experience certificate in works of a similar nature and size for each of the last Five years with certificates from the concerned officer of the minimum rank of Executive Engineer-in-Charge or equivalent;

(h) Scanned copy of Information regarding any litigation or arbitration during the last five years in which the Bidder is involved, the parties concerned, the disputed amount, and the matter;

(i) A detailed Technical proposal of the project as specified in the RFP.

12.2.3 The documents listed at clause 12.2.2 shall be placed in an envelope, which shall be sealed. The envelope shall clearly bear the identification "BID for (Name of the Project)" and shall clearly indicate the name and address of the Bidder. In addition, the BID Due Date should be indicated on the right hand top corner of the envelope.

12.2.4 The envelope shall be addressed to the officer designated whose Name and Address is given in the Bid document.

12.2.5 If the envelope is not sealed and marked as instructed above, the Authority assumes no responsibility for the misplacement or premature opening of the contents of the BID submitted and consequent losses, if any, suffered by the Bidder.

12.2.6 BIDs submitted by fax, telex, telegram or e-mail shall not be entertained and shall be summarily rejected.

12.3 The following documents, which are not submitted with the bid, will be deemed to be part of the bid.

Section	Particulars
1	Notice Inviting Bid
2	Instruction to the bidders
3	Conditions of Contract
4	Contract Data
5	Scope of work, Technical Specification and Particular specifications
6	List of Approved Makes of Materials
7	Tender Drawings
8	Finishes Matrix
9	Special Conditions of Contract

13. Bid Prices

13.1 The Contract shall be on EPC mode and the quoted bid price(exclusive of GST) includes complete work as per approved drawings submitted by the Contractor for the whole Works, as described in Clause 1.1 based on the priced Bill of Quantities submitted by the Bidder.

13.2 **The bidder shall quote bid prices on appropriate format enclosed as part of tender document on https:// eprocure.gov.in/eprocure/app.**

13.3 The bidder is required to quote the amount excluding GST. GST at the existing rate & applicable laws will be paid to the contractoralongwiththe eachbill, however, the contractor has to submit the proof of GST payment to government before next bill. In case, of non submission of GST proof, the same will be recovered in the next bill.

13.4 Based on the amount quoted, the rates and prices shall be fixed for the duration of the Contract and shall not be subject to adjustment.

14. Currencies of Bid and Payment

14.1 The price shall be quoted by the bidder entirely in Indian Rupees. All payments shall be made in Indian Rupees.

15. Bid Validity& Bid Document Cost

15.1 Bids shall remain valid for a period of **120 days** after the deadline date for bid submission specified in Clause 20.

15.2 In exceptional circumstances, prior to expiry of the original time limit, the Executing Agency may request that the bidders may extend the period of validity for a specified additional period. The request and the bidders' responses shall be made in writing or by e-mail. A bidder may refuse the request without forfeiting his bid security. A bidder agreeing to the request will not be required or permitted to modify his bid, but will be required to extend the validity of his bid security for a period of the extension, and in compliance with Clause 16 in all respects.

15.3 The Bidder isrequired to pay a non-refundable feeas mentioned in Appendix to ITBtowards cost of Bid Documentthrough RTGS/ NEFT/ other online mode to the NHIDCL's designated bank account. Detailsof designated bank account are as under:

Sr.No.	Particulars	Details
1.	Name of Beneficiary	NHIDCL ESTABLISHMENT ACCOUNT
2.	Beneficiary Bank Account No.	76513070002321
3.	Beneficiary Bank Branch Name and Address	Canara Bank (erstwhile Syndicate Bank) Leh Branch, Tsaskan Complex near LIC Office, Distt. Public library Road, Leh-194101
4.	Beneficiary Bank Branch IFSC	CNRB0017651

The Bidder must upload **Copy of the online payment receipt (UTR/ Reference No./Transaction ID)** towards payment of cost of Bid document.

15.4 Any bid not accompanied by Bid document fee/cost, shall be rejected by the Executing Agency as **non-responsive.**

16. Bid Security

16.1 **The Bidder is not required to submit the bid security in Cash/BG/NEFT/RTGS/ FDR/any other online mode.** However, the bidderhas to sign a Bid securing declaration accepting that if the bidder withdraw or modify its bid during the period of validity i.e. not less that 180 (one hundred eighty) days from the bid due date or if the bidder is awarded the contract and fail to sign the contract or to submit a performance security before the deadline defined in the request of the bid documents, the bidder will be suspended for participation in the tendering process for the works of NHIDCL and works under other Centrally Sponsored Scheme, for a period of one year from the bid due date of this work. The bid securing declaration shall be submitted as per the format mentioned in the RFP.A scanned copy of the Bid Securing Declaration shall be uploaded online while applying to the tender.

Note: Forfeiture/ Forfeit and/ or appropriation/ appropriate of bidsecurity mentioned anywhere in the RFP/Contract Agreement shall mean, "the bidder will be suspended for participation in the tendering process for the works of NHIDCL and works under other Centrally Sponsored Schemes, for a period of one year from the bid due date of this work."

16.2 **The Bid Security will be forfeited:**

a) if the Bidder withdraws the Bid after its submission during the period of Bid validity;**or**
b) if the Bidder does not accept the correction of the bid price, pursuant to Clause 27; **or**

c) in the case of a successful Bidder, if the Bidder fails within the specified time limit to
   i. **Sign the Agreement**; and/or
   ii. **Furnish the required Performance Security;** and/or
   iii. **Submit the original documents as specified in Clause 12.2;**
   iv. **Corrupt or Fraudulent Practices as specified in Clause 35.**

17. Alternative Proposals by Bidders

17.1 Bidder shall submit offers that fully comply with the requirement of the bidding document including conditions of contract, conditional offer or alternate offer will not be considered further in the process of tender evaluationand the bid will be declared **non-responsive**.

18. Format and Signing of Bid

18.1 The Bidder shall submit e-bid comprising of the documents as described in Clause 12 of the ITB.

D. Submission of Bids

19. Marking of Bids

19.1 The documents to be submitted in Online Mode should be as per clause 12.2 of ITB

20. Schedule for Submission of Bids

20.1 Complete E-Bid to be uploaded on e-procurementportal before due date & time.

20.2 The Executing Agency may extend the deadline for submission of bids by issuing an amendment in accordance with Clause 10, in which case all rights and obligations of the Executing Agency and the bidders previously subject to the original deadline will then be subject to the new deadline.

20.3 The detailed schedule for submission of bid shall be, as given in Appendix to ITB.

21. Deleted

22. Modification and Withdrawal of Bids

22.1 Bidders may modify or withdraw their e-bids before the deadline prescribed in Clause20.

22.2 No bid may be modified after the deadline for submission of Bids.

22.3 Withdrawal of a Bid between the deadline for submission of bids and the expiration of the original period of bid validity specified in Clause 15.1 above or as extended pursuant to Clause 15.2 shall result in the forfeiture of the Bid security pursuant to Clause 16.

E. Bid Opening and Evaluation

23. Bid Opening

Bid opening shall be carried out in two stages. Firstly, 'Technical Bid' of all the bids received shall be opened on the date and time mentioned in the Appendix to ITB. 'Financial Bid' of those bidders whose technical bid has been determined to be substantially responsive shall be opened on the subsequent date through online process of e-tender, which will be notified to such bidders.

23.1 The Executing Agency will open the "Technical Bid" of all the bids received within due date and time, in the presence of the bidders/bidders' representatives who choose to attend at the time, date and place specified in the **NIB**. In the event of the specified date for the submission of bids being declared a holiday for the Executing Agency, the Bids will be opened at the appointed time and location on the next working day.

23.2 In all other cases, the Bid Security Declaration, forms and validity shall be announced. Thereafter, the Executing Agency at the opening as the Executing Agency may consider appropriate, will announce the bidders' names and such other details.

23.3 TheExecuting Agency will prepare minutes of the Bid opening, including the information disclosed to those present in accordance with Clause 23.1.

23.4

i. The bids accompanied with bid security declaration will be taken up for evaluation with respect to the Qualification Information and other information furnished in Part I of the bid pursuant to Clause 12.1.

ii. As soon as possible, the Evaluation Committee will finalize the list of responsive bidders whose financial bids are eligible for consideration.However, to assist in the examination, evaluation of technical bids, the Executing Agency may at his discretion, ask any bidder for clarification of his bid, however, no additional documents in support of clarification will be entertained.

23.5 The Executing Agency shall inform the bidders, whose technical bids are found responsive, of the date, time and place of opening of the financial bids. The bidders so informed, or their representative, may attend the meeting of opening of financial bids.

23.6 The financial bids of only the responsive bidders will be opened. The responsive bidders' names, the Bid prices, the total amount of each bid, pursuant to clause 22 and such other details as the Executing Agency may consider appropriate will be announced by the Executing Agency at the time of bid opening.

23.7 The Executing Agency shall prepare the minutes of the opening of the Financial Bids.

24. Process to be Confidential

24.1 Information relating to the examination, clarification, evaluation, and comparison of bids and recommendations for the award of a contract shall not be disclosed to bidders or any other persons not officially concerned with such process until the award to the successful Bidder has been announced. Any attempt by a Bidder to influence the Executing Agency's processing of bids or award decisions may result in the rejection of his Bid.

25. Clarification of Bids and Contacting the Executing Agency

25.1. To assist in the examination,evaluation, and comparison of Bids, the Executing Agencymay, at his discretion, ask any Bidder for clarification of his-Bid, including breakdowns of unit rates. The request for clarification and the response shall be in writing or by email, but no change in the price or substance of the Bid shall be sought, offered, or permitted except as required to confirm the correction of arithmetic errors discovered by the Executing Agency in the evaluation of the Bids in accordance with Clause 27.

25.2 Subject to sub-clause 25.1, no Bidder shall contact the Executing Agency on any matter relating to his bid from the time of the bid opening to the time the contract is awarded. If the Bidder wishes to bring additional information to the notice of the Executing Agency, he should do so in writing.

25.3 Any effort by the Bidder to influence the Executing Agency in the Executing Agency's bid evaluation, bid comparison or contract award decisions may result in the rejection of the Bidders' bid.

26. Examination of Bids and Determination of Responsiveness

26.1 During the detailed evaluation of "Technical Bids", the Executing Agency will determine whether each Bid

(a) meets the eligibility criteria defined in Clauses 3 and 4;
(b) the required documents uploaded by the bidder are in order; and
(c) is substantially responsive to the requirements of the bidding documents. During the detailed evaluation of the "Financial Bids", the responsiveness of the bids will be further determined with respect to the remaining bid conditions, i.e., priced bill of quantities, technical specifications and drawings etc.

27. Correction of Errors.

27.1 Financial Bids determined to be substantially responsive will be checked by the Executing Agency for any arithmetic errors.

27.2 The amount stated in the Financial Bid will be corrected by the Executing Agency for the correction of errors and shall be considered as binding upon the Bidder. If the Bidder does not accept the corrected amount, the Bid will be rejected, and the Bid Security shall be forfeited in accordance with Sub-Clause 16.6(b).

28. Evaluation and Comparison of Financial Bids.

28.1 The Executing Agency will evaluate and compare only the bids determined to be substantially responsive in accordance with Clause 26.

28.2 In evaluating the bids, the Executing Agency will determine for each Bid the evaluated Bid price by adjusting the Bid price after making any correction for errors pursuant to Clause 27;

28.3 **If the Bid of the successful Bidder is seriously unbalanced** then an irrevocable and unconditional guarantee from a Bank should also be submitted in the same form given in Section-IV towards an Additional Performance Security **(the "Additional Performance Security"**) for an amount calculated as under:

a) If the Bid Price offered by the Selected Bidder is lower than 15% but upto 20% of the Estimated Project Cost, then the Additional Performance Security shall be 10% of the Bid Price offered by the selected Bidder.

b) If the Bid Price offered by the Selected Bidder is lower than 20% of the Estimated Project Cost, then the Additional Performance Security shall be 20% of the Bid Price offered by the Selected Bidder.

c) This Additional Performance Security shall be treated as part of the Performance Security.

28.4 A bid, which is quoted unrealistically low and which cannot be substantiated satisfactorily by the bidder, may be rejected as non-responsive.

29. Deleted

F. Award of Contract.

30. Award Criteria.

30.1 Subject to Clause 32, the Executing Agency will award the Contract to the Bidder whose Bid has been determined:

i. To be substantially responsive to the bidding documents and who has offered the lowest evaluated Bid price.

31. Executing Agency's Right to accept any Bid and to reject any or all Bids

31.1 Notwithstanding Clause 30, the Executing Agency reserves the right to accept or reject any Bid, and to cancel the bidding process and reject all bids, at any time prior to the award of Contract, without thereby incurring any liability to the affected Bidder or bidders or any obligation to inform the affected Bidder or bidders of the grounds for the Executing Agency's action.

32. Notification of Award and Signing of Agreement.

32.1 The bidder who's Bid has been accepted will be notified of the award by the Executing Agency. This letter (hereinafter and in the Part I *General Conditions of Contract* called the "Letter of Acceptance") will state the sum that the Executing Agency will pay to the Contractor in consideration of the execution, completion and maintenance of the Works, by the Contractor as prescribed by the Contract (hereinafter and in the Contract called the "Contract Price").

32.2. The notification of award will constitute the formation of the Contract.

32.3. The Agreement will incorporate all agreements between the Executing Agency and the successful Bidder. It will be signed by the Executing Agency and the successful Bidder within 7 days of receipt of valid Performance Security for full amount.

33. Performance Security.

33.1 **Within 15 (fifteen) days** after receipt of the Letter of Acceptance, the successful Bidder shall deliver to the Executing Agency a balance Performance Security i.e. Three (**3%)percent of the Contract Price**, valid for the period of **28 days** after the expiry of defect liability period from the date of issue of certificate of completion

of work plus additional security for unbalanced Bid in accordance with clause 28.3 of ITB and sign the contract. The performance Security for the work shall be as mentioned in the Appendix to ITB.

33.2 The performance security shall be either in the form of a Bank Guarantee in the name of the Executing Agency, from a Bank as per the details specified below or can be submitted by online mode directly into the NHIDCL's bank account as mentioned in **Data sheet.**Bank Guarantee shall be accepted from Public Sector Banks or Scheduled Private Sector Banks having Net Worth of Rs. 1,000/- Crores or more as per latest annual report of the bank. Authority reserves the right to add or remove any of names bank on which BG shall be accepted based on advisory from the Government/RBI. **The BGs issued by 'Foreign Banks' and 'Banks not mentioned in the list below' shall not be accepted.**

List of Public Sector Banks	List of Scheduled Private Sector Banks
1. Bank of Baroda	1. Axis Bank Ltd.
2. Bank of India	2. Bandhan Bank Ltd.
3. Bank of Maharashtra	3. CSB Bank Ltd.
4. Canara Bank	4. City Union Bank Ltd.
5. Central Bank of India	5. DCB Bank Ltd.
6. Indian Bank	6. Federal Bank Ltd.
7. Indian Overseas Bank	7. HDFC Bank Ltd.
8. Punjab National Bank	8. ICICI Bank Ltd.
9. Punjab & Sind Bank	9. Indusind Bank Ltd.
10. State Bank of India	10. IDFC First Bank Ltd.
11. UCO Bank	11. Jammu & Kashmir Bank Ltd.
12. Union Bank of India	12. Karnataka Bank Ltd.
	13. Karur Vysya Bank Ltd.
	14. Kotak Mahindra Bank Ltd.
	15. Lakshmi Vilas Bank Ltd.
	16. RBL Bank Ltd.
	17. South Indian Bank Ltd.
	18. Tamilnadu Mercantile Bank Ltd.
	19. Yes Bank Ltd.
	20. IDBI Bank Ltd.

33.3 Failure of the successful bidder to comply with the requirement of sub-clause 33.1 shall constitute sufficient ground for cancellation of the contract and forfeiture of the bid security converted into Performance Security (part) and debarment for a period of 2 years from the date of debarment.

34. Advances.

34.1 The Executing Agency will provide Mobilization Advance as provided in Part-I General Conditions of Contract.

35. Corrupt or Fraudulent Practices.

The Executing Agency will reject a proposal for award if it determines that the Bidder recommended for award has engaged in corrupt or fraudulent practices in competing for the contract in question and will declare the firm ineligible, either indefinitely or for a stated period of time, to bid for any work with National Highways Authority of India, if it at any time determines that the firm has engaged

in corrupt or fraudulent practices in competing for the contract, or in its execution.

For the purpose of this clause, the following terms shall have the meaning hereinafter respectively assigned to them

(a) **" Corrupt practice"** means (i) the offering, giving, receiving, or soliciting, directly or indirectly, of anything of value to influence the actions of any person connected with the Bidding Process (For avoidance of doubt, offering of employment to, or employing, or engaging in any manner whatsoever, directly or indirectly, any official of the Authority who is or has been associated in any manner, directly or indirectly, with Bidding Process, at any time prior to the expiry of one year from the date such official resigns or retires from or otherwise ceases to be in the service of the Authority, shall be deemed to constitute influencing the actions of a person connected with the Bidding Process);

(b) **"Fraudulent practice"** means a misrepresentation or omission of facts or suppression of facts or disclosure of incomplete facts, in order to influence the Bidding Process;

The Executing Agency requires the bidders/Contractors to strictly observe the laws against fraud and corruption enforced in India, namely, Prevention of Corruption Act, 1988.

Appendix to ITB

Clause No.

1.1 The Executing Agency is Executive Director(P),Regional Office, Ladakh, National Highways & Infrastructure Development Corporation Limited**.**

RFP No. NHIDCL/Infra/Ladakh/H&P/2021-22/

"Construction of 8 nos. Special T4 Staff Quarters and Staff hostel at Geyser Palace site, Leh in the Union Territory of Ladakh"

1.1
3.1 Bidder may be a natural person, private entity, sole or partnership firm, company incorporated and registered in India**.**

4.4 (a) achieved an averageannual financial turnover (in all classes of civil Engineering constructiononly) equivalent to **20% ofthe Estimated Cost put to tender**during last three year ending 31st March of the previous financial yearduly certified by Chartered Accountant and shall have a minimum Net Worth of **5% ofthe Estimated Cost put to tender**at the close of the preceding financial year.

4.4 (b)

i. One similar completed work**costing not less than amount equals to**80% of the Estimated Cost put to tender**

OR

ii. Two similar completed works** costing not less than amount equals to **60% of the Estimated Cost put to tender**

OR

iii. Three similar completed works** costing not less than amount equals to **40% of the Estimated Cost put to tender.**

(**The "similar work" means Construction of RCC buildings or any other RCC infrastructure work)

15.3 Bid Document fee (Incl. 18% GST): **Rs.5,900/-(Rupees FiveThousand Nine Hundred only.)**

20.3 **Schedule for submission of Bids**

Sl. No.	Event Description	Date
1.	Invitation of RFP (NIT)	26.04.2021
2.	Last date for receiving queries through e-mail	03.05.2021 upto 1100 Hrs
3.	Pre-BID meeting through VC (Bidder may request link for VC through email)	04.05.2021 at 1500 Hrs
4.	Authority response to queries latest by	06.05.2021
5.	BID submission start date	07.05.2021
6.	BID Due Date for online submission	13.05.2021 (upto 1100 Hrs IST)
7.	Physical Submission of Bid	Before opening of Financial Bid
8.	Opening of Technical BIDs	14.05.2021 (1130 Hrs IST onwards)
9.	Declaration eligible / qualified bidders	To be intimated later
10.	Opening of Financial BID	To be intimated later
11.	Letter of Award (LOA)	To be intimated later
12.	Validity of BID	120 days from bid due date

33.1 Performance Security : Three(3%) percent of the Contract Price.

33.2 Bank Account details of NHIDCL **(only for Bid Document cost)** are given below:

Sr.No.	Particulars	Details
1	Name of Beneficiary	NHIDCL ESTABLISHMENT ACCOUNT
2	Beneficiary Bank Account No.	76513070002321
3	Beneficiary Bank Branch Name and Address	Canara Bank (erstwhile Syndicate Bank) Leh Branch, Tsaskan Complex near LIC Office, Distt. Public library Road, Leh-194101
4	Beneficiary Bank Branch IFSC	CNRB0017651

Format for CV

Photo

Format of Curriculum Vitae (CV) For Proposed Key Staff

1. Proposed Position: _____
2. Name of Staff: _____
3. Date of Birth: _____**(Please furnish proof of age)**
4. Nationality: _____
5. Educational Qualification:

(*Summarize college/university and other specialized education of staff member, giving names of schools, dates attended and degrees obtained).* ***(Please furnish proof of qualification)***
Contact Address with Phone and mobile numbers:

6. Membership of Professional Societies: _____
7. Publication:

(List of details of major technical reports/papers published in recognized national and international journals)

8. Employment Record:

(Starting with present position, list in reversed order, every employment held. List all positions held by staff member since graduation, giving dates, names of employing organization, title of positions held and location of assignments. For experience ***period of specific assignment must be clearly mentioned*****,** also give client references, where appropriate).

9. Summary of the CV

(Furnish a summary of the above CV. The information in the summary shall be precise and accurate. The information in the summary will have bearing on the evaluation of the CV).

A) Education:
i) Field of Diploma/Graduation and year
ii) Field of post-graduation and year
iii) Any other specific qualification
B) Experience:
i) Total experience : _____ Yrs
ii) Responsibilities held:

a) _____Yrs.
b) _____ Yrs.
c) _____ Yrs.
d) Relevant Experience: _____ Yrs.
C)Permanent Employment with the Firm (Yes/No):

If yes, how many years:
If no, what is the employment?
Arrangement with the firm?
Certification:

1 *I am willing to work on the project and I will be available for entire duration of the project assignment and I will not engage myself in any other assignment during the currency of this assignment on the project*

2 I, the undersigned, certify that to the best of my knowledge and belief, this bio-data correctly describes myself my qualification and my experience.

Signature of the Candidate _____

Place _____
Date _____

Signature of the Authorized Representative of the firm_____
Place _____
Date _____

Note: Each page of the CV shall be signed in ink by both the staff member and the Authorized Representative of the firm.

(SECTION –III)

QUALIFICATION INFORMATION

The information to be filled in by the Bidder in this section on E-portal &**Scanned Copies of documents to be submitted online** will be used for the purposes of post qualification as provided for in Clause 4 of the Instructions to Bidders.

1. For Individual Bidders

1.1 Constitution or legal status of Bidder

[Upload scanned copy of Original]

Details of Ownership _____

Place of registration: _____

Principal place of business: _____

1.2 Power of attorney of signatory of Bid
[Upload scanned copy & also submit Original copy in physical form]

1.3 Total value of Civil Engineering construction work performed in the last three years (in Rs. Lakh) Refer ITB Clause 4.5 A(a)
(Upload scanned copies of Turnover certificates from Chartered Accountant & also submit original certificate from Chartered Accountant)

2018-2019----------
2019-2020----------
2020-2021----------

Total ----------
Average per year ----------

1.4 **(a)**Work performed as prime contractor, work performed in the past as a nominated sub- contractor duly approved by Executing Agency will also be considered, provided further that all other qualification criteria are satisfied (in the same name) on works of a similar nature during the last **Five** years to qualify as per ITB.

Project Name	Name of the Executing Agency*	Description of work	Contract No.	Value of Contract (Rs. Crore)	Date of issue of work order	Stipulated period of completion	Actual date of completion *	Remarks explaining reasons for delay & work Completed

** Attach certificate(s) from the minimum rank of Executive Engineer-in-Charge or equivalent*

Note: In case of nominated sub-contractor – a certificate from the minimum rank of Executive Engineer-in-Charge or equivalent of the Prime Executing Agency should be obtained from whom an approval for subcontractor has been obtained.

(b) Information on Bid Capacity (works for which bids have been submitted and accepted and works which are yet to be completed) as on the date 7 days before the last date for bid submission (as per Cl 4.6 of the ITB).

(i) Existing commitments and on-going works (B)

Description of works	Place & State	Contract No.	Name & Address of Executing Agency	Value of Contract (Rs. Cr)	Stipulated Period of Completion	Value of works remaining to be completed in the next N years (Rs Cr)	Escalation factor	Anticipated date of completion	Escalated value of remaining work during completion period of work for which bids are invited
1	2	3	4	5	6	7	8	9	10

ii) Details of works for which bid submitted and accepted (i.e. where contract signing is pending)

Description of works	Place & State	Name & Address of Executing Agency	Date of issue of Latter of Acceptance (LOA)	Value given in LOA	Stipulated period for completion	Value of work during completion period of work for which bids are invited
1	2	3	4	5	6	7

Upload copy of LOA

iii) Bid capacity (Bidder shall calculate, mention his bid capacity and enclose the supporting calculation)
A = Rs _____ Lakh (enclose the details)
B = Rs…_____Lakh (enclose the details)
Assessed Available Bid capacity = (A* 2.5 – B)

1.5. The bidder must provide information regarding Availability of Key Equipment essential for carrying out the Works.

Item of Equipment	**Requirement**	**Availability Proposals**			**Page no. of the proof attached**
		Owned/Leased/rented	**Nos./Capacity**	**Age/Condition**	
Tipper/Trucks					

Hydraulic Excavator					
Batch Mix Plant					
Concrete Mixer					
Water Tanker					
Transit Mixer					
Vibrators					
Concrete Pump					
Crane/Hydra					
Any Other Equipment/ Machinery required to carry out the work					

1.6. Qualifications and Experience of Key Personnel proposed for administration and execution of the Contract. **Attach biographical data for technical personnel.**

Position	Name	Qualification	Year of Experience (General)	Years of experience in the proposed position
Etc.				

Note : The detailed and signed CV's of all the Key Technical Personnel, signed by the key personnel himself, be uploaded along with the bid as per proforma given in Appendix to ITB.

1.7. Information on litigation/ arbitration history in which the Bidder is involved.

Other Party (ies)	Executing Agency	Cause of Dispute	Amount involved	Remarks showing Present Status

2. Bidders should provide the following affidavits/ undertakings as per formats enclosed hereafter: -

(i) Affidavit (it should be on stamp paper attested by Notary)
(ii) Undertaking that the Bids shall remain valid for the period specified in Clause 15.1.

AFFIDAVIT

(To be notarized by Notary)

1. I, the undersigned, do hereby certify that all the statements made in the required attachments are true and correct.

2. The undersigned also hereby certifies that neither our firm M/s_____ have abandoned any work on National Highways in India nor any contract awarded to us for such works have been rescinded, during last **Five** years prior to the date of this bid.

3. The undersigned hereby authorize(s) and request(s) any bank, person, firm or corporation to furnish pertinent information deemed necessary and requested by the Department to verify this statement or regarding my (our) competence and general reputation.

4. The undersigned understand and agrees that further qualifying information may be requested, and agrees to furnish any such information at the request of the Department Project implementing agency.

_____
(Signed by an Authorized Officer of the Firm)

_____
Title of Officer

_____
Name of Firm

_____
DATE

UNDERTAKING

I, the undersigned do hereby undertake on behalf of our firm M/s [Name of the bidder],that we shall not withdraw or modify our bid during the period of validity from the bid submission date.

I, on behalf of the bidder, [Name of the bidder], also accept the fact that in case the bid is withdrawn or modified during the period of its validity or if we fail to sign the contract in case the work is awarded to us or we fail to submit a performance security before the deadline defined in the Bid, then [Name of the bidder] will be debarred for participation in the tendering process for the works of NHIDCL and other works under other Centrally Sponsored Schemes, for a period of two year from the bid due date of this work.

_____
(Signed by an Authorized Officer of the Firm)

_____
Title of Officer

_____
Name of Firm

_____
DATE

Annexure-A

Letter Head of the Statutory Auditor
(Giving phone number, address and email address)
CERTIFICATE OF NET WORTH BY STATUTORY AUDITOR

1. This certificate is being issued on the request of ……..(Name of the Bidder and address) for participating in tender in respect of National Highways and Infrastructure Development Corporation of India Ltd. in accordance with the applicable auditing standards and guidance Note issued by the Institute of Chartered Accountant of India.

2. We M/s ……..(Name of the Statutory Auditor) are statutory auditors of ……..……..(Name of the Bidder) for the year ended 31st March 20XX (appropriate year may be filled in).

   Note 1: In case the certificate is issued by any firm other than statutory Auditors of a company, the form no. ADT 1.duly filed with the Registrar of Companies is attached.

   Note 2: In cases the Bidder does not have statutory auditor, the firm of chartered accountants that audited last financial statements/books of accounts shall be treated as Statutory Auditor while in case of a company, the statutory auditor shall have same meaning as 'Auditor' defined under the Companies Act, 2013.

3. We have obtained all relevant record and information that were necessary for providing this certificate.

4. We have read and understood the tender documents relating to financial (**e.g. 'Turnover' and 'Net worth**), verified the standalone audited financial statements of …… (Name of the Bidder), books of accounts and other relevant records and information as at 31st March 20XX produced before us by ……..……..(Name of the Bidder), and on basis of such verification, information and explanation given to us, we certify that Net Worth of ……..……..(Name of the Bidder) as on 31 March 20XX has been computed strictly in compliance with the provision of clause 2.2.2.9(ii) of the RFP documents of the NHIDCL and as under:

Sr. No.	Particulars	Amount (₹ in lakh)	Remarks
1	Paid of Equity Share Capital (This does not include advance against equity and application money pending allotment)		
2	Reserves and Surpluses (Other equity in case of Financial Statements are prepared under Ind AS) created out of profits)		
2.1	Accumulated Profits		
2.2	Share/Security premium		
2.3	Other Reserves		
	Total		
	Less Accumulated losses, if any		
	Less Miscellaneous expenditure to the extent not written off or adjusted		
	Less Deferred Revenue Expenditure, if any		
	Less write back of depreciation, if any		
	Less any other reserve created out of profits like amalgamation,		

	capital restructuring, first time adoption of Ind AS or debt restructuring prior to full settlement of debts.		

5. This is certified that the Calculation of Net worth is based on **standalone financial statements** of ……..……..(Name of the Bidder) prepared in conformity with applicable Accounting Standards and it does not include following components:
   i. Advance against equity;
   ii. Share application money, pending allotment;
   iii. Redeemable or non-redeemable Preference share capital ;
   iv. Convertible and non-convertible debentures;
   v. Revaluation Reserves;
   vi. Accumulated losses;
   vii. Write back of depreciation;
   viii. Other comprehensive income, in cases where financial statements are prepared based on Ind AS;
   ix. Reserves created from restructuring of debt etc till their settlement of debts;
   x. Deferred Tax Liabilities; and
   xi. Impact of restructuring or amalgamation of the bidder.

For XYZ & Associates
Chartered Accountant
(FRN: ……)

Name of CA: ……..
Partner/Proprietor Membership No.: ……
Place: ……
Date: …….
UDIN: ……

Annexure-B

Letter Head of the Statutory Auditor
(Giving phone number, address and email address)

CERTIFICATE OF TURNOVER BY STATUTORY AUDITOR

1. This certificate is being issued on the request of ……..(Name of the Bidder and address) for participating in tender in respect of National Highways and Infrastructure Development Corporation of India Limited in accordance with the applicable auditing standards and guidance Note issued by the Institute of Chartered Accountant of India.
2. We M/s ……..(Name of the Statutory Auditor) are statutory auditors of ……..……..(Name of the Bidder) for the year ended 31st March 20XX (appropriate year may be filled in).

   Note 1: In case the certificate is issued by any firm other than statutory Auditors of a company, the form no. ADT 1.duly filed with the Registrar of Companies is attached.

   Note 2: In cases the Bidder does not have statutory auditor, the firm of chartered accountants that audited last financial statements/books of accounts shall be treated as Statutory Auditor while in case of a company, the statutory auditor shall have same meaning as 'Auditor' defined under the Companies Act, 2013.
3. We have obtained all relevant record and information that were necessary for providing this certificate.
4. We have read and understood the tender documents relating to financial and technical capacity (**e.g. 'Turnover' and 'Net worth**), verified the standalone audited financial statements of …… (Name of the Bidder), books of accounts and other relevant records and information as at 31st March 20XX produced before us by ……..……..(Name of the Bidder), and on basis of such verification, information and explanation given to us, we certify as under:

S.No.	Financial year	Turnover (₹ In lakh)
1	Year 1 (2019-2020)	
2	Year2 (2018-2019)	
3	Year 3 (2017-2018)	

In case financial statements of the latest financial year are not audited and therefore, the bidder cannot make it available, the bidder shall provide an undertaking to this effect and statutory auditor shall certify the same. In such case, the bidder shall provide the audited financial statements for five yearimmediately preceding the year for which the audited annual report is not being produced as per clause 2.2.2.8 of the RFP. In case,undertaking duly certified by statutory auditor is not submitted under such circumstances, the annual turnover for the year for which audited annual financial statements are not available shall be considered as 'Nil' for the purposes of arriving at the average annual turnover.

5. Annual Turnover updated to the price level of the year, based on factors indicated in table xxx of the tender documents, is given below:

Year	Year-1	Year-2	Year-3	Year-4	Year-5
Updation factor	**1.00**	**1.05**	**1.10**	**1.15**	**1.20**
Actual Turnover (₹ In lakh)					
Updated Turnover (₹ In lakh)					

Average Updated Turnover (to the price level of the year) = …… (₹ In lakh)

6. This is also certified that the Calculation of turnover is based on **standalone financial statements** of ……..……..(Name of the Bidder) prepared in conformity with applicable Accounting Standards and it does not include any component of indirect tax like GST.
7. This is also certified that the that turnover mentioned in para 5 is in individual capacity of ……..……..(Name of the Bidder) and its share in the Joint Venture where the work had been executed jointly with other party/parties and such a joint venture is not a separate legal entity. Further, the above turnover does not include any turnover related to joint venture or subsidiary having a separate legal entity.
8. This is also certified that turnover mentioned in para 5 is in respect of execution of construction/ civil /Engineering activities and does not include any trading activity of ……..……..(Name of the Bidder).

For XYZ & Associates
Chartered Accountant
(FRN: ……)

Name of CA: ……..
Partner/Proprietor Membership No.: ……
Place: ……
Date: ……
UDIN: ……

SECTION-IV
FORMS OFBANK GUARANTEES, LOA & AGREEMENT
Form of Bank Guarantee
[Performance Security/Additional Performance Security]

To

[National Highways and Infrastructure Development Corporation Limited]
[Yartsa House near Changspa Farm, Changspa, Leh, UT of Ladakh-194101]

WHEREAS_____[name and address of Contractor] (hereafter called the "Contractor") has undertaken, in pursuance of Letter of Acceptance (LOA) No. Dated_ for construction of [~~name~~ of the Project] (hereinafter called the"Contract")

AND WHEREAS the Contract requires the Contractor to furnish an {Performance Security/ Additional Performance Security} for due and faithful performance of its obligations, under and in accordance with the Contract, during the {Construction Period/ Defects Liability Period and Maintenance Period} in a sum of Rs….. cr. (Rupees ……..….. Crore) (the "**Guarantee Amount**"[1]).
AND WHEREAS we, …….. through our branch at .....
. (the "**Bank**") have agreed to furnish this Bank Guarantee (hereinafter called the **"Guarantee**") by way of Performance Security.
NOW, THEREFORE, the Bank hereby, unconditionally and irrevocably, guarantees and affirms as follows:

1. The Bank hereby unconditionally and irrevocably guarantees the due and faithful performance of the Contractor's obligations during the {Construction Period/ Defects Liability Period and Maintenance Period} under and in accordance with the Contract, and agrees and undertakes to pay to the Authority, upon its mere first written demand, and without any demur, reservation, recourse, contest or protest, and without any reference to the Contractor, such sum or sums up to an aggregate sum of the Guarantee Amount as the Authority shall claim, without the Authority being required to prove or to show grounds or reasons for its demand and/or for the sum specified therein.
2. A letter from the Authority, under the hand of an officer not below the rank of [Offg. Executive Director, of National Highways & Infrastructure Development Corporation Limited], that the Contractor has committed default in the due and faithful performance of all or any of its obligations under and in accordance with the Contract shall be conclusive, final and binding on the Bank. The Bank further agrees that the Authority shall be the sole judge as to whether the Contractor is in default in due and faithful performance of its obligations during and under the Contract and its decision that the Contractor is in default shall be final and binding on the Bank, notwithstanding any differences between the Authority and the Contractor, or any dispute between them pending before any court, tribunal, arbitrators or any other authority or body, or by the discharge of the Contractor for any reason whatsoever.
3. In order to give effect to this Guarantee, the Authority shall be entitled to act as if the Bank were the principal debtor and any change in the constitution of the Contractor and/or the Bank, whether by their absorption with any other body or corporation or

[1] Guarantee Amount for Performance Security and Additional Performance Security shall be calculated as per Contract.

otherwise, shall not in any way or manner affect the liability or obligation of the Bank under this Guarantee.

4. It shall not be necessary, and the Bank hereby waives any necessity, for the Authority to proceed against the Contractor before presenting to the Bank its demand under this Guarantee.

5. The Authority shall have the liberty, without affecting in any manner the liability of the Bank under this Guarantee, to vary at any time, the terms and conditions of the Contract or to extend the time or period for the compliance with, fulfillment and/ or performance of all or any of the obligations of the Contractor contained in the Contract or to postpone for any time, and from time to time, any of the rights and powers exercisable by the Authority against the Contractor, and either to enforce or forbear from enforcing any of the terms and conditions contained in the Contract and/or the securities available to the Authority, and the Bank shall not be released from its liability and obligation under these presents by any exercise by the Authority of the liberty with reference to the matters aforesaid or by reason of time being given to the Contractor or any other forbearance, indulgence, act or omission on the part of the Authority or of any other matter or thing whatsoever which under any law relating to sureties and guarantors would but for this provision have the effect of releasing the Bank from its liability and obligation under this Guarantee and the Bank hereby waives all of its rights under any such law.

6. This Guarantee is in addition to and not in substitution of any other guarantee or security now or which may hereafter be held by the Authority in respect of or relating to the Contract or for the fulfillment, compliance and/or performance of all or any of the obligations of the Contractor under the Contract.

7. Notwithstanding anything contained hereinbefore, the liability of the Bank under this Guarantee is restricted to the Guarantee Amount and this Guarantee will remain in force for the period specified in paragraph 8 below and unless a demand or claim in writing is made by the Authority on the Bank under this Guarantee all rights of the Authority under this Guarantee shall be forfeited and the Bank shall be relieved from its liabilities hereunder.

8. The Guarantee shall cease to be in force and effect on ****. Unless a demand or claim under this Guarantee is made in writing before expiry of the Guarantee, the Bank shall be discharged from its liabilities hereunder.

9. The Bank undertakes not to revoke this Guarantee during its currency, except with the previous express consent of the Authority in writing, and declares and warrants that it has the power to issue this Guarantee and the undersigned has full powers to do so on behalf of the Bank.

Any notice by way of request, demand or otherwise hereunder may be sent by post addressed to the Bank at its above referred branch, which shall be deemed to have been duly authorized to receive such notice and to effect payment thereof forthwith, and if sentby post it shall be deemed to have been given at the time when it ought to have been delivered in due course of post and in proving such notice, when given by post, it shall be sufficient to prove that the envelope containing the notice was posted and a certificate signed by an officer of the Authority that the envelope was so posted shall be conclusive.

10. This Guarantee shall come into force with immediate effect and shall remain in force and effect for up to the date specified in paragraph 8 above or until it is released earlier by the Authority pursuant to the provisions of the Contract.

11. This Guarantee is subject to the Uniform Rules for Demand Guarantees (URDG) 2010 Revision, ICC Publication No. 758, except that the supporting statement under Article 15(a) is hereby excluded.

12. This guarantee shall also be operatable at our ICICI Branch at Leh,UT of Ladakh, from whom, confirmation regarding the issue of this guarantee or extension / renewal thereof shall be made available on demand. In the contingency of this guarantee being invoked and payment there-under claimed, the said branch shall accept such invocation letter and make payment of amounts so demanded under the said invocation.

13. The guarantor/bank hereby confirms that it is on the SFMS (Structural Finance Messaging System) platform & shall invariably send an advice of this Bank Guarantee to the designated bank of [MoRT&H/NHAI/NHIDCL/State PWD/BRO], details of which is as under:

S.No.	Particulars	Details
1	Name of Beneficiary	National Highways & Infrastructure Development Corporation Limited NHIDCL UT Ladakh Project Account
2	Beneficiary Bank Account No.	362305000136
3	Beneficiary Bank Branch IFSC	ICIC0003623
4	Beneficiary Bank Branch Name	3623 Leh Ladakh Branch
5	Beneficiary Bank Address	ICICI Bank,Leh-194101

Signed and sealed this ……. day of ……., 20…… at ……..

SIGNED, SEALED AND DELIVERED
For and on behalf of the Bank by:
(Signature)
(Name)
(Designation)
(Code Number)
(Address)

FORM OF LETTER OF APPLICATION

To,

The Executive Director(P)
National Highways & Infrastructure Development Corporation Limited.
Yartsa House,Changspa Farm, Changspa,
Leh, UT of Ladakh-194101

Name of Work:Construction of 8 nos. Special T4 Staff Quarters and Staff hostel at Geyser Palace site, Leh in the Union Territory of Ladakh

Dear Sir,

Having examined the Bid Document, Instruction to Bidders Qualification Information, Scope of works, etc. for the subject work. We, hereby submit our technical and financial bid for the subject work.

It is certified that the information furnished in this document is true and correct. The proposal is unconditional and unqualified. We undersigned accept that NHIDCL reserves the right to reject any or all application without assigning any reason.

Thanking you,

Yours faithfully,

(Authorized Signatory)
For and on behalf of M/s_____

FORM OF LETTER OF ACCEPTANCE

No. ……. Dated ……..

To
M/s…….

Sub.: ……. Name of Work ……

Sir,

Based on your bid submitted on …….. in compliance of bidding document of NHIDCL for execution of the work of …….. , it is hereby notified that your bid for a contract price of **Rs…….** (**Rupees in words……)** has been accepted by the Competent Authority.

You are hereby requested to furnish unconditional Performance Security in the form detailed in para 33.2 of ITB for an amount equivalent to **Rs…….** (**Rupees in words……)** within 15 days as per provisions of clause 33.1 of ITB of the bid document and failing which the actions as stipulated in clause- 33.3 of ITB shall be taken. You are also required to sign the contract agreement within 7 days from the receipt of the valid performance security.

Thanking you,

Yours faithfully,

(……..)
Authorized Signatory

FORM OF AGREEMENT

AGREEMENT

This agreement made the _____day of _____ 20…..._____ between the National Highways & Infrastructure Development Corporation Limited, New Delhi (hereinafter called "the Executing Agency" of the one part and _____ (here in after called "the Contractor") of the other part.

AND WHEREAS the Executing Agency invited bids from eligible bidders for the execution of certain works, viz ……

AND WHEREAS pursuant to the bid submitted by the Contractor, vide _____ (here in after referred to as the "BID" or "ÖFFER") for the execution of works, the Executing Agency by his letter of acceptance dated _____ accepted the offer submitted by the Contractor for the execution and completion of such works and remedying of any defects thereon, on terms and conditions in accordance with the documents listed in para 2 below.

AND WHEREAS the Contractor by a deed of undertaking dated _____ has agreed to abide by all the terms of the bid, including but not limited to the amount quoted for the execution of Contract, as stated in the bid, and also to comply with such terms and conditions as may be required from time to time.

AND WHEREAS the contractor has agreed to undertake such works and has furnished a performance security pursuant to clause 33 of the instructions to bidders (Section-I).

NOW THIS AGREEMENT WITNESSETH as follows:

1. In this agreement words and expressions shall have the same meaning as are respectively assigned to them in the conditions of contract hereinafter referred to;

2. the following documents shall be deemed to form and be read and construed as part of this agreement viz.

    (a) Agreement,
    (b) Letter of Acceptance
    (c) Contractor's Bid including Financial Bid Form,
    (d) Contract Data,
    (e) Conditions of Contract
    (f) Scope of work & Technical specifications
    (g) List of Approved Makes of Materials
    (h) Drawings
    (i) Bill of Quantities, and
    (j) Any other document listed in the Contract Data.

3. The foregoing documents shall be construed as complementary and mutually explanatory one with another. Should any ambiguity or discrepancy be noted then the order of precedence of these documents shall be subject to the order as listed above and interpreted in the above order of priority.

4. In consideration of the payments to be made by the Executing Agency to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Executing Agency to execute and complete the works and remedy any defects therein in conformity in all respects with the provisions of the contract.

5. the Executing Agency hereby covenants to pay the contractor in consideration of the execution and completion of the works and remedying of defects therein, the contract price or such other sum as may become payable under the provisions of the contract at the times and in the manner prescribed by the contract.

IN WITNESS WHEREOF the parties here to have caused this agreement to be executed the day and year above written. Signed, sealed and delivered by the said Executing Agency through his Authorized Representative and the said Contractor through his Power of Attorney holder.

Binding Signature of Executing Agency _____

For and on behalf of National Highways & Infrastructure development Corporation Limited, New Delhi

Binding Signature of Contractor _____

For and on behalf of M/s. _____

In the presence of
1. Name :
Address:

2. Name :
Address:

In the Presence of
1. Name:
Address:

2. Name:
Address:

FORMAT FOR POWER OF ATTORNEY FOR SIGNING OF BID

Know all men by these presents, We **(name of the firm and address of the registered office)** do hereby irrevocably constitute, nominate, appoint and authorize Mr./Ms (name), son/daughter/wife of **(Name)** and presently residing at **(Address)**, who is presently employed with us/ the Lead Member of our Joint Venture and holding the position of **(Designation),** as our true and lawful attorney (hereinafter referred to as the "Attorney") to do in our name and on our behalf, all such acts, deeds and things as are necessary or required in connection with or incidental to submission of our BID for the Project proposed or being developed by the National Highways & Infrastructure Development Corporation Ltd. (the "Authority") including but not limited to signing and submission of all applications, BIDs and other documents and writings, participate in Pre-BID and other conferences and providing information/ responses to the Authority, representing us in all matters before the Authority, signing and execution of all contracts including the agreement and undertakings consequent to acceptance of our BID, and generally dealing with the Authority in all matters in connection with or relating to or arising out of our BID for the said Project and/ or upon award thereof to us and/or until the entering into of the Contract with the Authority.

AND we hereby agree to ratify and confirm and do hereby ratify and confirm all acts, deeds and things done or caused to be done by our said Attorney pursuant to and in exercise of the powers conferred by this Power of Attorney and that all acts, deeds and things done by our said Attorney in exercise of the powers hereby conferred shall and shall always be deemed to have been done by us.

IN WITNESS WHEREOF WE,……., THE ABOVE NAMED PRINCIPAL HAVE EXECUTED THIS POWER OF ATTORNEY ON THIS …… DAY OF ……. 2…..

For ……..
(Signature, name, designation and address)
of person authorized by Board Resolution
(in case of Firm/ Company)/ partner in case of Partnership

Witnesses:
firm
1.
2.

Accepted

…… (Signature)
(Name, Title and Address of the Attorney)

(Notarised)
Person identified by me/ personally appeared before me/
Attested/ Authenticated*
(*Notary to specify as applicable)
(Signature Name and Address of the Notary)

Seal of the Notary
Registration No. of the Notary
Date:……

Notes:

- *The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the*

executant(s) and when it is so required, the same should be under common seal affixed in accordance with the required procedure.

- *Wherever required, the Bidder should submit for verification the extract of the charter documents and documents such as a board or shareholders' resolution/ power of attorney in favour of the person executing this Power of Attorney for the delegation of power hereunder on behalf of the Bidder.*
- *For a Power of Attorney executed and issued overseas, the document will also have to be legalised by the Indian Embassy and notarised in the jurisdiction where the Power of Attorney is being issued. However, the Power of Attorney provided by Bidders from countries that have signed the Hague Legislation Convention 1961 are not required to be legalised by the Indian Embassy if it carries a conforming Appostille certificate.*

Bid Securing Declaration

(Refer Clause 16)

I hereby submit a declaration that the bid submitted by the undersigned, on behalf of the bidder, **[Name of the bidder],** either sole or in JV, shall not be withdrawn or modified during the period of validity i.e. not less than 180 (one hundred eighty) days from the bid due date.

I, on behalf of the bidder, **[Name of the bidder]**, also accept the fact that in case the bid is withdrawn or modified during the period of its validity or if we fail to sign the contract in case the work is awarded to us or we fail to submit a performance security before the deadline defined in clause 7 of the Request for Proposal (RFP), then **[Name of the bidder]**will be suspended for participation in the tendering process for the works of NHIDCL and works under other Centrally Sponsored Schemes, for a period of one year from the bid due date of this work.

(Signature of the Authorised Signatory)
(Official-Seal)

(SECTION –V)

CONDITIONS OF CONTRACT & CONTRACT DATA

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Section-V

Conditions of Contract

A. General

1. Definitions

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

Bill of Quantities means the priced and completed Bill of Quantities forming part of the Bid.

Compensation Events are those defined in Clause 41 hereunder.

The Completion Date is the date of completion of the Works as certified by the Engineer-in-Charge, in accordance with Clause 49.1.

The Contract is the Contract between the Executing Agency and the Contractor to execute, complete, and maintain the Works. It consists of the documents listed in Clause 2.3.

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

The Contractor is a person or corporate body whose Bid to carry out the Works has been accepted by the Executing Agency.

The Contractor's Bid is the completed bidding document submitted by the Contractor to the Executing Agency and includes technical and financial bids.

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

Days are calendar days; months are calendar months.

A **Defect** is any part of the Works not completed in accordance with the Contract.

The Defects Liability Certificate is the certificate issued by Engineer-in-Charge, after the Defect Liability Period has ended and upon correction of Defects by the Contractor.

The Defects Liability Period is the period named in contact data and calculated from the Completion Date.

Drawings include calculations and other information provided or approved by the Engineer-in-Charge for the execution of the Contract. Tender Drawings are the drawings enclosed with the RFP conveying indicative scope of the work .

Employer is Hospitality and Protocol Department , UT of Ladakh represented by its "Director".

The Executing Agency is the party (NHIDCL) as defined in the Contract Data, who employs the Contractor to carry out the Works. The Executing Agency may delegate any or all of its functions to a person or body nominated by him for specified functions.

The Engineer-in-Charge is the person named in the Contract Data (or any other competent person appointed by the Executing Agency and notified to the Contractor, to act in replacement of the Engineer-in-Charge) who is responsible for supervising the execution of the Works and administering the Contract.

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

The Initial Contract Price is the Contract Price listed in the Executing Agency's Letter of Acceptance.

The Intended Completion Date is the date on which it is intended that the Contractor shall complete the Works. The Intended Completion Date is specified in the Contract Data. The Intended Completion Date may be revised only by the Engineer-in-Charge by issuing an extension of time after the approval from Executing Agency.

Materials are all supplies, including consumables, used by the Contractor for incorporation in the Works.

Plant is any integral part of the Works that shall have a mechanical, electrical, electronic, chemical, or biological function.

Projectmeans complete scope of works forming part of contract.

The **Site** is the area defined as such in the Contract Data.

Site Investigation Reports are those that were included in the bidding documents and are factual interpretative reports about the surface and subsurface conditions at the Site.

Specification means the Specification of the Works included in the Contract and any modification or addition made or approved by the Engineer-in-Charge.

The **Start Date** is given in the Contract Data. It is the date when the Contractor shall commence execution of the Works. It does not necessarily coincide with any of the Site Possession Dates.

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

Temporary Works are works designed, constructed, installed, and removed by the Contractor that are needed for construction or installation of the Works.

A **Variation** is an instruction given by the Engineer-in-Charge after the approval from NHIDCL, which varies the Works.

The **Works** are what the Contract requires the Contractor to construct, install, maintain, and handover to the Executing Agency, as defined in the Contract Data.

2. Interpretation

2.1 In interpreting these Conditions of Contract, singular also means plural, male also means female or neuter, and the other way around. Headings have no significance. Words have their normal meaning under the language of the Contract unless specifically defined. The Engineer-in-Charge will provide instructions clarifying queries about these Conditions of Contract.

2.2 If sectional completion is specified in the Contract Data, references in the Conditions of Contract to the Works, the Completion Date, and the Intended Completion Date apply to any Section of the Works (other than references to the Completion Date and Intended Completion Date for the whole of the Works).

2.3 The documents forming the Contract shall be interpreted in the following order of priority.

(a) Agreement,
(b) Letter of Acceptance
(c) Contractor's Bid including Financial Bid Form,
(d) Contract Data,
(k) Conditions of Contract
(f) Scope of work& Technical specifications
(g) List of Approved Makes of Materials
(h) Drawings
(g) Bill of Quantities, and
(h) Any other document listed in the Contract Data.

3. Language and Law

3.1 The language of the Contract and the law governing the Contract are stated in the Contract Data.

4. Engineer-in-Charge's Decisions

4.1 Except where otherwise specifically stated, the Engineer-in-Charge will decide contractual matters between the Executing Agency and the Contractor in the role representing the Executing Agency.

5. Delegation

5.1 The Engineer-in-Charge, duly informing the Executing Agency, may delegate any of his duties and responsibilities to other people except to the Adjudicator, after notifying the Contractor, and may cancel any delegation after notifying the Contractor.

6. Communications

6.1 Communications between parties that are referred to in the Conditions shall be effective only when in writing. A notice shall be effective only when it is delivered.

7. Subcontracting

7.1 The Contractor may subcontract any portion of work, up to a limit specified in Contract Data, with the prior approval of the Executing Agency in writing. Subcontracting shall not alter the Contractor's obligations.

7.2 The Contractor shall not be required to obtain any consent from the Executing Agency for:

a. the sub-contracting of any part of the Works for which the Sub-Contractor is named in the Contract;
b. the provision of labour or labour component.
c. the purchase of Materials which are in accordance with the standards specified in the Contract.

9.3 Beyond what has been stated in clauses 7.1 and 7.2, if the Contractor proposes sub-contracting of any part of the work during execution of the Works, because of some unforeseen circumstances to enable him to complete the Works as per terms of the Contract, the Executing Agency will consider the following before according approval:

a) The Contractor shall not sub-contract the Works more than the limit specified in Contract Data.
b) The Contractor shall not sub-contract any part of the Work without prior consent of the Executing Agency. Any such consent shall not relieve the Contractor from any liability or obligation under the Contract and he shall be responsible for the acts, defaults and neglects of any of his sub-Contractor, his agents or workmen as fully as if they were the acts, defaults or neglects of the Contractor, his agents and workmen.

7.3 The Engineer-in-Charge should satisfy himself before recommending to the Executing Agency whether
a) the circumstances warrant such sub-contracting; and
b) the sub-Contractor so proposed for the Work possess the experience, qualifications and equipment necessary for the job proposed to be entrusted to him in proportion to the quantum of Works to be sub-contracted.

8. Other Contractors

8.1 The Contractor shall cooperate and share the Site with other Contractors, public authorities, utilities, and the Executing Agency between the dates given in the Schedule of Other Contractors, as referred to in the Contract Data. The Contractor shall also provide facilities and services for them as described in the Schedule. The Executing Agency may modify the Schedule of Other Contractors, and shall notify the Contractor of any such modification.

8.2 The Contractor should take up the works in convenient reaches as decided by the Engineer-in-Charge to ensure there is least hindrance to the smooth flow of traffic including movement of vehicles and equipment of other Contractors till the completion of the Works.

9. Personnel

9.1 The Contractor shall employ the technical personnel named in the Contract Data. The ED, NHIDCL will approve any proposed replacement of technical personnel (except Project Manager) only if their relevant qualifications and experience are substantially equal to or better than those of the personnel stated in the Contract Data. If the personnel stated in the contract data are not deployed on site by the contractor, a penalty of Rs. 50,000/- per month in case of Project Manager and Rs. 25,000/- in case of other key personnel will be imposed upto a maximum period of 3 months. Thereafter, it will be treated as a breach of contract and action will be taken as per clause 53. The replacement of Project Manager will be approved byEngineer-in-Charge in Charge after the approval of Competent Authority.

9.2 If the Engineer-in-Charge asks the Contractor to remove a person who is a member of the Contractor's staff or work force, stating the reasons, the Contractor shall ensure that the person leaves the Site within seven days and has no further connection with the Works in the Contract.

10. Executing Agency's and Contractor's Risks

10.1 The Executing Agency carries the risks which this Contract states are Executing Agency's risks, and the Contractor carries the risks which this Contract states are Contractor's risks.

11. Executing Agency's Risks

11.1 The Executing Agency is responsible for the excepted risks which are (a) in so far as they directly affect the execution of the Works in the Executing Agency’s country, the risks of war, hostilities, invasion, act of foreign enemies, rebellion, revolution, insurrection or military or usurped power, civil war, riot commotion or disorder (unless restricted to the Contractor’s employees), natural calamities and contamination from any nuclear fuel or nuclear waste or radioactive toxic explosive, or (b) a cause due solely to the design of the Works, other than the Contractor’s design.

12. Contractor's Risks

12.1 All risks of loss of or damage to physical property and of personal injury and death, which arise during and in consequence of the performance of the Contract other than the excepted risks, are the responsibility of the Contractor.

13. Insurance

13.1 The Contractor at his cost shall provide, in the joint names of the Executing Agency and the Contractor, insurance cover from the Start Date to the end of defect liability period for events (a) to (d), in the amounts and deductibles stated in the Contract Data for the following events which are due to the Contractor's risks:

a) Contractor’s All Risk Policy (CAR Policy)loss of or damage to the Works, Plant , Materials etc.;
b) loss of or damage to Equipment;
c) loss of or damage to property (except the Works, Plant, Materials, and Equipment) in connection with the Contract; and

d) Personal injury or death.

13.2 Insurance policies and certificates for insurance shall be delivered by the Contractor to the Engineer-in-Charge for the Engineer-in-Charge's approval before the Start Date. All such insurance shall provide for compensation to be payable in Indian Rupees to rectify the loss or damage incurred.

13.3 If the Contractor does not provide any of the policies and certificates required, the Executing Agency may affect the insurance which the Contractor should have provided and recover the premiums the Executing Agency has paid from payments otherwise due to the Contractor or, if no payment is due, the payment of the premiums shall be debt due.

13.4 Alterations to the terms of insurance shall not be made without the approval of the Engineer-in-Charge.

13.4 Both parties shall comply with any conditions of the insurance policies.

14. Site Investigation Reports

14.1 The Contractor, in preparing the Bid, may rely on any Site Investigation Reports referred to in the Contract Data, if any, supplemented by any other information available to him, before submitting the bid. However, at the time of execution, the contractor shall carry out necessary site sub-soil investigation for design of the foundations in consultation with the Engineer-in-Charge.

15. Queries about the Contract Data

15.1 The Executive Director(P),RO-Ladakh NHIDCL will clarify queries on the Contract Data.

16. Contractor to Construct the Works & maintenance during defect liability.

16.1 The Contractor shall construct, install and maintain the Works during defect liability period in accordance with the documents forming part of the contract. No payment for maintenance during defect liability period is payable.

17. The Works to Be Completed by the Intended Completion Date

17.1 The Contractor may commence execution of the Works on the Start Date and shall carry out the Works in accordance with the Programme submitted by the Contractor, as updated with the approval of the Engineer-in-Charge, and complete them by the Intended Completion Date.

18. Approvals

18.1 The Contractor shall submit Specifications, Design and Drawings including quantities of each item showing the proposed Works to the Engineer-in-Charge within 15 days of signing of Contract Agreement, who shall approve them after proof checking within 7 days, if they comply with specifications and drawings.

18.2 The Contractor shall be responsible for detailed design and drawing of allthe Works.

18.3 The Engineer-in-Charge's approval shall not alter the Contractor's responsibility for design of all Works.

18.4 The Contractor shall obtain approval of third parties to the design of all the Works, where required, as directed by the Engineer-in-Charge.**The structural design of the buildings shall be made considering Seismic Zone V .**The contractor shall arrange vetting of structural design and drawings from approved Government Institute like IITs/NITs/Government Engineering College, at his own cost.

18.5 All Drawings prepared by the Contractor for the execution of the temporary or permanent Works, are subject to prior approval by the Engineer-in-Charge before their use.

18.6 The Contractor shall construct the structures as per contract specifications and as per the design approved by the Engineer-in-Charge. In case of any deficiencies, the same will be intimated to the contractor for rectification.

18.7 The Contractor shall submit shop drawings of all items procured from approved vendors/manufacturer's and obtain approval of Engineer-in-Charge before procurement to site.

19. Safety

19.1 The Contractor shall be responsible for the safety of all activities on the Site.

20. Discoveries

20.1 Anything of historical or other interest or of significant value unexpectedly discovered on the Site shall be the property of the Executing Agency. The Contractor shall notify the Engineer-in-Charge of such discoveries and carry out the Engineer-in-Charge's instructions for dealing with them.

21. Possession of the Site

21.1 The Executing Agency shall give complete possession of the Site to the Contractor on the date of signing of agreement.

22. Access to the Site

22.1 The Contractor shall allow access to the Site and to any place where work in connection with the Contract is being carried out, or is intended to be carried out and to any place where material or plant are being manufactured /fabricated / assembled for the works to the Engineer-in-Charge and any person/persons/agency authorized by:

a. The Executing Agency
b. The Engineer-in-Charge

23. Instructions

23.1 The Contractor shall carry out all instructions of the Engineer-in-Charge, which comply with the applicable laws where the Site is located.

23.2 The Contractor shall permit the Executing Agency to inspect the Contractor's accounts and records relating to the performance of the Contractor and to have them audited by Auditors appointed by the Executing Agency if so required by the Executing Agency.

24. Maintenance

24.1 The contractor shall maintain the buildings/structure during the defect liability period of **One (1) year**which is reckoned from the actual recorded date of completion of the project. No separate payment will be made to the contractor for maintenance during the defect liability period.

25. Dispute and Arbitration

25.1 Dispute Resolution

(i) Any dispute, difference or controversy of whatever nature howsoever arising under or out of or in relation to this Agreement (including its interpretation) between the Parties, and so notified in writing by either Party to the other Party (the "Dispute") shall, in the first instance, be attempted to be resolved amicably in accordance with the conciliation procedure set forth in Clause 25.2.

(ii) The Parties agree to use their best efforts for resolving all Disputes arising under or in respect of this Agreement promptly, equitably and in good faith, and further agree to provide each other with reasonable access during normal business hours to all non-privileged records, information and data pertaining to any Dispute.

25.2 Conciliation

In the event of any Dispute between the Parties, either Party may call upon the Authority's Engineer-in-Charge, or such other person as the Parties may mutually agree upon (the "Conciliator") to mediate and assist the Parties in arriving at an amicable settlement thereof. Failing mediation by the Conciliator or without the intervention of the Conciliator, either Party may require such Dispute to be referred to the Chairman of the Authority and the Chairman of the Board of Directors of the Contractor for amicable settlement, and upon such reference, the said persons shall meet no later than 7 (seven) business days from the date of reference to discuss and attempt to amicably resolve the Dispute. If such meeting does not take place within the 30 (thirty) business day period or the Dispute is not amicably settled within 30 (thirty) days of the meeting or the Dispute is not resolved as evidenced by the signing of written terms of settlement within 30 (thirty) days of the notice in writing referred to in Clause 25.1. or such longer period as may be mutually agreed by the Parties, either Party may refer the Dispute to arbitration in accordance with the provisions of Clause 25.3 but before resorting to such arbitration, the parties agree to explore conciliation by the Conciliation Committees of Independent Experts set up by the Authority in accordance with the procedure decided by the panel of such experts and notified by the Authority on its website including its subsequent amendments. In the event of the conciliation proceedings being successful, the parties to the dispute would sign the written settlement agreement and the conciliators would authenticate the same. Such settlement agreement would then be binding on the parties

in terms of Section 73 of the Arbitration Act. In case of failure of the conciliation process even at the level of the Conciliation Committee, either party may refer the Dispute to arbitration in accordance with the provisions of Clause 25.3.

25.3 Arbitration

(i) Any dispute which remains unresolved between the parties through the mechanisms available/ prescribed in the Agreement, irrespective of any claim value, which has notbeen agreed upon/ reached settlement by the parties, will be referred to the Arbitral Tribunal as per the Arbitration and Conciliation Act.

(ii) Deleted

(iii) The Arbitral Tribunal shall make a reasoned award (the "Award"). Any Award made in any arbitration held pursuant to this Clause 25 shall be final and binding on the Parties as from the date it is made, and the Contractor and the Authority agree and undertake to carry out such Award without delay.

(iv) The Contractor and the Authority agree that an Award may be enforced against the Contractor and/or the Authority, as the case may be, and their respective assets wherever situated.

(v) This Agreement and the rights and obligations of the Parties shall remain in full force and effect, pending the Award in any arbitration proceedings hereunder. Further, the parties unconditionally acknowledge and agree that notwithstanding any dispute between them, each Party shall proceed with the performance of its respective obligations, pending resolution of Dispute in accordance with this Article.

(vi) In the event the Party against whom the Award has been granted challenges the Award for any reason in a court of law, it shall make an interim payment to the other Party for an amount equal to 75% (seventy five per cent) of the Award, pending final settlement of the Dispute. The aforesaid amount shall be paid forthwith upon furnishing an irrevocable Bank Guarantee for a sum equal to 120 % (one hundred and twenty per cent) of the aforesaid amount. Upon final settlement of the Dispute, the aforesaid interim payment shall be adjusted and any balance amount due to be paid or returned, as the case may be, shall be paid or returned with interest calculated at the rate of 10% (ten per cent) per annum from the date of interim payment to the date of final settlement of such balance.

25.4 Adjudication by Regulatory Authority, Tribunal or Commission

In the event of constitution of a statutory regulatory authority, tribunal or commission, as the case may be, with powers to adjudicate upon disputes between the Contractor and the Authority, all Disputes arising after such constitution shall, instead of reference to arbitration under Clause 25.3, be adjudicated upon by such regulatory authority, tribunal or commission in accordance with the Applicable Law and all references to Dispute Resolution Procedure shall be construed accordingly. For the avoidance of doubt, the Parties hereto agree that the adjudication hereunder shall not be final and binding until an appeal against such adjudication has been decided by an appellate tribunal or court of competent jurisdiction, as the case may be, or no such appeal has been preferred within the time specified in the Applicable Law.

26 Deleted

B. Time Control

27. Programme

27.1 The Engineer-in-Charge shall issue a Notice to Proceed for all the site locations to the contractor immediately after signing of agreement. The Contractor shall submit to the Engineer-in-Charge for approval a programme within **7 days from the signing of the Contract Agreement for each site separately,** showing the general methods, arrangements, order, and timing for all the activities in the Works, along with monthly cash flow forecasts.

27.2 An update of the Programme shall be a programme showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining Works, including any changes to the sequence of the activities.

27.3 The Contractor shall submit to the Engineer-in-Charge for approval an updated Programme at intervals. If the Contractor does not submit an updated Programme within this period, the Engineer-in-Charge may withhold the amount stated in the Contract Data from the next payment certificate and continue to withhold this amount until the next payment after the date on which the overdue Programme has been submitted.

27.4 The Engineer-in-Charge's approval of the Programme shall not alter the Contractor's obligations. The Contractor may revise the Programme and submit it to the Engineer-in-Charge again at any time. A revised Programme shall show the effect of Variations and Compensation Events.

28. Extension of the Intended Completion Date

28.1 The Engineer-in-Charge shall extend the Intended Completion Date only after the approval of NHIDCL if a Compensation Event occurs or a Variation is issued which makes it impossible for Completion to be achieved by the Intended Completion Date without the Contractor taking steps to accelerate the remaining Works, which would cause the Contractor to incur additional cost.

28.2 The Engineer-in-Charge shall decide whether and by how much time to extend the Intended Completion Date within 21 days of the Contractor asking the Engineer-in-Charge for a decision upon the effect of a Compensation Event or Variation and submitting full supporting information. If the Contractor has failed to cooperate in dealing with a delay, the delay by this failure shall not be considered in assessing the new intended Completion Date.

29. Delays Ordered by the Engineer-in-Charge

29.1 The Engineer-in-Charge may instruct the Contractor to delay the start or progress of any activity within the Works.

30. Management Meetings

30.1 Either the Engineer-in-Charge or the Contractor may require the other to attend a management meeting. The business of a management meeting shall be to review the plans for the remaining Works and to deal with matters raised in accordance with the early warning procedure.

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

C. Quality Control

31. Identifying Defects

31.1 The Engineer-in-Charge shall check the Contractor's work and notify the Contractor of any Defects that are noticed. Such checking shall not absolve the contractor from its obligations and its responsibilities. The Engineer-in-Charge may instruct the Contractor to search for a Defect and to uncover and test any work (existing work/work executed by the contractor) that the Engineer-in-Charge considers may have a Defect.

32. Tests

32.1 The contractor shall be solely responsible for:

a. Carrying out the mandatory tests prescribed in the CPWD Specifications 2019 (volume-I and volume II) and technical specifications forming part of contract.
b. For the correctness of the test results, whether preformed in his laboratory or elsewhere.
c. All charges related to cost of samples, transportation to third party lab and testing charges are deemed to be included in the Contract Price of Contractor and hence will not be reimbursed by Executing Agency.
d. The Authority may engage third party for testing of executed items. The payment for the same would be made by the Authority.

32.2 If the Engineer-in-Charge instructs the Contractor to carry out a test not specified in the Specification to check whether any work (executed by the contractor) has a Defect and the test shows that it does, the Contractor shall pay for the test and any samples. If there is no defect, the cost of such tests shall be borne by the Authority otherwise by the Contractor.

33. Correction of Defects noticed during the Defect Liability Period.

33.1 The Engineer-in-Charge shall give notice to the Contractor of any Defects before the end of the Defects Liability Period, which begins from the next day of Actual Recorded Date of Completion of Project and as defined in the Contract Data. The Defects Liability Period shall be extended for as long as Defects remain to be corrected.

33.2 Every time notice of a Defect is given, the Contractor shall correct the notified Defect within the reasonable time specified by the Engineer-in-Charge's notice as per good industry practice. If any defect including shrinkage cracks, other

faults appears in the work within defect liability period, the Engineer-in-Charge shall give Notice to the Contractor of such defects before end of defect liability period and shall extend the defect liability period as long as defects remain to be corrected.

34. Uncorrected Defects/ Incomplete Works

34.1 If the Contractor has not corrected the Defect, to the satisfaction of the Engineer-in-Charge, within the time specified in the Engineer-in-Charge's notice/indent, the Engineer-in-Charge will assess the cost of having the Defect corrected and get the defects rectified through some other agency at the risk and cost of the Contractor and the Contractor will pay 1.2 times of this amount.

34.2 If the Contractor has not completed the work to the satisfaction of the Engineer-in-Charge, within the time specified in the Engineer-in-Charge's notice/indent, in no case exceeding one month, the Engineer-in-Charge will assess the cost of having the work completed and get the work completed through some other agency and the Contractor will pay this amount in addition to the damages specified as per clause 45.

D. Cost Control

35. Bill of Quantities

35.1 The Bill of Quantities to be submitted by the Contractor along with financial bid shall be for lumpsum cost for the construction, installation, testing, and commissioning of all components of the whole project and for comprehensive annual maintenance contract of the E&M system/equipments during the four year period beyond the one year Defect Liability Period ,to be done by the Contractor.

35.2 **Lumpsum cost quoted by the contractor will be the Contract Price.** The Contractor is paid as per clause 40.2 for **work done in accordance with the percentage weightage of each item as per Payment Schedule mentioned below:**

Payment Schedule

1.1 The Contract Price (exclusive of GST) for this EPC Agreement is **Rs. ……Crore.**

1.2 The Contractor shall enclose the computerized measurements (three copies) of all items of work executed(sub-head –wise and building-wise) till the date of submission of running bills for verification by Engineer-in-Charge and record.

1.3 Proportions of the Contract Price for different stages of Construction of the each building/structure shall be as specified below:

Item	Weightage in percentage to the Contract Price	Stage for Payment	Percentage weightage to Particular item (col.2)
1	2	3	4
One building block having two units of	7.31	**(1) Civil Works**	**47.54%**
		a) Earth Work	1.02%

Item	Weightage in percentage to the Contract Price	Stage for Payment	Percentage weightage t o Particular item (col.2)
1	2	3	4
Special Type-4 residential quarters at Geyser Palace Site ,Leh**(Building No.1)**		b) Plain Cement Concrete Work	2.09%
		c) Reinforcement Cement Concrete Work	11.70%
		d) Reinforcement Steel Work	11.30%
		e) Masonry Work	10.95%
		f) Water Proofing Work,Terrace over deck insulation and tile flooring	10.48%
		(2) Architectural Works	**40.47%**
		a) Plaster	4.52%
		b) Tile Flooring and Dado	9.44%
		c) Painting and finishing	2.97%
		d) Doors, Windows, ventilators, Wet Cladding on Façade	14%
		e) Wood work of modular kitchen and cupboards in all rooms	6.29%
		f) False ceiling	3.25%
		(3) PHE Works	**3.32%**
		(4) Electrical Works	**5.07%**
		(5) Fire Fighting Works	**0.00%**
		(6) Radiant Heating Works	**3.60%**
One building block having two units of Special Type-4 residential quarters at Geyser Palace Site ,Leh**(Building No.2)**	7.31	**(1) Civil Works**	**47.54%**
		a) Earth Work	1.02%
		b) Plain Cement Concrete Work	2.09%
		c)Reinforcement Cement Concrete Work	11.70%
		d)Reinforcement Steel Work	11.30%
		e) Masonry Work	10.95%
		f) Water Proofing Work,Terrace over deck insulation and tile flooring	10.48%
		(2) Architectural Works	**40.47%**
		a) Plaster	4.52%
		b)Tile Flooring and Dado	9.44%
		c)Painting and finishings	2.97%

Item	Weightage in percentage to the Contract Price	Stage for Payment	Percentage weightage t o Particular item (col.2)
1	2	3	4
		d) Doors, Windows, ventilators, Wet Cladding on Façade	14%
		e) Wood work of modular kitchen and cupboards in all rooms	6.29%
		f) False ceiling	3.25%
		(3) PHEWorks	**3.32%**
		(4) Electrical Works	**5.07%**
		(5) Fire Fighting Works	**0.00%**
		(6) Radiant Heating Works	**3.60%**
One building block having two units of Special Type-4 residential quarters at Geyser Palace Site ,Leh**(Building No.3)**	7.31	**(1) Civil Works**	**47.54%**
		a) Earth Work	1.02%
		b) Plain Cement Concrete Work	2.09%
		c) Reinforcement Cement Concrete Work	11.70%
		d) Reinforcement Steel Work	11.30%
		e) Masonry Work	10.95%
		f) Water Proofing Work,Terrace over deck insulation and tile flooring	10.48%
		(2) Architectural Works	**40.47%**
		a) Plaster	4.52%
		b) Tile Flooring and Dado	9.44%
		c) Painting and finishing	2.97%
		d) Doors, Windows, ventilators, Wet Cladding on Façade	14%
		e) Wood work of modular kitchen and cupboards in all rooms	6.29%
		f) False ceiling	3.25%
		(3) PHE Works	**3.32%**
		(4) Electrical Works	**5.07%**
		(5) Fire Fighting Works	**0.00%**
		(6) Radiant Heating Works	**3.60%**

Item	Weightage in percentage to the Contract Price	Stage for Payment	Percentage weightage t o Particular item (col.2)
1	2	3	4
One building block having two units of Special Type-4 residential quarters at Geyser Palace Site ,Leh**(Building No.4)**	7.31	**(1) Civil Works**	**47.54%**
		a) Earth Work	1.02%
		b) Plain Cement Concrete Work	2.09%
		c) Reinforcement Cement Concrete Work	11.70%
		d) Reinforcement Steel Work	11.30%
		e) Masonry Work	10.95%
		f) Water Proofing Work,Terrace over deck insulation and tile flooring	10.48%
		(2) Architectural Works	**40.47%**
		a) Plaster	4.52%
		b) Tile Flooring and Dado	9.44%
		c) Painting and finishings	2.97%
		d) Doors, Windows, ventilators, Wet Cladding on Façade	14%
		e) Wood work of modular kitchen and cupboards in all rooms	6.29%
		f) False ceiling	3.25%
		(3) PHE Works	**3.32%**
		(4) Electrical Works	**5.07%**
		(5) Fire Fighting Works	**0.00%**
		(6) Radiant Heating Works	**3.60%**
Construction of Staff Hostel building at Geyser Palace, Leh	32.88	**(1) Civil Works**	**41.86%**
		a) Earth Work	1.23%
		b) Plain Cement Concrete Work	1.12%
		c) Reinforcement Cement Concrete Work	14.10%
		d) Reinforcement Steel Work	11.06%
		e) Masonry Work	8.90%
		f) Waterproofing, Terrace over deck insulation and tile flooring	5.45%

Item	Weightage in percentage to the Contract Price	Stage for Payment	Percentage weightage t o Particular item (col.2)
1	2	3	4
		(2) Architectural Works	**42.00%**
		a) Plaster	2.10%
		b) Tile Flooring and Dado	3.00%
		c) Painting and finishings	2.90%
		d) Doors, Windows, ventilators, Wet Cladding on Façade, structural glazing	15%
		e) Wood work of modular kitchen and cupboards in all rooms	9.0%
		f) Wood Work-false ceilings in all rooms, wall paneling and wooden flooring in executive rooms	10%
		(3) PHE Works	**4.30%**
		(4) Electrical Works	**6.55%**
		(5) Fire Fighting Works	**0.64%**
		(6) Radiant Heating Works	**4.65%**
External Services for Special T4 Staff Quarters and Staff Hostel project **External civil work, pneumatic water supply, drainage services, external electrical installations like lighting, sub-station (transformers etc.),DG sets,earthing ,Fire fighting system, underground water sumps for fire**	35.77	**(1)External PHE incl. solar water heating works ,borewells, bio-digestors ,rainwater harvesting Services etc.**	**20.11%**
		a) External Sewage lines	2.07%
		b) External Storm water Drain work	2.74%
		c) External Water Supply Lines	0.56%
		d) Rain Water harvesting (2 nos)	0.75%
		e) External Irrigation work	0.67%
		f) Borewells (2 nos)	0.49%
		g) Bio-digestors(2nos.)	2.09%
		a) Pneumatic Water pumping System	3.43%
		b) Solar Water Heating System	7.31%

Item	Weightage in percentage to the Contract Price	Stage for Payment	Percentage weightage t o Particular item (col.2)
1	2	3	4
water and domestic requirements,Bio-digestors for sewage treatment, Radiant Heating Plant with complete system comprising heat pumps, boilers, HSD tanks, ventilation/heating, pumps, hot water tanks, piping network etc., internal roads of the site along with necessary road markings & signages, foot paths,car parking, borewells , CCTV surveillance system for staff hostel,solar compound lighting, shuttle/badminton courts, landscaping and hardscaping etc complete as per the scope of work, finishes matrix,tender drawings, schedule of quantities,special conditions of contract and as per the approved design, drawings and specifications		**(2) External Electrical Services**	**35.69%**
		a) SITC of 11 Kv 3 HT panel board	1.00%
		b) SITC of Transformers(2x630 KVA)	2.75%
		c) SITC of Servo Stabilizers (2x 630 KVA)	3.50%
		d) SITC of Diesel Generators(2x750 KVA)	11.70%
		e) SITC of MV Panels	8.94%
		f) SITC of Safety & Testing Equipments	0.12%
		g) SITC of HV,MV Panels	6.38%
		h) SITC of Solar (5 Kwp) compound lighting	0.30%
		i) Other enabling works	1.00%
		(3) Radiant Heating System (HVAC) Services	**26.28%**
		a) SITC of Radiant heating equipment i.Heat pumps ii. Boilers iii.Pumping system, Micro bubble & dirt strainers iv. AHUs v. HSD storage tanks vi. Others	 14.32% 1.46% 1.95% 0.46% 0.26% 0.59%
		b) SITC of pumps & piping work	2.84%
		c) SITC of Electrical work	2.43%
		d) SITC of Mechanical Ventilation	1.15%
		e) SITC of Air distribution	0.82%
		(4)Internal Roads , footpaths, car parking, shuttle/badminton courts	**17.92%**

Item	Weightage in percentage to the Contract Price	Stage for Payment	Percentage weightage to Particular item (col.2)
1	2	3	4
		,hardscaping ,plinth protection of buildings, Landscaping,	
		a) Internal Roads i. Subgrade,GSB&WMM ii. DBM &BC iii. Footpfath,drains,sign ages, car parking	2.00% 2.23% 0.70%
		b) Plant Room of HVAC	10.53
		c) Landscaping,Shuttle & Badminton courts, Hardscaping and other enabling works	2.46%
*Comprehensive Annual Maintenance (CAMC) of complete Radiant Heating System, Sub-station(transformers etc), DGs, Lift of the project for Five(5) years beginning from the commencement of Defects Liability Period(DLP) of one year from the date of actual recorded date completion of the project	2.11	During One Year of Defect Liability Period (DLP)	Nil
		For the Year one(For the period of twelve months commencing from the next day of end date of DLP)	0.5275%
		For the Year Two(For the period of twelve months commencing from the next day of end date of Year One CAMC)	0.5275%
		For the Year Three(For the period of twelve months commencing from the next day of end date of Year Two CAMC)	0.5275%
		For the Year Four(For the period of twelve months commencing from the next day of end date of Year Three CAMC)	0.5275%

***The contractor has furnish performance security in form of bank guarantee in specified format for an amount equal to 10% of the total CAMC charges quoted**

by him for four years CAMC period beyond the free AMC during one year DLP. The BG shall be submitted after declaration of actual recorded date of completion of the project.

36. Variations

36.1 Change in executed quantities either w.r.t. the Schedule of Quantities enclosed with the bid documents (Cost Estimate) or the quantities submitted by the contractor as per his design & drawings and approved by the Engineer-in-Charge shall not constitute variation or Change of Scope (COS). However, for any new items to be executed by the contractor as per the directions and approval of the Engineer-in-Charge will be considered as variation or change in scope for which Engineer-in-Charge will issue a notice to the contractor.

36.2 In case of change in design of the building by the Executing Agency or by the Engineer-in-Charge due to which the floor area increases or new building is asked to construct, the cost of new building/structure in such cases shall be dealt on the basis of quoted rates/cost of the nearest building under the contract.

37. Payments for Variations

The Contractor shall, within 14 days of the issue of order of Variation work, inform the Engineer-in-Charge, the rate which he proposes to claim, supported by analysis of the rates. The Engineer-in-Charge shall assess the quotation, analysis and determine the rate based on prevailing market rates within 15 days of the submission of the claim by the Contractor and approval from NHIDCL will be taken. As far as possible, the rate analysis shall be based on the CPWD Analysis of Rates (DAR) and the current schedule of rates of the district public works division/CPWD DSR.

38. Cash Flow Forecasts

38.1 When the Programme is updated, the Contractor shall provide the Engineer-in-Charge with an updated cash flow forecast.

39. Payment Certificates

39.1 The Contractor shall submit to the Engineer-in-Charge in accordance of clause 40.2 the value of the work executed with supporting documents.

39.2 The Engineer-in-Charge shall check the Contractor's statement within 7 days and certify the amount to be paid to the Contractor after taking into account any credit or debit for the month in question.

39.3 The value of work executed shall be determined, based on measurements submitted along with the running bills duly certified by the Engineer-in-Charge.

39.4 The value of work executed shall comprise the value of the quantities of the items executed in accordance with the payment schedule.

39.5 The value of work executed shall also include the valuation of Variations and Compensation Events.

39.6 The Engineer-in-Charge may exclude any item certified in a previous certificate or reduce the proportion of any item previously certified in any certificate in the light of later information to rectify the mistakes with detail justification acceptable to Executing Agency.

39.7 The final bill of the work shall be submitted by the contractor within one month of the recorded date of completion of the work; otherwise the Engineer-in-Charge certificate of the measurement and of the total amount payable for work accordingly shall be final and payment made accordingly within a period of sixty days.

40. Payments

40.1 Payments shall be adjusted for deductions for mobilization payments, 5% security deposit(retention money), other recoveries in terms of the Contract and taxes at source, as applicable under the law. The Executing Agency shall pay the Contractor the amounts Engineer-in-Charge had certified within 14 days of the date of each certificate.

40.2 The contractor shall submit to the Engineer-in-Charge bill in three copies and the Executing Agency shall make the payment certified by the Engineer-in-Charge.

40.3 The Contractor shall submit to the Engineer-in-Charge a bill prepared in accordance with the approved quantities and as per the Payment Schedule attached as Annexure-IV for the work executed for each building/structure(Special T4 Building no.1 to Building No.4 Staff Hostel building, Services). The minimum value of work of all the executed items for each building/Services should be 5% of the Total Cost (Civil, Architectural, Electrical,HVAC, PHE & Fire Fighting) of that building/structure for the purpose of claiming of running bill.

40.4 No escalation is payable on the Contract Price due to increase of prices of construction materials and minimum wages of labour. The Contract Price shall remain firm .Additional payment over and above the Contract Price shall be allowed only in case of notified variations by Engineer-in-Charge at approved rates.

40.5 GST charges at applicable rates on the actual value of the work done in every running bill shall be reimbursed subject to furnishing documentary evidence of having paid to Government the GST charges reimbursement paid in the previous bill. The documentary evidence shall be specific to the work.

41. Compensation Events

41.1 The following shall be Compensation Events unless they are caused by the Contractor:

a) The Engineer-in-Charge orders a delay or does not issue/approve drawings, specifications or instructions required for execution of works in reasonable time.

b) The Engineer-in-Charge gives an instruction for dealing with an unforeseen condition, caused by the Executing Agency, or additional work required for safety or other reasons.
c) Other contractors, public authorities, utilities or the Executing Agency does not work within the dates and other constraints stated in the Contract, and they cause delay or extra cost to the Contractor.

41.2 If a Compensation Event would prevent the Works being completed before the Intended Completion Date, the Intended Completion Date shall be extended. The Engineer-in-Charge shall decide whether and by how much the Intended Completion Date shall be extended after the approval of the Executing Agency.

41.3 The contractor shall not be entitled to compensation to the extent that the Executing Agency's interests are adversely affected by the Contractor not having given early warning or not having cooperated with the Engineer-in-Charge/Executing Agency.

42. Currencies for payments

All payments will be made in Indian Rupees.

43. Deleted

44. Security Deposit / Retention Money

44.1 The Executing Agency shall retain security deposit of five percent of the amount from each payment due to the Contractor until Completion of the whole of the Works.

44.2 The security deposit/retention money (5%) and the performance security(3%) will be released to the Contractor when the Defect Liability period is over, and the Engineer-in-Charge has certified that the Defects, if any, notified by the Engineer-in-Charge to the Contractor before the end of this period have been corrected.

44.3 If the contractor so desires then the Security Deposit/retention money can be released on submission of unconditional Bank Guarantee at the following two stages:-
(a) At a point after the progress of work in financial term (gross value of work done) has reached 50% of the contract amount
(b) After the retention money has been deducted to the full value (5% of the Contract Amount).

45. Liquidated Damages

45.1 The Contractor shall pay liquidated damages to the Executing Agency at the rate or part thereof stated in the Contract Data for each day that the Completion Date is later than the Intended Completion Date. The total amount of liquidated damages shall not exceed the amount defined in the Contract Data. The Executing Agency may deduct liquidated damages from payments due to the Contractor and/ or Performance Bank Guarantee. Payment of liquidated damages shall not affect the Contractor's other liabilities.

45.2 If the Intended Completion Date is extended after liquidated damages have been paid, the Engineer-in-Charge shall correct any overpayment of liquidated damages by the Contractor by adjusting in the next payment certificate. The contractor shall not be paid interest on the over payment of liquidated damages.

46. Advance Payment

46.1 **Mobilization Advance:**

The Authority shall make an interest-bearing advance payment (the "Advance Payment") @ "Bank Rate + 3%", not exceeding 10 % (ten percent) of the Contract Price, exclusively for mobilization expenses, if requested by the contractor in writing within one month of the order to commence the work. "Bank Rate" means the standard rate at which Reserve Bank of India is prepared to buy or re-discount bills of exchange or other commercial paper eligible for purchase under the Reserve Bank of India Act 1934

The Advance Payment for mobilization expenses shall be made in two installments each equal to 5% (five percent) of the Contract Price. The second 5% (five percent) mobilization advance would be released after submission of utilization certificate by the Contractor for the first 5% (five per cent) advance already released earlier.

The Contractor may apply to the Authority for the first installment of the Advance Payment at any time after issuance of order to commence the work, along with an irrevocable and unconditional guarantee from a Bank for an amount equivalent to 110% (one hundred and ten percent) of such installment, substantially in the form provided at Annexure-I, to remain effective till the complete and full repayment thereof. The recovery of mobilization advance shall be effected on achieving financial progressof 10% and fully recovered on achieving 80% financial progress on pro-rata basis along with interest.

46.2 **Secured Advance against Materials** :

Deleted

47. Securities

47.1 Subject to further condition in contract data, the Performance Security equal to **Three(3%) percent** of the contract price shall be provided to the Executing Agency no later than the date specified in the Letter of Acceptance and shall be issued in the form given in the Contract Data and by a prescribed bank. The Performance Security shall be valid until a date 28 days after the expiry of Defect Liability Period .The validity shall account for additional 45 days time to account for BG verification, signing of contract and start date

48 Cost of Repairs

48.1 Loss or damage to the Works or Materials to be incorporated in the Works between the Start Date and the end of the Defects Liability Period shall be remedied/ rectified by the Contractor at their cost if the loss or damage arises from the Contractor's acts or omissions.

E. Finishing the Contract

49. Completion

49.1 When the whole of the works has been completed as per the provision of the Contract, the Contractor shall request the Engineer-in-Charge to issue a certificate of Completion of the Project. The Engineer-in-Charge shall, within 14 days of the date of receipt of such request, either issue to the Contractor, with a copy to the Executing Agency, a completion certificate, recording the date on which, the project was completed in accordance with the contract, or give instructions in writing to the contractor specifying all the works which, in the Engineer-in-Charge's opinion, is required to be done by the Contractor before the issue of such completion certificate.

50. Taking Over

50.1 The Executing Agency shall take over the Site and the Works within fifteen days of the Engineer-in-Charge's issuing a certificate of Completion.

51. Final Account

The Contractor shall supply to the Engineer-in-Charge with a detailed account of the total amount that the Contractor considers payable under the Contract before the end of the Defects Liability Period. The Engineer-in-Charge shall issue a Defects Liability Certificate and certify any final payment that is due to the Contractor within 56 days of receiving the Contractor's account if it is correct and complete. If it is not, the Engineer-in-Charge shall issue within 56 days a schedule that states the scope of the corrections or additions that are necessary. If the Final Account is still unsatisfactory after it has been resubmitted, the Engineer-in-Charge shall decide on the amount payable to the Contractor and issue a payment certificate within 56 days of receiving the Contractor's revised account.

For carrying out the comprehensive annual maintenance of the contract, the Executive Agency will draw a supplementary agreement with the contractor with a time period of Five(5) years wef recorded date of completion of work. The Contractor shall render CAMC services free of cost during the one year period of defect liability period. There-after, the Contractor shall be paid for CAMC services for next four years at the quoted rates .The payment for the CAMC service shall be made every quarter in equal instalments of the rate quoted for the particular year.

The format of supplementary agreement is enclosed with the tender documents in Section-X.

52. "As built" Drawings

TheContractor is required to submit 'As Built Drawing' for the work executed before release of final bill payment.If the Contractor does not supply the "As Built' Drawings and/or manuals by the stipulated date or they do not receive the Engineer-in-Charge's approval, the Engineer-in-Charge shall withhold the amount equal to Rs. 5 lakhs from payments due to the Contractor.

53. Termination/Foreclosure

53.1 The Executing Agency may terminate the Contract if the Contractor causes a fundamental breach of the Contract.

53.2 Fundamental breaches of Contract include, but shall not be limited to, the following:

a) the Contractor stops work for 28 days when no stoppage of work is shown on the current Programme and the stoppage has not been authorized by the Engineer-in-Charge;
b) the Contractor is declared as bankrupt or goes into liquidation other than for approved reconstitution or amalgamation;
c) the Engineer-in-Charge/Executing Agency gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Engineer-in-Charge;
d) the Contractor does not maintain a Security, which is required;
e) the Contractor has delayed the completion of the Works by the number of days for which the maximum amount of liquidated damages can be paid, as defined in clause 45;
f) the Contractor fails to provide insurance cover as required under clause 13;
g) if the Contractor, in the judgement of the Executing Agency, has engaged in the corrupt or fraudulent practice in competing for or in executing the Contract. For the purpose of this paragraph, **" Corrupt practice"** means (i) the offering, giving, receiving, or soliciting, directly or indirectly, of anything of value to influence the actions of any person connected with the Bidding Process (For avoidance of doubt, offering of employment to, or employing, or engaging in any manner whatsoever, directly or indirectly, any official of the Authority who is or has been associated in any manner, directly or indirectly, with Bidding Process, at any time prior to the expiry of one year from the date such official resigns or retires from or otherwise ceases to be in the service of the Authority, shall be deemed to constitute influencing the actions of a person connected with the Bidding Process);
h) **"Fraudulent practice"** means a misrepresentation or omission of facts or suppression of facts or disclosure of incomplete facts, in order to influence the Bidding Process; if the Contractor has not completed at least thirty percent of the value of Work required to be completed after half of the completion period has elapsed;
i) if the Contractor fails to set up a field laboratory with the prescribed equipment, within the period specified; and
j) any other fundamental breach as specified in the Contract Data.

53.3 Without prejudice to any other right or remedies which the Executing Agency may have under this contract, upon occurrence of a Contractor's fundamental breach of contract, the Executing Agency shall be entitled to terminate this contract by

issuing a Termination Notice to the Contractor ; provided that before issuing the Termination Notice, the Executing Agency shall by a Notice inform the Contractor of its intention to issue such Termination Notice and grant 15 days to the Contractor to make a representation, and may after the expiry of such 15 days, whether or not it is in receipt of such representation, issue the Termination Notice.

53.4 Notwithstanding the above, the Executing Agency may terminate the Contract for convenience.

53.5 If the Contract is terminated, the Contractor shall stop work immediately, make the Site safe and secure, and leave the Site as soon as reasonably possible but in no case later than 7 days.

53.6 **Foreclosure**- NHIDCL may foreclose the contract before the expiry of the scheduled contract period due to administrative decision by giving one month Notice.

54. Payment upon Termination / Foreclosure

If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Engineer-in-Charge shall issue a certificate for the value of the work done less advance payments received up to the date of the issue of the certificate and less the percentage to apply to the value of the work not completed, as indicated in the Contract Data. Additional Liquidated Damages shall not apply. If the total amount due to the Executing Agency exceeds any payment due to the Contractor, the difference shall be a debt payable to the Executing Agency and Executing Agency may recover the same from Performance Bank Guarantee.

55. Property

All Materials on the Site, Plant, Equipment, Temporary Works, and Works shall be deemed to be the property of the Executing Agency for use for completing balance work if the Contract is terminated because of the Contractor's fundamental breach of contract.

56. Release from Performance

If the Contract is frustrated by the outbreak of war or by any other event entirely outside the control of the Executing Agency or the Contractor, the Engineer-in-Charge shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all work carried out before receiving it and for any work carried out afterwards to which a commitment was made.

F. Other Conditions of Contract

57. Labour

57.1 The Contractor shall, make arrangements of his own cost and expenses for the engagement of all staff and labour, local or others; for their payment, housing, feeding and transport; and for compliance with various labour laws/ regulations.

57.2 The Contractor shall, as asked by the Engineer-in-Charge, deliver to the Engineer-in-Charge a return in detail, in such form and at such intervals as the Engineer-in-Charge may prescribe, showing the staff and the numbers of the several classes of labour from time to time employed by the Contractor on the Site and such other information as the Engineer-in-Charge may require.

58. COMPLIANCE WITH LABOUR REGULATIONS

58.1 During the currency of the Contract, the Contractor and his sub Contractors shall abide at all times by all existing labour enactments and rules made thereunder, regulations, notifications and bye laws of the State or Central Government or local authority and any other labour law (including rules), regulations, bye laws that may be notified already or that may be notified under any labour law in future either by the State or the Central Government or the local authority. Salient features of some of the major labour laws that are applicable to construction industry are given below. The Contractor shall keep the Executing Agency indemnified in case any action is taken against the Executing Agency by the competent authority on account of contravention of any of the provisions of any Act or rules made thereunder, regulations or notifications including amendments. If the Executing Agency is caused to pay or reimburse, such amounts as may be necessary to cause or observe, or for non-observance of the provisions stipulated in the notifications/bye laws/Acts/Rules/regulations including amendments, if any, on the part of the Contractor, the Engineer-in-Charge/Executing Agency shall have the right to deduct any money due to the Contractor including from his performance security/ retention money. The Executing Agency/Engineer-in-Charge shall also have right to recover from the Contractor any sum required or estimated to be required for making good the loss or damage suffered by the Executing Agency. The employees of the Contractor and the Sub-Contractor in no case shall be treated as the employees of the Executing Agency at any point of time.

58.2 SALIENT FEATURES OF SOME MAJOR LABOUR LAWS APPLICABLE TO ESTABLISHMENTS ENGAGED IN BUILDING AND OTHER CONSTRUCTION WORK.

a) **Workmen Compensation Act 1923**: - The Act provides for compensation in case of injury by accident arising out of and during the course of employment.

b) **Payment of Gratuity Act 1972**: - Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed the prescribed minimum years (say, five years) of service or more or on death the rate of prescribed minimum days' (say, 15 days) wages for every completed year of service. The Act is applicable to all establishments employing the prescribed minimum number (say, 10) or more employees.

c) **Employees P.F. and Miscellaneous Provision Act 1952**: The Act Provides for monthly contributions by the Executing Agency plus workers at the rate prescribed (say, 10% or 8.33%). The benefits payable under the Act are:

i. Pension or family pension on retirement or death as the case may be.
ii. Deposit linked insurance on the death in harness of the worker.
iii. Payment of P.F. accumulation on retirement/death etc.

d) **Maternity Benefit Act 1951**: - The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.

e) **Contract Labour (Regulation & Abolition) Act 1970**: - The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Executing Agency by Law. The principal Executing Agency is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Executing Agency if they employ prescribed minimum (say 20) or more contract labour.

f) **Minimum Wages Act 1948**: - The Executing Agency is to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of buildings, roads,runways are scheduled employment.

g) **Payment of Wages Act 1936:** - It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers.

h) **Equal Remuneration Act 1979**: - The Act provides for payment of equal wages for work of equal nature to male and female workers and for not making discrimination against female employees in the matters of transfers, training and promotions etc.

i) **Payment of Bonus Act 1965**: - The Act is applicable to all establishments employing prescribed minimum (say, 20) or more workmen. The Act provides for payments of annual bonus within the prescribed range of percentage of wages to employees drawing up to the prescribed amount of wages, calculated in the prescribed manner. The Act does not apply to certain establishments. The newly set-up establishments are exempted for five years in certain circumstances. States may have different number of employment size.

j) **Industrial Disputes Act 1947**: - The Act lays down the machinery and procedure for resolution of industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.

k) **Industrial Employment (Standing Orders) Act 1946**: - It is applicable to all establishments employing prescribed minimum (say, 100, or 50). The Act provides for laying down rules governing the conditions of employment by the Executing Agency on matters provided in the Act and get these certified by the designated Authority.

l) **Trade Unions Act 1926**: - The Act lays down the procedure for registration of trade unions of workmen and Executing Agencys. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities.

m) **Child Labour (Prohibition & Regulation) Act 1986**: - The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulations of employment of children in all other occupations and processes. Employment of child labour is prohibited in building and construction industry.

n) **Inter-State Migrant Workmen's (Regulation of Employment & Conditions of Service) Act 1979**: - The Act is applicable to an establishment which employs prescribed minimum (say, five) or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as Housing, Medical-Aid, Travelling expenses from home up to the establishment and back etc.

o) **The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996** and **the Cess Act of 1996**: - All the establishments who carry on any building or other construction work and employs the prescribed minimum (say, 10) or more workers are covered under this Act. All such establishments are required to pay cess at the rate not exceeding 2% of the cost of construction as may be modified by the Government. The Executing Agency of the establishment is required to provide safety measures at the building or construction work and other welfare measures, such as canteens, first-aid facilities, ambulance, housing accommodations for workers near the work place etc. The Executing Agency to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the Government.

p) **Factories Act 1948:** - The Act lays down the procedure for approval of plans before setting up a factory, health and safety provisions, welfare provisions, working hours, annual earned leave and rendering information regarding accidents or dangerous occurrences to designated authorities. It is applicable to premises employing the prescribed minimum (say, 10) persons or more with aid of power or another prescribed minimum (say, 20) or more persons without the aid of power engaged in manufacturing process.

59. Drawings and Photographs of the Works

59.1 The contractor shall do photography/videography of the site firstly before the start of the work, secondly mid-way in the execution of different stages of work and lastly after the completion of the work. No separate payment will be made to the contractor for this.

59.2 The Contractor shall not disclose details of Drawings furnished to him and works on which he is engaged without the prior approval of the Engineer-in-Charge in writing. No photograph of the works or any part thereof or plant employed thereon, shall be taken or permitted to be taken by the Contractor or by any of his employees or any employees of his sub-Contractors without the prior approval of the Executing Agency in writing. No photographs/ Videography shall be published or otherwise circulated without the approval of the Executing Agency in writing.

Contract Data

Clause Reference

Items marked "N/A" do not apply in this Contract.

1. **The Tender Inviting Authority (also Executing Agency)** [Cl.1.1]

Executive Director(P),
Regional Office, Ladakh,
NHIDCL:Yartsa House ,near ChangspaFarm,
Changspa, Leh, UT of Ladakh – 194101

Employer (**Authority)**

Hospitality & Protocal department (represented by 'Director')
UT of Ladakh , Leh – 194101

Engineer-in-Charge

Designation: General Manager (P),PMU-Infra,Leh

Address: NHIDCL, PMU-Infra ,Leh

Email: nhidcl.infraleh@gmail.com [Cl.1.1]

3. The Time period for Completion of the Work is **12months**[Cl.1.1, 17&28] from start date. A supplementary agreement shall be drawn with the contractor for Comprehensive Annual Maintenance Contract (CAMC) of Five years after completion of work of the main Agreement.

4. Site is located at Leh,**in the Union Territoryof Ladakh** [Cl.1.1]

5. The Stipulated Start Date shall be from 7th day after the date of issue of the Notice to Commence with the work. [Cl.1.1]

6. (a) The name and identification number of the Contract **"Construction of 8 nos. Special T4 Staff Quarters and Staff hostel at Geyser Palace site, Leh in the Union Territory of Ladakh".** [Cl.1.1]

(b) The Work consists of **"Construction of 8 nos. Special T4 Staff Quarters and Staff hostel at Geyser Palace site, Leh in the Union Territory of Ladakh"and Five years of comprehensive annual maintenance contract as mentioned in clause 7.2 of section II (ITB).** [Cl.1.1]

3.1 (a) The law which applies to the Contract is the **law of Union of India**. [Cl.3.1]

(b) The language of the Contract documents is **English**. [Cl.3.1]

7.1 The limit of subcontracting is **49%.** [Cl.7.1]

8.1 Schedule of Other Contractor – **NIL** [Cl.8.1]

13.1. Amount for insurance are: [Cl.13.1]

a) Rupees equivalent to Contract price.
b) Rupees equivalent to 5% of Contract price.
c) Rupees equivalent to 5% of contract price
d) Rupees 20 lakhs for multiple incidents
And deductible as per premium rate.

14.1 Site Investigation Report – NIL [Cl 14.1]

27.3 Amount to be withheld for delays in submission of updated programme: Rs. 10,000 per dayup to a maximum limit of Rs. 5,00,000/-.

33 The Defects Liability Period for all items under the work is One (1) **year** from the actual recorded date of completion of the project.

45.1 (a) Amount of liquidated damages for delay in completion of works — 0.05 percent of the Contractprice, rounded off to the nearest thousand, per day with the minimum of Rs. 100000/- per day

(b) Maximum limit of liquidated damages for delay in completion of work. — 5 per cent of the Initial Contract Price rounded off to the nearest thousand

[Cl.45.1]

47.1. The standard form of Performance Security acceptable to the Executing Agency shall be an unconditional Bank Guarantee of the type as specified inthe Bidding Documents.

[Cl. 47.1]

54.1. The percentage to apply to the value of work not completed representing the Executing Agency's additional cost for completing the work shall be 20%.

[Cl.54.1]

SECTION - VI

Scope of Work& Technical Specifications

Scope of Work under this EPC Contract

The responsibility of investigations, designing, planning, procurement, construction, safety, quality, and risk of engineering lies with the contractor. The Scope of work under this Contract includes construction of following buildings/structures in all respects as per tender drawings/approved working drawings/finishes matrix/Schedule of quantities/Technical and Particular Specification/Conditions and Special Conditions of Contract:

- **Construction of 8 nos. Special T4 Staff Quarters (Four typical buildings, each building consisting of two staff quarters – one in ground floor and the other in first floor) in Geyser Palace site, Leh (G+1 floor structure) with radiant heating system,Electrical,PHE,Solar Hot Water system with heat pump backup**

1. **cup boards, modular kitchen, false ceiling , etc. Complete as per drawings**

2. **Construction of Staff Hostel in Geyser Palace site, Leh (G+2 floors structure).The building comprises of following:**

   i. **Ground floor comprises entrance lobby, reception, guest lounge 6 nos. normal rooms (Room no. 1 to Room no.6),recreation hall and dining hall and kitchen etc.**
   ii. **3 nos. Executive Rooms, 6 nos. normal rooms(Room no. 7 to Room no.12) etc in first floor**
   iii. **12 Normal rooms (Room no.13 to Room no. 24) in second floor**
   iv. **Solar water heating and lighting etc. services at terrace**

   - **Services include machine room less lift, radiant heating system, Electrical, PHE,Solar Hot Water system with heat pump backup, solar common lighting and compound lighting, cup boards ,false ceiling in all rooms , wall panelling and wooden flooring in Executive Room(3nos), structural glazing,Shuttle /Badminton courts , mechanical ventilation in kitchen etc. complete as per drawings.**

3. **Internal roads with footpaths, Car parking, Radiant Heating System Plant room, Underground Tanks (minimum one day storage), New Borewells(2nos.- one each for staff hostel and for staff quarters),Bio-digestors (2nos.- one each for staff hostel and for staff quarters) for sewage treatment,Landscaping, Fire-Fighting System etc.**

All items of work, part of work or work itself shown on the tender drawings or mentioned in the tender document are to be executed by the contractor. Non-appearance of any of the items either in the tender drawings or in the tender shall not vitiate the purpose for which the buildings shall be constructed. The contractor is responsible for carrying out all mandatory tests (field and

at third party labs) on materials used for the work specified in CPWD Specifications 2019, Volume-I and Volume-II. All costs towards material testing shall be borne by the Contractor.
The time period for the project completion is Eighteen (18) months plus Five(5) years for Comprehensive Annual Maintenance Contract(CAMC) post completion of the project.

The indicative scope of workof the contractor includes the following items:-

1) Clearing of Site,barricading the site area by using GI sheets supported suitably by MS Structures up to 6mt Height , Name Boards for safety and site development display, site watch and ward

2) Geo-technical investigation of sub-soil characteristics by specialized agency to assess the safe bearing capacity of the soil strata for structural design of foundation.

3) Preparation of working drawings of Architectural/Structural design and drawings/PHE/Electrical/Radiant Heating System/Fire Fighting /Internal roads/hardscaping/landscaping/all other services and obtain approval of Engineer-in-Charge for execution. The structural design and drawings shall be vetted from IITs/NITs/Govt. Engineering college or any other approved institution.

4) Excavation and Top soil preservation

5) RCC isolated/combined Foundation

6) PCC and soiling

7) Backfilling and Compaction

8) RCC Substructure and Superstructure including staircase

9) Plinth beam and plinth area construction

10) Masonry in precast PCC blocks

11) Internal and External plaster

12) Pneumatic Water supply system including water meters, sewage disposal system, plumbing fittings and sanitary fixtures

13) Waterproofing of toilets, terrace, chajjas, balconies, refuge area, and other sunk areas etc. and over deck insulation on terrace slabs

14) Flooring, Bathroom, kitchen tiling ,terrace flooring, tiling in water tanks

15) Laminated wooden flush doors, uPVC windows and ventilators(wood finish profiles) including locks and associated hardware/accessories

16) Strom water drainage

17) Internal and external painting

18) Electrical conduiting, wiring, switchboards, electrical fittings & fixtures

19)Fire fighting system including underground and overhead fire water tanks, fire pumps, Hose Reel System and Fire extinguishers, exit signage, Sand Buckets etc. as per Fire department NOC .The fire fighting system shall be designed keeping in view the extreme minus temperatures that prevails in Leh during winter months. The minimum requirements for staff hostel shall be as following:

- **Hose Reel** system to be provided for every 1000 Sqm of floor area per floor as per requirements, so that no portion within the building is more than 30m from an internal hydrant.

- Each **Hose Reel** system shall consists of20mm dia first-aid fire hose reels with 40 m with 5mm bore gunmetal nozzle as per I.S: 884-1969.

- **Hose Reel System** shall be connected with the fire pumps, which will be operated automatically. Therefore, entire system will remain pressurized all the time, so that water is always available with required pressure, for firefighting purpose. There shall be a provision for the fire brigade inlet connection with non-return valves to the fire ring main for emergency purpose.

- **FIRE EXTINGUISHERS**

The following type of portable fire extinguishers shall be provided at all levels of the towers, at strategic locations as per requirements, generally to follow IS – 2190: 1992)

Location	**Type Of Fire Extinguisher**
Main Gate (Security Gate/s)	Multipurpose 6kg ABC
Every Floor	Multipurpose 6 kg ABC & 4.5 Kg CO_2 Type
Electric room/Pump room	4.5 Kg CO_2 gas type

20) Radiant Heating System in all rooms of Type-4 Staff Quarters and Staff Hostel building

21) Lift in Staff Hostel building as per local municipality (NMC) norms

22) Roof top grid connected solar panel system for hot water supply to all fixtures of toilets,kitchen,washing area. Solar panel system shall also be for common lighting and compound lighting . Developing and maintaining automatic dust cleaning system (like wiper or water sprinkler or automatic cleaning system along with sensors) on the inclined roof solar roof panel.

23) Underground and overhead tanks fire and domestic water tanks with associated plumbing works

24) Telephone, DTH Cabling and data cabling works

25) Fire Pumps, Water Supply pumps, panels and pump room

26) Meter room, feeder pillar, main cabling, Earth pits, and Lightning arrester etc.

27) Basement lighting, External lighting and electrical works

28) Site office, site laboratory, temporary store and sample room, Construction Machineries, First aid box, safety material, sanitary facilities for labour, temporary lighting for site area while executing works, water supply and construction power arrangements.

29) Associated works related to Green building features

30) Radiant Heating Plant room with mechanical ventilation and heating system along with heat pumps(air and geo-thermal), boilers, hot water storage tank,HSD storage tanks and day tanks, piping network to end user network, panels, safety equipment complete

31) The Electrical component of the scope of contravt includes the following in addition to other items specified in tender document:

i. 11kv three HT panel board (outdoor type) (1lbs in and 2 vcb out)
ii. Transformers (2x630kva)
iii. Servo stabilizer (2x630kva)
iv. Diesel generators (2x750kva)
v. Medium Voltage (MV) panels
vi. Safety and testing equipments
vii. Supply of light fixtures & fans
viii. Lightning conductor
ix. Wiring
x. Distribution boards
xi. Cable trays
xii. Earthing system
xiii. HV, MV and control cables
xiv. Solar (5kwp) for common lighting and compound lighting
xv. Solar water heating system

32) The Radiant Heat System shall be designed for following conditions:

Outside Design Date(Peak)

Loation : Leh, ladakh
Geographical Location : 34.15° N, 77.577° E
Altitude : 3508 MT m above mean sea level
Temparature in Winter (DB/WB): -25 to -30 Degree Celicius

Summer(DBT/WBT) : 23.8 to 38 Degree Celisius

Desired Inside Conditions:

A) In Winter : 22 +/-1 Degree Celsius
Relative Humidity : 30% +/- 5% Approx.

B) In Summer : 24 +/- 1 Degree Celsius
Relative Humidity : 40% +/- 5% Approx.

The following Radiant heating System minimum guidelines/equipments shall be in the scope of the contractor

i. **Diversity factor of 0.72** for **heating system.**
ii. **5# 120 Kw (single / multiple modules) (3w+2s)** actual capacity heat pumps on minus 20ºC comprising of **5 # air to water heat pumps** (Minimum 2.26 COP at AHRI /Euro vent Condition) **along with piping & valves.**
iii. **2 # 2,50,000 Kcal/ Hr. as a standby hot water generator boilers** with diesel pumps & tanks which shall be functional during non-operation of heat pumps.
iv. 40kl hot water storage cum mixing insulated tank with 2#partitions
v. 5# primary hot water pumps(3W+2S).
vi. Staff Hostelpumping system with 3# Secondary Hot Water Pumps(2W+1S)
vii. T4 Staff Quarters pumping system with 3# Secondary Hot Water Pumps(2W+1S)

viii. **Air Handling Units for Plant Room& FA unit for Kitchen(staff hostel)**

Design Parameters for selection of Air Handling units and its components shall be as follows:-

a) Maximum face velocity across filters : 155m/min

b) Maximum face velocity across cooling coils: 155m/min

c) Maximumfan outlet velocity : 610m/min

d) Maximum fan speed-Forward : 1000rpm

e) Maximum fan motor speed :1450rpm

a) Minimum static Pressure : 50 mm

v. **Pe-X Pipes :** 20 mm dia and 2 mm wall thickness (Maximum temperature of 90^{o} Centigrade and maximum pressure of 8 bar).The Pe-X pipes shall be laid over 25 mm thick XPS board(32-40kg/m^{3})k-value0.33W/m^{2}K and 300 G Polythene sheet. The Pe-X pipes network shall be embedded in minimum 40 mm thick screed concrete comprising cement concrete 1:2:4 (1 cement: 2 Coarse sand: 4 stone aggregate 20 mm nominal size).

vi. **Stainless steel /brass manifold :**The stainless steel / Brass heating/cooling manifold has been designed specifically for the precise control of under floor heating/cooling systems. The return manifold is located at the top with the control valves with an external threads on which the actuators are mounted. The flow manifold is located below with either flow meter or flow limiter.

vii. Fresh air system& humidification system:

Note: The decentralized units shall be installed for 3 # executive rooms of staff hostels.

a) Each area as detailed in parameters of air-conditioned system shall be provided with fresh air in accordance with ASHRAE Standard 62.1 to maintain the indoor air quality (IAQ) by decentralized ventilation units(under the scope of contractor) & humidification by portable humidifier (not under the scope of Contractor) so that the provided fresh air in peak winter shall be rich in latent load to resist the skin dryness & maintain oxygen level.

b) The decentralized ventilation unit shall be mounted directly to the outside wall, the decentralized ventilation unit is ideal for retrofitting and renovation. In this way, individual rooms can be specifically ventilated and ventilated, especially with subsequent building insulation. The EC fans are particularly quiet and therefore also ensure a high level of living comfort. A cross-counter current heat exchanger recovers the heat contained in the exhaust air in order to heat the outside air. In winter, the anti-icing function prevents the heat exchanger from freezing. • Targeted, controlled ventilation of individual rooms. For healthy and pleasant indoor air in every season. • Fast and inexpensive installation. Ideal for renovation and retrofitting - especially for insulation measures. • Particularly efficient. The integrated heat exchanger uses the heat of the exhaust air to control the temperature of the fresh supply air. Continuous and comfortable heat recovery through constant volume flow. • Long-term comfort. Quiet fans, low maintenance, attractive service package with extended warranty. • Guaranteed hygienic - also suitable for allergy sufferers. Effective pollen protection thanks to high filter quality. Prevention of mold formation - and a valuable contribution to the long-term preservation of the building fabric.

Air volume flow 15/30/45/55 m³ / h
Energy efficiency class * B.
Heat exchanger Cross countercurrent
Heat recovery rate Max. 87%
Degree of heat provision Max. 83%
Standard sound level difference 51 dB
Sound pressure level (levels 1/2/3/4) 8.1 / 21.1 / 28.6 / 33.5 dB (A)

Air filter class F7 / G4
Dimensions (W x H x D) 340 x 340 x 320 mm
Wall thickness (without adjoining room connection) min. 320 mm

viii. High & low side chilled water/hot piping distribution scheme :

1. High Side: -The proposed hot water shall be pumped through MS C Class insulated hot water pipes from plant room located externally to hostel & residential building blocks via trench. Thehot water circuit shall have combined air &dirt separator glycol tank & expansion tank, to be located in plant room.
2. The underground MS C class hot water piping shall be insulated with underground piping treatment. All pipes shall be supported in a manner, which will avoid transmission of vibrationof roof ceiling slab and occupied floors. Closed expansion tank along with air separator shall be provided in hot water line and located within the plant room area.

c) The hot water pipe headers shall be designed to take the load as per total heat pumps installed capacities including standby.

d) The design parameters for piping shall be based on the lowest of the velocity or friction loss indicated below.

Velocity	**Friction loss m/sec**	**Pa/m**
Main Headers	2.5	3000
Branches	2.0	2000
Equipment connection	3.0	4500

e) Low side: - For under floor radiant Heating/Cooling PEX pipes are made of medium density polyethylene (MDPE) with a unique molecular structure which gives the pipe its durability to high temperatures.
Technical Data Material PEX Sizes 20mm Dia. X 2 mm wall thickness
Max Pressure 8 Bar
Max temperature 90° C

33) Storage of water(Minimum capacity)

- UGT Storage = 1 Day and OHT Storage = 1/2 Day
- Under Ground water tank for Type-4 staff quarters = 10 KLD
- Under Ground water tank for Staff Hostel = 15 KLD
- Over Head Fire storage tank (insulated) = 5 KLD (Staff Hostel)
- Over Head Domestic water Tank(insulated) = 10 KLD (Staff Hostel)
- Over Head Domestic water Tank (insulated) = 1 KLD SS Tank (4 nos. in Type-4 staff quarter-one for each building))
- Over Head Hot water Tank (insulated) = 3 KLD SS Tank (2 nos. in Staff Hostel)

34) Bio Digestors

a) Minimum capacity for T4 Staff Quarters: 8 KLD
b) Minimum capacity for Staff Hostel : 10 KLD

35) New Internal roads as shown in tender drawings (approx. 375 m long).Overall width of the road shall be 6.0m comprising 4.50 m pavement ,0.30m precast cc saucer drain and 1.20 m foothpath with 60 mm thick M30 grade cc paver blocks) The road shall be on embankment/cutting as per approved ToR(Top of Road) levels. Minimum elements of the road shall be as follows:

i. Compacted sub-grade
ii. 200 mm thick GSB (in two layers)
iii.150 mm thick WMM
iv. 50 mm DBM
v. 30 mm Wearing course (BC)

35)Water Harvesting pits (2 nos.)

36) Car parking with 60 mm thick cc interlocking paver blocks of M30 grade over 50 mm snad bed laid on 150 mm thick WMM .

37) IP based CCTV Surveillance system for staff hostel as per specifications and approved drawings.

38)Obtaining all statutory NOC/approvals as applicable in UT Ladakh.

Note: **Above items are only indicative and for guidance & brief description of jobs, but should not be considered limited to this list. Tenderer should refer to the detailed tender documents, finishes matrix,technical and particular specifications, Special Conditions of Contract and tender drawings, schedule of quantities for detailed items and scope of work included in this project. Any discrepancy in the above shall be brought to the notice of NHIDCL in the pre-bid meeting.**

GENERAL SCOPE/COMPLAINCE FOR GREEN BUILDING

Introduction:

NHIDCL has engaged consultant for providing Comprehensive services for Architectural, Green building Consultancy services best suiting the local climate,

herein further referred as Architect-Consultant. The contractor has to follow the instruction given by Architect-consultant.

Proposed project is comprehensively designed in association with the Architect Consultant and their structural and MEP Building Consultants by suitably incorporating green building requirements to achieve desired Green Building features. However, if there are certain items which are not detailed out or mentioned in the tender shall also be required to be executed as per the instructions of NHIDCL's Architect Consultant in order to make it functional Green Building well responding to the local climate.

NHIDCL along with Architect-Consultant and their consultants has incorporated possible green building feature in the design, specification, BOQ and scope of work. However, the achievement of green building functions is possible only upon contractor's commitment and compliance of relevant green building criteria.

Contractor to submit a narrative, supported with Invoices and certificate from manufacturer and test certificate and Photographs for the same for showing the compliance of green building Conditions.

Commitment, Compliance & Appraisal of green building Criteria:

The contractor shall commit and comply with the green building guidelines, advice and instructions of NHIDCL, Architect-Consultant and their structure and MEP Consultants. Photos to be taken daily and especially to support the following conditions and submitted along with narratives. Failure to do so will be considered as non-compliance to tender agreement and result in charging of penalty. Some of the important GRIHA Criteria's along with their requirements have been briefly indicated hereunder:-

a) Preserve and protect landscape during construction/compensatory depository forestation:
1. Construction activities to been planned in a way that excavation & construction work, up to plinth level is not coinciding with rainy season and the site disruption is restricted to pre-designated areas.
2. Construction work and erosion control applications to be scheduled and sequenced during dry weather periods when the potential for erosion is the lowest.
3. Measures such as collecting runoff from construction areas and material storage sites; diverting water flow away from such polluted areas, so that pollutants do not mix with storm water runoff undisturbed areas.

4. Temporary drainage channels, perimeter dike/swale, etc. shall be constructed to carry the pollutant-laden water directly to treatment device or facility. The plan shall indicate how the above is accomplished on site, well in advance of the commencing of the construction activity.
5. Topsoil removal and preservation to be compulsorily done. Topsoil shall be stripped to a depth of 200 mm from areas proposed to be occupied by buildings, roads, paved areas and external services. Topsoil is rich in organic content and is essential to establish new vegetation. It shall be stockpiled to a height of 400 mm in designated areas and shall be reapplied to site during plantation of the proposed vegetation. Topsoil shall be separated from sub-soil debris and stones larger than 50 mm diameter. The stored top soil may be used as finished grade for planting areas. If the topsoil is not stored on site, it can be alternatively given to the nursery or for gardening purposes. Documentation of topsoil preservation has to be maintained at site as per the requirement of Architect Consultant/NHIDCL.
6. Spill prevention and control plans to be made and submitted, clearly stating measures to stop the source of the spill, to contain the spill, to dispose the contaminated material and hazardous wastes, and stating designation of personnel trained to prevent and control spills. Hazardous wastes include pesticides, paints, cleaners, petroleum products, fertilizers and solvents.
7. Protect & Preserve existing trees, if any, as per directions of Engineer-in-Charge-in-charge.
8. Slope construction techniques to control erosion to be used when construction during wet season is unavoidable. Sedimentation collection systems, drainage systems and run off diversion systems shall be installed before construction activity. The Architect-Consultant/ Engineer-in-Charge-in-charge shall monitor the site conditions and progress of work and schedule appropriate timing and sequencing of construction.
9. Soil erosion to be avoided by maintaining a protective cover on the soil, and creating a barrier to the erosive agent (i.e., wind and water).
10. Stabilize bare soils on the site: by using erosion control mats, seeding / planting.
11. Remove sediment from runoff before it leaves the site: use stabilized construction entrances/exits, silt fences, sediment traps, check dams etc.
12. Plan soil disturbance activities for the dry season.
13. Making Silt fences to hold water, allowing sediment to settle out as an effective sediment control measure.

b) Provide minimum level of sanitation/safety facilities for construction workers:

1. Ensure the health and safety of workers during construction, with effective provisions for the basic facilities such as sanitation and drinking water, and safety PPEs/equipment's for workers, first aid box, etc. at site.
2. Ensure cleanliness of workplace with regard to the disposal of waste and effluent; provide clean drinking water and latrines and urinals as per applicable standard.

c) Reduce Air and Noise pollution during construction:

1. Cover skips and trucks loaded with construction materials and continually damp down with low levels of water.
2. Segregate, tightly cover and monitor toxic substances to prevent spills and possible site contamination.
3. Cover up and protect all drains on site.
4. Collect any wastewater generated from site activities in settlement tanks, screen, discharge the clean water, and dispose of remaining sludge according to environmental regulations.
5. Use low-sulphur diesel oil in all vehicle and equipment engines, and incorporate the latest specifications of particulate filters and catalytic converters. PUC of vehicles to be submitted.
6. No burning of materials on site.
7. Noise pollution to be reduced through careful handling of materials; modern, quiet power tools, equipment and generators; low impact technologies; and wall structures as sound shields.

d) Efficient water use during construction:-

1. The use of potable water during construction to be minimized.
2. Materials such as pre-mixed concrete for preventing loss during mixing or use recycled treated water and control the waste of curing water to be used.
3. Gunny bags to be used for column, plinth beams concrete curing and slabs to be cured by water ponding.

e) Utilization of locally available mud in the building structure:

1. Use of low-embodied energy locally available mud as the construction material. Use of locally available mud , brickwork, plaster, block-work, etc. in the building.

f) Reduce volume, weight, and time of construction by adopting an efficient technology:

1. Use pre-cast systems, ready-mix concrete, etc.
2. Replace a part of the energy-intensive materials with less energy-intensive materials and/or utilize regionally available materials, which use low energy/energy-efficient technologies.

g) Use low-energy material in the interiors:

1. Out of the total quantity of all interior finishes and products used in each of the categories mentioned below, a minimum of 70% should be low-energy finishes/ materials/ products, which minimize wood as a natural resource or utilize industrial waste by using products in any category as listed.

1.1 Sub-assembly/internal partitions/false ceiling/in-built furniture

1.2 Flooring

1.3 Doors/windows and frames

2. Before ordering materials contractor to ask Green Building Certificate from manufacturer or dealer and submit the same to Architect-Consultant and NHIDCL for approval or While ordering materials following should be considered:-

2.1 Purchasing materials that have a recycled content

2.2 Ordering paints with low odour and VOC emissions

2.3 Minimize packaging

2.4 Ordering in standard sizes to minimize on site cutting and wastage

2.5 Provide adequate storage that is weatherproof and secure

2.6 Follow suppliers' storage instructions

2.7 Keep harmful chemicals in secure areas

2.8 Protect lightweight materials from wind

2.9 Store liquids and sand away from drains and water courses

h) Water recycle and reuse (including rainwater):

1. Rainwater storage and recharge system to be implemented at site including ground water recharge where potable municipal water is normally used, to reduce the load on municipal supplies and to improve the groundwater level.

i) Reduction in waste during construction:

1. Ensure maximum resource recovery and safe disposal of wastes generated during construction and reduce the burden on landfill.
2. Keep record of the waste generated and take pictures.
3. Designate separate areas for storage of recyclables
4. Submit records tabulating the total waste material generated and the quantities which were diverted from landfills.
5. A minimum of 4% of the total site area should be allocated for storage of the waste. This storage area should be covered and the pollutants from the waste should not affect the surrounding.

j) Efficient waste segregation:

1. Different types of waste to be segregated in different categories of waste sections /areas during construction to promote the segregation of waste.

k) Use of low-VOC (volatile organic compounds) paints/ adhesives / sealants:

1. VOC Limits for Materials

Please follow the type of material & their VOC Limit as mentioned below:-

Paints:-

Non-flat paints - 150 g/L
Flat (Mat) paints - 50 g/L
Anti-corrosive/ anti-rust paints - 250 g/L
Varnish - 350 g/L

Adhesives:

Tile adhesives - 65 g/L
Wood - 30 g/L

l) Reduce the water use by the building:

1. Flow rates of Water Fixtures:-

Select water fixtures whose average flow rates / capacities should not exceed the values mentioned below. Baseline Flow Rates / Capacity for Water Fixtures in a Typical Household are:-

1. Flush fixtures - LPF 6/3
2. Flow fixtures - LPM 12

At a flowing water pressure of 3 bar

2. Flow fixtures include faucets, basin mixer, taps, showers, shower mixers. The baseline flows can be demonstrated at flowing water pressure of 3bar. Flowing water pressure of 3bar does not mean that the water supply inthe building is at 3 bar.

3. The building fixtures can operate at lower pressures but to show compliance under this credit, the design flow rates are to be submitted at 3 bar. The average flow rate is a simple arithmetic average of all the respective flush / flow fixtures

m) Minimize ozone - depleting substances:

1. Halon-free fire suppression and fire extinguishing systems to be used to eliminate or control the release of ozone-depleting substances into the atmosphere wherever applicable.

n) Ensure water quality:

1. Ensure groundwater and municipal water meet the water quality norms as prescribed in the Indian Standards for various applications (Indian Standards for

drinking [IS 10500-1991], irrigation applications [IS 11624-1986]. In case the water quality cannot be ensured, provide necessary treatment to raw water for achieving the desired concentration for various applications.

TECHNICAL SPECIFICATIONS

A. TECHNICAL SPECIFICATION OFCIVIL WORKS:

1.0 GENERAL:

1.1 The work shall in general conform to the **Latest CPWD Specifications Volume-I and Volume-II 2019** (corrected up to the last date of submission/uploading of bid). Work under this Contract shall consist of furnishing all labour, materials, equipment, tools & plants and appliances necessary and required.

1.2 The Contractor shall conduct his work, so as not to interfere with or hinder the progress or completion of the work being performed by other Contractor(s) or by the Engineer-in-Charge-in-Charge and shall as far as possible arrange his work and shall place and dispose of thematerials being used or removed, so as not to interfere with the operations of otherContractor simultaneously working or he shall arrange his work with that of the others inan acceptable and coordinated manner and shall perform it in proper sequence to thecomplete satisfaction of others.

1.3 Regarding testing of civil & electrical & other materials, the testing of materials shall beconducted in Govt. Laboratory/ Govt. Engineer-in-Charge Colleges/ IITs/ NITs or from thelaboratory approved by Engineer-in-Charge. **The charges of samples, packing and transportation ,testing charges shall be borne by the Contractor.**

1.4 No payment shall be made for any damage caused by rain, snowfall, flood or any othernatural calamity, whatsoever during the execution of the work. The Contractor shall befully responsible for any damage to the govt. property and work for which the payment hasbeen advanced to him under the contract and he shall make good the same at his risk andcost. The Contractor shall be fully responsible for safety and security of his material, T&P,Machinery brought to the site by him.

1.5 The Contractor shall comply with the safety procedures, norms and guidelines (asapplicable) as outlined in the document Part 7 Constructional practices and safety- 2016,National Building code of India, Bureau of Indian Standards. A copy of all pertinentregulations and notices concerning accidents, injury and first-aid shall be prominentlyexhibited at the work site. Depending upon the scope & nature of work, a person qualifiedin first-aid shall be available at work site to render and direct first-aid to causalities. Atelephone may be provided to first-aid assistant with telephone numbers of the hospitalsdisplayed. Complete reports of all accidents and action taken thereon shall be forwarded to the competent authorities.

1.6 Contractor should spray curing water on concrete structure and shall not allow free flowof water. Concrete structures should be kept covered with thick cloth/gunny bags andwater should be sprayed on them. Contractor shall do water ponding on all sunken slabsusing cement and sand mortar.

1.7 **Approved Makes**:

Specification/brands names of materials to be used as per the scope of work are listed inthe bid documents. The Contractor should also consider the availability of spares parts/ componentsfor maintenance purposes while proposing any brand/ manufacturer. The materials of anyother brand/manufacturer may be proposed for use by the Contractor in case the brandsspecified below are not available in the market and/or Contractor intends to use someother brand better than the brands mentioned in this list. The alternate brand can be usedonly after the approval of Engineer-in-Charge. The list of approved makes is appended to this document.

1.8 **Method Statement:**
The Contractor shall submit a 'Methods statement' for each important activity for theapproval of the Engineer-in-Charge-in-charge soon after the award of work to him. The 'Methodsstatement' is a statement by which the construction procedures for any activity ofconstruction is formulated and stated in chronological order. The 'Methods statement',should have a description of the item with elaborate procedures in steps to implement thesame, the specifications of the materials involved, their testing and acceptance criteria,equipment to be used, Precautions to be taken, etc.

1.9 The work shall be carried out in accordance with the Design Basis Report,Architectural drawings and structural drawings (proof checked/vetted by theContractor) and approved by the Engineer-in-Charge. The Technical Specificationsare to be read with and in general conforming to the Latest CPWD Specifications.

1.10 The Contractor shall procure the required materials in advance so that there issufficient time to testing of the materials and clearance of the same before use in thework. The Contractor shall provide at his own cost suitable weighing and measuringarrangements at site for checking the weight / dimensions as may be necessary forexecution of work.

2.0 **For Detailed Specification of J&K/DSR items of Civil works (Based on J&K SoR 2020/DSR 2019) mentioned in BOQ shall be as per latest CPWD specification 2019 VOLUME I AND VOLUME II** (corrected up to the last date of submission/uploading of bid)

3. UPVC WINDOWS AND VENTILATORS:

3.1 GENERAL:

(All profiles of the uPVC windows and ventilators shall be in mahagony shade or approved shade(wood finish)

SCOPE OF WORK

The Contractor shall be responsible for preparation of shop drawings based on actual site measurement, fabrication, supply, installation, testing and guarantee of all uPVC fenestrations based on the tender architectural drawings and approved drawings. The sizes & specifications shown in the tender drawing and tender schedule of quantites are indicative & are the minimum requirements.

3.2.0 STANDARDS

3.2.1 Work under this contract shall be carried out to following Indian or International standards. Any conflict noticed in various standards and building regulations shall be reported to the Engineer- in-charge and his direction and approval shall be obtained. All standards shall be the latest revisions.

1. IS 456-2000 Plain and reinforced concrete.
2. IS 875 Designed loads for building structures. (Part I, II, III)
3. EN 513 Resistance to artificial weathering.
4. EN 514 Strength of welded corners and T-joints.
5. BS EN 12608 Specification for fabrication of windows and doors.
6. BS 7412 Extruded virgin hollow profiles.
7. BS 7413 Testing criteria for extruded hollow profiles.
8. BS 5368 Part 3 Wind resistance (up to wind pressure of 2400PA).
9. DIN 4108- Class 1 Thermal Insulation.
10. DIN 4109- Class 5 Acoustics Insulation.
11. BS 6375 Water Tightness.
12. BS 476- Part 7 Fire Resistance.
13. DIN 77498 Impact Resistances, Structural Strength.
14. BS 7950 Enhanced security performance of window for domestic application.
15. PAS 23 General performance for door assemblies.
16. PAS 24 Enhanced security performance requirements for door assemblies.
17. ASTM C 1046 Standard specification for Heat treated float glass FT and HS coated and uncoated glass.
18. IS 3548 Glazing in building
19. ASTM-D412, Weather Seal in windows.

20. ASTM-D2240
21. BS 5889 Silicone sealant

3.0 GENERAL

3.1 Quality Assurance

3.1.1 Manufacturer shall certify that extruded sections conform to BS / ASTM standards specified.

3.2 Submittals

3.2.1 The Contractor shall submit detailed literature, catalogues along with certification that material meets or exceeds standards.

3.2.2 The Contractor shall submit design calculations for every unit and shall include method of statement for fabrication, installation, testing and maintenance along with shop drawings meeting criteria specified.

3.2.3 Shop drawings

Shop drawings shall be complete with following

A) Fully dimensioned plans, elevations and sections
B) Locations of exposed fasteners and joints.
C) Fabrication, installation and finishing details of specified systems.

3.2.4 Samples & Mock up

The contractor shall submit for approval a set of labelled samples of each required material for uPVC, DGU glass, Ironmongery fabricated together in 300 x 300 L-shaped section. These shall be in specified colour and shall be exact representative of actual material to be used. All catalogues, test reports and other details of product from proposed manufacturer shall be submitted for approval of the Engineer in-charge. Sealant product information and colour shall also be submitted for approval by the Engineer in-charge.

Contractor shall prepare full size mock - up after sample approval for typical Windows and install at location approved by the Engineer in-charge for his final approval at no extra cost as specified in the Special Conditions of the Contract.

3.3 Delivery, Storage and Handling

3.3.1 Windows and ventilator frames shall be cardboard wrapped and crated to provide protection during transit at site store. Additional care shall be taken to prevent damage to factory finish surfaces during execution and till its handing over to the Engineer – in – charge.

3.3.2 The design of all sealed joints shall be in accordance with the recommendation of the sealant and/or gasket manufacturer.

3.3.3 All adjoining surfaces shall be protected not to receive sealant and gaskets against staining by masking and/or other methods.

3.3.4 Joints and joint surfaces shall be clean, dry and free of any material that may have an adverse effect on the bonding and/or seal of the sealant and gasket materials.

3.3.5 Sealants and gaskets shall be applied under the conditions recommended by the manufacturers. All surfaces shall be primed to receive sealant and gaskets unless recommended otherwiseby the manufacturer. No sealant that has started to set in its container or a sealant that has exceeded the shelf life published by the manufacturer shall be used.

3.3.6 All joints shall be filled continuously and completely with sealant, forming a neat, uniform, concave bead. The material shall be finished flush with adjoining surfaces unless otherwise shown in the drawings. All sealant surfaces shall be tooled smooth.

3.4 The brief scope of work is summarised but should not be taken as complete and conclusive.

3.4 MATERIAL

3.4.1 UPVC extrusion members

3.4.1.1 UPVC Extrusion shall meet BS / DIN / ASTM standards.

3.4.1.2 The extrusion shall be clean, straight and sharply defined lines. It shall be free from distortion and defects impairing strength, durability and appearance. Profiles shall be able to meet required strength in respect of tensile, shear and bending stresses. They shall be rigid and capable of providing local and lateral stability.

3.4.1.3 Internal reinforcement if any shall be of hot dip galvanized steel bars / pipes or other alloys and temper recommended by the manufacturer appropriate for specified finish with separators to withstand designed criteria.

3.4.2 Fasteners

3.4.2.1 All fixing anchor, bolts, screws, nuts, washers or other miscellaneous anchoring / fixing devices shall be of non-magnetic stainless steel or other non-corrosive materials compatible and approved by Engineer in-charge. These materials shall be compatible with finished UPVC used in work and shall provide adequate strength.

1. Exposed conditions : Stainless steel with EPDM or Neoprene Gasket washers.
2. Concealed Conditions : Steel or Cadmium plated

3.4.2.2 Where screws, bolts or other fastenings are exposed they shall match the colour of the UPVC member with which they are used.

3.4.2.3 All concealed fastenings that are not required to be stainless steel shall be hot dipped galvanized steel.

3.4.3 Separators

Separators between steel and UPVC members where required shall be rigid type, high impact resistant, smooth both sides Teflon with a minimum thickness of 0.8mm as approved by the Engineer in-charge.

3.4.4 Sealant

3.4.4.1 Sealant shall be Silicon Sealant of approved make compatible with metal, glass and adjoining works. Sealants shall be with Low VOC (Volatile Organic Compounds) content as per GRIHA Rules and as per instructions of Engineer in-charge.

3.4.4.2 All sealant applications must be clearly designated on the shop drawings with details and references to a master sealant schedule of the approved manufacturer, special instructions and application procedures.

3.4.4.3 The sealants shall be quality controlled one part low module silicone confirming to BS 5889. Structural silicone shall only be factory applied selected colour silicone as per approval of Engineer in-charge.

3.4.4.4 Runs of sealant to joints between frames and structure shall not be less than 6mm width and thickness and where greater than 6mm width the depth shall not be less than half the width including backing rods.

3.4.4.5 Joint fillers and back-up materials shall be polyethylene foam, sponge neoprene as per the sealantmanufacturer's recommendations for each specific application.

3.4.4.6 All sealantsshall be non-staining and compatible with adjoining and/or adjacent sealant, back-up materials, substrate materials and their respective finishes and/or applied colour coatings.

3.4.5 Ironmongery

3.4.5.1 Fittings and fixtures (Ironmongery) shall be installed with all necessary / required best quality hardware. It shall be matching to adjacent finishes. All ironmongery used shall be approved by the Engineer in-charge prior to being installed and shall be noted accordingly in shop drawings.

3.4.6 Glazing

3.4.6.1 Glazing shall be with double glazed unit DGU (5mm clear toughened glass+10mm air gap+5mm clear toughened glass) confirming to relevant codes.

3.4.7 Scaffolding / Hoisting

3.4.7.1 The Contractor shall be responsible to provide, erect and remove double legged metal scaffolding. Scaffolding shall be rigid, strong and suitable for work. It shall provide access to all places.

3.5 WORKMANSHIP

3.5.1 All joints in frames shall be machined and fitted to form hair line joints prior to assembly. The joints shall be fusion welded joints. All corners, junctions, shall be mechanically cleated and assembled to provide strong and rigid frame work. Joints shall be sealed. Required permissible tolerance for expansion and contraction shall be provided. The jointing accessories such as cleats, brackets, etc. shall be of such material so as not to cause any bimetallic action. All accessories shall be such that they are fully concealed.

3.5.2 The fabrication of Windows and Ventilators shall be done in suitable parts / sections to facilitate easy transportation, handling and installation. Adequate provision shall be made in the Windows and Ventilator members for anchoring to supports and fixing of hardware and other fixtures as approved by the Engineer in-charge.

3.5.3 Joints around UPVC work and building such as at heads, jams, sills between masonry / concrete etc. shall be grouted with silicon sealants.

3.5.4 Windows and Ventilators shall be fitted with approved hardware and operating devices. Mechanisms shall be such that they operate smoothly and freely without noise and excessive friction and shall be adequate for intended purpose. Casement Windows and sashes shall be hung on ss friction hinges. They shall be fitted with handles as specified in BOQ in sliding units, adjacent upvc members shall not slide upon each other. They shall be separated by material which does not interfere with sliding action.

All external shutters shall be fully water tight. Glazing of shutters shall be from inside, secured by upvc beads fitted into extruded frames and sealed with EPDM or Neoprene gaskets in vertical and horizontal direction.

Spring shutters shall be hung on pivot / floor springs. Springs can be single or double action as required. For double leaf shutters one shutter shall be provided with concealed two tower bolts.

extruded frames and EPDM or Neoprene gaskets. It shall be ensured that it is fully water-tight and secured.

3.5.6 Antigalvanic Action

3.5.6.1 Dissimilar metal / material surfaces shall be isolated to prevent galvanic action. Materials used for this purpose shall be non-absorptive.

3.5.6.2 All steel parts shall receive a protective treatment commensurate with their respective functions. The treatment shall be one or more of those described above, and approved by the Engineer in-charge.

3.5.7 Sealant and Gasket Applications

3.5.7.1 Sealant and gaskets shall be provided where shown on the drawings or required for a permanently watertight installation.

3.5.8 Gaskets

Gaskets shall be provided at all locations as required for to render the Doors and Windows absolutely air- tight and weather tight. It shall have high resistance to ageing; prolong periods of compressive stress, ability to recover from compression deformation, to allow joint movements, etc. Samples of the gaskets shall be produced for approval and procurement shall be made after approval only.

B. TECHNICAL SPECIFICATION OFPUBLIC HEALTH

WORKS:

1.0 For Detailed Specification of DSR items of Public health works mentioned in SOQ shall be as per CPWD specification 2019 VOLUME I AND VOLUME II (corrected up to the last date of submission/uploading of bid)

2.0 For Non-scheduled item mentioned in SOQ shall be installed as per manufacturer's direction approved by the Engineer-in-Charge.

3.0 Specification/brands names of fixtures to be used as per the scope of work are listed inthe bid documents. The efforts should be made by the Contractor to use indigenousproducts. The Contractor should also consider the availability of spares parts/ componentsfor maintenance purposes while proposing any brand/ manufacturer. The materials of anyother brand/manufacturer may be proposed for use by the Contractor in case the brandsspecified below are not available in the market and/or Contractor intends to use someother brand better than the brands mentioned in this list. The alternate brand can be usedonly after the approval of Engineer-in-Charge. The list of approved makes is appended to this document.

C. TECHNICAL SPECIFICATION OFELECTRICAL WORKS:

1.0 INTERNAL ELECTRICAL WORKS INSTALLATION & ALLIED WORKS

For Detailed Specification of DSR items of Internal Electrical works mentioned in SOQ shall be as per CPWD General specification for electrical works Part 1 (Internal) 2013 (corrected up to the last date of submission/uploading of bid).

1.0 **GENERAL**

The electrical Installation work shall be carried out in accordance with Indian Standard Code of Practice. It shall also be in conformity with the current Indian Electricity rules and regulations of local Electricity Rules. Fire Insurance Rules, I.S. Codes and Indian Electricity Rules.

General Specifications for Electrical Works.

- Part -I - Internal Work - 2005.
- Part -II - External Work - 2007.
- Part -IV - Substation Work - 2007.

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

The details of scope of work subhead wise are given in the subsequent paras. The quantities worked out in schedule of quantities are based on particular equipment considered at design stage. The contractor is required to recheck the quantities based on equipment offered by him to achieve required parameters.

TECHNICAL SPECIFICATION FOR L.T CABELS

1.0 GENERAL

L.T. Cables shall be supplied, inspected, laid tested and commissioned in accordance with drawings, specifications, relevant Indian Standards specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drums. The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed.

1.2 MATERIALS

The L.T. Power cables shall be XLPE insulated PVC sheathed type aluminium conductor armoured cable conforming to IS : 7098 : 1988 (Part-I) with upto date ammendments where as control cable shall be XLPE insulated and PVC sheathed copper conductor armoured/ unarmoured cable conforming to IS:7098 (Part-I) 1988.

1.3 INSTALLATION OF CABLES

Cables shall be laid directly in ground, pipes, masonry ducts, on cable tray, surface of wall/ceiling etc. as indicated on drawings and/or as per the direction of Engineer-in-Charge. Cable laying shall be carried out as per CPWD specifications.

1.4 **INSPECTION**

All cables shall be inspected at site and checked for any damage during transit.

1.5 **JOINTS IN CABLES**

The Contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoiding of cable joints. This apportioning shall be got approved from Engineer-in-Charge before the cables are cut to lengths.

1.6 **LAYING CABLES IN GROUND**

Cables shall be laid by skilled experienced workmen using adequate rollers to minimize stretching of the cables. The cable drums shall be placed on jacks before unwinding the cable. With great care it shall be unrolled on over wooden rollers placed in trenches at intervals not exceeding 2 metres. Cables shall be laid at depth of 0.75 metres below ground level. A cushion of sand total of 250mm shall be provided both above and below the cable, joint boxes and other accessories. Cable shall not be laid in the same trench or along side a water main.

The cable shall be laid in excavated trench over 80mm layer of sand cushion. The relative position of the cables, laid in the same trench shall preserved. At all changes in direction in horizontal and vertical planes, the cables shall be bent smooth with a radius of bent not less than 12 times the diameter of cables. Minimum 3 metre long loop shall be provided at both end of cable.

Distinguishing marks may be made on the cable ends for identifications of phases. Insulation tapes of appropriate voltage and in red, yellow and blue colours shall be wrapped just below the sockets for phase identifications.

1.7 **PROTECTION OF CABLES**

The cables shall be protected by bricks laid on the top layer of the sand for the full length of underground cable. Where more than one cables is laid in the same trench, the bricks shall cover all the cables and shall project a minimum of approximately 80mm on either side of the cables. Cable under road crossings and any other places subject to heavy traffic, shall be protected by running them through Hume Pipes of suitable size.

1.8 **EXCAVATION & BACK FILL**

All excavation and back fill required for the installation of the cables shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layer not exceeding 150mm. Each layer shall be properly rammed and consolidated before laying the next layer.

The Contractor shall restore all surface, roadways, side walks, kerbs wall or the works cut by excavation to their original condition to the satisfaction of the Engineer-in-Charge-In-Charge.

1.9 **LAYING OF CABLES ON CABLE TRAY/SURFACE OF WALL/CEILING**

Cable shall be laid on perforated M.S. Cable tray. Cables shall be properly dressed before cable ties/clamps are fixed. Wherever cable tray is not proposed, cables shall be fixed on surface of wall or ceiling slab by suitable MS clamps/ saddles**.** Care shall be taken to avoid crossing of cable.

1.10 **CABLES ON HANGERS OR RACKS**

The Contractor shall provide and install all iron hangers racks or racks with die cast cleats with all fixings, rag bolts or girder clamps or other specialist fixing as required.

Where hangers or racks are to be fixed to wall sides, ceiling and other concrete structures, the Contractor shall be responsible for cutting away, fixing and grouting in rag bolts and making good.

The hangers or racks shall be designed to leave at least 25mm clearance between the cables and the face to which it is fixed. Multiple hangers shall have two or more fixing holes. All cables shall be saddled at not more than 150mm centres. These shall be designed to keep provision of some spare capacity for future development.

1.11 **CABLES TAGS**

Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. Trays tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 metres / at both ends only.

1.12 **TESTING OF CABLES**

Prior to installation, burying of cables, following tests shall be carried out. Insulation test between phases, phase & neutral, phase & earth for each length of cable.

a. Before laying.
b. After laying.

c. After jointing.

On completion of cable laying work, the following tests shall be conducted in the presence of the Engineer-in-Charge-In-Charge.

a. Insulation Resistance Test (Sectional and overall).

b. Continuity Resistance Test.

c. Earth Test.

All tests shall be carried out in accordance with relevant Indian Standard code of practice and Indian Electricity Rules**.** The Contractor shall provide necessary instruments, equipments and labour for conducting the above tests & shall bear all expenses of conducting such tests.

TECHNICAL SPECIFICATION FOR CABLE TRAY

1.0 CABLE TRAY

The cable tray shall be fabricated out of slotted/perforated MS sheets as channel, sections, single or double bended**.** The channel sections shall be supplied in convenient lengths and assembled at site to the desired lengths. These may be galvanized or painted to the desired lengths. Alternatively, where specified, the cable tray may be fabricated by two angle irons of 50mm x 50mm x 6mm as two longitudinal members, with crosses bracings between them by 50mm x 5mm flats welded/bolted to the angles at 1 m spacing. 2mm thick MS perforated sheet shall be suitably welded/bolted to the base as well as on the two sides.

Typically, the dimensions, fabrication details etc.are shown in CPWD General Specification for Electrical Works - Part II -External, 1994**.**

The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. In order to maintain proper earth continuity bond, the paint on the contact surfaces between the coupler plates and cable tray shall be scraped and removed before the installation**.**

The maximum permissible uniformly distributed load for various sizes of cables trays and for different supported span are as per CPWD General Specification of Electrical Work Part II -1994. The sizes shall be specified considering the same.

The width of the cable tray shall be chosen so as to accommodate all the cable in one tier, plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100mm. The overall width of one cable tray shall be limited to 800mm.

Factory fabricated bends, reducers, tee/cross junctions, etc. shall be provided as per good Engineering practice. Details are typically shown in figure 3 of CPWD General Specification of Electrical Work Part-II -1994. The radius of bends, junctions etc. shall not be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

The cable tray shall be suspended from the ceiling slab with the help of 10mm dia MS rounds or 25mm x 5mm flats at specified spacing as per of CPWD General Specification of Electrical Work Part II -1994. Flat type suspenders may be used for channels upto 450mm width bolted to cable trays. Round suspenders shall be

threaded and bolted to the cable trays or to independent support angles 50mm x 50mm x 5mm at the bottom end as specified. These shall be grouted to the ceiling slab at the other end through an effective means, as approved by the Engineer-in-Charge, to take the weight of the cable tray with the cables.

The entire tray (except in the case of galvanized type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint.

The cable tray shall be bonded to the earth terminal of the switch boards at both ends.

The cable trays shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross joints, etc, and paid for accordingly.

Cable laid on cable tray shall be clamped on the tray at suitable intervals as per CPWD specifications.

TECHNICAL SPECIFICATION OF POINT WIRING

1.0 **SCOPE**

This section covers the general technical requirements and measurement of the various component in Internal Electrical Installation Works.

1.1 **TERMINOLOGY**

The definition of terms shall be accordance with IS 732: 1989 (Indian Standard Code of Practice for Electrical Wiring), except for the definitions of point, circuit and submain wiring, which are defined in Clause 1.2, 1.3 and 1.3.2 hereunder.

1.2 **POINT WIRING**

1.2.1 Definition :

A point (other than socket outlet point) shall include all works necessary in complete wiring to the following outlets from the controlling switch or MCB. The scope of wiring for a point shall, however, includes the wiring work necessary in tapping from another point in the same distribution circuit: -

a) Ceiling rose or connector (in the case of points for ceiling/ exhaust fan points, pre-wired light fittings and call bells)

b) Ceiling rose (in case of pendants except stiff pendants)

c) Back plate (in the case of stiff pendants)

d) Lamp holder (in the case of gooseneck type wall brackets, batten holders and fittings which are not pre-wired.

1.2.2 In the case of call bell points, the words “from the controlling switch or MCB” shall be read as “from the ceiling rose meant for connection to bell push”.

1.2.3 Scope

i) Following shall be deemed to be included in point wiring :

a) Conduit, accessories for the conduit and wiring cables between the switch box and point outlet, loop protective earthing of each fan/ light fixture.

b) All fixing accessories such as clips, nails, screws, Phil plug, rawl plug etc. as required.

c) Metal switch boxes for control switches, regulators, sockets etc. recessed or surface type and phenolic laminated sheet covers in case of piano type switches and outer & inner cover plates in case of modular type switches.

d) Outlet boxes, junction boxes, pull-through boxes etc. but excluding metal boxes if any, provided with switchboards for loose wires/ conduit terminations.

e) Control switch or MCB as specified.

f) Ceiling rose or connector as required.
g) Connections to ceiling rose, connector, lamp holder, switch etc.

h) Interconnection wiring between points on the same circuit, in the same switch box or from another.

i) Protective (loop earthing) conductor from one metallic switch box to another in the distribution circuits, and for socket outlets. (The length of protective conductor run alongwith the circuits/ submains is excluded form the scope of points)

j) Based conduit or porcelain tubing where wiring cables pass through wall etc.

ii) Following shall be deemed to be included in group control point wiring :

Conduit, accessories for the conduit and wiring cables between the Switchboard/ MCBDB to the first point or wiring cable between points forming a group including loop protective earthing of each fan/ light fixture. (Providing MCB/Switch is not included in this scope and will be measured separately].

All fixing accessories such as clips, nails, screws, Phil plug, raw plug etc. as required.

Junction boxes, pull-through boxes etc. but excluding metal boxes if any, provided with Switchboard/ MCBDB for loose wires/ conduit terminations.

Ceiling rose or connector as required.

Connections to ceiling rose, connector & Switch/ MCB etc.

Bushed conduit or porcelain tubing where wiring cables pass through wall etc.

1.3 **MEASUREMENT**

1.3.1 POINT WIRING (OTHER THAN SOCKET OUTLET POINT)

Unless and otherwise specified, there shall be no linear measurement for point wiring for light points, fan points, exhaust fan points and call bell points. These shall be measured on unit basis by counting.

No separate measurement will made for interconnections between points in the same distribution circuit and for the circuit protective (loop earthing) conductors between metallic switch boxes.

1.3.2 POINT WIRING FOR SOCKET OUTLET POINTS

i) The light plug (5 / 6 Amp) point and power(15 / 16 Amp) point wiring shall be measured on linear basis, from the respective tapping point of live cable, namely, switchbox, another socket outlet point, or the Sub distribution board as the case may be, upto the socket outlet.

ii) The metal box with covers, switch/ MCB, socket outlet and other accessories shall be measured and paid as separate item.

iii) The power point may be 15/5 Amp or 16/6 Amp 6 pin socket outlet, where so specified in the Tender documents. (2 pin or 5 pin socket outlet shall not be permitted.)

1.3.3 SWITCH CONTROL GROUP POINT WIRING

i) In the case of points with more than one point controlled by one switch, such points shall be measured in part i.e. from switch to the first point outlet as one point and (from switch to first point of group controlled point). Subsequent looping points i.e one point to another point in the same group will be measured under group controlled point (from one point to another point).

ii) No recovery shall be made for non provision of more than one switch in such cases.

1.3.4 MCB CONTROL GROUP POINT WIRING

i) In the case of points with more than one point controlled by one MCB, such points shall be measured in part i.e. from MCB to the first point outlet as one point and will be measured under group controlled point (from MCB to first point of group controlled point). Subsequent looping points i.e one point to another point in the same group will be measured under group controlled point (from one point to another point).

ii) Providing MCB is not covered in this scope and will be measured separately and shall be separately paid for.

1.3.5 TWIN CONTROL LIGHT POINTS WIRING

i) A light point controlled by two numbers of two way switches shall be measured as two points from the fitting to the switches on either side.

ii) No recovery shall be made for non-provision of more than one ceiling rose or connector in such cases.

1.4 CIRCUIT AND SUBMAIN WIRING

1.4.1 Circuit Wiring

Circuit wiring shall mean the wiring from the distribution board upto the tapping point for the nearest first point of that distribution circuit, viz. upto the nearest first switch box.

1.4.2 Submain Wiring

Submain wiring shall mean the wiring from one Main/Distribution switchboard to another. Measurement of circuit and submain wiring.

i) Circuit and submain shall be measured on linear basis along the run of the wiring. The measurement shall include all lengths from end to end of conduit exclusive of interconnections inside the switchboard etc. The increase on account of diversion or slackness shall not be included in the measurement

ii) The length of circuit wiring with two wires shall be measured from the distribution board to the first nearest switch box in the circuit irrespective of whether the neutral conductor is take to switch box or not.

iii) When wires of different circuit are grouped in as single conduit the same shall be measured on linear basis depending on the actual numbers and sizes of wires run.

iv) When circuit wires and wires of point wiring are run in the same conduit, circuit wiring shall be measured on linear basis depending on the actual number and sizes of wires run in the existing conduit. As far as, practicable circuit wiring and point wiring shall be drawn in different conduit.

v) Circuit wiring and submain shall not be run in the same conduit.

vi) Protective (loop earthing) conductors, which are run along the circuit wiring and the submain wiring, shall be measured on linear basis and paid for separately.

1.5 OTHER WIRING WORKS

i) Except as specified above for point wiring, circuit wiring and submain wiring, other types of wiring shall be measured separately on linear basis alongwith the run of wiring depending on the actual number and sizes of wires run.

1.6 SYSTEM OF DISTRIBUTION AND WIRING

The main distribution board and branch distribution board shall be controlled or provided with linked switch fuse unit or miniature circuit breaker (MCB) of specified rating on the phase or live conductor or combined phase and neutral control gear for incoming and outgoing as indicated in the BOQ.

Distribution of submain and circuits.

As per final approved single line diagram.

1.6.1 Balancing of Circuits

i) The balancing of circuits in three wire or poly phase installations shall be arranged before handling to the satisfaction of the Engineer-in-Charge-In-Charge.

1.6.2 Wiring System

i) Unless and otherwise specified in the tender documents, wiring shall be done only by the “Looping System”. Phase of live conductors shall be looped at the switch boxes and neutral conductors at the point outlets.

ii) Lights, fans and call bell shall be wired in the ‘lighting’ circuits. 15/ 16 Amp socket outlets and other power outlets shall be wired in the ‘Power’ circuits. 5/ 6Amp socket outlets shall be wired in the ‘lighting circuits’.

iii) The wiring throughout the installation shall be such that there is no break in the neutral wire except in the form of linked switchgear

1.6.3 Run of Wiring

The type of wiring shall be as specified in tender document, i.e. conduit.

Surface wiring shall run, as far as possible, along the walls and ceiling so as to be easily accessible for inspection.

In no case, the open wiring shall be run above the false ceiling without the approval of Engineer-in-Charge-In-Charge.

In all types of wiring, due consideration shall be given for neatness, good appearance and safety.

1.6.4 Passing through walls or floors

When wiring cables are to pass through a wall, these shall be taken through a protection (Steel/PVC) pipe or porcelain tube of suitable size such that they pass through in a straight line without twist or cross in them on either end of such holes. The ends of metallic pipe shall be neatly bushed with porcelain, PVC or other approved material.

Where a wall pipe passes outside a building so as to be exposed to weather, the outer end shall be bell mouthed and turned downwards and properly bushed on the open end.

All floor openings for carrying any wiring shall be suitably sealed after installation.

1.6.5 Joints in Wiring

i) No bare conductor in phase and/or neutral or twisted joints in phase, neutral, and/or protective conductors in wiring shall be permitted.

ii) There shall be no joints in the through runs of cables. If the length of final circuit or submain is more than the length of a standard coil, thus necessitating a through joint, such joints shall be made by means of approved mechanical connectors in suitable junction boxes.

iii) Termination of multi-stranded conductors shall be done using suitable crimping type thimbles.

1.7 CONFORMITY TO IE ACT, IE RULES AND STANDARDS

i) All electrical works shall be carried out in accordance with the provisions of Indian Electricity Act, 1910 and Indian Electricity Rules, 1956, amended up to date and a certificate to this effect shall be submitted by the contractor to the Owners.

ii) The works shall also conform to relevant Indian Standard Codes of Practice shall be followed.

1.8 GENERAL REQUIREMENTS OF COMPONENTS

1.8.1 Quality of Materials

All material and equipments supplied by the Contractor shall be new. They shall be of such design, size and materials as to satisfactorily function under the rated conditions of operation and to withstand the environmental conditions at site.

1.8.2 Conformity of Standards

a) All components shall conform to relevant Indian Standard Specification, wherever existing. However, for conduits, wiring cables, piano switches and socket outlets, ISI marked materials shall only be permitted.

b) The Indian Standards, including amendments or revisions thereof upto the date of tender acceptance, shall be applicable.

1.8.3 Interchangeability

Similar parts of all switches, lamp holders, distribution fuse boards, switchgears, ceiling roses, brackets, pendants, fans and all other fittings of the same type shall be interchangeable in each installation.

1.9 CABLES

1.9.1 Wiring Cables

Conductors of wiring cables (other than flexible cables) shall be of aluminium or copper, as specified.

Stranded aluminium conductor shall not be used in wiring cables upto and including 6 Sq.mm. size.

Unless and otherwise specified, copper conductor of size 1.5 Sq.mm. and above used for wiring shall be stranded.

1.9.2 Flexible Cables

i) Conductor of flexible cables shall be of copper. The minimum cross sectional area of conductor for flexible cable shall be 0.0006 Sq. inch (14/.0076" or 14/0.193 mm).

ii) Only 3 core flexible cables shall be used for connecting single-phase appliances.

iii) Unless armour, or tough rubber, or PVC sheath mechanically protects the flexible cables, these shall not be used in workshops and other places where they are liable to mechanical damage.

iv) Flexible cable connection to bell push from ceiling rose shall be taken through steel conduit/ metallic casing and capping.

1.10 WIRING ACCESSORIES

1.10.1 Control Switches For Points

i) Combined switch cum socket shall not be permitted.

ii) Control switch shall be placed only in the live conductor of the circuit. No single pole switch or fuse shall be inserted in the protective (earth) conductor, or earthed neutral conductor of the circuit.

1.10.2 Socket Outlets

i) 5/ 6Amp and 15/ 16Amp 6 Pin socket outlets shall be installed at the following positions, unless otherwise specified.

a) Kitchen/ Pantry 23 cm above working platform and away from the likely positions of stove and sink.

b) Toilets in non-residential building – 1.25 mt. Above floor level.

c) At all other places – 23 cm above floor level.

1.10.3 Switch box covers

Phenolic laminated sheet of 3 mm thick of approved shade shall be used for switch box covers in case of piano type switches. For modular type switches/sockets suitable outer and inner cover plates as specified shall be provided over the standard box as recommended by the manufacturers of modular type switch/ sockets and no separate sheet cover is required to be provided.

1.10.4 Ceiling Rose

i) A ceiling rose shall not be used on circuit the voltage of which normally exceeds 250 Volts.

ii) Only one flexible cord shall be connected to ceiling rose. Specially designed ceiling roses shall be used for multiple pendants.

iii) A ceiling rose shall not embody fuse terminal as an integral part of it.

1.11 FITTINGS

The type of fittings shall be as specified in BOQ of tender documents.

1.11.1 Indoor Type Fittings

i) The contractors shall supply the specified model and make of the fittings. The standard constructional features of specified make and model as given in the tender document are acceptable.

ii) Where conductors are required to be drawn through tube or channel leading to the fitting, the tube or channel must be free from sharp angles or projection edge, and of such size as will enable them to be wired with the conductors used for the final circuit without removing the braiding or sheathing. A far as possible all such tubes or channels should be of sufficient size to permit looping back.

iii) Pendants in verandahs and similar situations exposed to wind shall be of fixed rod type.

iv) Fittings using discharge lamps shall be complete with power factor correction capacitors, either integrally or externally. An earth terminal with suitable marking shall be provided for each fitting for discharge lamps.

v) Fittings shall be installed such that the lamp is at a height specified in approved drawings or as directed by the Engineer-in-Charge.

1.12 ATTACHMENT OF FITTINGS AND ACCESSORIES

1.12.1 Conduiting Wiring System

i) All accessories like switches, socket outlets, call bell pushed and regulators shall be fixed in flush pattern inside the switch/ regulator boxes.

Accessories like ceiling roses, brackets, batten holders, stiff pendants etc. shall be fixed on metal outlet boxes.

ii) Brass screws shall be used to fix the accessories to their bases.

iii) The switch box/ regulator box shall normally be mounted with their bottom 1.25 m from floor level, unless otherwise directed by the Engineer-in-Charge.

1.12.2 Fixing of Walls and Ceiling

i) PVC sleeves/ dash fasteners should normally be used for fixing to walls or ceiling.

ii) Plugging of walls or ceiling can be done in a better way where neatness is the first consideration. In all such cases, an approved type of asbestos or fiber fixing plug (rawl or Phil plug) with correct size of tools shall be used and done in a workmanlike manner.

1.12.3 **FANS, REGULATORS AND CLAMPS**

1.12.3.1 Ceiling Fans

i) Ceiling fans including their suspension shall conform to relevant Indian Standards.

ii) Any additional hardware items required for installation of ceiling fans including fan hooks/ clamps as specified below, shall be provided as specified in BOQ as a separate item.

iii) All ceiling fans shall be wired to ceiling roses or to special connector boxes, and suspended from hooks or shackles, with insulators between hooks and suspension rods. There shall be no joint in the suspension rod.

iv) For wooden or steel joists and beams, the suspension shall consist of MS flat of size not less than 40mm x 6mm, secured on the sides of the joists or beams by means of two coach screws of size not less than 5 cm for each flat. Where there is space above the beam, a through bolt of size not less than 1.5cm dia shall be placed above the beam from which the flats are suspended. In the latter case, the flats shall be secured from movements by means of another bolt and nut at the bottom of the beam. A hook consisting of MS rod of size not less than 1.5 cm dia shall be inserted between the MS flat through oval holes on their sides. Alternatively, the flats may be bent inwards to hold tightly between them by means of a bolt and nut, a hook of 'S' form.

v) In the case of 'I' beams, flats shall be shaped suitably to catch the flanges and shall be held together by means of a long bolt and nut.

vi) For concrete roofs, a 12mm dia. MS rod in the shape of 'U' with their vertical legs bent horizontally at the top at least 19cm on either side and bound to the top reinforcement of the roof shall be used.

vii) In buildings with concrete roofs having a low ceiling height, where the fan clamp mentioned under sub clause (vi) above cannot be used, or wherever specified, recessed type fan clamp inside a metallic box shall be used. The metallic box shall suitably be covered with 3mm thick phenolic laminated sheet.

viii) Canopies on top of suspension rod shall effectively hide the suspension.

ix) The leading in wire shall be of copper and nominal cross sectional area not less than 1.5 Sq.mm. and shall be protected from abrasion.

x) All ceiling fans shall be hung at a height as directed by the Engineer-in-Charge-In-Charge.

xi) In the case of measurement of extra down rod for ceiling fan including wiring, the same shall be measured in units of 10 cm. Any length less than 5cm shall be ignored.

xii) The wiring of extra down rod shall be paid as supplying and drawing cable in existing conduit.

1.12.3.2 Exhaust Fans

i) Exhaust fans shall conform to relevant Indian Standards.

ii) Exhaust fans shall be erected at the places indicated by the Engineer-in-Charge-In-Charge additional hardware items required for installation of ceiling fans including fan hooks/ clamps as specified below, shall be provided as specified in BOQ as a separate item.

1.12.3.3 Regulators

The metallic body of regulators of ceiling fans / exhaust fans shall be connected to earth by protective conductor.

1.12.3.4 Workmanship

Good workmanship is an essential requirement to be complied with. The entire work of manufacture/ fabrication, assembly and installation shall conform to sound Engineering practice.

The work shall be carried out under the direct supervision of an Engineer-in-Charge, employed by the contractor, who shall rectify then and there the defects pointed out by the Engineer-in-Charge-In-Charge during the progress of work. The qualification of Engineer-in-Charge or supervisor for over all supervision and to take instructions from the Engineer-in-Charge-In-Charge shall be as specified in the special conditions.

1.13 TESTING OF INSTALLATION

All the completed installations shall be tested as per specification for "Testing of Installation".

1.13.1 Drawings

i) The work shall be carried out in accordance with the drawings enclosed with the tender documents and also in accordance with modification thereto from time to time as approved by the Engineer-in-Charge-In-Charge or as per the drawing prepared by the contractor based on inventory and approved by Engineer-in-Charge-In-Charge.

ii) All wiring diagrams shall be deemed to be 'Drawings' within the meaning of the term as used in the Conditions of Contract. They shall indicate the main switchboard, the distribution boards (with circuit numbers controlled by them), the runs of various mains and submains and the position of all points with their controls.

iii) All circuits shall be indicated and numbered in the wiring diagram and all points shall be given the same number as the, circuit to which they are electrically connected.

1.14 COMMISSIONING OF COMPLETION

1.14.1 Before the workman leaves the work finally, he must make sure that the installation is commissioned, after due testing.

1.14.2 Completion Plan and Completion Certificate

i) For all E&M items , completion certificate after completion of work as required by NHIDCL/Employer shall be submitted to the Engineer-in-Charge.

ii) Completion plan drawn to a suitable scale in tracing sheet with three blue print copies of the same shall also be submitted.

a) General Layout of the building.

b) Locations of main switchboard and distribution boards.

c) Position of all points and their controls indicating the circuit numbers controlled by them.

d) Types of fittings, viz. C.F.L., L.E.D. bracket fans, Exhaust fans etc.

e) Name of work, job number, accepted tender reference, actual date of completion, name of Engineer-in-Charge, and name of the firm who executed the work with their signature.

NON-METALLIC CONDUIT WIRING SYSTEM

1.0 SCOPE

This section covers the detailed requirements for wiring work in non metallic conduits. This section covers both surface and recessed types of works.

1.1 APPLICATIONS

Conduit system used shall be Rigid.

Flexible conduits may only be permitted for interconnections between switchgear & DBs and conduit terminations in wall.

1.2 MATERIALS

1.2.1 Conduits :

i) All rigid conduit pipes shall be of Heavy grade F.R.L.S. PVC. The wall thickness shall be 1.6mm (16 SWG) for conduits upto 32mm dia. and 2mm (14 SWG) for conduits above 32mm dia and as per IS. These shall be solid drawn or reamed by welding, and finished with galvanized or stove enameled surface.

ii) The maximum number of PVC insulated cables conforming to IS: 694-1990 that can be drawn in one conduit is given size wise in TableI., and the number of cables per conduit shall not be exceeded. Conduit sizes shall be selected accordingly in each run.

iii) No conduits less than 20mm in diameter shall be used.

1.2.2 Conduits Accessories :

i) The conduit wiring system shall be complete in all respects, including their accessories.

ii) All conduit accessories shall be of slip joint type, and under no circumstances pin grip type or clamp grip accessories shall be used.

iii) Bends, couplers etc. shall be solid type in recessed type of works and may be solid or inspection type as required, in surface type of works.

iv) a) Saddles for surface conduit work on wall shall not be less than 0.55mm (24 gauge) for conduits upto 25mm dia and not less than 0.9mm (20 gauge) for larger diameter. The corresponding widths shall be 19mm and 25mm.

b) The minimum width and the thickness of girder clips used for fixing conduits to steel joints, and clamps shall be as per Table-II.

1.2.3 Outlets :

i) The switch box regulator box shall be made of metal on all sides, except on the front. In case of welded mild steel sheet boxes the wall thickness shall not be less than 1.2mm (18 gauge) for boxes upto a size of 20 cm x 30 cm and above this size 1.6mm (16 gauge) thick MS boxes shall be used. The metallic boxes shall be duly painted with anticorrosive paint before erection as per painting specification.

ii) a) Outlet boxes for light/ power sockets shall be of standard size of manufacturer to accommodate required number of modular switches, socket outlet.

b) Where a large number of control switches and/ or fan regulators are required to be installed at one place, these shall be installed in more than one outlet box adjacent to each other for ease of maintenance.

iii) An earth terminal with stud and metal washers shall be provided in each DB/MS box for termination of protective conductor and for connection to socket outlet/ metallic body of fan regulator etc.

iv) A metal strip shall be welded/ screwed, to the metal box as support if fan regulators are to be fixed herein.

v) Clear depth of the box shall not be less than 50mm, and this shall be increased suitably to accommodate mounting of fan regulators in flush pattern.

vi) The fan regulators can also be mounted on the switch box covers, if so directed by the Engineer-in-Charge-In-Charge.

vii) The size of the switchbox in case of piano type switches shall be as below

a) Without any fan regulator/ Dimmer on the Switch box:- The size of the switch box shall be minimum 75mm x 75mm x 60mm deep to accommodate the number of switches meeting spacing requirements mentioned below.

b) With electronic/ resistance type fan regulator on the Switch box:- The size of the switch box shall be minimum 75mm x 75mm x 60mm to accommodate the number of switches and fan regulators meeting spacing requirements mentioned below.

Spacing Requirements

The spacing between any edge of live terminal of Switch/ socket and the body shall not be less than 26mm at any point.

viii) The size of the switch box in case of modular type switches shall be as per manufacturer's standard.

1.3 **INSTALLATION**

1.3.1 Common aspects for recessed and surface conduit works.

i) Conduit Joints

a) The conduit work in each circuit or section shall be completed before the cables are drawn in.

b) Conduit pipes shall be joined by means of slip joints and using proper adhesive

c) Cut ends of conduit pipes shall have no sharp edges, nor any burrs left to avoid damage to the insulation of the conductors while pulling them through such pipes.

d) The Engineer-in-Charge-In-Charge, with a view to ensuring that the above provision has been carried out, may require that the separate lengths of conduit etc. after they have been prepared shall be submitted for inspection before being fixed.

ii) Bends in Conduit

a) All necessary bends in the system, including diversion, shall be done either by neatly bending the pipes without cracking with bending radius of not less than 7.5 cm., or alternatively, by inserting suitable solid or inspection type normal bends, elbows or similar fittings, or by fixing cast iron inspection boxes, whichever is most suitable.

b) No length of conduit shall have more than the equivalent of four quarter bends from outlet to outlet.

c) Conduit fittings shall be avoided as far as possible on conduit system exposed to weather. Where necessary, solid type fittings shall be used.

iii) Outlets

a) All outlets such as switches, wall sockets etc. may be either flush mounting type, or of surface mounting type, as specified in the additional specifications if any or as directed by the Engineer-in-Charge-In-Charge.

b) All piano type switches and accessories shall be fixed on the phenolic laminated sheet covers in flush pattern.

iv) Fixing Conduit On Surface

Conduit pipes shall be fixed by saddles, secured to suitable approved plugs with screws in an approved manner at an interval of not more than one metre, but on either side of the couplers or bends or similar fittings, saddles shall be fixed at a distance of 30 cm from the centre of such fittings.

Where conduit pipes are to be laid along the trusses, steel joists etc. the same shall be secured by means of saddles or girder clips or clamps as required by the Engineer-in-Charge-In-Charge.

In long distance straight run of conduit, inspected type couplers at reasonable intervals shall be provided, or running threads with couplers and jam nuts shall be provided.

v) Fixing Outlet Boxes

Only a portion of the switch box shall be sunk in the wall, the other portion being projected out for suitable entry of conduit pipes into the box.

1.3.3 Additional requirements for recessed conduit works

i) Making Chase

a) The chase in the wall shall be neatly made, and of ample dimensions to permit the conduit to be fixed in the manner desired.

b) In the case of building under construction, the conduits shall be buried in the wall before plastering, and shall be finished neatly after erection of conduit.

c) In chase of exposed brick/ rubber masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work.

ii) Fixing Conduits in Chase

a) The conduit pipe shall be fixed by means of staples, J-hooks, or by means of saddles, not more than 60 cm apart, or by any other approved means of fixing.

b) All threaded joints of conduit pipes shall be treated with some approved preservative compound to secure protection against trust.

iii) Fixing Conduits in RCC work

a) The conduit pipes shall be laid in position and fixed to the steel reinforcement bars by steel binding wires before the concreting is done. The conduit pipes shall be fixed firmly to the steel reinforcement bars to avoid their dislocation during pouring of cement concrete and subsequent tamping of the same.

a) Fixing of standard bends or elbows shall be avoided as far as practicable, and all curves shall be maintained by bending the conduit pipe itself with all long radius, which all permit easy drawing in of conductors.

iv) Fixing Inspection Boxes

Suitable inspection boxes to the minimum requirement shall be provided to permit inspection, and to facilitate replacement of wires, if necessary. The distance between inspection/ junction boxes shall not exceed 12.5 mts in straight run.

Location of inspection/ junction boxes in RCC work should be identified by suitable means to avoid unnecessary chipping of the RCC slab subsequently to locate these boxes.

These shall be mounted flush with the wall or ceiling concrete. Minimum 65mm depth junction boxes shall be used in roof slabs and the depth of the boxes in other places shall be as per IS : 2667-1977.

Suitable phenolic laminated sheet cover shall be provided on the inspection box.

Suitable ventilating holes shall be provided in the inspection box covers.

v) Fixing Switch Boxes and Accessories

Switch boxes shall be mounted flush with the wall. All outlets such as switches, socket outlets etc. shall be flush mounting type, unless otherwise specified.

vi) Fish wire

To facilitate subsequent drawing of wires in the conduit, GI fish wire of 1.6mm / 1.2mm (16/ 18 SWG) shall be provided alongwith the laying of the recessed conduit.

vii) Bunching of Cables

a) Cables carrying direct current may, if desired, be bunched whatever their polarity, but cables carrying alternating current, if installed in metal conduit shall always be bunched so that the outgoing and return cables are drawn into the same conduit.

b) Where the distribution is for single phase loads only, conductors for these phases shall be drawn in one conduit.

c) In case of three phase loads, separate conduits shall be run from the distribution boards to the load points or outlets as the case may be.

1.3.4 Earthing Requirements

i) The entire system including the outlet boxes and other metallic accessories, shall be mechanically and electrically continuous by proper screwed joints, or by double check nuts at termination. The conduit shall be continuous when passing through wall or floors.

ii) Protective (loop earthing) conductor (s) shall be laid along the runs of the conduit between the metallic switch boxes and the distribution boards/ switchboards, terminated thereto. The conductors shall be of such size and material as specified. Depending upon their size and material, the protective earth conductors shall be either drawn inside the conduits alongwith the cables, or shall be laid drawn in outside the conduits. When laid external to the conduits, this shall be properly clamped with the conduit at regular intervals.

iii) The protective conductors shall be terminated properly using earth studs, earth terminal block etc. as the case may be.

iv) Gas or water pipe shall not be used as protective conductor (earth medium).

TABLE - I

Maximum number of PVC insulated 1100 V grade aluminium/copper conductor cable conforming to IS : 694 - 1990

Nominal Cross-Sectional area of conductor in sq.mm	20mm		25mm		32mm		38mm		51mm		64mm	
	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	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 4.25m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns headed 'B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.

3. Conduit sizes are the nominal external diameters.

TABLE - II

Girder clips or clamps

Size of Conduit		Width	Thickness
i)	20 mm - - - -	19 mm	0.9mm (20 SWG)
ii)	25 mm - - - -	19 mm	0.9mm (20 SWG)
iii)	32 mm & above - - - -	25 mm	1.2mm (18 SWG)

1.4 SPECIFICATION FOR PAINTING

1.4.1 SCOPE

This section covers the requirements of painting work in internal electrical installations, carried out manually by brush. This does not cover spray painting work of factory made items.

1.4.2 PAIINTING WORK IN GENERAL

1.4.2.1 PAINTS

Paints, oils, vanishes etc. of approved make, in original tin to the satisfaction of the Engineer-in-Charge-In-Charge shall only be use.

1.4.2.2 PREPRATION OF THE SURFACE

The surface shall be thoroughly cleaned and made free from dust or foreign matter before painting is started. The proposed surface may be inspected by the Engineer-in-Charge-In-Charge before the paint is applied.

1.4.2.3 APPLICATION :

i) Paint shall be applied with brush. The paint shall be spread as smooth and even as possible. Particular care shall be paid to rivets, nuts, bolts and over-lapping. Before drawing out in small containers, it shall be continuously stirred with a smooth stick, while painting work is taken up.

ii) Primary coat of anti-corrosive paint shall be given in the case of steel work, after preparation the surface. In all cases of painting work, finishing shall be with 2 coats of paint in approved shade.

iii) Each coat shall be allowed to dry out sufficiently before a subsequent coat is applied.

1.4.2.4 PRECAUTIONS

All furniture, fixture, glazing, floors etc. shall be protected by suitable covering. Al stains, smears splashing, dropping etc. shall be removed. While painting of wiring etc. it shall be ensured that the painting of wall and ceiling etc. is not spoiled in any way.

TESTING OF INSTALLATION

1.0 SCOPE

This section describes the details of test to be conducted in the completed internal electrical installation, before commissioning.

1.1 GENERAL:

1.1.1 TESTS

On completion of installation, the following tests shall be carried out :-

i) Insulation resistance test.
ii) Polarity test of switch.
iii) Earth continuity test.
iv) Earth electrode resistance test.

1.1.2 WITNESSING OF TESTS

Testing shall be carried out for the completed installations, in the presence of and to the satisfaction of the Engineer-in-Charge-In-Charge by the Contractor. All test results shall be recorded and submitted to the Department.

2.0 INSULATION RESISTANCE

The tests described below shall be made before the installation is permanently connected to the supply. For these tests large installations may be divided into groups of outlets, each containing not less than 50 outlets. For the purposes of this code the term 'outlet' includes every point and every switch except that a socket outlet, appliance or luminaire incorporating a switch is regarded as one outlet. The test voltage for insulation resistance measurement shall be 1000 V.

When measured with all fuse links in place, all switches (including, if practicable, the main switch) closed and, all poles or phases of the wiring electrically connected together, the insulation resistance to earth shall be not less than 1 mega ohm.

When measured between all the conductors connected to any one phase or pole of the supply and, in turn, all conductors connected to each other phase or pole the insulation resistance shall be not less than 1 mega ohm. Wherever practicable, so that all parts of the wiring may be tested, all lamps shall be removed and all current-using equipment shall be disconnected and all local switches controlling such lamps or other equipment shall be closed. Where the removal of lamps and/or the disconnection of current-using equipment is impracticable, the local switches controlling such lamps and/or equipment shall be open. Particular attention shall be given to the presence of electronic devices connected in the installation and such devices shall be isolated so that the test voltage does not damage them.

Where equipment is disconnected for the tests prescribed above, and the equipment has exposed conductive parts required by these clauses to be connected to protective conductors, the insulation resistance between the exposed conductive parts and all live parts of the equipment shall be measured separately and shall comply with requirements of the appropriate Indian Standard and the insulation resistance shall not less than 0.5 mega ohm.

3.0 POLARITY TEST OF SWITCH

In a two wire installation, a test shall be made to verify that all the switches in every circuit have been fitted in the same conductor, throughout, and such

conductor, shall be labeled or marked for connection to the phase conductor, or to the non-earthed conductors of the supply.

In a three wire or a four wire installation, a test shall be made to verify that every non-linked single pole switch is fitted in a conductor which is labeled, or marked for connection to one of the phase conductors of the supply.

The installation shall be connected to the supply for testing. The terminals of all switches shall be tested by a test lamp, one lead of which is connected to earth. Glowing of test lamp to its full brilliance, when the switch is in 'ON' position irrespective of appliance in position or not, shall indicate that the switch is connected to the right polarity.

4.0 TESTING OF EARTH CONTINUITY PATH

The earth continuity conductor, including metal conduits and metallic envelops of cables in all cases, shall be tested for electric continuity. The electrical resistance of the same alongwith the earthing lead, but excluding any added resistance, or earth leakage circuit breaker, measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

5.0 MEASUREMENT OF EARTH ELECTRODE RESISTANCE

5.1 Two auxiliary earth electrodes, besides the test electrode, are placed at suitable distance from the test electrode. A measured current is passed between the electrode 'A' to be tested and an auxiliary current electrode 'C' and the potential difference between the electrode 'A' and auxiliary potential 'B' is measured. The resistance of the test electrode 'a' is then given by

$R = V/I$

Where,

R- Resistance of the test electrode in ohms

V- Reading of the voltmeter in volts

I- Reading of the ammeter in amps

5.1.1 i) Stray currents flowing in the soil may produce serious errors in the measurement of earth resistance. To eliminate this, hand driven generator is used.

ii) If the frequency of the supply of hand driven generator coincides with the frequency of stray current, there will be wandering of instrument pointer. An increase or decrease of generator speed will cause this to disappear.

5.1.2 At the time of test, the test electrode shall be separated from the earthing system.

5.1.3 The auxiliary electrodes shall be of 13mm diameter mild steel rod driven upto 1 m into the ground.

5.1.4 All the three electrodes shall be so placed that they are independent of the resistance area of each other. If the test electrode is in the form of a rod, pipe or plate, the auxiliary current electrode C shall be placed at least 30 m away from it and the auxiliary potential electrode 'B' shall be placed mid-way between them.

5.1.5 Unless three consecutive readings of test electrode resistance agree, the test shall be repeated by increasing the distance between electrodes A and C upto 50 m, and each time placing the electrode B mid-way between them.

5.1.6 On these principles, "Megger Earth Tester" containing a direct reading ohm-meter, a hand driven generator and auxiliary electrodes are manufactured for direct reading of earth resistance of electrodes.

6.0 **TEST CERTIFICATE**

On completion of an electrical installation or an extension to an installation, a certificate shall be furnished by the Contractor, countersigned by the competent Engineer-in-Charge PMC Rep.

FORM OF COMPLETION CERTIFICATE

I/We certify that the installation detailed below has been installed by me/us and tested and that best of my/ our knowledge and belief it complies with Indian Electricity Rules 1956, as well as the Contract Specifications.

Electrical Installation at _____

Voltage and system of supply _____

2.0 EXTERNAL ELECTRICAL WORKS

For Detailed Specification of D.G. Set of Electrical works (Based on DSR 2018) mentioned in SOQ shall be as per CPWD General specification for electrical works Part VII (D.G SET) 2013. (corrected up to the last date of submission/uploading of bid).

For Detailed Specification of Substation of Electrical works (Based on DSR 2018) mentioned in SOQ shall be as per CPWD General specification for electrical works Part IV (SUBSTATION) 2013. (corrected up to the last date of submission/uploading of bid).

CCTV Surveillance System:

Design concept & scope of work:

3.1 IP CCTV SURVEILLANCESYSTEM

3.1.1 DESIGNCONCEPT:

a) The entire IP surveillance system shall be designed to control and monitor the different floors of the staff hostel. The entrance, reception lounge , stair case ,lift in all floors shall have IP Fixed dome cameras to monitor the connecting corridors

3.1.2 SCOPE OF WORK:

b) Supply, installation, testing and commissioning high quality fast-acting IP CCTV surveillance system along with power supply, power distribution and required accessories at specified locations.
c) The entire system shall be as approved by Engineer-in-Charge .
d) The CCTV Surveilance system shall be with power supply, accessories and other devices complete withsoftware.
e) The CCTV surveillance system should consist of IP Fixed dome cameras (indoor type), PTZ & fixed box cameras (outdoor type), software, server, power supply andcables.
f) Video management software shall offer both video stream management and video stream storage management. Recording frame rate and resolution in respect of individual channel shall beprogrammable. Hard disk of 1 TB to store the footage shall be provided with the system.
g) Provide supervisory specialists and technicians at the job to assist in all phases of system installation, start up andcommissioning.
h) Cat 6cable/fiber cable connectivity with all required hardware upto networking switches of LAN, locations of networking switches in hostelbuilding .
i) 230voltsACPowersupplydistributionfromUPStoeachlocationofcamerasalongwithDBs, JBs, cabling work etc. with required accessories.
j) Power supply unit as required forcameras.
k) Integrated testing and commissioning of CCTV system .
l) Training & handing over of all materials, equipment andappliances.
m) Any other items/accessories required for installation, testing and commissioning of CCTV system.
n) No extra cost shall be paid for any enabling miscellaneous items if required to complete the work as per the designconcept.

D. TECHNICAL SPECIFICATION OFLIFT WORK:

1.0 SCOPE OF WORK

These specifications cover the details of 1(One) nos. 13 persons capacity Passenger lift including suitable Brake release tools to be designed supplied, inspection as may be necessary before dispatch, delivery at site, installation, testing, commissioning and handing over and the defects liability for a period of 1 year from the actual recorded date of completion of overall project. **Scope of work shall also include CAMC (Comprehensive Annual maintenance contract) for Four(4) years commencing after one year of defect liability period .**

These specifications shall be read in conjunction with the General Conditions of Contract, Additional Conditions of Contract.

2.0 GENERAL

The equipment and installation covered by these specifications shall conform to codes of practice in force and highest standards of workmanship and materials. This work shall be done in accordance with the provisions of the Local Lifts Authority rules and shall also conform to requirements of local municipal by laws, and subsequent provisions, as also any state or local Act in force and latest Indian Standard 14665 and all latest applicable BIS, NBC code and 'CPWD General Specifications for Electrical Works (Part III, Lifts & Escalators) 2003'.

The Entire electrical installation shall be done in accordance with the Indian Electricity Act 2003, Indian Electricity Rules 1956 as amended to-date. The Electrical wiring shall strictly comply with IS:732 and latest applicable BIS and NBC code. The electrical works shall also conform to CPWD General Specification for Electrical Work Part-I (Internal) 1994 and Part-II (External) 1994 as amended up to date.

The Contractor shall follow all Statutory Requirements as well as best trade practices in the manufacture & installation of lifts. The Contractor shall arrange to obtain the statutory approval of the Inspectorate of Lifts as may be required for commissioning of the lifts and handover for operation after satisfactory tests.

3.0 DRAWINGS

Before commencing work, the Contractor shall prepare and submit all drawings for lift in required nos. necessary to show the general arrangement and details of lift installation, electrical etc. These drawings must be approved by the NHIDCL before installation and shall become part of the contract.

The Contractor shall, within 3(three) weeks of receipt of a Letter of award of contract, submit 4(four) copies of all working drawings showing pit, hoistway layouts clearly indicating and specifying all connected structural, electrical and architectural works including imposed structural static / dynamic loads (including breaking load on guides, reaction of buffers on lift pits, reaction on support points in machine room, lift well etc.) and electrical ratings including calculations for selection of kW rating of motor. Within 10 days of receipt of letter of award of contract, the Contractor shall obtain from the NHIDCL all the information he needs to prepare his drawings and shall have any interaction with the Engineer-in-Charge to finalise all parameters and data for design. The Contractor will be responsible for any discrepancies, errors and omissions in the drawings or particulars submitted by him even if these have been approved by the Engineer-in-Charge. On approval of these drawings (within 2 weeks of submission of full documentation), the Contractor shall submit 5(five) copies of approved working drawings incorporating corrections / comments, if any, and shall immediately commence work.

On completion of work, the contractor shall supply four sets of CD's and 5 (five) copies of the detailed wiring diagram, 'As built' drawings and equipment operation & maintenance manuals and original certificates from 'Inspector of Lifts' for all the lifts. Further, a copy of such detailed diagram and a set of instructions for evacuation of passengers in case of breakdown of the lifts shall be framed and installed in the respective machine room by the Contractor.

The Contractor shall carry out all the work strictly in accordance with drawings, details and instructions of Engineer-in-Charge.

4.0 TESTS ON COMPLETION

The following tests shall be carried out to the satisfaction of the Engineer-in-Charge.

i. Insulation resistance and earth test for all electrical apparatus.
ii. Continuous operation of the lift under full load conditions and simulated starts and stops (150 nos. per hour each) for one hour at the end of which time the service temperature of the motor and the operating coils shall be tested. This shall be as per B.I.S. specification.
iii. The car shall be loaded until the weight on the rope is twice the combined weight of the car and the specified load. The load must be carried on for about 30 minutes, without any sign of weakness, temporary set or permanent elongation of the suspension rope strands.
iv. The following items shall be tested :

a. Levelling accuracy at each landing in conditions of fully loaded and empty car.
b. No load current and voltage readings both on 'Up' and 'Down' Circuits.
c. Full load current and voltage readings both on 'Up' and 'Down' Circuits.
d. One and quarter load current and voltage readings both on 'Up and 'Down' Circuits.
e. Stalling current and voltage and time taken to operate overload.
f. Overload protection.
g. Gate sequence relays, if provided and installed.
h. Car and landing door interlocks.
i. Collective control and priority sequences, if installed.
j. Safety gear mechanism for car and counterweight with fully loaded car and also with only 68 kg load.
k. Speeds on Up and Down travel with full load, half load and empty car.
l. Door contacts.
m. Final terminal stopping device.
n. Normal terminal stopping device.
o. Car and counterweight buffers with contract load and contract speed.
p. Operation of controllers.
q. Manual operation of lift at mid-way travel.
r. Emergency operation.

v. Tests on completion shall also be performed to the satisfaction of Inspector of Lifts and a certificate will be obtained from the 'Lift Inspector ' by the contractor.

17.0 STATUTORY APPROVALS

All statutory approvals from commencement to commissioning of lifts shall be obtained by the Contractor from the Inspector of Lifts and / or other authorities. However, the client will provide all necessary assistance for providing documents, drawings and certificates pertaining to other contractors, if required.

The contractor shall pay necessary fees in connection with the approval of installation of lifts.

5.0 PERFORMANCE PARAMETERS

The following parameters shall be achieved in the installation :

*	Levelling Accuracy	$\pm$ 3 mm for 1.5 m/s speed $\pm$ 4 mm for 0.75 m/s speed
*	Jerk level	0.9 – 1.5 m/s^3
*	Noise level in car	58 dB

*	Noise level at 1 M in machine room	60 dB
*	Acceleration rate	0.6 – 1.0 m/s^2 (adjustable)
*	Max. car vibration	20 milli gals.

20.0 SUBMITTALS 'ALONGWITH TENDER' AND 'POST AWARD'

(A) The following items are required to be submitted induplicate **along with the Tender**.

i. Catalogues with offered items highlighted.
ii. List of imported components, if any.
iii. Compliance Statement for guaranteed performance parameters given in Specification .
iv. Confirmation that offer submitted meets the technical specifications & scope of work and there are no deviations and exclusions from NIT.
v. The contractor shall specify in his offer the full capability of his system in this regard.

(B) The successful contractor, **after award of the contract**,shall furnish following technical particulars of the equipment/devices for the approval by NHIDCL.

i) Single line/ schematic diagram of electronic control panel, lift & equipment etc.
ii) Layout of Hoist-way showing foundation details in the pit, machine room, electric control panel, Lift & equipment etc.
iii) Earthing layout.
iv) Inspection manual for equipment & accessories covered in the scope of supply (8 copies).
v) Technical literature of operation, control and maintenance etc. (8 copies) along-with CDS.
vi) Schedule of scope of maintenance service during defect liability period and CAMC.

The technical parameters furnished by the tenderer would be examined in detail during design submission stage. All improvements considered necessary to meet the tender Technical Specifications would have to be incorporated without any additional cost to NHIDCL with objective of providing high performance and safety Lifts.

21.0. MAINTENANCE DURING DEFECTS LIABILITY PERIOD AND FURTHER

FOUR YEARS CAMC PERIOD

Comprehensive maintenance during Defects Liability Period and next four years CAMC period shall include periodic servicing, prompt attention to Employer complaint, prompt rectification of all malfunctions and equipment failures, replacement of defective equipment / parts, replacement of light fittings, lubrication including lubricants, maintaining correct alignment and levelling of cars and ensuring smooth running, starts and stops etc. all

complete to NHIDCL's satisfaction shall be done by the contractor at own cost.

E. TECHNICAL SPECIFICATION OF LANDSCAPE WORK:

1.0 LANDSCAPE WORK:

Landscaping (Horticulture) operations shall be started on ground previously levelled and dressed to required formation levels and slopes. In case where unsuitable soil is met with, it shall be either removed or, replaced or it shall be covered over to a thickness decided by the Engineer-in-Charge with good earth. In the course of excavation or trenching during horticultural operations, any walls, foundations, etc. met with shall not be dismantled without pre-measurement and prior to the written permission of the Engineer-in-Charge.

2.0 TRENCHING IN ORDINARY SOIL:

2.1 TRENCHING:

Trenching is done in order to loosen the soil, turn over the top layer containing weeds etc. and to bring up the lower layer of good earth to form a proper medium for grassing, re-grassing, hedging and shrubbery. Trenching shall be done to the depth ordered by the Engineer-in-Charge. The depth is generally 30 cm for grassing and 60 cm for re-grassing in good soil.

2.1.1 The trenched ground shall, after rough dress, be flooded with water by making small kiaries to enable the soil to settle down. Any local depression unevenness etc. shall be made good by dressing and/or filling with good soil.

2.1.2 Weeds or other vegetation which appear on the ground are then uprooted and removed and disposed off and paid.

2.1.3 Trenching shall consist of the following operations: 1. The whole plot shall be divided into narrow rectangular strips of about 1.5 m width or as directed by the Engineer-in-Charge-in-Charge. 2. These strips shall be sub-divided lengthwise into about 1 m long sections. Such sections shall be excavated serially and excavated soil deposited in the adjacent section preceding it. 3. In excavating and depositing care shall be taken that the top soil with all previous plant growth including roots, get buried in the bottom layer of trenched area, the dead plants so buried incidentally being formed into humus. 4. The excavated soil shall be straight away dumped into the adjoining sections so that double handling otherwise involved in dumping the excavated stuff outside and in back filling in the trenches with leads is practically eliminated.

2.2GOOD EARTH

2.2.1 The earth shall be stacked at site in stacks not less than 50 cm high and of

volume not less than 3.0 cum.

2.3 SUPPLY AND STACKING OF SLUDGE

2.3.1 It shall be transported to the site in lorries with efficient arrangement to prevent spilling en-route. It shall be stacked at site. Each stack shall not be less than 50 cm height and volume not less than 3 cum.

2.4 SUPPLY AND STACKING OF MANURE

2.4.1 Farmyard Manure: Same as 2.3.1.

2.5 EXCAVATION AND TRENCHING FOR PREPARATION OF BEDS FOR HEDGE AND SHRUBBERY

2.5.1 Beds for hedges and shrubbery are generally prepared to width of 60 cm. to 125 cm. and 2 to 4 meters respectively.

2.5.2 Beds for hedges and shrubbery shall be prepared in the following manner. The beds shall first be excavated to a depth of 60 cm. and the excavated soil shall be stacked on the sides of the beds. The surface of the excavated bed shall then be trenched to a further depth of 30 cm, in order to loosen the soil, in the manner described in 2.1. No flooding will be done at this stage but the top surface shall be rough dressed and levelled. The excavated soil from the top 60 cm depth of the bed stacked at the site shall then be thoroughly mixed with sludge over manner in the proportion 8:1 by ratio or other proportion described in the item. The mixed earth and manure shall be refilled over the trenched bed, levelled neatly and profusely flooded so that the water reaches even the bottom most layers of the trenched depth of the bed. The surface after full subsidence shall again be refilled with the earth and manure mixture, watered and allowed to settle and finally fine dressed to the level of 50 mm to 75 mm below the adjoining ground or as directed by the Engineer-in-Charge. Surplus earth if any, shall be disposed off as directed by the Engineer-in-Charge. Any surplus earth if removed beyond initially lead shall be paid separately. Stones, bricks bats and other foreign matter if met with during excavation or trenching shall be removed and stacked within initially lead & lift, such material as is declared unserviceable by the Engineer-in-Charge shall be disposed by spreading and levelling at places ordered by him. If disposed outside the initial lead & lift, then the transport for the extra leads will be paid for separately. If a large proportion of material unsuitable for the hedging and shrubbery operations is met with and earth from outsides is required to be brought in for mixing with manure and filling, the supply and stacking of such earth will be paid for separately.

2.6 DIGGING HOLES FOR PLANTING TREES

2.6.1 In ordinary soil, including refilling earth after mixing with oil cake, manure and watering.

2.6.1.1 Holes of circular shape in ordinary soil shall be excavated to the dimensions described in the items and excavate soil broken to clods of size not exceeding 75 mm in any direction, shall be stacked outside the hole, stones, brick bats, unsuitable earth and other rubbish, all roots and other undesirable growth met with during excavation shall be separated out and unserviceable material removed from the size as directed. Useful material, if any, shall be stacked properly and separately. Good earth in quantities as required to replace such discarded stuff shall be brought and stacked at site by the contractor which shall be paid for separately. The tree holes shall be manured with powdered Neam/castor oil cake at the specified rate along with farm yard manure over sludge shall be uniformly mixed with the excavated soil after the manure has been broken down to powder, (size of particle not be exceeded 6 mm in any direction) in the specified proportion, the mixture shall be filled in to the hole up to the level of adjoining ground and then profusely watered and enable the soil to subside the refilled soil shall then be dressed evenly with its surface about 50 to 75 mm below the adjoining ground level or as directed by the Engineer-in-Charge.

2.7 M.S. FLAT IRON TREE GUARD

2.7.1 M.S. Iron Riveted Tree Guard

2.7.1.1 The tree guard shall be 600 mm in diameter and 2-meter-high above ground level and 25 cm in below ground level.

2.7.1.2 The tree guard shall be framed of 4 nos. 25 x 6 m M.S. flat 2 meter long excluding displayed outward at lower and upto an extent 10 cm and 8 nos. 25 x 3 mm vertical M.S. Flat Rivetted to 3 Nos. 25 x 6 mm Flat iron rings in two halves, bolted together 8 mm dia and 30 mm long M.S. bolts and nuts. The entire tree guard shall be given two coats of synthetic enamel paint of approved brand and manufacturer of required shade over a priming coat of ready mixed steel primer of approved brand and manufacturer. The design of tree guards shall be shown in the drawing.

2.7.2 M.S. Flat Iron Welded Tree Guard

2.7.2.1 The tree guard shall be 600 mm in diameter and 2-meter-high above ground level and 25 cm in below ground level.

2.7.2.2 The tree guard shall be framed of 4 nos. 25 x 6 mm MS. Flat 2 meters long excluding displayed outward at lower and upto an extent 10 cm and 8 Nos. 25 x 3 mm vertical M.S. Flat Riveted to 3 nos. 25 x 6 mm flat iron rings in two halves, bolted together 8 mm dia and 30 mm long M.S. Bolts & nuts. The entire tree guard shall be given two coats of synthetic enamel paint of approved brand and

manufacturer of required shade brand and manufacturer of required shade over a priming coat of ready mixed steel primer of approved brand and manufacturer. The design of tree guards shall be shown in the drawing.

2.8 FILLING MIXTURE OF EARTH & SLUDGE OVER MANURE

2.8.0 The separately specified earth and sludge shall be broken down to particles of size not exceeding 6 mm in any directions before mixing. Good earth shall be thoroughly mixed with sludge over manure in specified proportions as directed by Engineer-in-Charge. During the process of preparing the mixture as above, trenches shall be flooded with water and levelled.

3.0 SPECIFICATIONS OF PLANTS (Plants, Trees Shrubs taken in SOQ) :

3.1 The plants, Trees and shrubs should be as per following specification.

1 The plants should be full of fresh and healthy foliage and importantly shall be suitable to the extreme climatic conditions of Leh.
2 The plants should be free from insect, pest and disease.
3 Plant should be healthy and vigorous growth
4 The height of the plants will be measured from top of the pots.
5 The plants should be well settled and should not be newly shifted.
6 The plants should be true to the variety and named Variety should be tagged.
7 Moss stick used should be made on plastic pipe.
8 Moss stick should be straight and properly fixed in the pot.
9 The rejected plants materials should be removed from the site immediately.
10 Moss stick should be covered with the plants in case of plants supplied with moss stick.
11 The Plant should be well stablished and good spread.
12. Good earth and manure used for filling the pot/poly bag free from any inert material and mixed to proper ratio.
13. Pot/ Poly bag used for filling the plants should be proper size good quality not
damaged.
14. There should be proper drainage in pots for plants.
15 The flowering plants should also have proper flowering and should be true to
the variety.
16 All plant should have the tendency of growth and should not be stunted type.

a. There should be no stagnation of water in the pots.

F. TECHNICAL SPECIFICATION OF SOLAR PANEL WORK:

Solar photo Voltaic Power Generation System

1) SOLAR PV MODULE:

A) The solar photovoltaic modules will be used Poly/Multi crystalline, Thin film PVtechnology modules.

B) The capacity of each Solar Modules should be equal to or greater than 300Wp.Solar Modules to be used have to be framed only. At locations where there isconstraint of space, it should be considered higher efficiency modules only.

C) Module would be PID Free and of positive Tolerance only.

D) Modules would have an efficiency of not less than 16% and the fill factor shouldbe above 75%.

E) Minimum dimension of the SPV module shall be preferred.

F) Each SPV Module would have IEC/BIS test certificate from any recognized IECaccredited or MNRE approved laboratory.

G) The SPV modules would confirm to the minimum technical specification laiddown by MNRE that can be referred on the MNRE website.

H) The PV Modules shall be tested for Salt Mist Corrosion Test as per MNREequirement.

PV modules used in solar power plants/ systems must be warranted for their outputpeak watt capacity, which should not be less than 90% at the end of 10 years and80% at the end of 25 years.

2) INVERTER:

The Inverter/s used would be robust, intelligent **On-grid** inverters of reputedmanufacturer/makes. The inverter/s must conform to the IEC 61683 and IEC 60068-

2, IEC 62116, IEC 61727. The typical specifications required are as under:

a) All inverters should be 3 phase, 415V, 50Hz AC output

b) The AC capacity of the Inverter can be minimum of 80% of the connected DCcapacity to the inverter.

c) Minimum Start Voltage should be greater than 200V

d) MPPT Range: 200V-800V

e) Maximum Input Voltage: 1000V DC

f) Euro / CEC Efficiency above 97%

g) Frequency: 50Hz +/- 1.5%

h) Power Factor > 0.99

i) THD < 3%

j) Ambient Temperature range: -5 deg C to + 60 deg C

k) Warranty: 5 Years Comprehensive warranty. This warranty from themanufacturer shall be in addition to the scope covered under defects liabilityperiod.

l) Integrated Ground Fault Protection

m) Anti Islanding Feature

n) Transformer less

o) Over Voltage/ Under Voltage Protection
p) Auto Shut down in case or Over Heat/ Over Temperature

3) SOLAR MODULE MOUNTING STRUCTURE:
a) The structure shall be designed in accordance to the requirement of the sitewith minimum tilt angle of 15 degrees for RCC roof structure. The arraymounting structure shall be designed to allow easy replacement of any moduleand shall be in line with site requirement. Structure shall be designed forsimple mechanical and electrical installation. It shall support SPV modules at agiven orientation, absorb and transfer the mechanical loads to the groundproperly.

b) The module mounting structure shall be mounted on clear roof spaceavailability with fixed tilt. Tilt angle to be decided by the party to maximizeannual energy output as per the site geographical location. Recommendedminimum angle of tilt for R.C.C Flat roof terrace for the location is 15 degrees.

The minimum thickness of galvanization for MS or MS extruded sections should be of 50microns.
All fixing fasteners and nuts and bolts should be of Stainless Steel only.
c) The minimum clearance of the lowest part of the module and the RCC roof levelshall not be less than 300 mm.
d) All structures are to be pre-fabricated for easy assembly at site.

4) EARTHING:
The array structure of the PV yard shall be grounded properly using adequate numberof earthing pits. All metal casing or shielding of the solar power plants shall bethoroughly grounded to ensure safety of the solar power plants.

5) ARRAY JUNCTION BOX:
a) The array junction box would be dust, vermin & water proof as per IP65 ratingand should be made of FRP/ABS plastic (Test certification is required for IP65degree of protection).
b) Suitable Fuses/ MCB's should be provided for each string.
c) A DC Surge Protection Device Class II should be provided in the AJB forgrounding the surges to protect the inverter.
d) The AJB should have suitable cable entry points fitted with cable glands ofappropriate sizes for both incoming and outgoing cables.
e) Suitable markings to be provided on the bus bar for easy identification andcable ferrules shall be fitted at the cable termination points for identification.

SECTION-VII

List of Approved Makes/Brands of Materials/Equipment
(CIVIL, INTERIOR, PLUMBING, BIO-DIGESTOR, ELECTRICAL, SOLAR PANEL ,RADIANT HEATING SYSTEM (HVAC), FIRE FIGHTING,LIFT)

Name of work:Construction of 8 nos. Special T4 Staff Quarters and Staff hostel at Geyser Palace site, Leh in the Union Territory of Ladakh

Sl. No.	Material/Equipment	Makes/Brands
A.	**CIVIL WORK**	
1	Cement	ACC, Ultratech, Ambuja, Vikram, Birla cement,JK Cement, Shree cement & Jaypee Cement
2	Reinforcement Steel / Structural Steel	SAIL, Tata Steel, RINL, Jindal
3	ALUMINIUM Extrusion / SECTIONS	Jindal, Hindalco, Indalco
4	Aluminium Accessories and Hardware	Hardima, Everite, Sigma, Argent, Classic,Jyoti
5	Aluminium Composite Panels	Alucobond, Reybond
6	Anchor Fastner/Dash Fastner	Hilti, Fisher, Canon
7	Ready Mix Concrete (RMC)	Ultratech, ACC, RMC India
8	Concrete Additive	Pidilite / Fosroc / Fairmate / MC Bauchemie/ Sika/ Cico
9	Door closer / Floor spring	Dorma,Godrej, Geze,Yale, Ozone
10	Door Locks	Godrej/Ingerroll Rand, Dorma
11	Factory made Laminated Door Shutters	Greenply , Kitply
12	Doors & Windows Fixtures / Fitting.	Godrej/Everite / Classic/ Crown / Earl Bihari
13	uPVCwindows/ventilators	Fenesta,Wintech,Winplast,Rehau

14	Paints (Exterior Emulsion Paint)	Asian (Apex Ultima)/ Berger (Weathercoat all Guard)/ ICI (Dulux weathershield max)
15	Paints - Other Paints / Primer	ICI Dulux/ Asian/ Berger/ Nerolac
16	Paints - Texture paint	Berger / Spectrum / Unilite Heritage /Asian
17	CC Paver blocks / Tiles (All Types)	KK / Uni Stone Products (India) Pvt. Ltd/ Hindustan Tiles/ NITCO
18	Epoxy Flooring	Fosroc/ Dr. Beck/ Flamaflor
19	False Ceiling - Calcium Silicate Boards & Tiles	India Gypsum/ Armstrong / Hilux / Saint Gobain (Gyproc)/Aerolite
20	False Ceiling - Metal	Armstrong / Hunter-Douglas / USG-Boral/ Saint Gobain/ Unimet
21	False Ceiling - Mineral fibre	Armstrong / Decosonic / USG-Boral/ AMF/ Saint Gobain (Gyproc)
22	Fire Rated Doors & Frames	Navair / Shakti-Hormann / Pacific/Promat
23	Fire Rated Glass	Asahi India Safety Glass Ltd./ Saint Gobain/ Pilington, Schott, Pyroguard, Glaverbel
24	Fire Retardant Paint	Viper FRS 881/ Nullifire/ Berger
25	Fire Seal	Sealz, Alstroflam/ Abacus
26	Fire: Door Closures, Mortice Dead locks	Becker Fire Solution/ Inersoll Rand/ Dorma/Godrej/ Geze/ Hafele
27	Fire: Panic Exit Devices	Becker Fire Solution/ Inersoll Rand LCN Series/ Dorma PHA Series/ D-line/Godrej
28	Glass : Float & Mirror	Atul / Saint Gobain/ Asahi India Safety Glass Ltd
29	Glass for Aluminum Doors/ Windows/ Structural Glazing	Saint Gobain / Pilkington/ Asahi India Safety Glass Ltd.
30	GRC Jali	Unistone/ Kuber Fibrostone/Everest Composites/ Birla white

31	GRC wall cladding	Unistone/ Kuber Fibrostone/Everest Composites/ Birla white
32	Grout: Non-Shrink	Fosroc / Sikka/Pidilite or equivalant
33	Laminates/ Veneers	Century/Archidply/Greenlam/Formica/Sunmica / Merino
34	Night Latch	Godrej / Dorma/ Ozone/Harrison/Link
35	Paints - Cement Based	Snowcem Plus/, Berger (Durocem Extra)/ Nerolac (Super Acrylic)/ TATA Cem, Asian
36	Plywood/Block board/Ply board	Duroply / Greenply/ Archidply/ Century/ Kitply/ National / Anchor/ Merino
37	Silicon sealants /Weather Sealant / Structural Glazing Sealant	GE- Silicon / Pidilite / Forsoc / Cico /Dow Corning / Sikka/ Wacker
38	Stainless Steel	Salem Steel/ Jindal or equivalent
39	Stainless Steel bolts, Screws, Nuts & Washers	Kundan / Puja / Atul
40	Stainless Steel Clamps	Hilti /Intellotech Koncept /Fisher
41	Stainless Steel Hinges	Hettich/ Godrej/ Dorma
42	Stone Adhesives	Fosroc / Sikka/Pidilite
43	Tiles: Ceramic Tiles	Kajaria / Somany/RAK/Nitco
44	Tiles: Glazed (Ceramic) tiles	Kajaria / Somany/RAK/Nitco
45	Tiles: Vitrified Tiles	Kajaria / Somany/RAK /Nitco
46	Vinyl Flooring	Wonder floor/Responsive
47	Water Proofing Materials	BASF/ Fosroc / Sikka / CICO / STP/ Pidilite/CHRYSO
48	Wooden Laminated Flooring	NITCO /Euro / Pergo /Armstrong
49	Expansion Joints	Sanfield (India) Ltd., MIGUA, TRISTAR
50	Automatic sliding door	Dorma or equivalent make

51	False flooring	Arena, unitile, or equivalent make
52	Roller blinds	Hunter dougles/ Phifer or equivalent make
53	M.D.F	Nuwood(Grade -I AND GRADE II), Durotuff
B	**PUBLIC HEALTH (PLUMBING)**	
1	Chinaware & CP Fittings	Hindware/Cera/Jaquar/Kohler
2	Butterfly Valve / Check Valve	Zoloto / Leader / Sant/ Audco/GPA
3	Ball Valves	Zoloto / Leader / Sant/ Audco/GPA
4	Cables	Skytone/Finolex/Polycab
5	PVC Copper Wire	Skytone/Finolex/Polycab
6	PP-R Pipes & Fittings	SFMC/Prince/Supreme
7	PP Pipe	Astral (Silencio) / Huliot(Ultra Silent), Poloplast
8	GI Pipes & Fittings	TATA/Jindal/Swastik
9	Rain Water Pipe (uPVC SWR Type-A)	Supreme/Prince/Astral
10	SS Sink	Hindware / Neelkanth / Nirali / Jayna /Neropure
11	Stainless Steel Grating	Camry / Chilly/Jayna
12	Air Release Valve	SANT/KARTAR/ZOLOTO
13	Gully Trap	Perfect / S.K.F/ R.K/ Hind / Anand
14	S.F.R.C. Manhole covers	K.K. Manhole and grating Co.
15	DWC Pipes	Astral / Supreme/ Prince
16	PVC encapsulated Foot rest	KK Manhole / KGM / Bentex
17	SUBMERSIBLE PUMP	GRUNDFOSS/ KSB / KIRLOSKAR/CROMPTON/MATHER & PLATT
18	HYDROPNEUMATIC SYSTEM	GRUNDFOSS/ KSB / ITT LOWARA/LUBI
19	HEATPUMP	AO SMITH/ SUNTEC/ JAQUAR
20	SOLAR PANEL	EMVEE/TATA/ELECTRA
21	BIO DIGESTER	DRDO APPROVED
22	Pressure relief Valve	Leader, Sant, TIMMIE, AIP
23	Thermostatic Valve	Oventrop, Scheneider, Schell
24	WC Pan Connector	MC Alpine, Viega, Supreme
25	Tube well Pumps	GRUNDFOSS/ KSB / ITT LOWARA/LUBI
26	Insulation	Armafex, Thermaflex, Armaflex, K-flex

C. ELECTRICAL WORK		
1	11kV Three HT Panel Board (Outdoor Type)	ABB/Schneider/Eaton/C&S
2	D.G. Batteries	Exide, TATA, Amron, Microtek
3	DG Set - Assembler	Kohler, Cummin, Cat, Powerica, Koel Green
4	DG Set - Alternator	CG, Stamford, Leroy Somer, Mecc Alte
5	DG Set - Engine	Mitsubishi, CAT, CUMMIN,MTU
6	Transformers	Ariva/Kirlosker/BHEL/Jindel Rectifier/EEE Switchgear
7	Servo Stabilizer	Legrand/Jindel Rectifier/Servokon Systems Limited/EEE Switchgear
8	Capacitor Fabricator	Epcos/Trinity/Legrand/Risha Control Private Limited In Delhi
9	MV/LV Panel Fabricator (TTA AND PTTA Panels)	Adlec Systems Private Limited In Delhi (Legrand)/Risha Control Private Limited In Delhi (L&T)/Tri Square Switchgears Private Limited (ABB)/AMBIT(SCHEINDER)/C&S
10	1.1KV Copper Wires as per IS:694/1990	RR kable/Polycab/KEI/Havells
11	MV/LV/ELV Cable-XLPE Insulated As Per IS:7098	RR kable/Polycab/KEI/Havells
12	Copper Bus Bars	RR Copper/Banco
13	Aluminium Busbars	Hindalco/Banco
14	Change Over Switch (Manual)	ABB/C&S/HPL/Indoasian/Socomec
15	LED Light Fixtures and Lamps	Havells/Philips/Wipro/Polycab/Light Technology
16	Lighting for Facade	Havells/Philips/Wipro/Polycab/Light Technology
17	Ceiling/Wall Fans & Exhaust Fans	Bajaj/Usha/Polycab/Crompton/Almonard/Khaitan/Orient
18	Lightening Arrestors	JMV/Triprotect/Dehn/OBO Bettermann
19	Earthing	JMV/Triprotect/Kors(Esteem)/Dehn/OBO Bettermann
20	Surge Protections	Argos/Schneider/JMV/OBO Bettermann/ABB
21	SFU/SDF/HRC FUSE	ABB/C&S/HPL/Indoasian/Socomec

22	MCB/ELCB/DB/RCCB Industrial Sockets-Sheet Metal Clad	Schneider/Legrand/C&S/L & T /ABB
23	Moulded Case Circuit Breaker (MCCB) Barriers, Spreader Links & Extended Rotary Handle	Schneider/Legrand/C&S/L & T /ABB
24	Air Circuit Breakers	Schneider/Legrand/C&S/L & T /ABB
25	Switches & Socket, Boxes And Faceplate Modular Type	Schneider/Legrand/Polycab/Panasonic
26	M.S. Conduit & Accessories	AKG/RM CON/BEC/Steel Krafts/Fitwell
27	PVC Conduit & Accessories	AKG/BEC/Polycab
28	Cable Trays & Raceway	Legrand/OBO/MEM/Rmcom
29	Time Switches	L&T Electrical & Automation Ic/Schneider/ Finder/Legrand/Crompton Greaves Limited/ABB/C&S
30	Push Buttons	L&T Electrical & Automation Ic/Teknik/Schneider/Kaycee/C&S
31	LED Type Indicating Lamps	L&T Electrical & Automation IC/Schneider/Kaycee/Teknik/ABB/C&S
32	Push Buttons Actuatos	L&T Electrical & Automation IC/Schneider/Kaycee/Teknik/ABB/C&S /MDS
33	HDPE Pipe	Dura-Line/BEC/Gemini/Supreme/Rex
34	Current/Potential Transformers Note:- For HT PANEL, CT, PT, Shall Be As Per Standard Fitment Of Panel Manufacture's	Kappa/Minilec/Pragati/Newtek Electricals/Kaycee
35	Selector Switches / Rotary Switches	Kaycee/Legrand/Salzer/L&T Electrical & Automation IC/Gepower/C&S/Teknict/Schneider/Rockwell
36	Crimping Type Lugs & Thimbles	Dowells/Comet/Jointwel/Action
37	Cable Glands	Dowells/Comet/HMI/MIC
38	Brass Cable Glands	Dowells/Comet/HMI/MIC/Polycab/Siemens/Braco

39	Pvc Cable Glands	Trinity/Lotus/Neptune/Havells
40	Panel Cooling Fans	Rexonard/Rittal/Finder/Philips
41	Relays	Minilec/Prok Devices/Procom/Finder/C&S
42	Multifunction Meters Door Mounted Dual Source Energy Meters	Newtek Electricals/C&S/Legrand/Neptune/Trinity
43	PLC/ Load Manager/ Sync. Relay	ABB/Siemens/Schneider/Allen Bredly
44	Fabrication Sheet	TATA Sheet/Bhushan Steel/Jindal Iron & Sheet
45	Automatic Transfer Switch	Asco/Russelectric/Eaton/Socomec
46	T.V. CO-Axial Cable	Delton/Bonton/RR Kable/ESC Cable
47	Solar	ABB/Wave shapes India/Delta
48	Street Light Poles	Sumip/Hensal/Bajaj
49	UPS	Emerson (Vertiv)/ Schnieder (APC)/ Eaton/ Socomec
50	Data/Telephone/TV Outlets	Schneider/Legrand/Polycab/Panasonic
51	Fire Extinguisher	Ceasefire/ Exflame/ Minimax/ Life Guard/ Safex
53	Battery Charger	Amaraja/ Sabnife/ Statcon/ Voltstat/ HBL

D	**HVAC EQUIPMENTS**	
1	Heat pumps(Water to air & Air to Air type)	Bluebox sewgon /Aermec / Airsource / oorja
2	Primary & Secondary Pumps	Xylem /Armstrong /Grundfoss
3	Pumps for oil system	Xylem /Armstrong /Grundfoss
4	Tanks for storage	Bens & Gaws / MAC /DLSE
5	Hot water generator / Boilers	Thermax / Bosch /eqvt
6	AHU Fans	Kruger / System air /VTS /Airflow
7	Inline Fans	Cariyare /Kruger/Sapphire
8	Air Washer & Scrubber Unit	MAC /Damir /Ambassador
9	Axial Flow Fans	Kruger /Systemair/Air flow

10	Air Separator & Expansion tank	Spirotech /Optivent/Calefi
11	Dry Scrubber	Rydair / Casalica /Crystal
12	Air Handling Unit (Double Skinned) & Exhaust Air Unit	VTS / Systemair / MAC /Edgetech
13	Decentralized ventilation unit	Glen Dimplex/Wolf /Inventer
14	Propeller Fans	Crompton greaves /Cariyare /Havells
D1	**PIPE FITTING & VALVES**	
1	Mild Steel Pipes	SAIL/TATA/ JINDAL (ISI MARKED)
2	Pe-X Piping & accessories	Oorja / Giacomini/ Rehau
3	Fittings	TATA / JINDAL
4	Water duty butterfly valve manual & on/Off Type Motorized& Y Strainer	Castle /Emerald /Advance
5	Dual plate check valve	Castle /Emerald /Advance
6	Balancing valves	Castle /Emerald /Advance
7	Ball Valve	CIM / Emerald / Zoloto
8	Auto Air Vent Valve	Spirotech / Spirotherm / Calefi
9	Pressure Gauges	Feibig / Emerald / Guru
10	Industrial type thermometer (MERCURY filled V form WITH VALVE)	Emerald / Taylor /Feibig / Guru
11	Closed expansion tank & Air Seprator	Emerald /ITT /Calefi
D2	**HVAC CONTROLS**	
1	Two-way Motorized Valve	Honeywell / Danfoss/ Johnson Control / Castle
2	Thermostat	Honeywell / Danfoss/ Johnson Control
3	Actuator	Danfoss (Model : REND) Honeywell (Model: T6571)/Johnson Control /Sauter (Model: NRT 105 F061)/Schneider (TA-168-2)/Siemens (Model: RDF 50.1)/Yamataki (Model: HY 7043)
4	Dial Thermometer Capillary Type	Penn/Tadington
5	Flow Switch	Rapid Control/Danfoss
D3	**HVAC (Radiant Heating System)**	
1	Vibration Isolator	Cori/Dunlop /Kanwal Industries Corporation Flexionics /Resistoflex

2	Flexible Pipe Connection	Flexionics /Resistoflex
3	Flexible duct connector	Mapro/Resistoflex
4	Heavy duty pipe support clamp	Hira Arosio/eqvt
5	Grooved Pipe Connector	Seven Star/Vectaulic
6	Paints	ICI / Asian /Berger
7	Dash Fasteners	Canon / Fisher / TKS
8	Welding Rods	Advani / L&T / Esab
9	Tar felt / CPRX compound	Shalimar tar product/ eqvt
10	Aluminum Tape	- Johnson / 3m / eqvt
11	Duct & pipes - Adhesives & coating	Xchem International / Momansa / Paramount Ploytreat
12	Fire retardant coating	Starcoat crc /Promate/Hiliti
13	Steel Wire rope hangers	Gripple / Hiltti/Dobygrip
D4	**DUCTING GRILLE DIFFUSER DAMPER ETC.**	
1	GSS Sheet	Sail / Tata / Jindal(ISI Marked)
2	Factory Fabricated Duct	Ductofab /Rolastar /Dustech
3	Pre Insulated Duct	Pie Pal / Lloyd / Western Air Duct
4	Factory Made Spiral Duct	Atco/ Seven Star
5	Fire & Smoke Damper Spring Type	Ravistar / Conaire / Air Flow
6	Fire Damper Actuator	Belimo / Siemens
7	Extruded aluminum Grills / Diffusers/ gravity louvers	Systemair /Ruskin/Titus / MAC
8	Pre Filters	Thermodyne / Klenzoid/ MAC
9	Sound Attenuator	Trox/uniflair /Caryaire/George Rao/Ravistar
10	XLPE Insulation	Trocellin / Thermobreak / Supreme
11	Fiber Glass	U.P.Twiga / Owen Corning
12	Vibration Isolation Spring	Dunlop / Resistoflex
13	Nitrile Rubber	Eurobatex /Armacell/K Flex
14	Protective Coating over Closed Cell Elastomeric – Fibre glass Woven Cloth	Armacell Armachek/Paramount/UP Twiga
15	Expanded Polystyrene	Mettur Beardsell / Styrene Packing
16	Toilet Exhaust valves	Air Flow /eqvt
17	Fiberglass	UP Twiga /Kflex /eqvt
18	Structural Steel (Channel / I-Section)	Sail / Tata / Jindal(ISI Marked)
D5	**ELECTRICAL ACCESSORIES**	

1	Motor Control Centre & Bus Ducts	Tricolite / Adelac /KEPL
2	PVC insulated XLPE aluminum/copper conductor armored MV Cables upto 1100 V grade	Skytone/ Havells / KEI / Gloster
3	Three phase motors	ABB/ Bharat Bijlee/Kirloskar/Siemens/C. G / Siemens / Kirloskar / ABB.
4	Starter	ABB/Allen Bradley/Kirloskar L & T/Schneider/Siemens
5	Variable Frequency Drive (VFD)	ABB/Danfoss/Siemens/Delta
6	Air-Circuit Breaker	L&T / Siemens /GE/ABB
7	Moulded Case Circuit Breaker(MCCB)	L&T / GE / Siemens / ABB
8	Motor Protection Circuit Breaker(MPCB)	L&T / GE / Siemens / ABB
9	Miniature Circuit Breaker(MCB)	L&T / GE / Siemens / ABB
10	HRC Fuse and Fittings	L&T / Siemens / GE/ C & S
11	Contactors	L&T / Siemens / BCH./ GE / ABB
12	Change Over Switch	C & S/Havells/H H Elcon/HPL – Socomec Larsen & Toubro/GE
13	Current Transformer & Control Transformer	Automatic Electric/Gilbert & Maxwell Indcoil/Matrix/ Pragati
14	Protection Relay	ABB/Areva/Larsen & Toubro/Siemens
15	Numeric Type	ABB/Areva/Larsen & Toubro/Siemens
16	Electromagnetic Type	ABB/Areva/Larsen & Toubro/Siemens
17	Indicating Lamps LED type and Push Button	Altos /GE Power Controls/Larsen & Toubro (ESBEE)/Schneider Electric (MG)
18	Power cable	ICC/ CCI/ Gloster / Universal
19	Control cable	Gloster / National
20	Voltmeter / Ammeter	A.E. / IMP./ Rishab
21	Switches	L&T / Siemens / GE
22	Selector / Toggle switch	Kaycee / L&T
23	Time Delay Device	Siemens / L&T/ BCH.
24	Single Phase Device	L&T / Minilec
25	Overload Relays	L&T / Siemens / BCH./GE / ABB
26	Prepaid Meters & accessories	Actaris/Conzerve/Secure
27	Cadmium Coated Cable Tray(Factory Fabricated)	Slotco / Pilco / KEPL / Ricco/Elcon
28	Fire Sealant & Fire Retardant Paint	BTHM Engineering/Birla 3 M/HILTI/Promat
29	Electromagnetic Meters	Automatic ElectricRishabh (L&T

30	PVC Conduit (ISI approved)	AKG/BEC/D Plast/Duraline/Polypack/Precision
31	Automatic Power Factor Correction Relay(Numeric Type)	Areva/BELUK (Germany)/Conzerv/Datar Ducati/Siemens
32	Thyristerised APFC Control Panel	ABB/Datar/Ducati /Meher(Larsen & Toubro) Power Matrix Solutions/Siemens
33	Cable Glands Double Compression with earthing links	Baliga Lighting/Comet/Cosmos
34	Bimetallic Cable Lug	Comet/Cosmos/Dowell's (Biller India)/Hax Brass (Copper Alloy India)
35	PVC insulated copper conductor stranded flexible wires (FRLS) -	Finolex/Lapp Kabel/Rajanigandha/R R Kabel Batra Henlay
36	Mettalic Conduit (ISI approved)	AKG/BEC/NIC/Vimco

E	**FIRE PROTECTION SYSTEM**	
1	Air Release Valve/Air Cushion Tank	Zoloto/Advance/Leader/Audco/Castle
2	Anchor Fastener	Fischer / Hilti or equivalent
3	Ball Valves	L&T/ Audco /Zoloto/ Advance/Emerald/ KSB
4	Battery	Exide/ AMCO /Amararaja/ Panasonic
5	Butterfly valves	L&T/ Audco/ Zoloto / Advance/ KSB
6	Cables	As per electrical make list
7	Check Valve/Foot Valve/Sluice Valve/	L&T/Audco / Zoloto Advance/KSB
8	Fire Extinguisher	Minimax / Newage/ Eversafe/ Tyco –Johnsons Control
9	FB inlet/ Hose reel drum /Nozzle	Ceasefire / Newage /Minimax/HD/Tyco
10	Fire Pumps	Mather&Platt(WILO)/Grundfos/Kirloskar/Xylem – ITT/ Armstrong Fluid Technology
11	Electrical Motors	ABB/ Siemens/Kirloskar/C&G/BALDOR
12	GI clamps	Chilly/Hilti or equivalent
13	Gl / MS Pipes	Tata / Jindal- Hissar/ SAIL

14.	Cables	Sky tone/ Finolex/ National
15.	Suction strainer	Sant/Zoloto
16.	Vibration eliminator connectors	Resistoflex/ Kanwal
17.	Single phasing preventer	Siemens/Minilec/l&t
18.	Pipe coat material	Pypkote/ Coalteck/ Johnson control
19.	Main control panel	Risa control/Devco/ ec
20.	Pressure switches	Indfoss/Switzer
21.	pressure gauge	H.Guru/Fiebig
22.	Battery	Exide/ Prestolite
23.	Enamel paint	Asian, Nerolac, Berger
F	**LIFT**	
	Lifts	OTIS/ Kone / Mitsubishi/ Schindler

SECTION VIII

Tender Drawings

(Drawings are enclosed separately with the tender documents)

SECTION-IX

INTEGRITY PACT

This integrity Pact is made at **National Highways Infrastructure Development Corporation Limited (NHIDCL)**, RO-Ladakh on this ____day **of** _____ **2021**.

BETWEEN

NATIONAL HIGHWAYS &INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED(NHIDCL) hereinafter referred to as "The Principal" (which expression, unless repugnant to the context thereof, shall mean and include its legal representatives, heirs and assigns)

AND

_____hereinafter referredto as "TheBidder"(which expression, unlessrepugnant tothecontext there of, shall mean and includeitslegal representatives, heirs andassigns)

Preamble

Whereas, The Principal intends to award, under laid down organizational procedures, contract(s) for _____ _____**(hereinafter referred to as the 'Project').** The Principal necessarily requires full compliance with all relevant laws of the land, rules, regulations, economic use of resources and of fairness/ transparencyin its relations with itsBidder(s)and/or Consultant(s).

In order to achieve these goals, the Principal has appointed _____ who will monitor the tender process and the execution of the contract for compliance with the Integrity Pact by all parties concerned, for all works covered in the Project. The contact details of Shri _____ are asunder-

_____

___

Section 1 - Commitments of the Principal

(1) The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles:-

a. No employee of the Principal, personally or through family members or through any other channel, will in connection with the tender for or the execution of a contract, demand, take a promise for or accept, for self or third person, any materialor immaterialbenefit,which the person is not legallyentitled to.

b. The Principal will, during the tender process treat all Consultant(s)/Bidder(s)with equity and reason. The Principal will in particular, beforeand during the tender process, provide to all Consultant(s)/Bidder(s)the same information and will not provide to any Consultant(s)/Bidder(s),confidential/additional information through which the Consultant (s)/Bidder(s) could obtain an advantage in relation to thetender process or the contract execution.

c. The Principal willexcludefrom the process all knownprejudiced persons. **The Principal shall** obtain bids from **only** those parties who have been short-listed or pre- qualified or through a process of open advertisement/web publishing or any combinationthereof.

(2) If the Principal obtains information on the conduct of any of its employees, Consultant (s) and/orBidder(s), which is a criminal offence under the IPC/PC Act, or if there be a substantive suspicion in this regard, the Principal will informtheChief Vigilance Officer and **subject to its discretion,**can **additionally**initiate disciplinary actions.

(3) The Principal will enter into agreementswithidentical conditionswithallConsultant(s)/Bidder(s)**for the different Work Packages in the aforesaid Project**

(4) The Principal will disqualify fromthe tender process all Consultant (s)/Bidder(s) in the range of Rs 50 Crore and above, who do not sign this Pact or violate itsprovisions.

Section 2 - Commitments of the Bidder(s) / Consultant(s)

(1) The Bidder(s) / Consultant (s) commit(s) itself/themselves to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the tender process and during the contract execution.

(a) The Bidder(s)/Consultant(s) will not, directly or through any other person or firm offer, promise or give to any of the Principal's employees involved in the tender process or the execution of the contract any material or other benefit which he/she is not legally entitled to, in order to obtain in exchange any advantage, of any kind whatsoever, duringthe tenderprocess or during the execution of thecontract.

(b) The Bidder(s)/ Consultant (s) will not enter with other Bidders into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the biddingprocess.

(c) The Bidder(s)/Consultant(s)will not use improperly,for purposeof competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.

(d) The Bidder(s)/ Consultant (s) of foreign origin shall disclose the name and address of the Agents/representatives in India, if any. Similarly the Bidder(s)/Consultant (s) of Indian Nationality shall furnish the name and address of the foreign principals, if any. Further details as mentioned in the "Guidelines on IndianAgents of Foreign Suppliers" shall be disclosed by the Bidder(s)/ Consultant(s). Further, as mentioned in the Guideline all the payments made to the Indian agent/representative have to be in Indian Rupees only.Copy of the "Guidelines on Indian Agents of Foreign Suppliers" is annexed and marked asAnnex-"A".

(e) The Bidder(s)/ Consultant (s) will, when submitting his bid, disclose any and all payments he has made, is committed to or

intends to make to agents, brokers or any other intermediaries in connection with the award of thecontract.

(2) The Bidder(s)/ Consultant (s) will not instigate third persons to commit offences outlined above or be an accessory to suchoffences.

Section 3: Disqualification from tenderprocess and/ or exclusion from future contracts.

(1) If the Bidder(s)/ Consultant(s), before awarding the Project or during execution

has committed a transgression by violating Section 2 above or in any other form so as to put his reliability or credibility in question, the Principal, at its sole prejudice to any other legal rights or remedies available to the Principal under the relevant clauses of GCC/SCC of the tender/contract.

(2) If the Consultant (s)/Bidder(s) has committed a transgression through a violation of any of the terms under Section 2 above or in any other form such as to put his reliability or credibility into question, the Principal will also be entitled to exclude such Consultant (s)/Bidder(s) from future tenders/contract award processes. The imposition andduration of the exclusion will be determined by thePrincipal,keeping in view the severity of the transgression. The severity will be determined by the circumstances of the case, in particular, the number of transgressions and/or the amount of thedamage.

(3) If it is observed after payment of final bill but before the expiry of validity of Integrity Pact that the Consultant has committed a transgression, through a violation of any of the terms under Section 2 above or any other term(s) of this Pact, during the execution of contract, the Principal will be entitled to exclude the Consultant from further tender/contract awardprocesses.

(4) The exclusion will be imposed for a minimumperiod of six (6) months and a maximumperiodof three (3) years.

(5) If the Consultant (s)/Bidder(s) can prove that he has restored/recouped the damage to the Principal caused by him and has installed a suitable corruption prevention system,the Principalmay, at its sole discretion,revoke or reduce the exclusion period before the expiry of the period of suchexclusion.

Section 4: Compensation for Damages

(1) If the Principal has disqualified the Bidder(s)/ Consultant (s) from thetender process priorto the awarding of the Project according to Section 3, the Earnest Money

Deposit (BID SECURITY)/Bid Security furnished, if any, along with the offer, as per terms of the Invitation of Tender, shall also be forfeited. The Bidder(s)/Consultant(s)understands and agrees that this will be in addition to the disqualification and exclusion of the Consultant (s)/Bidder(s)as may be imposedby thePrincipal, in terms of Section 3 above.

(2) If, at any time after the awarding of the Project, the Principal has terminated the contract according to Section 3, or if the Principal is entitled to terminate the contract according to Section 3, the Security Deposit/Performance Bank Guarantee furnished by the Consultant, if any, as perthe terms of the NIT/Contract shall be forfeited without prejudice to any other legal rights and remedies available to thePrincipal under the relevant clauses of General/ Special Conditions of Contract.

The Consultant (s)/Bidder(s) be in addition to the Bidder(s)/ Consultant (s), as terms of Section 3 *above.* Understands and agrees that this willdisqualification and exclusion of the may be imposed by the Principalin

Section5:Previous transgression

(1) The Bidder(s)/ Consultant (s) herein declares that it has committed no transgressions in the last 3years with any other Company in any country conforming to the anti corruption approach as detailed herein or with government/ any other Public Sector Enterprise in India that could justify its exclusion from the tender process.

(2) If at any point of time during the tender process or after the awarding of the Contract, it is found that the Bidder(s)/ Consultant (s) has made an incorrect statement on this subject, he can be disqualified from the tender process or if, as the case may be, that the Contract, is already awarded, it will be terminated for such reason and the Bidder(s)/ Consultant (s) can be black listed in terms of Section 3 above.

Section 6: Independent External Monitor / Monitors

(1) The Principal shall, in case where the Project Value is in excess of Rs 50 Crore and above, appoint competent and credible Independent External Monitor(s) with clearance from Central VigilanceCommission. The Monitor shall review independently, the cases referred to it to assess whether and to what extent the parties concerned complywith the obligations under this Integrity Pact.

(2) In case of non-compliance of the provisions of the Integrity Pact, the complaint/non-compliance is to be lodged by the aggrieved party with

the Nodal Officer only, as shall be appointed bythe MD, NHIDCL. The Nodal Officer shall refer the complaint/non-compliance so received by him to the aforesaidMonitor.

(3) The Monitor will not be subject to any instructions by the representatives of the partiesandwillperform itsfunctionsneutrally andindependently. TheMonitorshall report to the Managing Director, NHIDCL.

(4) The Bidder(s)/ Consultant(s)accepts that the Monitor shall have the right to access, without restriction, all Project documentation of the Principal including that provided by the Consultant. The Consultant will also grant the Monitor, upon his/her request and demonstration of a validinterest, unrestricted and unconditional access to its project documentation. The Monitor is under contractual obligation to treat the information and documents of the Bidder (s) / Consultant (s)withconfidentiality.

(5) The Principal will provide to the Monitor, sufficient information about all meetings among the parties related to the Project, provided such meetings could have an impact on the contractual relations between the Principal and the Consultant.

(6) As soon as the Monitor notes, or believes to note, a violation of this Pact, he will so inform the Principal and request the Principal to discontinue and/or take corrective action, or to takeother relevant action (s). The Monitor can inthis regardsubmit non-binding recommendations. However, beyond this, the Monitor has no right to demand from the parties that they act in a specific manner and/or refrain from action and/or tolerateaction.

(7) The Monitor will submit a written report to the MD, NHIDCL within 4 to 6 weeks from the date of reference or intimation to it and, should the occasion arise, submit proposals for corrective actions for the violation or the breaches of the provisions of theagreementnoticed bythe Monitor.

(8) If the Monitor has reported to the MD, NHIDCL, of a substantiated suspicion of an offence under relevant IPC/PC Act, and the MD, NHIDCL, has not, within the reasonable time taken visible action to proceed against such offence or reported it to the ChiefVigilance Officer, the Monitor may also transmit this information directly to the Chief Vigilance Officer, NHIDCL /MD.

(9) The word 'Monitor' means Independent External Monitor andincludesboth singular and pluralforms.

Section 7 Criminal Consultant(s)/charges against violating Bidder(s) / Subconsultant(s)

If the Principal obtains knowledge of conduct of a Bidder/ Consultant or any employee or a representative or an associate of a Bidder/ Consultant, which constitutes a criminal offence under the IPC/PC

Act, or if the Principal has substantive suspicion in this regard, the Principal will forthwith inform the same to the Chief Vigilance Officer,NHIDCL/MD.

Section 8 - Duration of the Integrity Pact

This Pactshall come into force when both parteshave legally signed it. ThePact shall expire, in case of the Consultant (s), 3 (three) months after the last payment under the Contract is made and in case of the unsuccessful Bidder(s), 2 (two) months after the contract for the project has been awarded.

If any claims ismade/lodged during this time,the same shall be bindingand continue to be validdespite the lapse of thispact as specified above,unless it is discharged/determined by MD of NHIDCL.

The Bidder(s)/Consultant (s), however, understands and agrees thateven upon the completion of the Project and/or the lastpayment under the Contract having been made, if any transgression/violation of the terms of this Pact comes/is brought to the notice of the Principal, it may, subject to its discretion, blacklist and/or exclude such Bidder(s)/Consultant(s) as provided for in Section 3, without prejudice to any other legal right or remedy so available to thePrincipal.

Section 9 - Other provisions

(1) This Agreement is subject to Indian Law. Place of performance and jurisdiction is the Registered Office of the Principal, i.e. New Delhi.

(2) Changes and supplements as well as termination notices need to be made in writing.

(3) If the Bidder/Consultant is a partnership or a consortium, this Agreement must be signedby allpartners or consortiummembers.

(4) Shouldone or several provisions of this Agreement turn out to be invalid, the remainder of this Agreement shall remain valid and binding. In such a case, the parties will strive to come to an Agreement in accordance to their original intentions.

(5) Wherever he or his as indicated in the above sections,the same may be read as he/she or his/her, as the case maybe.

SIGNED, SEALED AND DELIVERED	SIGNED, SEALED AND DELIVERED
For and on behalf of	For and on behalf of
Executive Director (P) **NHIDCL RO-Ladakh**	**(Authorized Signatory)** _____

Witness:

1) Signature	**1) Signature**
Name	**Name**
Address	**Address**
2) Signature	**2) Signature**
Name	**Name**
Address	**Address**

SECTION-X

FORM OF SUPPLEMENTARY AGREEMENT

This Agreement made this day the _____ between _____hereinafter called the First Party which expression shall include his heirs, executors and administrators/their successors and assigns and the **Executive Director(P), National Highways and Infrastructure Development Corporation Limited, Regional Office ,Ladakh**, hereinafter called the Secondary Party, which expression shall include his successors and assigns, shown as under:

1. That this Agreement shall be called as Supplementary Agreement to the Agreement No. _____ relating to the Name of work "**Construction of 8 nos. Special T4 Staff Quarters and Staff hostel at Geyser Palace site, Leh in the Union Territory of Ladakh"** entered into by the parties to this Agreement.
2. That WHEREAS the First Party has substantially completed the execution of the work described in and covered by the Agreement No. _____ except the items mentioned in the Schedule annexed to this Agreement and whereas the items of the work mentioned in the Schedule annexed to this agreement cannot now be executed on account of the need to comply to observations of District Fire Officer for according Fire NOC and some other related work; and whereas both the parties are desirous that the items mentioned in the Schedule annexed to this Agreement should be executed by the First Party as specified in the original Agreement No. _____, it is hereby further agreed as under:
   (a) That First Party shall and will execute the work covered by the items mentioned in the Schedule annexed to this Agreement at the rates and as per the terms and conditions of the original Agreement No._____ whatsoever called upon to do so by the Engineer-in-Charge, within a period of **one year** from the date hereof.
   (b) That the First Party shall have absolutely no claim of whatsoever nature against the Second Party for doing the work mentioned in the Schedule annexed to this Agreement as required under clause (a) above, except that which he would be entitled to under the original Agreement No._____**.**
   (c) That the First Party shall have to execute all the items which the Engineer-in-Charge consider necessary.
   (d) That the First Party shall start with the work of the remaining items mentioned in the Schedule annexed to this Agreement from the next day of recorded date of completion of the work of original Agreement

no._____ on the receipt of a letter to the effect from the Engineer-in-Charge or from any date fixed in the said letter and shall complete the said work within the time fixed by the Engineer-in-Charge or as extended by him from time to time.

(e) That on the due execution and completion of this Agreement by the parties, the bill of the First Party in relation to the work already done by him under the Original Agreement No._____ shall be provisionally finalized by the Second Party and payment on account, if any amount due, shall be made to the First Party provided that the Second Party shall have a right to retain such amount as is considered reasonable by him as a security for the execution of the work mentioned in the Schedule annexed to this Agreement and the Second Party shall have right to deal with the said amount of security as he thinks proper under the terms and conditions of the Original Agreement. Further, on the due execution and original completion of this Agreement, the First Party shall be entitled to claim back his security deposit relating to the work in question, subject to the right of the Second Party to retain such amount as he thinks reasonable as mentioned above soon after the maintenance period of **Five (5) years** as mentioned in clause of the Original Agreement, is over.

(f) That quarterly payments are made by the Second Party to the First Party for the services rendered during the period of Supplementary Agreement at the rates quoted by the First Party in the Original Agreement No._____.

3. Except as modified by this Agreement the said Agreement No._____ shall remain in full force and effect.

IN WITNESS WHEREOF THE ABOVE MENTIONED PARTIES HAVE PUT THEIR SIGNATURE ON THIS DAY THE……

SECTION-XI

SPECIAL CONDITIONS OF CONTRACT
(CIVIL,PHE,INTERNAL ROADS,INTERIOR WORK,LANDSCAPING)

1.0 GENERAL :

1.1. Special Conditions of Contract shall be read in conjunction with the General Conditions of Contract, Schedule of Quantities, specifications of work, tender drawings , finishes matrix and any other documents forming part of this contract wherever the context so requires. The order of precedence of the above documents shall be interpreted as per General Conditions of Contract.

1.2. Notwithstanding the sub-division of the document into these separate sections and volumes, every part of each shall be deemed to be supplementary of every other part and shall be read with and into the contract so far as it may be practicable to do so.

1.3. The materials, design and workmanship shall satisfy the relevant Indian Standards (Latest), the job specifications contained herein and other national / international codes (Latest) referred to. Where the job specifications, stipulate requirements in addition to those contained in the standard codes and specifications, these additional requirements shall also be satisfied. In the absence of any Standards/Specifications/Codes of practices for detailed specifications covering any part of the work covered in this tender, Contractor shall ensure that the work is executed as per the best and sound engineering practices and/or as per the instructions/directions of Engineer- in-Charge. The decision of EIC as regards the specification to be adopted and their interpretation and the mode of execution of work shall be final and binding on the Contractor and no claim whatsoever shall be entertained on this account.

1.4. The Contractor shall execute the whole and every part of the Works in the most professional and workman-like manner and both as regards materials and in other respects in strict

accordance with specifications and latest Indian and international codes.

1.5. The Contractor shall also conform exactly, fully and faithfully to the designs, drawings and instructions in writing relating to the work signed by the Engineer-in-Charge and lodged in his office and to which the Contractor shall be entitled to have an access for the purpose of inspection at such office or on the site of the work during office hours. The Contractor will submit four sets of duly signed and stamped working drawings in hard copies for approval.

1.6. Excavated good earth declared surplus or otherwise shall be disposed of at designated locations as per the directions of the Engineer – in – charge,which shall be different from the disposal site for clay soil.

1.7. For soil required for re-filling, if sufficient space is not available for stacking at site of excavation, the Contractor shall make his own arrangements for transporting and stacking the earth elsewhere and then bring it back for re-filling.Nothing extra shall be paid on this account for to and fro carriage.

1.8. Disposal of surplus excavated earth including mud, liquid mud, dismantled RCC, dismantled brick work etc. shall be made only in the dumping yard approved by local authority. It will be the responsibility of the contractor to get the permission for dumping yard from local authority as required. If any royalty/fees is payabletolocal authority, such royalty/fees shall also be borne by the contractor. Disposal shall be carried out strictly as per the regulations of local authority. However, the above materials shall not be removed out of owner's premises without prior written authorization of EIC.

1.9. The Contractor shall put in place a Vehicle Wash area to ensure that the vehicles exiting the construction work site are free from sediment to avoid dirtying the public roads.

1.10. The Contractor shall carefully protect and preserve all bench marks, site details, pegs and other things used in the setting out of the building for Construction. All preliminary works such as establishment of a set of bench marks, permanent DGPS, Total Station/theodolite stations, centre line pillars, etc including required materials, tools, plants, equipment, labour, etc. for performing such functions necessary and ancillary there to for the commencement and during the progress of the work and till physical completion of the work shall be carried out by the Contractor at his own cost. It shall be Contractor's

responsibility to shift the existing benchmark to his work site to set out the necessary control points and alignment of the various works. The Contractor shall also provide DGPS instrument with other required precision Survey Instruments as per site requirement and/or as directed by EIC. The work of setting out shall be deemed to be a part of general works preparatory to the execution of the work and no separate payment shall be made for the same.

1.11. The work will be carried out in accordance with the architectural drawings and structural drawings approved by the Engineer-in-Charge. The structural and architectural drawings shall have to be properly correlated before executing the work.

1.12. In case of any difference noticed between Architectural and Structural drawings, the Contractor shall intimate the differences/discrepancies to EIC well in advance prior to scheduled start of the relevant item of works and shall obtain final decision in writing of the Engineer-in-Charge before executing the particular portion of the work. The delay caused on account of non-timely action by the Contractor in resolution of the differences whatsoever shall not be considered as compensation event for extension of time unless otherwise accepted by EIC.

1.13. In case of any discrepancy in the description of the item of the schedule of quantities submitted along with bid by the contractor and approved architectural drawings relating to the relevant item, the provision of former shall prevail unless given otherwise in writing by the Engineer-in-Charge,

1.14. Shop drawings giving complete information for the fabrication of the component parts including the location, type, size, length and details of connections shall be prepared well in advance by the contractor before the actual fabrication and got approved from the Engineer-in-Charge. Delay in submission of the drawings by the contractor causing consequent delay in approval by the Engineer in charge shall not absolve the contractor of his responsibilities.

1.15. Wherever the BoQ item stipulates design, the Contractor shall have to supply designs and shop drawings which shall have to be vetted by any IIT/NIT/Govt Engineering College or any other Institute of repute as approved by Engineer – in – charge, and all costs towards the same, including charges for vetting shall be deemed to have been included in the quoted rates.

1.16. Plumbing drawings are schematic but shall be followed as closely as actual construction permits. Any deviations made shall

be in conformity with the structural, architectural and other services drawings. Detailed drawings shall be prepared by the Contractor and got approved by EICwell in advance prior to start of the relevant item of work.

1.17. Architectural drawings shall take precedence over plumbing or other services drawings in respect of overall dimensions unless and otherwise directed by EIC.

1.18. All temporary works, ancillary works, enabling works, including dewatering of surface and subsoil water, preparation and maintenance of temporary drains at the work site, preparation and maintenance of approaches to working areas, wherever required, for execution of the work, shall be the responsibility of the Contractor and all costs towards the same shall be deemed to have been included in the quoted prices

1.19. The Contractor shall, at his own expense and without extra charges, make provision for all pumping, dewatering, dredging or bailing out water, if necessary, irrespective of the source of water. The water so pumped out shall be discharged as per local byelaws and as approved by the Engineer-in-charge. The Contractor shall also take all necessary precautions in diverting channels and in discharging the drained water as not to cause damage to the works, crops or any other property within/outside the plot. Excavated area for the basement/ foundation trenches shall be kept free from water while all the works below Ground level are in progress. Nothing extra shall be paid on this account in terms of time and cost.

1.20. The Contractor shall at his own expense and without extra charges, take all precautions such as shoring for all depths or any other arrangement as approved by Engineer-in-Charge for ensuring that there shall be no sliding / collapsing of the excavated earth and nothing extra shall be payable on account of shoring/other arrangements.

1.21. Earth work in excavation and filling for, building works shall be governed under provisions of CPWD Specifications and Delhi Analysis of Rates (DAR), plan of internal road works and any other works not related to building works shall be governed by MORTH Specifications and MORTH Standard Data Book for Analysis of Rates.

1.22. Further contractor shall take all necessary precautions to protect and safe guard the foundation of the adjacent building / Structure / Overhead/Underground utilities. Nothing extra shall be payable on this account.

1.23. The rate for every item of work to be done under this contract shall be for all levels, leads and heights and nothing extra shall be paid on this account.

1.24. For items covered by J&K SoR/CPWD Specifications, reference may be made to the relevant CPWD Specifications. Where it is felt that the CPWD Specifications concerned does not reflect the full scope of work under any item, reference may be given to Indian Standards or any other relevant Specifications.

1.25. Should work be suspended by reason of rain, strike, lockouts or any other cause, Contractor shall take all precautionary measures for the protection of works and at his own cost and shall make good any damage arising from any of these causes to satisfaction of EIC

1.26. Work shall normally be done in a single shift/day. However if the work is required to be executed in more than one shift in a day for meeting the time lines, the Contractor with prior approval of the Engineer – in – charge, shall have to make necessary arrangements for the same and all costs towards the same shall be deemed to have been included in the quoted rates

1.27. Defect liability period shall start from the date of taking over of entire project after its completion in all respects as per the scope of the contract by the Engineer – in – charge. Taking over of the entire project shall be reckoned as actual date of completion of the project.

1.28. Labour Camp:

NHIDCL shall not permit the contractor to set up labour camp within the site boundary. Contractor shall make his own arrangements to set up labour camps. The facilities like dwelling units, water supply, lighting arrangement, drainage and sanitation as stipulated in the contract shall be arranged by the Contractor and all costs towards the same shall be deemed to have been included in the quoted rates.

The Contractor shall put in place an arrangement for controlled entry and exit of labourers / workers / technicians with Gate Passes or Identification Badges with Colour photographs individually authorized by the Contractor and all costs towards the same shall be deemed to have been included in the quoted prices.

1.29. Precision Works

Machine foundations, equipment installations are precision works. Contractor shall ensure utmost precision in location of

holding down bolts, slots, pockets and the like with (+/-) 1 mm tolerance.

1.30. Maintenance of Register of Tests -

All the registers of tests carried out at Construction Site or in outside laboratoriesshall be maintained by the contractor which shall be issued to the contractor byEngineer-in-charge. Contractor shall be responsible for safe custody of all the test registers.

1.31. Method Statement

The contractor shall submit a 'Methods statement' for the approval of the EIC soonafter the award of work to him. The 'Methods statement' is a statement by which the construction procedures for important activities of construction are stated, checked, and approved. The 'Methods statement', should have a description of the item with elaborate procedures in steps to implement the same, the specifications of the materials involved, their testing and acceptance criteria, equipment to be used, precautions to be taken, mode of measurement, etc.

1.32. Floors & Levels :

a)Floor 1 shall be the lowest floor above the average ground level ofthemain building to be constructed at site. The Floor above Floor 1 shall benumbered in sequence as Floor 2, Floor 3 andso on. The number shall increaseupwards.

b) Floor Level - Top level of structural slab shall be the floor level.
c) Plinth Level - Floor 1 level shall be the plinth level.

2.0 WORK PROGRAMME:

2.1 The Contractor shall, within 10 days after the date of award of the work, submit his detailed work programme preferably in Microsoft Project, detailed Project quality plan for works executable at site and also at manufacturer's place, safety plan, for the approval of the Engineer in - charge, which shall clearly set out his proposed schedule for the whole of the Works, the time for completing the major sections of the Works and his schedule for mobilizing the materials and equipment necessary

for implementing the Works in a timely cohesive and efficient manner. The Contractor shall submit the above Resource Mobilization Plan on the basis of site/region prevalent labour constants/productivity factors and separately a Project Material Procurement Plan clearly mentioning the procurement strategy for long lead items.

2.2 **Slab Cycle Requirements**:

The Contractor shall plan and design Concrete Strength at various stages of work commensurate to the slab cycle requirements through submitted shuttering plan / design which shall be the sole responsibility of the Contractor and this shall not absolve him of his responsibilities despite approvals accorded by EIC.The quoted rate shall be deemed to include the cost of the above.

2.3 Project Review Meetings

The contractor, immediately on award of work shall submit details of his key personnel to be engaged for the work at site. In addition, he shall furnish the Engineer-in-Charge detailed organogram involved with the work.
The Contractor shall present the programme and status at various review meetings as required.

i) Weekly Review Meetings: Shall be attended by Local Team headed by Project -in-Charge.

Agenda	a) Weekly programme v/s actual achieved in the past week and programme for next week. b) Remedial Actions and hold up analysis. c) Client query approval.

ii) Monthly Review Meetings: Shall be attended by Project -in-Charge and the Management Representative who can take independent decisions.

Agenda	a) Progress Status/Statistics. b) Completion Outlook. c) Major hold ups / slippages. d) Assistance required. e) Critical issues. f) Client query/approval.

	g) Anticipated cash flow requirement for next two months

3.0 WATER AND POWER

3.1 Water: Contractor shall make his own arrangement for water, required and suitable for construction. This shall also include arrangement of adequate water for hydro-tests of liquid/water retaining structures or any other installations as directed by EIC.

3.2 Power: Contractor shall make his own arrangements for power required for construction of the Project. Alternately, he may apply for and arrange power at the project site. All associated activities for obtaining necessary approvals and sanctions for construction power shall be coordinated by the contractor, the cost of which shall be deemed to be included in the quoted rates. All installations / fixtures & fittings / cabling for construction power shall be in the scope of the contractor without any additional cost to the NHIDCL. The delay on part of the Contractor in timely getting the statutory clearances and establishing required installation for adequate power supply shall not be accounted for extension of time and also shall not absolve him of Contractual responsibilities

3.3 If the NHIDCL/Employer provides water and electricity, the cost for such facility will be borne by the contractor at the prevailing rates of local Government bodies as per actuals.

4.0 MEASUREMENTS, BILLING & TERMS OF PAYMENT :

4.1 All works shall be measured in metric system based on actual work done as per the terms and conditions of the tender document.

4.2 Contractor shall submit computerized bills

4.3 **Terms of Payment**: Following shall be the terms of payments for the subject work:-

Running Account Bills:

The running bills shall be paid in stages. The above progressive payments are subject to deduction towards income tax and other recoveries as applicable as per the terms of the contract.

5.0 CONTRACT DRAWINGS

The contractor shall keep mandatorily one copy each of approved drawings, conditions of contract, specifications, instructions and schedule of quantities at the site of works available for reference by any authorized representative of Employer/Engineer- in-charge, at all times during the progress of the works. The drawings shall be displayed and arranged as directed by the Engineer- in-Charge.

6.0 WORK TO BE CARRIED OUT BY SPECIALISED AGENCIES:

6.1 Followingspecializedworksshouldbegotexecutedonlythroughagenciesspecializedin thefieldandthecontractorshallberequiredtosubmitthedetailsofsuchagenciesto theEngineer-in-Chargeandobtainnecessaryapproval prior to their engagement:-

- Anti-termite Treatment
- Water Proofing Work
- Structural Glazing
- Fire-fighting/fire suppression/ fire alarm systems
- Radiant Heating Systems
- Thermal insulation
- Bio-Digestor for sewage Treatment
- Modular Kitchen, cupboards and kitchen cabinets.
- Plumbing with polypropylene pipes using advanced technology for jointing.
- Signages
- uPVC windows

6.2 The specialized agency should have successfully completed at least one work of similar nature.

6.3 The contractor shall submit the following details of the specialized agency before execution of work for approval of EIC :

List of similar works carried out by the agency during the last five years along with the name of work, name and address of clients, year of execution, value of work done and brief specification of the work. The credentials for such completed works shall be obtained from the Project Manager / Executive Engineer concerned along with contact address.

6.4 Notwithstanding the approval of the Engineer-in-Charge for the specialized agencies, the services of the specialized agencies shall be removed whereverthe Engineer-in-Charge is not satisfied with the performance of the specializedagency. Thereupon, the Contractor shall immediately arrange for an

alternate specialized agency conforming to prescribed eligibility criteria. Nothing extra shallbe payable on this account. Further, no extension of time shall be permissible onthis account.

7.0 MOCK-UP

7.1 The concept of Mock Ups is to assess the performance parameters / quality standards specified for specified item in the project. The main objective of the section is to address issues prior to construction to minimize disruption to the critical path of construction program and is as follows;

- Determine whether the contractor possesses required skill level necessary to construct the activity, assemblies or systems such that the as-built construction will satisfy specified requirement.
- To understand the sequence of operation and discuss alternative sequencing options if any.
- To assess the standard of workmanship and aesthetics to be replicated throughout the project.
- To recognize and resolve potential areas of conflict prior to the commencement of construction.

7.2 The contractor shall prepare the full scale mock up at site for activity showing the following but not limited to:

- Flooring patterns, hardware, accessories, exterior windows(sill, corner, jamb),structural glazing, Doors, Glazing works, External Façade systems, false ceiling, electrical and mechanical fixtures, wall panelling system , false ceiling system etc.,
- To determine the acceptable standard of workmanship, the Contractor shall execute a sample unit (one of each type decided by the Engineer-in-charge) completing all items of works and services such as walls, floors, roof, plastering, joinery including fittings, sanitary fittings, plumbing, electrification, painting, entire kitchen and bathroom fittings, doors, windows, wood works, cabinets, cupboards and pelmets etc. complete in all respects. The brands of various materials incorporated as well as finishes will be approved by the Engineer-in-charge. These will be guiding samples for future execution of the rest of the Units.

7.3 The contractor shall construct mock ups for the purpose of testing as given in the particular specification for the following items of work:

- Semi Unitized Structural Glazing

7.4 Contractor shall build mock-ups for each form of construction and finish required, including materials indicated for the completed work as per given specifications.

7.5 Mock up shall be constructed by the same personnel who will be constructing actual construction of the said activity or system on the project along with acting site supervisors, key personnel during actual construction.

7.6 Contractor shall furnish the Mock up schedule taking care to ensure that sufficient time period is available between erection / installation of the mock up and actual execution of that item of work to enable EIC to incorporate changes and take corrective actions if any.

7.7 The Contractor shall establish the acceptable quality of workmanship as desired by the EIC for each of the items of the Works and their elements by preparing specimens and mock ups as directed by the EIC.

7.8 Nothing extra shall be payable for preparing the specimens and the mock ups. No claims of any kind whatsoever including the claim of extension of time will be entertained due to the incorporation of this requirement.

7.9 In case of non-approval of the mock-ups by EIC on account of quality issues or other reasons attributable to the Contractor, the mock ups shall be rebuilt up by the Contractor at no extra cost and time to EIC.

8.0 MATERIALS AND SAMPLES:

The contractor shall arrange a sample room at site for displaying approved samples which shall be maintained till the completion of the work. Nopaymentwillbe madetothecontractorforthesamplesprocured.

The sample approval shall be given in writing by EIC within 15 days after submission of the sample with supporting catalogues and other documents as required by EIC.

The delay in submittal of the samples by the Contractor and further cascading delay in subsequent approvals and procurement shall not attract any extra cost and time to the Contract.

9.0 RECOMMENDED MAKES OF MATERIALS.

9.1 A list of recommended makes of materials is laced with contract

9.2 The order of preference amongst the various products/materials shall be as follows:

The products/materials shall be as per the Brand specified in the list of approved makes

If the Brand is not specified then the products/material shall be ISI marked and the same shall be got approved by the Engineer-in-Charge before execution.

If ISI marked product/material is not available, the same shall be as approved by the Engineer-in-Charge before execution.

9.3 In case of natural products such as Kota stone, Granite etc.,

a) the stones used shall be of **premium** grade and they shall be homogenous in colour with consistency in pattern, texture, tone, marking and colour. No discolouration, spots, fissures or cracks and pocked surfaces shall be allowed.

b) Where it is difficult to guarantee uniformity in colour and other properties, contractor shall make all efforts to match the colour, shade, texture of the product with the approved sample. If in the opinion of the Engineer-in-Charge there is significant variation in properties, the Engineer-in-Charge shall direct the contractor to remove the same from the siteimmediately and replace with products matching with the approved sample within reasonable

period. The decision of Engineer-in-Charge shall be final and binding. Nothing extra shall be paid on this account.

10.0 COMPLETION CERTIFICATES/ NOC FROM LOCAL STATUTORY BODIES

Contractor has to arrange at his own cost building/ work completion certificates or NOCs if required to be obtained, from the local statutory bodies of central and state govt. such as electrical, safety, Fire authority, Chief Controller of Explosives(CCOE) etc.Any fees required for obtaining such NOCs shall be paid by NHIDCL/Employer on production of relevant depository challans/ receipts from such Govt. authorities.

The application on behalf of NHIDCL/Employer for submission to relevant authorities along with copies of required certificates complete in all respects shall be prepared and submitted by the Contractor well ahead of time so that the actual construction / commissioning of the work is not delayed for want of the approval / inspection by concerned authorities.

The inspection of the works by the authorities shall be arranged by the Contractor and necessary co-ordination and liaison work in this respect shall be the responsibility of the Contractor.

11.0 COMPLETION DRAWINGS :

11.1 During the execution of the Works a set of drawings shall be retained in the Contractor's Site Offices for the exclusive purpose of recording approved changes made to the Work as the construction proceeds. On completion of the Work, the Contractor shall submit required details and "Mark- up" of changes if any in all drawings of the project to the EIC. The Contractor shall submit the "AS BUILT" drawings after completion of the project . These drawings shall include and show all the changes / deviations made from the approved working drawings during the course of construction and also the other details as called for by the Engineer-in-Charge.

12.0 TOOLS, PLANTS AND MACHINERY

The Contractor shall provide and install at site, T &P as stipulated in the Contract. The deployment of T&P shall be planned as per work requirement to suit the nature, quantum and speed of the work for lifting/hoisting construction materials/equipment etc. The T&P shall be maintained in good working condition throughout the progress of work. All adequate precaution regarding formal upkeep of valid Statutory/Safety credentials of major construction equipment as directed by EIC, their installation, operation, maintenance,

materials etc., shall be taken care of. The operating staff to be deployed shall be properly qualified and adequately trained and experienced. All safety precautions shall be taken during the project duration, against possible accident. The Contractor shall deploy his representative to effectively enforce the safety rules and regulations in this regard. Nothing extra shall be payable on this account for the above.

Construction Equipment & Mechanisation of Construction Activities

The above list is only minimal and indicative. The contractor shall deploy all necessary tools and plants as per the requirement of the work.
The Contractor shall without prejudice to his overall responsibility to execute and complete the work as per specifications and Time Schedule, progressively deploy adequate equipment, and tools & tackles and augment the same as decided by Engineer-in-Charge depending on the exigencies of the work so as to suit the construction schedule.

The Contractor shall mechanise the construction activities to the maximum extent by deploying all necessary construction equipment/ machinery in adequate numbers and capacities.

13.0 CENTRING AND SHUTTERING FOR R.C.C WORK:-

The work is to be completed in specified periodof 15months,hence thecontractor shall adopt a suitable system complying with BIS standards regarding stripping time, with requisite number of sets of centring and shuttering. Nothing extra shall be payable on account of the above and the rates shall be restricted to the quoted rates for the corresponding item.

14.0 CEMENT & STEEL:

14.1 For Cement and Steel and other materials, as prescribed, the quantities brought at site shall be entered in the respective material at site accounts and shall be treated as issued for maintenance of daily consumption.

The procurement of Cement and Reinforcement Steel, and, their issue and consumption shall be governed as per

conditions laid down hereunder.

14.1.1 Cement

The Contractor shall procure 43 grade (Conforming to IS:8112) Ordinary Portland Cement, as required in the work, from reputed manufactures of cement, having a production-capacity of one million tonnes per annum or more, such as ACC, Ultratech, etc., as approved by Engineer-in-Charge. Procurement of cement of other type and grade shall be on prior approval of the EIC for specific area of application.

The Cement shall be brought at site in bulk supply as per requirement of work or as decided by the Engineer-in-Charge.

The cement godowns of the capacity to store appropriate quantity of cement as decided by the Engineer-in-Charge shall be constructed by the Contractor at site of work for which no extra payment shall be made. The Contractor shall facilitate the inspection of the cement godowns by the Engineer-in-Charge at any time.

14.1.2 Steel

Reinforcement steel shall mean Fe-500D unless otherwise specified. The Contractor shall procure steel reinforcement TMT bars (of Fe 500 D grade having elongation ratio more than 14.5%) conforming to IS:1786-2008 or latest / Structural steel conforming to IS:2062,from main producers of Steel like SAIL, TISCOetc., or as approved by the Engineer-in-Charge. The Contractor shall have to obtain and furnish test certificates to the Engineer-in-Charge in respect of all supplies of steel brought by him to the site of work.

The structural steel, reinforcement steel shall be stored by the Contractor at site of workstrictly on hard elevated bed or wooden sleepers enclosed within demarcated area (fabrication yard, reinforcementyard)in sucha way as to prevent distortion, corrosion and nothing extra shall be paid on this account. Bars of different sizes (diameters) and lengths shall be stored separately away from the scrapsto facilitate easy counting and checking.

Coefficient of weight i.e. the weight per unit length of the steel procured by the Contractor shall be ascertained at site before using it and certified by the Engineer-in-Charge. In case, weight per unit length is beyond the rolling margin as laid down in the BIS: 1786 / IS:1852 for reinforcement steel / structural steel respectively, the steel will be rejected and shall be removed from the site of work

forthwith. In case weight per unit length is more than the standard coefficient of weight for the diameter, but is within the rolling margin, thenthe payment shall be made as per the standard weight per unit length, and, where the weight per unit length is lesser than the standard coefficient of weight for the diameter, but is within the rolling margin, the payment shall be restricted with respect to the actual weight per unit length of the diameter.For this Coefficients indicated in CPWD Specifications or any other BIS Standards shall be adopted.

The standard sectional weights referred to in standard table under para5.3.4, of the CPWD Specifications 2019 are to be considered for conversion of length of various sizes of Steel Reinforcement bars into weight and are as per clause 6.2 of IS 1786.

14.2 The actual issue and consumption of steel and Cement on the work shall beregulated and proper accounts maintained as provided in clause 10 of the contract. The theoretical consumption of steeland cementshall be worked out .

14.3 Steel and Cement brought to site and remaining unused shall not be removed from site without the written permission of the Engineer-in-Charge.

15.0 ITEMS OF WORK REQUIRING PERFORMANCE GUARANTEE BOND

The following items of works require submission of performance guarantee bond:

A. **External Façade (Structural glazing)**
B. **Water proofing treatment system**
C. **Anti-termite treatment**

For the above works , the Contractor shall give a guarantee to the effect that the work shall remain structurally stable and shall guarantee against faulty design, workmanship, fabrication, erecting, installation, leakages etc including defective material, if any. The Contractor shall furnish a Guarantee Bond, as per prescribed format. The Guarantee

Period shall be for 10 (Ten) years after completion of defect liability period.

16.0 REPORTS TO BE SUBMITTED

The Contractor shall prepare and submit monthly progress reports (Including Progress Photographs) for the month to the EIC in three copies within first 7 days of the following /next month. Reporting shall continue until the Contractor has completed all work including the outstanding work as on the completion date as stated in the Taking-Over Certificate for the Works. Each report shall include but shall not be limited to the following:

(a) the status of supply and delivery of major materials and Plant to be incorporated in the Works, and the supply of major items of the Contractor's construction plant;

(b) records of personnel and Contractor's equipment on site;

(c) Activities executed/achievements during the month.

(c) copies of quality assurance documents, test results and certificates of materials;

(d) safety statistics, including details of any hazardous incidents and activities relating to environmental aspects and public relations; and

(e) comparisons of actual and planned progress, with details of any aspects which may jeopardize the completion in accordance with the Contract, and the measures being (or to be) adopted to overcome such aspects.

(f) Areas of concern/problems/hold ups& its impact and action plans

And any other reports sought by the EIC.

17.0 QUARRY MATERIALS

The Contractor shall be wholly responsible to identify the suitable sources for quarry materials required for the Works, such as earth, sand, stone, gravel, murrum, etc., and to make his own arrangements(within the contract price) for collection and transportation of the materials irrespective of the leads and lifts required. The party managing the quarry identified by

the Contractor should have proper license from the UT of Ladakh. All materials supplied by the Contractor shall satisfy the requirements set forth in the Specifications contained in this Bid and shall be subject to the approval of the EIC. The Contractor shall take this into account while offering his rates and no claims whatsoever shall be entertained for extra costs on this account. All the seignorage(royalty)charges, levies etc., payable to Government shall be paid by the Contractor and are deemed to be included in the quoted rates.

18.0 INTERFERENCE WITH TRAFFIC AND ADJOINING PROPERTIES/BUILDINGS

18.1 The Contractor shall prepare General Maintenance of Traffic Plan which will be subject to the approval of the EIC. In case any operation connected with the Works requires temporary diversion of the traffic, or obstruction or closure of any road, or any other 'right of way', the approval of the EIC and the respective competent authorities shall be obtained at least one week in advance.

18.2 The Contractor shall at all times during execution of the Works, ensure an uninterrupted flow of traffic/occupants of existing buildings on the work locations.

18.3 The Contractor shall at all times during execution of the Works, provide convenient access to parts, steps, bridges or drives for all entrances to property abutting the work sites and maintain them clear, tidy and free from mud or objectionable matter.

18.4 If in order to avoid undue interference with the traffic and adjoining properties, the EIC instructs the Contractor to take special precautions or work within restricted time periods; the Contractor shall carry out the Works during such time and in such manner as directed by the EIC.

18.5 The Contractor shall not claim any extra cost or payment on account of all or any of the works specified in above clauses.

19.0 CONTRACTOR TO CO-ORDINATE HIS WORK WITH OTHER CONTRACTORS

Various other works may be progressing simultaneously in the project site. The Contractor shall co-ordinate with the other concerned Contractors and take into account the inter-relation with other works while planning his daily construction activities, so as to eliminate any hindrance to any work(s)

and/or to avoid any damages to the work(s) already carried out by other Contractors. The Contractor shall co-ordinate with the other concerned Contractors for all such works as per the Engineer's directions at no extra cost and he shall provide unhindered access to the T&P and machinery of the other contractors as per the directions of EIC.

20.0 SHIFTING OF UTILITY LINES

During the course of execution of the Works under this Contract, the Contractor is bound to undertake shifting of any Utility line(s) that are required to complete the Works satisfactorily. However, NHIDCL reserves the option to get such work carried out by other agency, but this shall not relieve the Contractor of any of his responsibilities and obligations under this Contract*implying that this shall not be treated as compensation event for extension of time unless otherwise consented by EIC.*

21.0 MOBILISATION OF MEN, MATERIALS AND EQUIPMENTS:

All expenses towards mobilization at site and demobilization including bringing the equipment, work force, materials, dismantling the equipment, clearing the site etc. shall be deemed to be included in prices quoted and no separate payments on account of such expenses shall be entertained.*The EIC shall have exclusive rights to accept or reject any material or equipment and also the manpower engaged by the Contractor during complete tenure of the Project. This can also lead to demobilisation of the supervisory manpower including key persons of the Contractor/ Specialized agency in case of their non-satisfactory performance.*

22.0 LIGHTING& WATCH AND WARD:

22.1 The contractor shall at his own cost take all precautions to ensure safety of life and property by providing necessary barriers, area lighting at the construction site and approaches, watchmen etc. during progress of work at all hours including night hours, if required, as directed by the Engineer-in-charge.

22.2 The Contractor shall be responsible for the watch and ward of the all construction premises and buildings, safety of all fittings and fixtures including sanitary and water supply fittings and fixtures provided by him against pilferage and breakage during the period of installation till handing over of

~~all~~ the works to NHIDCL/Employer. Nothing extra shall be payable on this account.

23.0 TENDER DRAWINGS

The hard copies of tender drawings are not being attached with the tender documents. Soft copies are uploaded along with bid document on CPPP/NHIDCL website. The bidders are required to go through the drawings before bidding for the work. A set of the drawings is available in the office of the NHIDCL, which the contractor may study during working hours, before quoting the rates if he so desires.

24.0 APPLICABLE PERMITS

24.1 The contractor(s) shall give to the Municipality, police and other authorities all necessary notices etc. that may be required by law and obtain all requisite licenses for temporary obstructions, enclosures etc. and pay all fee, taxes and charges which may be levied on account of these operations in executing the contract. He shall make good any damage to the adjoining property whether public or private and shall supply and maintain lights either for illumination or for cautioning the public at night.

24.2 The Contractor shall ensure that applicable permits mandated by the local bodies are obtained as required under the Applicable Laws. An indicative but not exhaustive list of some of the applicable permits are mentioned below for the guidance of the Contractor.

24.3 Consequences on account of failure to obtain the mandatory permits shall be the sole responsibility of the contractor and no claim what so ever shall be entertained by the EIC. Any liability incurred by EIC on account of such failure shall be recovered from the amounts/ payments due to the Contractor.

- Permission of the UT Government for extraction of boulders from quarry;
- Permission of Pollution Control Board for installation of crushers;
- Permission of the UT Government for drawing water from river/reservoir;

- Licence from Inspector of factories or other competent authority for setting up Batching Plant;
- Clearance of Pollution Control Board for setting up Batching Plant;
- Clearance of Pollution Control Board for Asphalt Plant;
- Clearance of Pollution Control Board for installation of diesel generator sets;
- Fire safety clearance from fire authorities;
- Permission of UT Government for cutting of trees, if any;
- Permit for employing unskilled/semiskilled labour during day/night;
- Permitfordismantling/reconstruction/underpinning/strengthening of affected structures, disposal of solid waste/excess material or soil, setting up of temporary campus on government/private/leased land;
- Clearance for any urban structure affecting the landscape/ environment from the concerned authority;
- Permission from Archaeological Survey of India for construction of any structure within the prescribed radius of protected monuments;
- Permissions from the public utilities for diversion of utilities including reinstatement/reconstruction to original specifications;
- Approvals for electric supply/distributions;
- Approval of Traffic Police for diversions and running of vehicles on specified routes; and
- Any other permits or clearance required under the Applicable laws.

25.0 QUALITY ASSURANCE

Detailed quality assurance programme to be followed for the execution of Contract under various divisions of works will be mutually discussed and agreed to.

The Contractor shall establish document and maintain an effective quality assurance system as outlined in recognised codes.

Quality Assurance System plans/procedures of the Contractor shall be furnished in the form of a QA manual. This document should cover details of the personnel responsible for the quality assurance, plans or procedures to be followed for quality control in respect of all the activities envisaged in the construction works. The quality assurance system should indicate organisational approach for quality control and quality assurance of the construction activities, at all stages of work at site.

NHIDCL or their representative shall reserve the right to inspect/witness, review any or all stages of work at site as deemed necessary for quality assurance and / or timely completion of the work.

The Contractor has to ensure the deployment of quality Assurance and Quality Control Engineer(s) depending upon the quantum of work. This QA/QC group shall be fully responsible to carryout the work as per standards and all codes' requirements. In case EIC feels that Contractor's QA/QC Engineer(s) are insufficient, Contractor has to deploy other experienced Engineer(s) as per site requirement and to the full satisfaction of EIC.

26.0 INSURANCE

Without limiting the Contractor's obligations and responsibilities stated elsewhere in the Contract, the Contractor shall at his own cost arrange,secure and maintain insurance in the joint names of NHIDCL and the contractor with any of the subsidiary of the General Insurance Corporation of India in such a manner that NHIDCL and the contractor are covered for all time during the period of contract i.e. the time period allowed for completion of work, extended period and the defect liability period. The insurance shall be effected in accordance with terms approved by NHIDCL and the contractor shall submit the insurance policiestothe Engineer-In-Charge within 15 (Fifteen) days of signing of the agreement along withthe receipt of premium. The contractor shall timely pay and submit the receipts of payment of premiums for extensions of policies, if any. Theinsurance shall coverthe following: -

32.1. Contractor's All Risks Insurance

The contractor shall insure the work for a sum equivalent to the Contract value orsuch additional sums as specified and the interests of NHIDCL against ALL RISKS claims, proceedings, loss or damages, costs, charges and expensesfromwhatsoever cause arising out of or in consequence of the execution and maintenance of the work for which the contractor is responsible under the contract

32.2. Workman Compensation & Employers Liability Insurance.

This insurance shall be effected for all the contractor's employeesengaged in the performance of the contract. NHIDCL shall not be liable in respect of anydamages or compensation payable at law in respect of or in consequence of any accident or injury to any workman or anyother person in the employment of thecontractor and the contractorshall indemnify and keep indemnified NHIDCL against all such damages and compensation and against all claims, demands,proceedings, costs, charges andexpenses, whatsoever in respect or in relation thereof.

32.3. Third Party Insurance.

The contractor shall be responsible for making good to the satisfactionof the Engineer-in-Charge any loss or any damage to all structuresand properties belonging to Employer or being executed or procured or being procured by Employer or of the other agencies within the premises ofall work of NHIDCL if such loss or damage is due to fault and or the negligence or wilful acts or omissions of the contractor, his employees, agents, representatives.

The contractor shall take sufficient care in moving his plants, equipment andmaterials from one place to another so that they do not cause anydamage to anyperson or to the property of Employer or any third party including overhead andunderground cables and in the event of any damage resulting to the property ofthe NHIDCL or to a third partyduring the movement of the aforesaid plant, equipment or materials, the cost of such damages including eventual loss of production, operation or services in any plant or establishment as estimated by the NHIDCL or ascertained or demanded by the third party, shall be borne by the contractor.

32.4. Before commencing the execution of the work, the contractor, shall insure andindemnify and keep NHIDCL harmless of all claims, against thecontractor's liability for any materials or physical damage, loss or injury which may occur to any property, including that of Employer or to any person including any employee of NHIDCL/Employer, or arising out of the execution of the work or in the carrying out of the contract, otherwise than due to the matters referred to in the provision to (a)above. Such insurance shall be effected for an amount sufficient tocover suchrisks. The terms shall include a provision whereby, in the event of any claim being brought or made against NHIDCL the insurer shall indemnify NHIDCL against such claims and anycosts, charges and expenses in respectthereof.

32.5. The contractor shall also at times indemnify NHIDCL against all claims, damages or compensation under the provisions of Payment or Wages Act,1936, Minimum Wages Act, 1948, Employer's Liability Act, 1938, theWorkman's Compensation Act,1947, Industrial Disputes Act,1947 and Maternity Benefit Act, 1961, or any modification thereof or any other law relating thereof and rules made there under from time to time.

32.6. Contractor shall also at his own cost carry and maintain any andall otherinsurance(s) which he may be required to take out under any law or regulation from time to time. He shall also carry and maintain any other insurance, which may be required by the Engineer-in-Charge.

32.7. The Contractor shall prove to the Engineer-in-charge fromtime to time he has taken out all the insurance policies referred to above andhaspaid the necessary premiums for keeping the policies alivetill expiry of the DefectsLiability Period.

32.8. The aforesaid insurance policies shall provide that they shall not be cancelled till the Engineer-in-charge has agreed for cancellation.

32.9. Remedy on the contractor's failure to insure

If the contractor shall fail to effect and keep in force the insurance referred to above or any other insurance which he/they may be required to effect under the terms of the contract then and in any such case Engineer-in-charge may without being bound to, effect and keep in force any such insurance and pay such premium or premiums, as may be necessary for that purpose and from time to time deduct the amount so paid by the Engineer-in-charge from any moneys due or which may become due to the contractor or recover the same as a debt due from the contractor.

27.0INDEMNITIES

(a)The Contractor shall indemnify and hold harmless the NHIDCL, the NHIDCL's Personnel, and their respective agents, against and from all claims, damages, losses and expenses (including legal fees and expenses) in respect of:

(a) bodily injury, sickness, disease or death, of any person whatsoever arising out of or in the course of or by reason of the Contractor's design (if any), the execution and completion of the Works and the remedying of any defects, unless attributable toany negligence, wilful act or breach of the Contract by the NHIDCL, the NHIDCL's personnel, orany of their respective agents, and

(b) damage to or loss of any property, real or personal (other than the Works), to the extent that such damage or loss arises out of or in the course of or by reason of the Contractor's design (if any), the execution and completion of the Works and the remedying of any defects, unless and to the extent that any such damage or loss is attributable to any negligence, wilful act or breach of the Contract by the NHIDCL, the NHIDCL's

personnel, their respective agents, or anyone directly or indirectly employed by any of them.

GENERAL

27.1 These special conditions shall be read in conjunction with general conditions of contract and amendments / corrections thereto, Special Conditions of Contract for Civil Works.

27.2 TheInternal electrical worksshall be carried out in accordance with theCPWDGeneralSpecificationsforElectricalworks(Part–I–Internal)2013and(Part-IIExternal)1994, HVAC Specifications 2017 other Relevant latest CPWD Specifications(Part-III to Part VII),IndianElectricityRules,RelevantIndianStandardand Additional termsandconditionsandspecificationsattached herewith.

27.3 The contractor must study carefully all the specifications/schedule of work / drawings / additional specifications and site parameters and quote his bid after accounting all works. No extra claim on any account shall be paid/ entertained other than the quoted rates.

27.4 The work shall be carried out in accordance with the drawings approved by the Engineer-in-charge. Before commencement of any item of work, the contractor shall correlate all the relevant architectural and structural drawings approved for the work and satisfy himself that the information available is complete and unambiguous. The discrepancy, if any, shall be brought to the notice of Engineer-in-charge before execution of work. The contractor himself shall be responsible for any loss or damage occurring by the commencement of work on the basis of any erroneous and or incomplete information.

27.5 The contractor shall leave such recesses, holes, openings, etc., as may be required for the electric, air-conditioning and other related works. For this purpose any required inserts, sleeves, brackets, conduits, base plates, clamps etc. shall be arranged by the contractor and fix the same at the time of casting of concrete, stone work & brick work, if required, and nothing extra shall be payable on this account.

27.6 The contractor shall give a trial run of the equipment and machinery for establishing its capability to achieve the specifications within laid down tolerances to the satisfaction of the Engineer-in-charge before commencement of work.

27.7 All tools, plant and machinery provided by the contractor shall, when brought at the site, be deemed to be exclusively intended for the construction and completion of this work and the contractor

shall not remove the same or any part thereofwithout the consent of the Engineer-in-charge.

27.8 All materials shall be got checked by the Engineer-in-charge on receipt of the same at site before use.

27.9 Samples of all materials, conduits, accessories, switches, wires, control cables fittings and other materials/articles required for execution of the work shall be got approved from the Engineer-in-charge prior to procurement. Materials/articles manufactured by the firms of repute as indicated in tender documents and approved by the Engineer-in-charge shall only be used.

27.10 These shall be submitted for approval and retention by Engineer In-charge/his representative and shall be kept in their site office for reference and verification till the completion of the Project.

27.11 The contractor shall be required to make a sample of each item of work at the earliest opportunity using all approved materials for approval of Engineer in charge before mass scale finishing works are taken up.

27.12 Even ISI marked materials shall be subjected to quality test at the discretion of the Engineer-in-charge besides testing of other materials as per the specifications described for the item/material. Whenever ISI marked materials are brought to the site of work; the contractor shall, if required by the Engineer-in-charge, furnish manufacturers test certificates to establish that the material procured by the contractor for incorporation in the work satisfy the provisions of IS codes relevant to the material and/or the work done.

27.13 The Contractor shall use only chase cutting machine for cutting the chases in the wall for recessed conduit wiring.

27.14 The contractor will have to ensure that the skilled labour i.e. wireman etc., engaged in the execution of the work must possess valid electrical license, otherwise he will not be permitted to execute the work.

27.15 The contractor shall be responsible for removal of all defects in the work during the guarantee/warranty period. If any failure is noticed during this period which is attributable to poor quality of material and bad workmanship, the contractor will be required to rectify the same at his own cost, failure of which the NHIDCL will be at liberty to get the defects rectified at the risk & cost of the contractor. The contractor will also be required to carryout his own

inspection/testing during the guarantee/warranty period and attend to any defect taking place during this period.

27.16 Guarantee: **All material shall be guaranteed for a period of Twelve(12) months from the actual date of actual completion of the overall project**by the Contractor against unsatisfactory performance and/or break down due to defective design, workmanship of material. The material or equipment or any other there of so found defective during guarantee period shall forthwith be repaired or replaced free of cost, to the satisfaction of the Engineer-in-charge. In case it is felt by the NHIDCL/Employer that undue delay is being caused by the contractor in doing this, the same will be got done by the NHIDCL at the risk and cost of the contractor. The decision of Engineer-in-charge in this regard shall be final & binding.

ASSOCIATED CIVIL WORKS

All Major or Minor civil works associated with M&E installation are included in the scope of this contract including all minor civil work like wall chasing by wall chaser, making holes etc. for installation of conduits/cables and making good. These shall be executed in accordance with approved shop drawings.

PERFORMANCE GUARANTEE

The contractor shall carry out the work in accordance with the approved Drawings, Specifications, Schedule of Quantities and other documents forming part of the Contract.

The contractor shall be fully responsible for the performance of the selected equipment (installed by him) at the specified parameters and for the efficiency of the installation to deliver the required end result.The contractor shall guarantee that the M&E system as installed shall perform to complete satisfaction of the NHIDCL/Employer.

Complete set of tender drawings is available in the NHIDCL's office and reference may be made to same for any details or information. The contractor shall also guarantee that the performance of various equipment individually, shall not be less than the quoted capacity; also actual power consumption shall not exceed the quoted rating, during testing and commissioning, handing over and guarantee period.

BYE-LAWS AND REGULATIONS

The work shall be carried out to the satisfaction of the Engineer-in-charge and in accordance with the Specifications, Regulations of the Electric Supply Authority, Indian Electricity Rules and Regulations, latest Indian Standards and as per the requirements of the Chief Fire Officer etc.,

FEES AND PERMITS

The Contractor shall obtain permits required for the installation of this work. On completion of the work, the contractor shall obtain and deliver to the NHIDCL/Employer, certificate of final inspection and approval by the local electricity authority for substation, DG sets, HSD storage system, fire detection system, fire fighting and Lifts (CFO/ Municipal, UT/Central govt. whichever is applicable).

Thecontractororhisrepresentativeshallattendsuchinspection and extendalltestfacilitiesasareconsiderednecessary,rectifyandcomplywit hallobservationsoftheInspectorswhicharepart of the agreement and arrangefor obtaining necessary clearance certificateinfavourofthedepartment.Incasethecontractorfailstoattendt heinspectionandmakedesiredfacilitiesavailableduringinspection,thed epartmentreservestheright to providethesameattherisk andcost ofthe contractor and impose penalty for the same. The installation will beacceptedbyNHIDCLonlyafterreceivingclearancefromrespective Inspectors,forthework executed bythecontractor undertheagreement.

AnyextraworkforobtainingapprovalfromCFO etc, shallbecarried outwithoutanyextracost totheNHIDCL. However, anyfeespayabletoCFOfortheclearanceshallbemade bytheNHIDCL/Employer.

DRAWINGS

The M&E Tender Drawings issued with tenders, are diagrammatic only and indicate arrangement of various systems and the extent of work covered in the contract. These Tender Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these TenderDrawings. The architectural / interiors drawings and details shall be examined for exact location of equipment, electrical points & fixtures.

The contractor shall follow the tender drawings in preparation of his bid drawings/shop drawings, and for subsequent installation work. He shall check the drawings of other trades to verify spaces in which his work will be installed.

Maximum headroom and space conditions shall be maintained at all points. Where headroom appears inadequate, the contractor shall notify the Engineer-in-charge before proceeding with the installation. In case installation is carried out without notifying, the work shall be rejected and contractor shall rectify the same at his own cost.

The contractor shall examine all architectural, structural, plumbing, HVAC, Electrical and other services drawings and check the as-built works before starting the work and report to the Engineer-in-charge any discrepancies and obtain clarification. Any changes found essential to coordinate installation of his work with other services and trades, shall be made with prior approval of the Engineer-in-charge without additional cost to the NHIDCL.

SHOP DRAWINGS

7.1 All the shop drawings shall be prepared on computer using Autocad software based on Architectural Drawings, site measurements and Interior Designer's Drawings. Within eight weeks of the award of the contract or as specified in Special Conditions of relevant item of work, the contractor shall furnish, for the approval of the EIC , four sets of detailed shop drawings of all equipment and materials including layouts for all conduit layouts, distribution panels, switch boards, cabinets, special pull boxes, cable trays and any other requirement to be fabricated or purchased by the contractor. Shop drawings shall also be submitted in soft format.

7.2 These shop drawings shall contain all information required to complete the Project as per specifications and as required by the Engineer-in-charge. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/ works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings.

Each item of equipment/material proposed shall be a standard catalogue product of an established manufacturer strictly from the approved makes list.

When the EIC makes any amendments in the above drawings, the contractor shall supply four fresh sets of drawings with the amendments duly incorporated along with check print, for approval. The contractor shall submit further six or as many sets as required by EIC of shop drawings to the Engineer-in-charge for the exclusive use by the Engineer-in-charge and all other agencies. No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawing for the particular material/equipment/installation.

7.3 Shop drawings shall be submitted for approval sufficiently in advance of planned delivery and installation of any material to allow the Engineer-in-charge ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved programme.

7.4 Manufacturers drawings, catalogues, pamphlets and other documents submitted for approval shall be in six sets. Each item in each set shall be properly labelled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.

7.6 Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supersede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.

7.7 Where the contractor proposes to use an item or equipment, other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundation, wiring or any other part of the mechanical, electrical or architectural layouts; all such re-design, and all new drawings and detailing required therefore, shall be prepared by the contractor at his own expense and gotten approved by the EIC.

MANUFACTURERS INSTRUCTIONS

Where manufacturer has furnished specific instructions, relating to the material and equipment used in this project, covering points not specifically mentioned in these documents, manufacturer's instructions shall be followed in that case duly bringing the same to the notice of EIC.

COMPLETION CERTIFICATE

On completion of the electrical installation a certificate shall be furnished by the Contractor countersigned by the licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local, UT/central govt./ municipal / fire authorities concerned.

INSPECTION AND TESTING

Inspection and testing of Heat pumps, Pumps, HT/LT Panels, Transformers, DG sets and other major items at manufacturer's works for this contract is the at discretion of NHIDCL. Inspection team for the same may constituted by NHIDCL. No equipment shall be delivered without prior written confirmation from the Engineer In-charge. All expenses related to testing at their or their sub vendors works shall be to Contractor account.

Tests on site of completed works shall demonstrate the following:

That the equipment installed complies with specification in all respect and is of the correct rating for the duty and site conditions.

That all items operate efficiently and quietly to meet the specified requirements.

That all circuits are fully protected and that protective devices are properly co-ordinated.

That all non-current carrying metal parts are properly and safely grounded in accordance with the specification and appropriate Codes of Practice.

The contractor shall provide all necessary instruments and labour for testing, shall make adequate records of test procedures and readings, shall repeat any tests requested by the Owner and shall provide test certificate signed by a authorised person. Such test shall be conducted on all materials and equipment and tests on completed work as called for by the Owner at contractor's expenses unless otherwise called for.

If it is proved that the installation or part thereof is not satisfactorily carried out then the contractor shall be liable for the rectification of the same. NHIDCL's decision as to what constitutes a satisfactory installation shall be final.

COMPLETION DRAWINGS

Upon completion of the work and before issuance of completion certificate , the contractor shall submit to the NHIDCL four sets of layout drawings in progressive manner for individual systems drawn at approved scale indicating the complete wiring system as installed. Drawings shall be prepared on AUTO-CAD (latest version) . Along with the hard copies, the contractor shall submit copies of all drawings on CD and one set of all drawings on RTF shall also be submitted. These drawings must provide:

a. Substation equipment layout & all power distribution panel layout.

b. Single line power distribution diagram including control wiring.

c. Cable Trays with number and size of cables installed.

d. Run and size of conduits, inspection, junction and pull boxes.

e. Raceways and Junction Boxes.

f. Number and size of conductors in each conduit with phase identification.

g. Location and rating of sockets and switches controlling the lighting and power outlets.

h. Location and details of distribution boards/panels, mains, switches along with phase balancing details.

i. A complete wiring diagram as installed and single line diagrams showing all connections in the complete electrical system.

j. Location of all earthing stations, route and size of all earthing conductors manhole.

k. Layout and particulars of all HT & LT cables.

l. Instruction, maintenance and operation manuals including maintenance schedule for all equipment. Testing & commissioning reports of all electrical equipment.

And any other drawing/document as required.

OPERATING INSTRUCTION & MAINTENANCE MANUAL

Upon completion and commissioning of part Mechanical & Electrical system **t**he contractor shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the contractor shall submit four (4) complete bound sets of typewritten / Printed operating instructions and maintenance manuals; one each for retention by NHIDCL and Employer's representative and two for Employer's Operating Personnel. These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for Four(4) year period of maintenance of each equipment.

ON SITE TRAINING

Upon completion of all work and all tests, the Contractor shall furnish necessary operators, labour and helpers for operating the entire installation for a period of thirty (30) working days of eight (8) hours each, to enable the Employer's staff to get acquainted with the

operation of the system. During this period, the contractor shall train the Employer's personnel in the operation, adjustment and maintenance of all equipment installed.

MAINTENANCE DURING DEFECTS LIABILITY PERIOD

14.1. Complaints

The contractor shall set up a single point contact (SPO) to receive complaints during the effect liability period. It shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 48 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

14.2. Repairs

All equipment that require repairing shall be immediately serviced and repaired. During the period of the defects liability period, all replacement parts and labour shall be supplied promptly free-of-charge to the Employer.

UPTIME GUARANTEE

The contractor shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall get extended by a month for every month having shortfall .

The Contractor shall provide log formats in the form of diskettes and bound printed comprehensive log book containing tables for daily record of all temperatures, pressures, humidity, power consumption, starting and stopping times for various equipment, daily services rendered for the system alarms, maintenance and record of unusual observations etc. Contractor shall also submit preventive maintenance schedule.

DEMONSTRATION TO NHIDCL/EMPLOYER

At completion, devices subject to manual operation shall be operated at least five times in presence of Engineer In-charge/ his representative to demonstrate satisfactory operation.

SITE CONDITIONS

Outside Design Date(Peak)

Loation : Leh, ladakh
Geographical Location : 34.15° N, 77.577° E
Altitude : 3508 MT m above mean sea level
Temparature in Winter (DB/WB): -25 to -30 Degree Celicius
Summer(DBT/WBT): 23.8 to 38 Degree Celisius

Desired Inside Conditions:

C) In Winter : 22+/-1 Degree Celsius
Relative Humidity : 30% Approx.

D) In Summer : 24 +/- 1 Degree Celsius
Relative Humidity : 40% Approx.

SPECIAL CONDITIONS OF CONTRACT FOR EI & FANS

The special conditions shall be read in conjunction with general conditions of contract and amendments / corrections thereto, Special Conditions of Contract for Civil Works. If there are any provisions in these special conditions, which are at variance with the provision in the above-mentioned documents, the provisions in these special conditions shall take precedence.

18.1 DRAWINGS TO BE SUBMITTED FOR APPROVAL:

The firm shall supply the following shop drawings within 30 days after award of the work as detailed below.

- ❖ Drawing showing the position of fittings, including Emergency fittings, switch boards and plug points etc.
- ❖ Detail drawings showing location of DBs with phase balancing details.
- ❖ Schematic diagram showing all connections in the complete electrical system.
- ❖ Location drawings of rising main, cable trays, raceways layouts and junction box with necessary catalogues.
- ❖ Drawings showing the position of Advance Lightning conductor Air terminal, Down conductor, Spike counter and Earth pits.
- ❖ Drawing showing the location of Signage lighting Fire Escape route lighting including common control at Ground floor

18.2 INSPECTION:

NHIDCL reserves the right to carry out inspection and testing at manufacturer's works for any equipment/item prescribed in this contract. Samples of materials like accessories, switches, conduit, wire etc shall be submitted to NHIDCL for approval.

18.3 TESTING AT SITE:

Following tests shall be carried out at site as per CPWD specifications and report submitted to the Engineer-in-charge.The installed system shall be tested by the NHIDCL Representatives .

18.4 COMPLETION OF WORK OF EI & FANS:

a) Date of completion of work for the Electrical Installation (Internal Electrical Installation) shall be the last date of successful testing and commissioning of the installations by NHIDCL Representatives.

b) The above date shall be the date of completion of Work only for the purpose of settlement of bills / payments. However the guarantee period shall start from the actual date of completion of overall project. The Security Deposit shall be released after the successful completion of Defects Liability Period.

18.5 COMPLETION DRAWINGS:

The Contractor shall supply five sets of drawings/documents after completion of the work as detailed below :

- ❖ Drawing showing the position of fitting, including Emergency fittings switch boards and plug points etc.
- ❖ Detail drawings showing location of DBs with phase balancing details.
- ❖ Schematic diagram showing all connections in the complete electrical system.
- ❖ Location drawings of rising main, cable trays, raceways layouts and junction box.
- ❖ Drawings showing the position of Advance Lightning conductor air terminal, Down conductor, Spike counter and Earth pits.
- ❖ Drawing showing the location of Signage lighting Fire Escape route lighting including common control at Ground floor

SPECIAL CONDITIONS OF CONTRACT FOR RADIANT HEATING SYSTEM

The special conditions shall be read in conjunction with general conditions of contract and amendments / corrections thereto, Additional Conditions (General), Technical and Particular Specifications . If there are any provisions in these special conditions, which are at variance with the provision in the above-mentioned documents, the provisions in these special conditions shall take precedence.

19.1 Drawings to be submitted for approval within 30 days from award of work:

The contractor shall submit the following drawings :

19.1.1 A dimensioned drawing giving complete details of the erection of the equipment in terrace and plant room and conditioned area(including Heat pumps ,hot water tanks, boilers, hot water pumps, Treated fresh air units, Electrical panels and ping & details of foundations).

19.1.2 Electric wiring diagrams for all electrical equipment including controls showing cable sizes and equipment capacities.

19.1.3 General arrangement drawing, Single Line Diagram, for Electrical panels, panels and control scheme etc.

19.1.4 Drawing showing layout of entire hot water piping, with all diameters, sizes and number of valves. Isometric drawing showing connections of each of the units for all floors.

19.1.5 Foundation details of all equipment.

19.1.6 Detailed drawings for mechanical Ventilation of Basement Plant room.

19.1.7 Diagram showing details of Heat Pumps system manager.

19.2 Testing

19.2.1 Routine tests certificate for Heat Pumps Package Unit shall be furnished along with supply of equipment.

19.2.2 NHIDCL reserves the right to depute representative for inspection of material / equipment and witness the test at contractor's / supplier's works and the firm shall be required to perform the following tests in addition to the routine test in the presence of NHIDCL's representative. The proforma for the routine test of Heat Pumps shall be supplied by the Principal Contractor in advance to NHIDCL. At least one-month' notice shall be given by the contractor to NHIDCL for fixing up inspection and factory test.

(a) Determination of COP value and IPLV for one of the Heat Pump package Unit other than the above as per the Test Standard ARI 550/590-1998 as specified by the Energy Conservation Building Code 2007.

However, Test Certificates for the above test for all the Units shall be furnished.

19.2.3 The contractor shall operate, test and adjust all Radient Heating System units, fans, motors, all appliances provided in connection with this installation A detailed record of the hot water flow in all outlets after adjustments shall be furnished by the contractor for approval of Engineer-in-Charge.

19.2.4 Following tests at site shall be conducted for the Radiant Heating System, after the physical completion of work.

a) **Trial Run**

After Physical installation of system and all adjustments including balancing of hot water circuits is completed , the plant shall be subjected to trial run. The trial run is to be conducted for a period of 7 days subject to minimum running of 120 hours in the presence of representative of the NHIDCL. During this test, performance of all the equipment and control systems shall be checked. Inside conditions shall also be recorded in this trial run. A record of this test shall be submitted to the Engineer-in-Charge who shall arrange for initial acceptance testing thereafter. A list of all defects and discrepancies noted, shall be prepared during the test.

b) Initial Acceptance Testing

After completion of trial run the plant shall be subjected to Initial Acceptance Testing as per standards of the NHIDCL. This testing shall be conducted jointly by the representative of the Engineer-in-Charge, Emplyer. A list of all defects and discrepancies shall beprepared during the test.

c) Final Performance Cum Seasonal Test

This test shall be conducted jointly by the representative of the Engineer-in-Charge, Employer's representative as per standards. However, this test shall be conducted only when the plant is free from all defects / discrepancies pointed out during trial run & initial A.T. The test shall be conducted between 1st December to 31st January.

19.2.5 Wherever relaxations are required, the same shall be conveyed by the Engineer-in-Charge after getting approval from competent authority well before the final performance cum seasonal test.

19.2.6 The contractor shall supply all test equipments, Operating personnel, oil and refrigerant, etc., as required for testing.

19.3 Completion of Work of Radiant Heating System

The work shall be deemed to have been completed after

a) Successful completion of the initial acceptance testing as per the NHIDCL's standards in the presence of representative of Employer.

The above date shall be the date of completion of Work only for the purpose of settlement of bills / payments. However the guarantee period shall start from the actual date of completion of overall project. The Security Deposit shall be released after the successful completion of DLP.

19.4 Completion Drawings

19.4.1 The contractor on completion of the work shall submit five sets of following drawings.

a. Plant installation drawings giving complete details of the entire equipment including foundations.
b. Electrical drawings showing cable sizes, equipment capacity, control components and control wiring.
c. Controls diagram giving detailed sequence of operation and notes to explain the operation of the control circuit.
d. Piping drawings showing all pipe sizes, valves and fittings.
e. Completion drawings for Mechanical Ventilation of Basement floor plant room.

f. Diagram showing the details of Heat Pumps system manager.

19.4.2 Three sets of service manuals in respect of Radient Heating System mentioning salient features of the plant.

19.5 Training of Employer's Personnel

The contractor shall arrange to impart the training to the Personnel on the following aspects prior to handing over of the plant:

19.5.1 Operation of plant.
19.5.2 Charging and pumping down of the system.
19.5.3 Adjustments of settings for controls and protective devices.
19.5.4 Preventive maintenance.
19.5.5 Identification & replacement of worn out parts.

SPECIAL CONDITIONS OF CONTRACT FOR FIRE FIGHTING SYSTEM

20.1 TEST CERTIFICATES:

The Contractor shall submit following test certificates on supply of the material at site.

20.1.1 Manufacturer's test certificates for Pumps, Motors Engine &Control panel.
20.1.2 Air Valves etc.
20.1.3 Sprinklers.
20.1.4 Hose reel, sluice valve, Hosepipe, Non return valve etc.
20.1.5 Fire Extinguishers,
20.1.6 NHIDCL reserves the right to call for inspection of original documents for purchase of any material for verification of Genuineness of the product.

After successful testing of installation, the system shall be offered for inspection/testing by the Fire Officer. It is the responsibility of the contractor to get the installation inspected and passed by Fire Officer as may be required, including payment of necessary inspection fee etc., The Contractor shall be responsible for carrying out modification / rectification as may be required by NHIDCL representative / Fire Officer.

20.2 DATE OF COMPLETION OF FIR-FIGHTING WORK:

20.2.1 Date of successful test and clearance by Fire officer shall be taken as completion date of the fire-fighting work.

20.2.2 The above date shall be the date of completion of Work only for the purpose of settlement of bills / payments. However the guarantee period shall start from the actual date of completion of overall project. The Security Deposit shall be released after the successful completion of guarantee period.

20.3 COMPLETION DRAWINGS:

The firm shall supply five sets of drawings/documents after completion of the work as detailed below.

20.3.1 Installation drawing giving complete details of the entire equipment's i/c foundation.
20.3.2 General Arrangement drawing giving details of switch gear capacity, instrument panel, control wiring etc.
20.3.3 Line diagram of control panel.
20.3.4 Layout of risers, and sprinklers, hydrant, panels, cables hooters etc.
20.3.5 Schematic control wiring diagram giving detailed sequence of operation.
20.3.6 Service manuals of the fire fighting system and salient features of the system.

20.4 TRAINING OF Employer's PERSONNEL:

The Contractor shall arrange training to Employer's staff on following aspects before handing over of the system:

20.4.1 Operation of the system

20.4.2 Adjustment and setting of controls and protective devices
20.4.3 Preventive maintenance
20.4.4 Trouble shooting

SPECIAL CONDITIONS OF CONTRACT FOR LIFT

21.1 DRAWINGS TO BE SUBMITTED FOR APPROVAL:

The following shop drawing shall be submitted by the contractor within a period of 30 days from the date of award of work.

21.1.1 General arrangement including lift well, machine room,if any, and landing entrances.
21.1.2 Control wiring/ power wiring diagram with all technical details
21.1.3 Details of foundation for equipment, load data, location, etc

21.2 TEST CERTIFICATE

Manufacturers' test certificates for lift motors, ropes and ARD etc. shall be produced by the firm at the time of supply.

21.3 INSPECTION & LICENSING

21.3.1 The contractor shall make arrangements to get the third party inspection by approved agency of NHIDCL at factory before dispatch of materials and for final inspection at site after completion of work. Nothing extra shall be paid to the contractor for the same.

21.3.2 Before subjecting the installation to statutory inspection, all test regarding safety shall be performed to the satisfaction of the Engineer – in – Charge

21.3.3 The contractor shall make arrangements to get the lift inspected by the Lift inspector or any competent authority of local Government and for issue of permission to install and license to operate the lift as per the provisions. Nothing extra, except fees for the first statutory inspection/license of the lift installation if any, will be payable by NHIDCL.

21.3.4 If the equipment is rejected in the first statutory inspection by the inspector and if a second payment becomes necessary that will be the responsibility of the contractor. This is applicable for third party inspection also.

21.4 COMPLETION OF WORK OF LIFT

21.4.1 The date of completion for Lift shall be reckoned as the date of successful inspection of the lift by the Lift Inspector of Local Government.

21.4.2 The above date shall be the date of completion of Work only for the purpose of settlement of bills / payments. However the guarantee period shall start from the actual date of completion of overall project. The Security Deposit shall be released after the successful completion of DLP.

21.5 COMPLETION DRAWING:

The Contractor shall supply five sets of drawings/documents after completion of the work as detailed below:

21.5.1 General arrangement including lift well, machine room and landing entrances.
21.5.2 Control wiring/ power wiring diagram with all technical details
21.5.3 Details of foundation for equipment, load data, location, etc
21.5.4 Operation and maintenance manual and maintenance schedules.

SPECIAL CONDITIONS OF CONTRACT FOR TRANSFORMER

22.1 DRAWING TO BE SUBMITTED FOR APPROVAL:

The following shop drawings shall be submitted by the contractor within a period of 30 days from the date of award of work.

22.1.1 Layout plan of equipment in transformer yeard with
22.1.2 clearances.
22.1.3 General arrangement drawing for all equipment.
22.1.4 Schematic diagram of transformer equipment.
22.1.5 Control wiring diagram.
22.1.6 H.T cable routing along with location of RMG and H.T panels.
22.1.7 Layout of earthing.

22.2 TEST CERTIFICATE:

The Contractor shall submit following test certificates on supply of the materials at site.

22.2.1 Manufacturer's test certificates for Transformers, HT & LT panels and HT cable.
22.2.2 A certificate that the LT panel has undergone 7 tank process shall be submitted.
22.2.3 Air circuit breaker and other switchgears.
22.2.4 Relays, capacitors and bus trunking.
22.2.5 CPRI test certificate for MPCC (similar panel/design).

22.3 INSPECTION AND TESTING:.

22.3.1 NHIDCL reserves the right to carry out inspection and testing at Manufacturer's works for any equipment / item prescribed in this contract at no extra payment to the Contractor.
22.3.2 All necessary pre-commissioning tests for the equipment installed by the firm in the substation including protective devices and switchgears shall be conducted before offering the transformer for inspection by authorized electrical inspector.
22.3.3 The transformer shall be commissioned only after successful clearance by electrical inspector.

22.4 DATE OF COMPLETION OF TRANSFORMER: -

22.4.1 The date of completion of transformer shall be the date on which the installation is cleared by the Electrical inspector.

22.4.2 The above date shall be the date of completion of work only for the purpose of settlement of bills / payments. However the guarantee period shall start from the actual date of completion of overall project. The Security Deposit shall be released after the successful completion of DLP.

22.5 COMPLETION DRAWINGS: -

The firm shall supply five sets of completion drawings/documents after completion of the work as detailed below.

22.5.1 Layout plan of equipment in transformer with clearances.
22.5.2 General arrangement drawing for all equipment.
22.5.3 Schematic diagram of transformer equipment.
22.5.4 Control wiring diagram.
22.5.5 Operation and maintenance manuals for all equipment.
22.5.6 Layout of earthing

SPECIAL CONDITIONS OF CONTRACT FOR ENGINE ALTERNATOR (EA) SET

23.1 General

The special conditions shall be read in conjunction with general conditions of contract and amendments / corrections thereto, Special Conditions of Contract. If there are any provisions in these special conditions, which are at variance with the provision in the above-mentioned documents, the provisions in these special conditions shall take precedence.

23.2 DRAWING TO BE SUBMITTED FOR APPROVAL:

The following drawings shall be submitted by the contractor within a period of 30 days from the date of award of work.

23.2.1 All general arrangement shop drawing with clearances for EA sets including acoustic enclosure, scrubber, earthing entry points etc.

23.2.2 Details of foundation for equipment, load data etc., of various assembled equipment, acoustic enclosure , chimney, fuel tanks, scrubber etc.

23.2.3 Control wiring diagram including sequence of operation of control circuits and auto synchronising control panel.

23.2.4 Schematic diagram for EA set panel, auto synchronising control panel., bus trunking, indicating the size of busbar, switchgears, circuit breakers, metering and protection equipment, size of cabling etc.

23.2.5 Single line diagram showing the fuel supply and return arrangements including arrangement of fuel tanks i.e., reserve and day tank.

23.3 TEST CERTIFICATES

The Contractor shall submit following test certificates on supply of the materials at site.

23.3.1 Manufacturer's test certificates for Engine, Alternator, Bus trunking ACBs, Synchronising Panel and Scrubber.

23.3.2 NHIDCL reserves the right to test any one of the unit at factory, as per the technical specifications without any extra payment, before dispatch of EA set from factory to site.

23.4 TESTING AT SITE

23.4.1 4.1 The contractor shall submit the test proforma, and approval of the format shall be obtained from NHIDCL. Contractor shall submit the test result as per approved format, for all DG sets to NHIDCL.

23.4.2 4.2 The load test is to be done in the presence of NHIDCL representative as detailed below :

a) Initial testing for half an hour at no load, two hours at full load and half an hour at10% over load shall be carried out.

b) Final Acceptance Testing in presence of representative of NHIDCL as per A/T standards.

23.4.3 The contractor shall arrange, without any extra cost to NHIDCL, all necessary testing equipment, instruments, materials, accessories, and the required labour.

23.4.4 Artificial load(s) and fuel for testing shall be supplied by the firm without any extra cost.

23.4.5 The Contractor shall ensure that each set along with acoustic enclosure shall be as perCPCB norms.

23.5 DATE OF COMPLETION OF EA: -

23.5.1 Date of successful final A/T Testing shall be taken as completion date of work of EA. Bill shall be finalized only after successful final A/T.

23.5.2 The above date shall be the date of completion of work only for the purpose of settlement of bills / payments. However the guarantee period shall start from the actual date of completion of overall project. The Security Deposit shall be released after the successful completion of DLP.

23.6 COMPLETION DRAWINGS: -

The firm shall supply five sets of drawings/documents after completion of the work as detailed below:

23.6.1 All general arrangement shop drawing with clearances for EA sets including acoustic enclosure, scrubber, earthing entry points etc.
23.6.2 Details of foundation of various assembled equipment, acoustic enclosure, chimney, fuel tanks, scrubber etc.
23.6.3 Control wiring diagram including sequence of operation of control circuits including auto synchronizing control panel.
23.6.4 Schematic diagram for EA set panel, auto synchronizing control panel., bus trunking indicating the size of busbar, switchgears, circuit breakers, metering and protection equipment, size of cabling etc.
23.6.5 Operation and maintenance manual.
23.6.6 Layout of earthing.
23.6.7 Single line diagram showing the fuel supply and return arrangements including arrangement of fuel tanks i.e., reserve and day tank.

SECTION-XII

PARTICULAR SPECIFICATIONS

PHE(PLUMBING WORKS)

SECTION I: GENERAL INSTRUCTIONS

1.0 GENERAL REQUIREMENTS

1.1 Scope of Work

1.1.1 The following clauses shall be considered as an extension and not in limitation of the obligation of the Contractor.

1.1.2 Work under this contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the Plumbing and other specialized services as described hereinafter and as specified in the Schedule of Quantities and/or shown on the Plumbing Tender Drawings.

1.1.3 Without restricting to the generally of the foregoing, the sanitary installations shall include the following:-

A. Plumbing Works

i) Sanitary Fixtures
ii) Soil, Waste & Vent and Rain Water Pipes and fittings.
iii) Water Supply System (Cold & Hot).
iv) Sewerage & Storm water drainage system
v) Pumping system & water Treatment Plant
vi) Solar hot water with heat pump backup system

1.1.4 Services rendered under this section shall be done without any extra charge.

1.2 Specifications

1.2.1 Work under this contract shall be carried out strictly in accordance with Technical Specifications specified in the tender.

1.2.2 Items not covered under these Specifications due to any ambiguity or misprints, or additional works, the work shall be carried out as per Technical Specifications of latest Central Public Works Department with upto date amendments as applicable in the contract and or as per the requirement of the NHIDCL or its representative.

1.2.3 Works not covered above in para 1.2.1 and 1.2.2 shall be carried out as per relevant Indian Standards and in case of its absence as per British Standard Code of Practice.

1.3. Execution of Work

1.3.1 The Bidder should the visit and examine the site of work and satisfy himself as to the nature of the existing roads and other means of communication and other details pertaining to the work and local conditions and facilities for obtaining his own information on all matters affecting the execution of work. No extra charge made in consequence of any misunderstanding, incorrect information on any of these points or on ground of insufficient description will be allowed.

1.3.2 The work shall be carried out in conformity with the Plumbing drawings and within the requirements of Architectural, HVAC, Electrical, Structural and Other specialized services drawings.

1.3.3 The Contractor shall cooperate with all trades and agencies working on the site. He shall make provision for hangers, sleeves, structural openings and other requirements well in advance to prevent hold up of progress of the construction schedule.

1.3.4 On award of the work, Contractor shall submit a schedule of construction in the form of a PERT Chart or BAR Chart for approval of the NHIDCL. All dates and time schedule agreed upon should be strictly adhered to, within the stipulated time of completion/commissioning along with the specified phasing, if any.

1.4 Drawings

1.4.1 Plumbing drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the Architectural and other services drawings.

1.4.2 Architectural drawings shall take precedence over Plumbing or other services drawings as to all dimensions.

1.4.3 Contractor shall verify all dimensions at site and bring to the notice of the Engineer-in-Charge all discrepancies or deviations noticed. Decision of the Engineer-in-Charge shall be final.

1.4.4 Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small scale drawings.

1.4.5 All approved drawings for the work are the property of the NHIDCL and Contractor shall not be lent, reproduced or used on any works other than intended without the written permission of the NHIDCL.

1.5 Inspection and Testing of Materials

1.5.1 Contractor shall be required, if requested, to produce manufacturers Test Certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Indian Standards.

1.5.2 For examination and testing of materials and works at the site Contractor shall provide all Testing and Gauging Equipment necessary but not limited to the followings:-

a) Theodolite, Steel tapes
b) Dumpy level
c) Weighing machine
d) Plumb bobs, Spirit levels, Hammers
e) Micrometers, Tachometers
f) Thermometers, Stoves
g) Hydraulic test machine
h) Smoke test machine

1.5.3 All such equipment shall be tested for calibration at any approved laboratory, if required by the Engineer-in-Charge.

1.5.4 All Testing Equipment shall be preferably located in a special room meant for the purpose.

1.5.5 Samples of all materials shall be got approved before placing order and the approved samples shall be kept at site in the sample room at site. Any materials declared defective by Engineer-in-Charge shall be removed from the site within 48 hours.

1.6 Metric Conversion

1.6.1 All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.

1.6.2 Any weights, or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost.

1.7 Reference Points

1.7.1 Contractor shall provide permanent Bench Marks, Flag Tops and other reference points for the proper execution of work and these shall be preserved till the end of the work.

1.7.2 All such reference points shall be in relation to the levels and locations given in the Architectural and Plumbing drawings.

1.8 Reference Drawings

1.8.1 The Contractor shall maintain one set of all approved drawings issued to him as reference drawings. These shall not be used on site. All important drawings shall be mounted on boards and placed in racks indexed. No drawings shall be rolled.

1.8.2 All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion drawings. All changes to be made shall be initialed by the Engineer-in-Charge.

1.9 Shop Drawings

1.9.1 The Contractor shall submit to the Engineer-in-Charge three copies of the shop drawings.

1.9.2 Shop drawings shall be submitted under following conditions:-

(a) Showing any changes in layout in the plumbing drawings.

(b) Equipment layout, piping and wiring diagram.

(c) Manufacturer’s or Contractor’s fabrication drawings for any materials or equipment supplied by him.

1.9.3 The Contractor shall submit two copies of catalogues, manufacturer’s drawings, equipment characteristics data or performance charts as required by the Project Manager.

1.10 **Completion Drawings**

1.10.1 On completion of work, Contractor shall submit one complete set of original tracings and two prints of "as built" drawings to the Engineer-in-Charge. These drawings shall have the following information.

a) Run of all piping, diameters on all floors, vertical stacks and location of external services.

b) Ground and invert levels of all drainage pipes together with location of all manholes and connections upto outfall.

c) Run of all water supply lines with diameters, locations of control valves, access panels.

d) Location of all mechanical equipment with layout and piping connections.

No completion certificate shall be issued unless the above drawings are submitted.

1.10.2 Contractor shall provide two sets of catalogues, service manuals manufacturer's drawings, performance data and list of spare parts together with the name and address of the manufacturer for all electrical and mechanical equipment provided by him.

1.10.3 All "Warranty Cards" given by the manufacturers shall be handed over to the Project Manager.

1.11. **Contractors Rates**

1.11.1 Rates quoted in this tender shall be inclusive of cost of materials, labour, supervision, erection, tools, plant, scaffolding, service connections, transport to site, taxes, octroi and levies, breakage, wastage and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition.

1.11.2 Rates quoted are for all heights and depths and in all positions as may be required for this work.

1.11.3 All rates quoted must be for complete items inclusive of all such accessories, Fixtures and fixing arrangements, nuts, bolts, hangers as are a standard part of the particular item except where specially mentioned otherwise.

1.11.4 All rates quoted are inclusive of cutting holes and chases in walls and floors and making good the same with cement mortar/concrete/water proofing of appropriate mix and strength as directed by Engineer-in-Charge. Contractor shall provide holes, sleeves and recesses in the concrete and masonry work as the work proceeds.

1.12 **Testing**

1.12.1 Piping and drainage works shall be tested as specified under the relevant clause(s) of the specifications.

1.12.2 Tests shall be performed in the presence of the Engineer-in-Charge.

1.12.3 All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.

1.12.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet Municipal or other bye-laws in force.

1.12.5 Contractor shall provide all labour, equipment and materials for the performance of the tests.

1.13 Site Clearance and Clean-up

1.13.1 The Contractor shall, from time to time clear away all debris and excess materials accumulated at the site.

1.13.2 After the Fixtures, equipment and appliances have been installed and commissioned, Contractor shall clean-up the same and remove all plaster, paints stains, stickers and other foreign matter of discoloration leaving the same in a ready to use condition.

1.13.3 On completion of all works, Contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done at Contractors risk and cost.

1.14 License Permits and Authorities

1.14.1 Contractor must keep constant liaison with the Municipal/statutory authority and obtain all approval of all drainage, water supply and other works carried out by him.

1.14.2 Contractor shall obtain, from the Municipal and other authority's necessary completion certificate(s) with respect to his work as required for occupation of the building. Contractor shall obtain permanent water supply and drainage connections from authorities concerned. NHIDCL/Employer shall pay all fees/deposits as required to be paid to the authorities towards connection charges.

1.15 Cutting of Water Proofing Membrane

No walls, terraces shall be cut for making and opening after water proofing has been done without written approval of Engineer-in-Charge. Cutting of water proofing membrane shall be done very carefully to ensure that other portion(s) of water proofing is (are) not damaged. On completion of work at such place the water proofing membrane shall be made good and ensured that the opening/cutting is made fully water proof as per specifications and details of water proofing approved by Engineer-in-Charge.

1.16 Cutting of Structural Members

No structural member shall be chased or cut without the written permission of the Engineer-in-Charge.

1.17 Materials

1.19.1 Unless otherwise specified and expressly approved in writing by the Engineer-in-Charge, only materials of makes and specifications mentioned in the list of approved makes attached with the Tender shall be used.

1.19.2 If required, the Contractor shall submit samples of materials proposed to be used in the works. Approved samples shall be kept in the office of the Engineer-in-Charge and returned to the Contractor at the appropriate time.

SECTION II: SANITARY FIXTURES

Soils, Waste, Vent Pipes & Fittings

1 Scope of work

1.1 Work under this section shall consist of furnishing all labour, materials, equipments and appliances necessary and required to completely install all soil, waste, vent and rain water pipes and fittings as required by the drawings and as given in the Schedule of Quantities.

1.2 Without restricting to the generality of the foregoing, the work shall include the following:-

a) Vertical and horizontal soil, waste, vent, and fittings, joints, clamps and connections to fixtures.
b) Soil & waste pipes to external sewers line.
c) Connection of all pipes to sewer lines as shown on the drawings at the ground floor.
d) Floor and urinal traps, cleanout plugs, inlet fittings.
e) Testing of all pipe lines.

2 General requirements

2.1 All materials shall be new and best quality conforming to Latest IS Code and specifications and subject to the approval of the Project Manager /Architect.

2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

2.4 Pipes shall be securely fixed to walls and ceilings by suitable clamps an interval specified.

2.5 Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

3 Piping System

3.1 Soil, Waste & Vent Pipes

a) The Soil & Waste pipe system above ground has been planned as a "two pipe system" as defined in IS: 5329, having separate pipes for waste from kitchen sinks, bath tubs, showers, washbasins, AHU's

condensate drains and floor drains and is approved by the local authority. Waste stacks have been provided with a "P" trap at basement ceiling.

b) Vertical soil & waste stacks shall be connected to a common horizontal drain pipe at basement floor ceiling as shown on the drawings.

c) All Floors of toilets, kitchens and other service areas located on structural slab are SUNK by 300 mm to accommodate all soil & waste pipes.

d) All soil and waste from areas below general ground level will be collected in sumps and pumped into sewer lines.

e) Anti-siphonage pipe (ASP) shall be provided for soil fittings on vertical stacks. It may also be provided for waste lines where shown on the drawings.

3.4.1 Soil & Waste Pipes

3.4.2 All pipes shall be straight and smooth and inside free from cracks and other manufacturing defects. Pipes shall be noise insulated **Polypropylene piping** system as per DIN EN 12056 and DIN1986-100 with 3 layer pipe made of External layer -PP, middle layer-Mineral reinforced PP, Internal layer-PP. push-fit type, food safe, having high impact and stiffness, offering sound levels of not more than 10 dBA as per DIN 4109 at a flow rate of 2 l/s and having pipe ring stiffness as per 1S0/DIS 9969 and tightness as per EN 1277/B and C and DIN 19560, density of pipe = 1.9 g/cm3, elongation break 50% and tensile strength 20 N/mm2,Coefficient of linear expansion 0.09 mm/mK.

3.5. Fittings

3.5.1 Fittings shall conform to the Indian Standard recommended for the pipes. Pipes and fittings must be of matching as per manufacturer specification. Interchange of pipes of one standard with fittings on the other standard will not be permitted.

3.5.2 Fittings shall be of the required degree of curvature with or without access door.

3.5.3 Connection from a vertical stack or position to a horizontal line shall be made only by a "Y" junction.

3.6 Fixing

3.6.1 All vertical pipes shall be fixed truly vertical to walls with approved type of GI clamp. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard). However shaft where more vertical pipes run, the pipes may be fixed to the slotted angle/channel supports fixed to walls at intervals specified here under:-

3.6.2 Horizontal pipes running on the floor shall be covered with cement concrete grade M-10, 75mm thick in bed and 75mm thick all around soil and waste pipes under floor

3.6.3 Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the Project Manager/Building Contractor for making such provisions in the structure as necessary. All damages shall be made good to restore the surfaces at no extra cost.

4.0 Clamps

4.1 Holder bat clamps shall be of standard design and fabricated from **galvanized MS standard flats** 40x3 mm thick and 12 mm dia MS rod and 6 mm nuts and bolts. Holder bat clamps shall be fixed in cement concrete 1: 2 : 4 mix blocks 10x10x10 cms deep.

4.2 Where holder bat clamps are to be fixed in RCC column or slotted angles, walls or beam they shall be fixed with **galvanized** 40x3 mm flat iron "U" type clamps with anchor fasteners of approved design or 6 mm nuts and bolts.

4.3 For SWR pipes conforming to IS: 13592 shall be clamped to wall with approved type of uPVC saddle clamp/U-clamp or as given in the Bill of quantities.

4.4 Structural clamps shall be fabricated by electro-welding from MS structural members e.g. rods, angles, channels flats as per detailed drawing. Contractor shall provide all nuts & bolts, welding material. All fabricated clamps, nuts, bolts and washers shall be not dipped galvanized.

4.5 Galvanized slotted angle/channel supports on walls shall be provided wherever shown on drawings. Angles/channels shall be of sizes shown on drawings or specified in schedule of quantities. Angles/channels shall be fixed to brick walls with bolts embedded in cement concrete blocks and to RCC walls with suitable anchor fasteners. The spacing of support bolts horizontally shall not exceed 1 m.

4.6 Wherever MS clamps are required to be anchored directly to brick walls, concrete slabs, beams or columns, nothing extra shall be payable for clamping arrangement and making good with cement concrete 1 : 2 : 4 mix (1 cement : 2 coarse sand : 4 mm stone aggregate 20 mm nominal size) as directed by the Project Manager.

4.7 For sleeves, anchor fasteners and clamp spacing chart shall be as follows:

MARKINGS:
All pipes shall carry the following markings: Time and date of manufacture; company name; dimension, application class,barcode and material details.

FITTINGS:
Single- Layered fitting in PP, a reinforced wall and factory fitted lip ring, hot water resistant upto 95 degree c in accordance to EN 1451-PART 1-6EN 12056 PART 1-5.

INSTALLATION: The piping system must be clamped properly as required, pipes passing through walls, beams, slabs, columns should pass through sleeves which are padded with insulation material internally (between pipe and sleeve) covering the pipe to avoid transfer of body and structural borne sounds (refer manufacturer's installation guide lines). The piping must not touch any wall, structure, paneling, false ceiling etc.

5.0 Traps

5.1 Floor traps

Floor traps shall be siphon type full bore P or S type cast iron having a minimum 50 mm deep seal. The trap and waste pipes in sunken area (where required) shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1 : 2 : 4 mix (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size) and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30x30 cms of the required depth.

5.2 Floor trap inlet

Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type inlet fitting fabricated from uPVC pipe without, with one, two or three inlet sockets fixed on side to connect the waste pipe. Joint between waste and hopper inlet socket of the trap shall be joined with solvent cement recommended by the manufacturer. Inlet shall be connected to an uPVC. P or S trap. Floor trap inlet hoppers and the traps if set in cement concrete blocks as specified in para above without extra charge. UPVC multi-inlet trap can be used where ever possible to be decided by the project Engineer.

Trap & Seals

All traps shall be self cleaning design and the seal depth shall be as specified below wherever the traps are not integral with the appliances:

Appliance or ware	Material	Trap Type	Seal depth(mm)
Lavatory /wash basin	C.P. cast brass	32 mm dia Bottle	75 mm
Sink	C.P. cast brass	40 mm dia Bottle	75 mm
Kitchen floor drain of fabricated drain boxes	uPVC/C.I.	75/100 mm dia 'P' or 'S'	50 mm
Urinals	uPVC/C.I.	100 mm dia 'P' or 'S'	50 mm

5.3 Floor Gratings

Floor and urinal traps shall be provided with 100-150mm square or round CP/stainless steel grating, with rim of approved design and shape. Minimum thickness shall be 4 mm or as specified in the Schedule of Quantities

5.4 Jointing

Pipe to pipe and pipe to fitting (SWR) joint shall be with 'O' rubber ring as recommended by the manufacturer. Jointing with solvent cement shall be applied to uPVC waste pipes (confirming to I.S. 4985) and fittings or as recommended by the manufacturer's.

6 Cleanout Plugs

6.1 PP Clean out pipe for Soil, Waste pipes laid under floors shall be provided near pipe junctions bends, tees, "Ys" and on straight runs at such intervals as required as per site conditions. Cleanout pipe shall terminate flush with the floor levels.

6.2 Cleanout on Drainage Pipes

a) Cleanout pipe shall be provided on starting point of each drain and in between at locations indicated on plans or directed by the Project Manager. Cleanout pipe shall be of size matching the full bore of the pipe but not exceeding 160 mm OD.

b) Cleanouts at ceiling level pipe shall be provided with a bend terminating at floor level above. The cap of the cleanout pipe shall have a cap flush with floor.

7.0 Waste pipe from appliances

7.1 General

a) Waste pipe from appliances e.g. wash basins, sinks and urinals shall be of noise insulated Polypropylene piping system as per DIN EN 12056 and DIN1986-100 with 3 layer pipe made of External layer -PP, middle layer-Mineral reinforced PP, Internal layer-PP. push-fit type, food safe, having high impact and stiffness, offering sound levels of not more than 10 dBA as per DIN 4109 at a flow rate of 2 l/s and having pipe ring stiffness as per 1S0/DIS 9969 and tightness as per EN 1277/B and C and DIN 19560, density of pipe = 1.9 g/cm3, elongation break 50% and tensile strength 20 N/mm2,Coefficient of linear expansion 0.09 mm/mK PP pipe 40, 50 mm OD as given in the Schedule of Quantities.

b) All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings. Where required pipes may be run at ceiling level in suitable gradient and supported on galvanized structural clamps. Spacing for clamps for such pipes shall be as per the pipe spacing chart given in section 1.

8.0 Encasing pipe in Cement Concrete

uPVC soil and waste pipes and drainage under floor in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1 : 2 : 4 mix (1 cement : 2 coarse sand : 4 stone aggregate 12 mm size) 75 mm in bed and all-round. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height at intervals of one meter. Rate for concreted round pipes shall be inclusive of pillars, supports, shuttering and centering.

9.0 Cutting and making good

9.1 Contractor's rate shall include for providing all necessary holes, sleeves, cut outs and chases in structural members as building work proceeds. Wherever holes are cut or left originally, they shall be made good with cement concrete 1 : 2 : 4 (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size) or cement mortar 1 : 2 (1 cement : 2 coarse sand) and the surface restored as in original condition.

10.0 Testing

10.1 Testing procedure specified below apply to all soil, waste and vent pipes above ground including pipes laid along basement ceiling.

10.2 Entire drainage system shall be tested for water tightness during and after completion of the installation. No portion of the system shall remain untested. Contractor must have adequate number of expandable rubber/bellow plugs, manometers, smoke testing machines, pipe and fitting work test benches and any other equipment necessary and required to conduct the tests. All testing equipment/motors etc. shall be certified for its calibration by an approved laboratory.

10.3 All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site.

10.4 Testing soil, waste and rainwater pipes

a) Apart from factory test all pipes and fittings shall be hydraulically tested for a head of 3 m preferably on a specially set up work bench. After applying pressure, strike the pipe with a wooden pallet and

inspect for blow holes and cracks. Pressure may be applied for about 2 minutes. Reject and remove all defective pipes.

b) After installation all connections from fixtures, vertical stacks and horizontal drains including pipes along ceiling shall be tested to a hydraulic pressure not exceeding 3 m. Such tests shall be conducted for each floor separately by suitable plugs.

c) After the installation is fully complete, it should be tested by flushing the toilets, running at least 20% of all taps simultaneously and ensuring that the entire system is self draining, has no leakages, blockages etc. Rectify and replace where required.

10.5 Contractor shall maintain a test register identifying date and time of each area. All tests shall be conducted in presence of Project Manager and signed by both.

11 Measurements

11.1 General

a) Rates for all items quoted shall be inclusive of all work and items given in the specifications and Schedule of Quantities.

b) Rates are applicable for the work in basements, under floors, in shafts at ceiling level area for all heights and depths.

c) Rates are inclusive of cutting holes and chase in RCC and masonry work and making good the same.

d) Rates are inclusive of pre testing, on site testing, of the installations, materials and commissioning of the works.

e) Pipes (unit of measurement. Linear meter to the nearest centimeter)

11.2 Pipes shall measured per running meter correct to a centimeter for the finished work which shall include fittings e.g. bends, tees, crosses, etc. The length shall be taken along centre line of the pipes and fittings. All pipes and fittings shall be classified according to their diameter, method of jointing and fixing substance, quality, and finish. The diameters shall be nominal outer diameter.

11.3 Cement concrete around pipes shall be measured along the center of the pipe line measured per linear meter and include any masonry supports, shuttering and centering cutting complete as described in the relevant specifications.

11.4 Slotted angles/channels shall be measured per linear meter of finished length and shall include support bolts, nuts and clamps embedded in masonry walls with cement concrete blocks and nothing extra will be paid for making good the same.

11.5 Fittings

Unit of measurement shall be the number of pieces. Pipe fittings are included in the rate for pipes. Urinal traps, trap gratings, hoppers, cleanout plugs shall be measured by number per piece and shall include all items described in the relevant specifications and Schedule of Quantities.

11.6 Excavation for soil pipes

No payment shall be admissible with respect to excavation, refilling and disposal of surplus earth for soil and waste pipes laid below ground, in sunken slabs or over basement rafts.

11.7 Project Manager's decision with respect to the correct interpretation regarding mode of measurement shall be final and binding on the contractor.

End of Section III

Soil, Waste Pipes & Fittings

SECTION IV: WATER SUPPLY SYSTEM

4. WATER SUPPLY SYSTEM

4.1 Scope of Work

4.1.1 Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the Schedule of Quantities.

4.1.2 Without restricting to the generality of the foregoing, the water supply system shall include the following:-

a) Distribution system from main supply headers to all fixtures and appliances for cold/hot water.
b) Cold water supply lines from tube-wells to underground water tanks.
c) Bore-well connections to U.G. water tanks.
d) Garden irrigation system if any
e) Excavation and refilling of pipes trenches.
f) Insulation to hot & cold water pipes.
g) To all the flushing in WC and Urinal should be done by the cold water supply by hydropenumatic system and all the domestic water required for wash basin, shower, and kitchen should be done by the hot water supply.

h) All the concealed by should be insulated by rubber nitrile insulation and all the exposed to wall pipe in the terrace and shaft by the aluminium cladding insulation with rockwool.
i) Pipe protection and painting.
j) Control valves, masonry chambers and other appurtenances.
k) Connections to all plumbing fixtures, tanks, appliances and Municipal mains

4.2 General Requirements

4.2.1 All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Project Manager.

4.2.2 Pipes and Fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

4.2.3 Short or Long bends shall be used on all main pipe lines as far as possible. Use of Elbows shall be restricted for short connections.

4.2.4 Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

4.2.5 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.

4.2.6 Clamps, hangers and supports on RCC walls, columns and slabs shall be fixed only by means of approved made of expandable metal fasteners inserted by use of power drills.

4.2.7 All pipe clamps, supports, nuts, bolts, washers shall be galvanized MS steel throughout the building. Painted MS clamps & MS nuts, bolts and washers shall not be accepted.

4.2.8 Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

4.3 Water Supply System

4.3.1 Contractor should study the site plan and water supply system diagram for an overview of the system.

4.3.2 Source

Water supply will be acquired from tube-wells within the site and collected in underground water storage tanks.

4.4.1 Pipe Supports

4.4.1.1 All pipes clamps, supports, hangers, rods, pipe supports, nuts and washers shall be factory made galvanized MS steel or alternatively galvanized after fabrication to suit site requirements.

4.4.1.2 PP-R pipes in shafts and other locations shall be supported by galvanized M.S clamps of design approved by pipes in wall chases shall be anchored by G.I hooks, pipes at ceiling level shall be supported on structural clamps fabricated from M.S structural steel. Pipes in typical shafts shall be supported on Galvanised slotted angles/channels as specified elsewhere.

4.4.1.3 Clamps

G.I. pipes in shafts and other locations shall be supported by M.S. clamps of design approved by Project Manager. Pipes in wall chases shall be anchored by iron hooks, Pipes at ceiling level shall be supported on structural clamps fabricated from M.S. structural steel as described above. Pipes in typical shafts shall be supported on slotted angles/channels as specified.

4.5 **Anchor Fasteners**

4.5.1 All pipes supports, hangers and clamps to be fixed on RCC walls, beams, columns, slabs and masonry walls 230mm thick and above by means of galvanised expandable anchor fasteners in drilled holes of correct size and model to carry the weight of pipes. Drilling shall be made only by approved type of power drill as recommend and approved by manufacturer of the anchor fasteners. Failure of any fastening devices shall be the entire responsibility and contractor shall redo or provide additional supports at his own cost. He shall also compensate the owner for any damage that may be caused by such failures.

4.6 **Unions**

Contractor shall provide adequate number of unions on all pipes to enable easy dismantling later when required. Unions shall be provided near each gunmetal valve, stop cock, or check valve and on straight runs as necessary at appropriate locations as required and/or directed by Project Manager.

4.7 **Flanges**

Flanged connections shall be provided on pipes as required or where shown on the drawings, all equipment connections as necessary and required or as directed by connections shall be made by the correct number and size of GI nuts, bolts & washers with 3 mm thick gasket. Where hot water or steam connections are made insertion gasket shall be of suitable high temperature grade and quality approved by Bolt hole dia for flanges shall conform to match the specification for C.I. sluice valve to I.S.780. and C.I. butterfly valve to IS: 3095.

4.8 **PP-R pipes, fittings & valves**

4.8.1 All pipes inside the buildings and where specified, outside the building shall be 3 layer PP-R (Poly propylene Random copolymer) pipes conforming to IS: 15801, UV stabilized and anti-microbial fusion welded, having thermal stability for hot and cold water supply.

4.8.1 **JOINING PIPE & FITTINGS**

a. Cutting
Pipes shall be cut either with a wheel type plastic pipe cutting or hacksaw blade and care shall be taken to make a square cut which provides optimal bonding area within a joint.

b. Deburing/ Beveling
Burrs and fittings should be removed from the outside and inside of pipe with a pocket knife or file otherwise burrs and fittings may prevent proper contact between pipe and fitting during assembly.

c. Fitting Preparation
A clean dry rag/cloth should be used to wipe dirt and moisture on the fitting sockets and tubing end. The tubing should make contact with the socket wall 1/3 or 2/3 of the way into the fitting socket.

d. Assembly

After applying the solvent cement on both pipe and fitting socket, pipes should be insert into the fitting socket within 30 seconds, and rotating the pipe ¼ to ½ turn while inserting so as to ensure even distribution of solvent cement with the joint. The assembled system should be held for 10 seconds (approx) in order to allow the joint to set up.

An even bead of cement should be evident around the joint and if this bead is not continuous, remake the joint to avoid potential leaks.

Set & Cure times:

Solvent cement set & cure times shall be strictly adhered to as per the below mentioned table:

Minimum Core prior to pressure testing at 150 psi

S.no	Ambient Temperature during Core period	Pipe Size	
		½" to 1"	1.1/4" to 2"
1	Above 15 deg C	1 Hr	2 Hrs
2	4 – 15 deg C	2 Hrs	4 Hrs
3	Below 4 deg C	4 Hrs	8 Hrs

e. Once an installation is completed and cored as per above mentioned recommendations, the system should be hydrostatically pressure tested at 150 psi (10 Bar) for minimum 24hrs.During pressure testing the system should be filled with water and if a leak is found, the joint should be cut out and replacing the same with new one by using coupler.

4.8.2 **Transition of PP-R to Metals**

When making a transition connection to metal threads, special brass/plastic transition fitting (Male & Female adopters) should be used. Plastic threaded connection should not be over torque Hard tight pluts one half turn should be adequate.

4.8.3 **Threaded Sealants**

Teflon tapes shall be used to make threaded connection leak proof.

4.8.4 **Hangers & Supports**

For horizontal runs, support should be given at 3 ft (90 cms) intervals for diameter of 1" and below and at 4 ft (1.20 mtr) intervals for larger size.

Hangers should not have throw or sharp edges which come in contact with the tubing and shall be of GI.

Support should be as per the below mentioned table:

S.No	Size of Pipe	21^0C	49^0C	71^0C	82^0C
	Inch	Ft	Ft	Ft	Ft

1	½"	5.5	4.5	3.0	2.5
2	¾"	5.5	5.0	3.0	2.5
3	1"	6.0	5.5	3.5	3.0
4	$1^{1/4}$"	6.5	6.0	3.5	3.5
5	$1^{1/2}$"	7.0	6.0	3.5	3.5
6	2"	7.0	6.5	4.0	3.5

4.8.5 All special fittings and accessories like internally or externally threaded brass adaptors, ball valves, globe valves, unions, diaphragm valves, butterfly valves; etc shall be made of CPVC by licensee.

4.8.7 Concealed Plumbing:
All internal concealed plumbing for hot & cold water supply shall be done with 3-layer PP-R pipe confirming to IS-15801 with all the necessary fittings.

4.10 **Thermal Insulation**

All the concealed water supply pipes in the toilet will be insulated by the rubber nitrile insulation and all the exposed to wall pipe shall be done by the rockwool insulation with aluminium cladding.

- Thermal insulation over domestic water supply pipes in shaft & Terrace in accordance with specifications rockwool 144 Kg / Cu-m density with Al cladding of 24 G. in all joints complete as per manufactuer's specifications.Insulation for Exposed on wall pipe (Terrace & Shaft Pipe)

Dia of pipe	OD after insulation
15 mm	65 mm OD with insulation
20 mm	70 mm OD with insulation
25 mm	75 mm OD with insulation
32 mm	82 mm OD with insulation
40 mm	90 mm OD with insulation
50 mm	100 mm OD with insulation
65 mm	145 mm OD with insulation

Thermal insulation over domestic water supply pipes in concealed work Nitrile rubber insulation of 13 mm thick on cold and hot water pipes complete with outer mechanical protection as per specification. in all joints complete as per manufactuer's specifications.

Dia of pipe	OD after insulation
15 mm	28 mm OD with insulation
20 mm	33 mm OD with insulation
25 mm	38 mm OD with insulation
32 mm	45 mm OD with insulation

4.10 **Trenches**

All water supply pipes below ground shall be laid in trenches with a minimum cover of 60 cms. The width and depth of the trenches shall be as follows

Dia of pipe	Width of Trench	Depth of Trench
15mm to 50mm	30 cms	75cms
65mm to 100mm	45 cms	100 cms

4.11 **Sand filling**

Pipes in trenches shall be protected with fine sand 15 cms all round before filling in the trenches.

Painting

4.10.1 All pipes above ground shall be painted with one coat of red lead and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard color code given in this document or specified by Project Manager.

4.11 **Pipe protection**

4.11.1 All GI pipes in eternal work shall be protected against corrosion by the application of two coats of bitumen paint covered with polythene tape and a final coat of bitumen paint.

4.11.2 G.I. water supply pipes, if buried in ground or sunken slab, shall be protected with multi layer bitumen membrane tape 3mm thick with a final coat of hot or cold applied bitumen. "Pypkote" or equivalent.

4.12 **Valves**

4.12.1 **Ball Valves**

Valves upto 50 mm dia. shall be screwed type Ball Valves with stainless steel balls spindle teflon seating and gland packing tested to a hydraulic pressure of 16 kg , sq.cm., and accompanying couplings and steel handles.(to BS 5351) protected with thermal insulation.

4.13 **Butterfly Valves – Slim Seal Type**

4.13.1 Valves 65 mm dia and above shall be cast iron butterfly valve to be used for isolation. The valves shall be bubble tight, resilient seated suitable for flow in either direction and seal in both direction with accompanying flanges and steel handle.

4.13.2 Butterfly valve shall be of best quality conforming to IS: 13095.

4.14. **Non Return Valve (Dual Slim Type)**

Where specified, non return valve shall be provided through which flow shall occur in one direction only.

Each Butterfly and Slim Type Swing Check (NRV) Valve shall be provided with a pair of flanges screwed or welded to the main line and having the required number of nuts, bolts and washers of correct length.

4.15. **Storage tanks Overhead Tank. (Accessories & Connections)**

4.15.1 Storage tanks for water supply shall be SS insulated tank in Type-4 accomodation and RCC tank in Staff hostel

SS Tank inner material should be SS 316 and outer should be SS 304 material with inner dia 850 mm and outer dia 1050 mm with PUF insulation for 1000 litre tank.

4.16 Outlets and overflow

All nozzles for puddle flanges in RCC tank for inlet, outlet, overflow and scour etc. shall be provided by civil contractor or as given in the Schedule of Quantities, further connections and accessories shall be provided under this contract.

4.17. Testing

All pipes, fittings and valves, after fixing at site, shall be tested by hydrostatic pressure of 1.5 times the working pressure or 7 kg / sq.cm whichever is more.
Pressure shall be maintained for a period of at least thirty minutes without any drop. A test register shall be maintained and all entries shall be signed and dated by Contractor (s) and Project Manager.

In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes' or failure of fittings, to the building, furniture and fixtures shall be made good by the Contractor during the defects liability period without any cost.

After commissioning of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves, which do not effectively operate, shall be replaced by new ones at no extra cost and the same shall be tested as above.

Hot water pipes chased into the walls shall be provided with a 6mm thick insulation with elastic flexible material having hermetic closed cell structure of expanded synthetic material rated for 60ºC hot water supply.

4.18 Measurement

a) Pipes above ground shall be measured per linear meter (to the nearest cm) and shall be inclusive of all fittings e.g. coupling, tees, bends, elbows, unions, flanges and U clamps with nuts, bolts & washers fixed to wall or other standard supports.

b) Jointing with teflon tape, white lead, solvent, crimping and insertion gasket of appropriate temperature grade.

c) Cutting holes, and chases in walls, floors, any pipe support required for pipes below ground & making good the same.

d) Excavation, backfilling, disposal of surplus earth and restoring the ground & floor in original condition.

4.19 Pipe Supports

Fabricated and / or galvanised supports shall be measured by weight. Weight for each type of clamp shall be calculated on basis of the quantity of structurals and MS used from the theoretical weight calculated on basis of the components theoretical weight of the sections.

4.20.1 Rate quoted for supports & hangers shall be inclusive of :

a) Expandable anchor fastens.

b) Galvanising of all supports & hangers.
c) Cutting holes in walls, ceilings on floors and making good where permitted.
d) Nuts, bolts and washers for fixing and assembling.
e) Wooden / PVC pipe saddles for vertical or horizontal runs.

4.20.2 **Valves**

Gunmetal, cast iron, butterfly and non return valves and puddle flanges shall measured by numbers and shall include wheels I caps, GI nuts, bolts, washers, insertion gasket.

4.20.3 **Painting/pipe protection/insulation**

Painting/pipe protection /insulation for pipes shall be measured per linear meter over finished surface and shall include all valves and fittings for which no deduction shall be made. No extra payment shall be made for fittings, valves or flanges.

END OF SECTION IV

TECHNICAL SPECIFICATIONS FOR

EXTERNAL SEWERAGE WORK

SECTION I

SPECIAL CONDITIONS OF CONTRACT

1.0 **Scope of Work**

1.1 The form of Contract shall be according to the "conditions of Contract". The following clauses shall be considered as an extension and not in limitation of the obligation of the Contractor.

1.2 Work under this Contract shall consist of furnishing all labor, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the plumbing and other specialized services as described hereinafter and as specified in the schedule of quantities and/or shown on the plumbing drawings.

2.0 **Specifications**

2.1 Work under this Contract shall be carried out strictly in accordance with specifications attached with the tender.

2.2 Items not covered under these specifications due to any ambiguity or misprints, or additional work, the work shall be carried out as per specifications of the latest Central Public Works Department with upto date amendments as applicable in the Contract.

2.3 Works not covered under para 2.1 and 2.2 shall be carried out as per relevant Indian Standards and in case of its absence as per British Standard Code of Practice.

3. **Execution of work**

3.1 The Contractor should visit and examine the site of work and satisfy himself as to the nature of the existing roads and other means of communication and other details pertaining to the work and local

conditions and facilities for obtaining his own information on all matters affecting the execution of work. No extra charge made in consequence of any misunderstanding incorrect information on any of these points or on ground of insufficient description will be allowed.

3.2 The work shall be carried out in conformity with the plumbing drawings and within the requirements of architectural, electrical, structural and other specialized services drawings.

3.3 The Contractor shall cooperate with all trades and agencies working on the site. He shall make provision for hangers, sleeves, structural openings and other requirements well in advance to prevent hold up of progress of the construction schedule.

3.4 On award of the work, contractor shall submit a schedule of construction in the form of a pert chart or bar chart for approval of the Consultant/Owner. All dates and time schedule agreed upon should be strictly adhered to, within the stipulated time of completion/ commissioning along with the specified phasing, if any.

3.5 The contractor shall be required to maintain the monthly record of Progress of work as well as the quality of working by taking periodical photographs and submit the same regularly to the Consultant/Owner.

4.0 **Drawings**

4.1 Plumbing drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the architectural and other services drawings.

4.2 Architectural drawings shall take precedence over plumbing or other services drawings as to all dimensions.

4.3 Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small-scale drawings.

5.0 **Inspection and testing of materials**

5.1 Contractor shall be required, if requested, to produce manufacturers test certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Indian Standards.

6.0 **Metric conversion**

6.1 All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.

6.2 Any weights or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost.

7.0 **Reference drawings**

7.2 All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion drawings. All changes to be made shall be initialed by the Consultant/Owner.

8.0 **Shop drawings**

8.1 The Contractor shall submit to the Consultant/Owner four copies of the shop drawings.

8.2 Shop drawings shall be submitted under following conditions:

a. Showing any changes in layout in the plumbing drawings.

b. Layout showing all invert level coordinated with all services dwg.

8.3 The Contractor shall submit four copies of catalogues, manufacturer's drawings, equipment characteristics data or performance chart with the name and address of manufacturer for all electrical and mechanical equipment provided by him after due approval as required by the Consultant/Owner.

9.0 **Completion drawings**

9.1 On completion of work, Contractor shall submit one complete set of original tracings and two prints of "as built" drawings to the Consultant/Owner. These drawings shall have the following information:

a. Run of all piping, diameters of pipes and location of external services.

b. Ground and invert levels of all drainage pipes together with location of all manholes and connections upto outfall.

c. Run of all water supply lines with diameters, locations of control valves access panels.

d. Location of all mechanical equipment with layout and piping connections.

No completion certificate shall be issued unless the above drawings are submitted.

9.2 Contractor shall provide four sets of catalogues, manufacturer's drawings, performance data and list of spare parts together with the name and address of the manufacture for all electrical and mechanical equipment provided by him.

9.3 All "warranty cards" given by the manufacturers shall be handed over to the Consultant/Owner and shall be in the name of the Owner.

10.0 **Contractor's rates**

10.1 Rates quoted in this tender shall be inclusive of cost of materials, labor, supervision, erection, tools, plant, scaffolding, service connections, transport to site, taxes, octroi and levies, breakage, wastage and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition.

10.2 Rates quoted are for all heights and depths and in all positions as may be required for this work.

10.3 All rates quoted must be for complete items inclusive of all such accessories, fixtures and fixing arrangements, nuts, bolts, hangers as are a standard part of the particular item except where specifically mentioned otherwise.

10.4 All rates quoted are inclusive of cutting holes and chases in walls and floors and making good the same with cement mortar/concrete of appropriate mix and strength as directed by Consultant/Owner. Contractor shall provide holes, sleeves, and recesses in the concrete and masonry work as the work proceeds.

10.5 The Contractor shall furnish the Consultant/Owner with vouchers, on request, to prove that the materials are as specified and to indicate that the rates at which the materials are purchased in order to work out the rate analysis of non tendered items which he may be called upon to carry out.

11.0 **Testing**

11.1 Piping and drainage works shall be tested as specified under the relevant clauses of the specifications.

11.2 All Tests shall be performed in presence of the Consultant/Owner.

11.3 All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.

11.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet Municipal or other byelaws in force.

11.5 Contractor shall provide all labor, equipment and materials for the performance of the tests and shall not be paid any extra on that account.

12.0 **Site clearance and cleanup**

12.1 The Contractor shall, from time to time, clear away all debris and excess materials accumulate at the site.

12.2 After the fixtures, equipment and appliances have been installed and commissioned, Contractor shall clean-up the same and remove all plaster, paints, stains, stickers and other foreign matter or discoloration leaving the same in a ready to use condition.

13.0 **License permits and authorities**

13.1 Contractor must hold a valid plumbing or any other as required license by the Municipal Authority or other competent authority under whose jurisdiction the work falls.

13.2 Contractor must keep constant liaison with the Municipal/statutory authority and obtain approval of all drainage, water supply and other works carried out by him.

13.3 Contractor shall obtain, from the municipal and other authorities completion certificate with respect to his work as required for occupation of the building and nothing extra shall be paid on this account.

14.0 **Cutting of structural members**

14.1 No structural member shall be chased or cut without the written permission of the Consultant/Owner.

15.0 **Materials**

15.1 Unless otherwise specified and expressly approved in writing by the Consultant/Owner, only materials of makes and specifications as mentioned in the list of approved makes attached with the specifications shall be used.

15.2 The Contractor shall submit samples of materials proposed to be used in the works. Approved samples shall be kept in the office of the Consultant/Owner and returned to the Contractor at the appropriate time.

End of Section

SECTION I: SEWAGE

1. Sewer work

1.1 Scope of work

1.1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install all the drainage system as required by the drawings and specified hereinafter or given in the Schedule of Quantities.

1.1.2 Without restricting to the generality of the foregoing, the drainage system shall include:-

a) Sewer lines including excavations, pipelines, manholes, drop connections and connections to the existing sewer.

b) Storm water drainage, excavation, pipelines, manholes, catch basins, drain channels and connections to the existing storm water drain.

1.2 General requirements

1.2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of the Project Manager.

1.2.2 Drainage lines and open drains shall be laid to the required gradients and profiles.

1.2.3 All drainage work shall be done in accordance with the local municipal bye-laws.

1.2.4 Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority.

1.2.5 Location of all manholes, etc. shall be got confirmed by the Contractor from the Architect / Landscape Architect. As far as possible, no drains or sewers shall be laid in the middle of road unless otherwise specifically shown on the drawings or directed by the Project Manager.

1.2.6 In sewer line pipe DWC HDPE SN8 confirming to 16098 Part II pipe will be used.

1.3 DWC HDPE Pipes (SN 8): IS 16098 Part II

1.3.1 DWC pipes shall be of first class quality and free from rough texture inside or outside and straight. All pipes shall have the manufacturers name marked on it and shall comply with IS-16098 Part II and shall be of approved makes.

1.3.2 **Laying and Jointing of DWC HDPE Pipes**

a) Pipes are liable to be damaged in transit and notwithstanding tests that may have been made before dispatch each pipe shall be examined carefully on arrival at site. Each pipe shall be rung with a wooden hammer or mallet and those that do not ring true and clear shall be rejected. Sound pipes shall be carefully stacked to prevent damage. All defective pipes should be segregated, marked in a conspicuous manner and their use in the works prevented.

b) The pipes shall be laid with sockets leading uphill and should rest on solid and even foundations for the full length of the barrel. Socket holes shall be formed in the foundation sufficiently deep to allow the pipe jointer room to work right round the pipe and as short as practicable to admit the socket and allow the joint to be made.

c) Where pipes are not bedded on concrete the trench bottom shall be left slightly high and carefully bottomed up as pipe laying proceeds so that the pipe barrels rest on firm ground. If excavation has been carried too low it shall be made up with cement concrete 1:5:10 mix at the Contractor's cost and charges.

d) If the bottom of the trench consists of rock or very hard ground that cannot be easily excavated to a smooth surface, the pipes shall be laid on cement concrete bed of 1:5:10 mix to ensure even bearing.

1.3.5 **Jointing of Pipes**

a) Tarred gaskin shall first be wrapped round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid, the pipe shall then be adjusted and fixed in its correct position and the gaskin caulked tightly home so as to fill not more than one quarter of the total length of the socket.

b) The remainder of the socket shall be filled with stiff mix of cement mortar (1 cement: 1 clear sharp washed sand). When the socket is filled, a fillet should be formed round the joint with a trowel forming an angle of 45 degrees with the barrel of the pipe. The mortar shall be beaten up and used after it has begun to set.

c) After the joint has been made any extraneous materials shall be removed from inside of the joint with a suitable scraper or "Badger". The newly made joints shall be protected until set from the sun, drying winds, rain or dust. Sacking or other materials, which can be kept damp, shall be used. The joints shall be exposed and space left all rounds the pipes for inspection by the Project Manager. The inside of the sewer must be left absolutely clear in bore and free from cement mortar or other obstructions throughout its entire length, and shall efficiently drain and discharge.

1.4 Testing

- All lengths of the sewer and drain shall be fully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole to manhole. All pipes shall be subjected to a test pressure of at least 1.5 meter head of water. The test pressure shall, however, not exceed 6 meter head at any point. The pipes shall be plugged preferably with standard design plugs with rubber plugs on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head.

- Sewer lines shall be tested for straightness by: (i) inserting a smooth ball 12 mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball should roll down the invert of the pipe and emerge at the lower end. (ii) means of a mirror at one and a lamp at the other end. If the pipeline is straight the full circle of light will be seen otherwise obstruction of deviation will be apparent.

- The Contractor shall give a smoke test to the drains and sewer at his own expense and charges, if directed by the Project Manager.

A test register shall be maintained which shall be signed and dated by Contractor.

END OF SECTION I

SECTION II: BIO DIGESTER SYSTEM

SPECIFICATION: DRDO BIODIGESTER (FOR HIGH ALTITUDE AREAS)

DRDO Biodigester tank specification: Required cubic meter tank (L X B X H, inner sizes) designed double walled FRP with outer wall with *minimum* thickness: 10mm, and inner wall minimum thickness 6mm and double wall of 100mm insulation duly filled between the two FRP walls with poly urethane foam of 100mm. The total wall thickness should be 10 + 6 + 100 [total (approx) = 116mm (*with ±3mm*)].
There must be 03 equal partition walls of 5 mm thick in biodigester, resulting in four chambers of approximately 3: 3: 2: 2 ratios. The volume of chamber containing inlet pipe is approximately 40% of total volume (partition wall- partial; 270cm Length x 100cm Height from opposite direction).
Bacteria attachment sites as per the norms should be added in the tank (A PVC immobilization matrix (10mm Thick) is to be provided on both sides of partition wall along with hanging type covering all the compartments with 100 mm distance.

Inlet and outlet: Both should be as per the design norms having 4 inch dia. Further, inlet pipe of the biodigester tank should be connected from nearby toilet block and this connecting pipe and outlet should be double walled

PVC with PUF insulation (min 3m or more length required for connecting each block). Entry of inlet should be from top, while exit of outlet should be from side wall, 100 mm below the top cover.
Heating elements: Efficient electric heating elements (200w x 2 nos. and 150w x 4 nos.) should be customarily designed the length of each heating element would be approx 75 cm, which will be fitted on uniquely designed screw mounted system from the top of the tank, along with provisioning for amendment or change the element. Each element should be encased in stainless steel pipes as jacket that will be filled up with hi-thermo oil.

Sensor and thermostat: Two sensors and 2 thermostats are required that will control the water temperature inside the tank. Thermostat should be controlled to regulate constant temperature at $25^0C \pm 2^0C$ with in the tank to have an optimal efficiency of the inoculums bacteria to degrade human faecal material. Necessary electric wires and cables for the system.

A proper stable , low maintenance and durable good quality biodigester shed of size 4m L X 2.5M B X 1.5M H with 220 GSM galvanized steel structure and double slope roof with 5mm thick FRP roofing sheet covering the whole digester to avoid direct snow fall and pilling up of snow.

Installation of Bio-digester:
i. Assembly of biodigester must be carried out at the site of installation and subsequent connection with the existing toilet must be done to complete the installation.
ii. All pipe, partition walls and cover plate with gasket are to be properly sealed with main tank body. For the sealing of pipes and partition walls to make the leak proof proper general purpose/suitable resin and fiber mat is to be used.
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iii. Proper digging and leveling of soil is to be carried for installation of biodigester. Leveling should be carried out carefully with the water gauge.

Anaerobic microbial inoculums (1600L) is to be provided in the biodigester tank in the first chamber either before cover plate assembly or it can also be poured from the toilet pot. Inoculum should be procured from DRDO approved facility; prior to charging, the quality of the inoculums must be certified by the DRDO laboratories (DRDE Gwalior/DRL Tezpur). DRL, Tezpur reserves the right to check the quality of inoculums at the installation site.

Transportation and installation of 2 Nos. biodigester tank and covering shed is required which will be installed at high altitude low temperature forwarded locations beyond Leh Ladakh. In case of any complain same shall be attended within 15 working days at site.
One year warrantee must be inclusive (for both complete digesters-all components and shed) along with the quote

i) Bio Digester of required size as per manufacturer size is required for 8 KLD in Type-4 accommodation and 10 KLD in staff hostel.
ii) Bio –Digester treated water will be used in gardening purpose.
iii) Treated water quality should be according to IS 11624.

SECTION II: SOLAR HOT WATER SYSTEM WITH HEAT PUMP BACK UP

Solar system For Type-4 accommodation.

i)Heat pump shall be 455 Liter inbuilt Storage tank & 8.0 KW output and 2.22 KW heat input , Air to Water Heat Pump. Flow max 200 L per hour. With 12 KW heating element. R134a refrigerant (1.85 kg), Cop upto 3.6 .Triple protection – Humidity sensor, built-in Anti-dry & Anti-frost function. Water can be heated upto 65°C with heat pump mode, which prevents breeding of Legionella bacteria including timer based control panel all interconnectivity cables with heat pumps, pipe ,valves, non return valves etc. complete in all respect.

ii) Solar Panel of 125 LPD - 4 nos. with 100 ltr SS insulated storage tank with SS 316 and SS 304 material with PUF insulation.

iii) Solar panel as per ISI marked.

iv) Automation system include - Hot water generate from solar system up to temp 50 deg C will go to Heat pump, If tem raise above 50 deg C it will go to Proposed UGT.

Solar system For Staff Hostel.

i) Heat pumps shall be rated at 8 KW of input power and 19.8 KW of output power. Refrigerant used should be environment friendly R-410a. Heat pump should heat water upto 55ºC on heat pump mode. It shall have silent operation and the sound level should not exceed 65 dB.R-410a/2.8 kg (Refrigerant). Nominal Input Power - 6.02 KW. Output Heating capacity - 19.8 kW

ii) Solar Panel of 125 LPD - 8 nos. with 3000 ltr SS insulated storage tank with SS 316 and SS 304 material with PUF insulation with inbuilt 20 KW heating element.

iii) Solar panel as per ISI marked.

iv) Automation system include - Hot water generate from solar system up to temp 50 deg C will go to Heat pump, If tem raise above 50 deg C it will go to Proposed UGT.

SECTION III PUMPS & EQUIPMENTS .

3.0 **Pumps & Equipment**

3.1 Work under this sub-head consists of furnishing all labour, materials, equipment and accessories necessary and required to completely install pumping system for various water supply services and water treatment as per drawings, specified hereinafter and given in the Bill of Quantities.

3.2 Without restricting to the generality of the foregoing, the work of pumps and water treatment equipment shall include the followings:

a) Hydropneumatic pump for domastic water supply
b) Motor control panels, power and control cabling and allied electrical works.
c) Pipes, valves, accessories, hangers, supports, delivery and suction feeders and connection to proposed pipe work.

3.3 **PUMP SET**

3.3.1 **Water Supply Pumps**

(These specifications are applicable for all clear water pumps and as specified in Bill of Quantities)

3.3.2 Water supply pumps shall be suitable for clean water. Pumps shall be single or multistage, monoblock horizontal, vertical, centrifugal pumps with cast iron/stainless steel body and stainless steel/bronze impeller, stainless steel shaft and coupled to a TEFC electric motor by means of a flexible coupling or as specified in bill of quantities. Each pump should operate a curve 10m below specified head.

3.3.3 Pump and motor shall be mounted on a common M.S. structural or C.I. base plate or as required as per site conditions.

3.3.4 Each pump shall be provided with a totally enclosed fan cooled induction motor of required H.P. and RPM specified in the bill of quantities and as per requirement.

3.3.5 Each pumping set shall be provided with a 150mm dia or of suitable size gunmetal "Bourden" type pressure gauge with gunmetal isolation cock and connecting piping.

3.3.6 Provide vibration-eliminating pads appropriate for each pump.

3.3.7 Provide rate of flow measuring meter with bypass arrangement with every set of pumps as shown on the drawings and given in the bill of quantities (to be paid separately).

3.3.8 All water supply pumps shall be provided with mechanical seals, of required specifications.

3.4 **PIPING**

3.4.1 Pipes for suction and delivery shall be galvanized/M.S tube (heavy duty) confirming to I.S:1239 upto 150mm dia and as per I.S:3589 for dia 200mm and above or as specified in bill of quantities. The M.S flanges shall confirm to I.S:6392-1971.

3.4.2 Gate valve and check valve above 65mm dia shall be C.I. double flanged conforming to I.S:780 manufactured by the reputed manufacturers or C.I. double flanged butterfly valves as specified in bill of quantities or elsewhere or as per approval of Engineer-in-charge.

3.4.3 Full way and check valves 65mm dia and below shall be gunmetal tested to 20Kg/cm^2 pressure certified and conforming to I.S:778.

3.4.4 Suction strainer or foot valves shall be C.I., confirming to I.S:4038 - 1979, as specified in bill of quantities.

3.4.5 **Joints**

All pipes and fittings shall be provided with flanged joints, with flanges either screwed or welded complete and jointed with 1.5mm thick gasket complete with nuts, bolts and washers etc.

3.4.6 **Testing**

All G.I/M.S pipes (except fire pipe) shall be tested hydrostically for a period of 30 minutes to a pressure of 7 Kg/cm^2 without drop in pressure and all G.I/M.S pipes for fire shall be tested hydrostically for a period of 30 minutes to a pressure of 10 Kg/cm^2 without drop in pressure.

3.5 **MEASUREMENTS**

3.5.1 Raw water, garden pump and other pumps shall be measured by numbers and hydro pumps and sump pumps shall be measured by sets and shall include all items as given in the bill of quantities.

3.5.2 Motor control panel and level controllers shall be measured by numbers.

3.5.3 Pipes for suction and delivery header and mains shall be measured per linear metre along the centre line of the pipe and shall be inclusive of all fittings.

3.5.4 Cable trays and cables shall be measured per linear meter.

3.5.5 Structural clamps including hangers shall be measured by weight calculated from sections used. No separate payment shall be admissible for bolts, anchor bolts, rawl plugs etc.

3.5.6 No separate payment shall be made for making connections of the existing service lines to the pumps. Vibration eliminator pads are included in the scope of this work.

3.6 **GUARANTEE**

3.6.1 The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.

3.6.2 The form of warranty shall be as approved by the Engineer-in-charge.

3.6.3 The warranty shall be valid for a period of one year from the date of commissioning and handing over.

3.6.4 The warranty shall expressly include replacement of all defective or under capacity equipment, Engineer-in-charge may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.

3.6.5 The warranty shall include replacement of any equipment found to have capacity lesser than the rated capacity as accepted in the contract. The replacement equipment shall be approved by the Engineer-in-charge.

PARTICULAR SPECIFICATION OF ELECTRICAL WORKS

1 SCOPE OF WORK

The general character and the scope of work to be carried out under the contract are illustrated in Drawings and BOQ. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Engineer In charge. The contractor shall furnish all labour, materials and equipment as listed in specifications and drawings. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract. The complex includes Staff hostel and Type-4 accommodation etc. **All the components, materials, accessories & equipment shall be supplied & designed as per -30^{o} C ambient temperature and about 3525 meters MSL. If the specification of items will increase as per the altitude above, the feasible specification shall be followed without cost increase.**

The system includes:

a) Wiring for Normal Electric supply & Emergency supply shall be done in PVC conduit / Cable tray/ Raceway system as per drawings.
b) Switches, plug sockets, cover plates and other wiring accessories.
c) Sub-Mains wires/cables from panel to respective flat DB/Floor.
d) Distribution boards
e) Cables on cable trays including installation, cable trays, hangers, supports, cable terminations and all fixing accessories.
f) Earthing (Grounding) System and Lightning Protection System.
g) Main LT Panels & Distribution Panels. The general construction shall confirm to IEC:61439 - 1/2.
h) All cabling from main LT panel at to each respective distribution panels on each floor.
i) Hi Side equipments like HT VCB Panel, Transformer and Servo stabilizer.
j) Diesel generator set
k) Lighting Fixtures and Fans

2 RELATED DOCUMENTS

These Specifications shall be read in conjunction with the CPWD General specification for Electrical work Part-1 Internal (2013), Part-2 External (1994), Part-4 Substation and Part-7 DG Sets (2013), drawings and other document connected with the work.

3 SUB MAINS AND POINT WIRING

3.1 Scope

The scope of this section comprises the supply, installation, testing and commissioning of following as per drawings:

1. Wiring for power outlets, heavy duty sockets/industrial sockets.
2. Wiring from distribution boards to different switchboards and from there onwards to individual points like light points, Bell Buzzers, Fan points and small exhaust fan points etc for all internal areas.
3. Switchboards, power plugs and its accessories like gang box, front plate, switch etc.
4. Wires and its accessories like conduits, Outlet boxes, junction boxes, pull-through boxes etc.
5. Ceiling rose, Connectors etc. for light points, Fan points, small exhaust fan points etc for all internal areas.
6. Conduit/channel as the case may be, accessories for the same and wiring cables between the switch box and the point outlet, loop protective earthing of each fan/ light fixture.
7. All fixing accessories such as clips, screws, raw plug etc. as required.
8. Metal switch boxes (as specified) for control switches, regulators, sockets etc, recessed or surface type, and phenolic laminated sheet covers over the same.
9. Control switch or MCB, as specified in drawings.
10. Connections to ceiling rose, connector, socket outlet, switch etc.
11. Flexible conduits from ceiling junction box to the fittings shall be provided duly coupled at both ends where false ceiling is coming. This shall be included within the scope of point wiring.)
12. Interconnecting wiring between switches within the switch box on the same circuit.

3.2 Codes & Standards

More particularly following documents should be strictly followed.

1. CPWD General Specification for Electrical work Part-1 Internal (2013)
2. CPWD General Specification for Electrical work Part-2 External (1994)
3. CPWD General Specification for Electrical work Part-4 Substation (2013)
4. CPWD General Specification for Electrical work Part-7 D.G sets (2013)
5. National Building Code - 2016
6. National Electrical Code - 2008
7. Indian Electricity Act 2003
8. Indian Electricity Rule 1956

Apart from above the relevant Bureau of Indian Standard codes as more particularly stated herein and broadly to all the codes, status and regulations as applicable shall be strictly enforced and adhered to.

3.3 Specifications

3.3.1 Wires:

The wires shall be PVC Insulated Copper Conductor multi strained FRLS confirming to IS: 694 and amendment up to date.

a. Wires from light/Fan circuit wiring and point wiring (along with internal loop earthing) shall be of 1.5 sq.mm size.

b. Wires from DB to 6A Socket outlet (along with internal loop earthing) shall be of 2.5 sq.mm size.
c. Wires from DB to 6/16A Socket outlet (along with internal loop earthing) shall be of 4 sq.mm. Size.
d. Wires from DB to Split AC, Geyser, Industrial sockets and Sheet steel MCB/MCCB box shall be as per drawings.

3.3.2 Thimbles/lugs:

The wires shall be terminated with the help of crimping lugs at both the terminals. The lugs shall be suitable for 1100V and the min temperature rating for these lugs shall be 150 degree Celsius. The lugs shall be pin/Hole type with pin designed in such a fashion to prevent damage to the wire from over tightening and ensure a reliable electrical connection. If Aluminum cable is used, aluminium lugs shall be used, for copper cables, copper lugs shall be used and if cable termination is of Aluminium conductor and main busbar is copper than tinned copper or bi-metallic lugs shall be used.

3.3.3 PVC conduits and accessories:

Wiring for Light/ Fan/Call Bell/Exhaust Fan point and circuit wiring and power wiring shall be done in PVC steel conduit confirming to IS: 2509 (1973) and IS: 3419 (1989) latest as on date for rigid conduit and IS: 9537 (Part-5) (2000) latest as on date for flexible conduit.

3.3.4 Modular GI Box:

The switch box for mounting modular switches and sockets shall be made out from pre galvanized sheet. The modular GI box having wall thickness not less than 1.2mm for boxes up to size of 20 cm X 30 cm and above this size of 1.6 mm thick shall be used.

3.3.5 Modular Base and cover plate:

The front plate shall have smooth surface from both the side and shall be properly matching the fixing alignment. Perfect alignment shall be maintained while fixing of the back boxes. The color shall be as per the engineer in-charge.

3.3.6 Switch - Socket Outlets:

The switch sockets shall be modular type of reputed make mentioned in preferred approved make list.

3.3.7 Blanking Plate:

Spare space in modular switch box shall be covered by blanking plate.

3.3.8 Electronic fan regulator:

Step Type two module Electronic regulators should be used.

4 DISTRIBUTION BOARD

4.1 Distribution Boards

The distribution board shall be made out of CRCA sheet steel with powder coated double metallic door with minimum IP: 42 protection compliance to IS: 8623-1 and 3 and IEC 61439-1 & 3 and amendment up to date.

5 CABLES TRAYS

Cable tray system shall comprise of perforated painted with powder coating M.S. cable trays with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with M.S. suspenders including bolts& nuts, painting suspenders including bends, Tee joints, Cross member and reducers etc as required. Refer all specification other than material from CPWD Part-I.

6 PROECTION OF BUILDING AGAINST LIGHTNING

This chapter covers the detailed requirements of installation of lightning conductor system for protection of buildings against lighting. For details not covered in these specifications, reference may be made to IS: 2309 -1989.

The principal components of a lightning protective system are:

a) Air Terminations
b) Down Conductors
c) Joint and Bonds
d) Testing Joints
e) Earth Termination and Earth Electrodes

6.1 Materials:

a) The materials of air terminations, down conductors, earth termination etc. of the protective system shall be reliably resistant to corrosion or be adequately protected against corrosion. The material shall be one of the following as specified.

i) **Galvanised Steel:** Steel thoroughly protected against corrosion by a zinc coating shall be used.

b) Aluminium should not be used underground or in direct contact with walls.
c) All air terminations shall be of GI and all down conductors shall be of GI or aluminium except where the atmospheric conditions necessitate the use of copper or copper clad steel for air terminations and down conductors.
d) The recommended shape and minimum sizes of conductors for use above and below ground as per below tables respectively:

Shapes and minimum sizes of conductors for use above ground.

Sl. No	Material and Shape	Minimum Size

1.	Round copper wire or copper clad steel wire	6mm diameter
2.	Stranded copper wire	50 sqmm or (7/3.00 mm dia)
3.	Copper strip	20mm x 3mm
4.	Galvanized Iron Strip	20mm x 3mm
5.	Round Aluminium Wire	8mm diameter
6.	Aluminium Strip	25mm x 3mm

Shapes and minimum sizes of conductors for use below ground

Sl. No	Material and Shape	Minimum Size
1.	Round copper wire or copper clad steel wire	8mm diameter
2.	Copper strip	32mm x 6mm
3.	Round Aluminium Wire	10mm x 6mm
4.	Galvanized Iron Strip	32mm x 6mm

6.2 Layout:

The system design and layout shall be done in accordance with IS: 2309-1989 and specified in the tender documents.

6.2.1 Air Terminations:

a) Air termination networks may consist of vertical or horizontal conductors or combinations of both. For the purpose of lightning protection, the vertical and horizontal conductors are considered equivalent and the use of pointed air terminations or vertical final is, therefore, not regarded as essential.

b) A vertical air termination, where provided, need not have more than one point and shall project at least 30cm, above the object, salient point or network on which it is fixed.

c) For a flat roof, horizontal air termination along the outer perimeter of the roof shall be used. For a roof of larger area a network of parallel horizontal conductors shall be installed. No part of the roof should be more than 9m from the nearest horizontal protective conductor.

d) Horizontal air terminations should be carried along the contours such as ridges, parapets and edges of flat roofs and where necessary over flat surfaces in such a way as to join each air termination to the rest and should themselves form a closed network.

e) All metallic projections including reinforcement on or above the main surface of the roof which are connected to the general mass of the earth, should be bonded and form a part of the air termination network.

f) If portions of a structure vary considerably in height, any necessary air terminations or air termination network for the lower portions should be bonded to the down conductors of the taller portions, in addition to their own down conductors.

6.2.2 Down Conductors:

The number and spacing down conductors shall be as specified or as directed by the Engineer-in-Charge.

6.2.3 Routing:

a) A down conductor should follow the most direct path possible between the air terminal network and the earth termination network. Where more than one down conductor is used, the conductors should be arranged as evenly as practicable around the outside walls of the structures.

b) The walls of light wells may be used for fixing down conductor, but lift shafts should not be used for this purpose.

c) Metal pipes leading rainwater from the roof to the ground may be connected to the down conductors, but cannot replace them, such connections should have disconnecting joints.

d) In addition on the routing of the down conductor, its accessibility for inspection, testing and maintenance should be taken them, such connections should have disconnecting joints.

6.3 Installation:

6.3.1 General:

a) The entire lightning protective system should be mechanically strong to withstand the mechanical forces produced in the even of a lightning strike.

b) Conductors shall be securely attached to the building or other object to the protected by fasteners which shall be substantial in construction, not subject to breakage and shall be galvanized steel or other suitable materials, with suitable precautions to avoid corrosion.

c) The lightning conductors shall be secured not more than 1.2m apart for horizontal run and 1m for vertical run.

6.3.2 Air Terminations:

All air terminals shall be effectively secured against overturning either by attachment to the object to be protected or by means of substantial bracings and fixings which shall be permanently and rigidly attached to the building. The method and nature of the fixings should be simple, solid and permanent, due attention given to the climatic conditions and possible corrosion.

6.3.3 Down Conductors:

a) The down conductor system must where practicable be directly routed from the air termination to the earth termination network and as far as possible be symmetrically placed around the outside walls of the structure starting form the corners. In all cases consideration to side flashing must always be given.

b) Practical reasons may not sometimes allow the most direct route to be followed. While sharp bends, such as arise at the end of roof are in-escapable (and hence permissible), re-entrant loops in a conductor can produce high inductive voltage drops so that the lightning discharge may ump across the open side of a loop. As a rough guide, this risk may arise when the length of the conductor forming the loop exceeds 8 times width of the open side of the loop.
c) When large re-entrant loops as defined above cannot be avoided, such as in the case of some cornices or parapets, the conductors should be arranged in such a way that the distance across the open side of a loop complies with the requirement indicated above. Alternatively, such cornices or parapets should be provided with holes through which the conductor can pass freely.

6.3.4 Joints to prevent side flashing:

Any metal in or forming a part of the structure or any building services having metallic parts which are in contact with the general mass of the earth should be either isolated from or bonded to the down conductor. This also applies to all exposed large metal items having any dimension greater than 2m whether connected to the earth or not.

6.3.5 Joints and Bonds:

6.3.5.1 Joints:

a) A lightning protective system should have as few joints as possible.

b) Joints should be mechanically and electrically effective, for example, clamped, screwed, bolted, crimped, riveted or welded.

c) With overlapping joints, the length of the overlap should not be less than 20mm for all types of conductors.

d) Contact surfaces should first be cleaned and then inhibited from oxidation with a suitable non-corrosive compound.

e) Joints of dissimilar metals should be protected against corrosion or erosion from the elements or the environment and should present an adequate contact area.

6.3.5.2 Bonds:

a) Bonds have to join a variety of metallic parts of different shapes and composition and cannot therefore be of a standard form.

b) There is the constant problem of corrosion and careful attention must be given to the metals involved i.e. the metal from which the bond is made and those of the items being bonded.

c) The bond must be mechanically and electrically effective and protected from corrosion in and erosion by the operating environment.

d) External metal on or forming part of structure may have to discharge the full lightning current and is bond to the lightning protective system should have a cross sectional area not less than that employed for the main conductors.

e) Structures supporting overhead electric supply, telephone and other lines must not be bonded to lightning protective system without the permission of the appropriate authority.

f) Gas pipe in no case shall be bonded to the lightning protective earth termination system.

6.3.6 Tests Joints:

Each down conductor should be provided with a test joint in such a position that while not inviting unauthorized interference, it is convenient for use when testing.

7 MAIN LT PANELS/DISTRIBUTION PANELS & LT SWITCHGEAR

7.1 Main LT Panels/Distribution Panels:

This chapter covers supply/erection/testing and commissioning of TTA Panels:-

a) For each equipment, required IP rating and short circuit rating capacity will be specified. Governing BIS also will be specified.

b) All the equipment will be factory fabricated in an approved factory having modern fabrication and testing process.

c) It shall have Nine tank pretreatment process comprising of Solvent/ Alkaline Degreasing, Water Rinsing, De- Rusting, Water Rinsing, Passivation, Phosphating, Water Rinsing, Activation and Drying.

d) The powder coating shall be as per IS: 13871 (1993) latest as on date having thickness 70-80 micron for Indoor enclosure and 100-120 micron for Outdoor enclosure or as specified in BOQ whichever is high.

e) The powder paint will be subjected to oven-heated process.

f) All panels will be provided with suitable gasket.

7.1.1 Reference Codes & Standards:

The reference codes and standards for Panel Assemblies shall be followed as mentioned below:

S.No.	Description	Reference Standard
1	**For TTA* Panel**	
i.	Low Voltage Switchgear Assemblies	IEC 61439- 1&2

ii.	Low Voltage Switchgear & Control Gear	IEC 61439- 1&2
2	Degree of Protection	IEC 60529
3	Mechanical Impact	IEC 62262
4	Internal Arc	IEC 61641

* The TTA Panels are defined under IS: 8623 and IEC 61439, the higher and the latest code of practice shall only be followed.

7.1.2 Material & Construction:

a) Cubicle Panel shall be floor mounted (on a base frame as specified in BOQ) or wall mounted with hooks. The design shall include all provisions for safety of operating and maintenance personnel.
b) The degree of protection for panel assemblies shall be IP: 52 for Indoor Enclosures and IP:55 for Outdoor Enclosures or as specified in BOQ.
c) The Panel shall be compartmentalized form 3b bolted type having space and arrangement for incoming cable/ bus-trunking, incoming switchgear/ switchgears, bus coupler, insulated and properly supported compartmentalized switchgear, bus bar supports, joint shrouds, cable alleys of suitable size for cabling routing, support and terminations, interconnection between bus bars and switchgear with auxiliary bus bars/ insulated conductors/ strips etc.
d) The panel enclosure shall be fabricated out of CRCA sheet steel of 2.0 mm thickness or as specified in BOQ whichever higher and gland plates shall be of 3.0mm thickness.
e) The framework may be angle iron/ channel/ bolted type construction.
f) All rear doors shall be hinged type for all the rear accessible type boards and outdoor panels.
g) Suitable pressure relief devices shall be provided to minimize danger to operator during internal fault conditions.
h) Internal Arc capacity should be 50kA for 0.1 sec for PTTA panels.
i) The ACB used for Incoming or bus-coupler shall be arranged in single tier formation only.
j) All switchboards having incomer equal or greater to 630A and Main LT Panels shall be readily extensible on both sides by addition of vertical/ horizontal section after removal of the end covers.
k) The overall height of the switch boards shall be limited to 2450mm or less as per manufacturer design. The maximum and minimum operational height shall be restricted between 1800mm to 300mm respectively from finished floor level.
l) Before assembling, all joint surfaces shall be filed or finished to remove burrs, dents and oxides and silvered to maintain good continuity of all joints.
m) All screws, bolts, washers shall be zinc plated and suitable grade nuts and bolts shall be used for bus bar connections.
n) Arrangement for Incoming/ Outgoing cable termination/ Terminal Block:

(i) Cable entries shall be provided either from the rear or from the front through cable alleys of suitable size.
(ii) Removable gland plate to be provided for each cable entry.
(iii) Incoming termination shall be suitable for receiving bus trunking / cables as per SLD. Cable terminations in case of bus bar shall be of tinned copper.
(iv) Cable support arrangement to be provided inside cable alley so that cables are neatly arranged and fixed.

(v) From each outgoing switchgear, up to 63A PVC insulated Cu flexible conductor, of equal of one rating higher capacity of the respective breaker, shall be used and above 63A bus bars of same material as of main bus bar of the system shall be used.

(vi) It is desirable that cables are not terminated directly to switchgear, but terminated through proper terminal blocks usually equal or one rating higher of the rating of the breaker.

7.1.3 Specification of cable Terminal Block:

a) Terminal block of reputed make shall be used. The housing material shall be polyamide having unbreakable and fire retardant characteristic. All the metal parts shall be made up of copper alloy including the screws. Mounting shall be 'Din' or 'G-rail' type. Screws shall be self-captive type. No protection cover is required and the block should be touch proof.

7.1.4 Bus bars/ Supports/ Clearances:

a) Bus bar supports insulators shall be class 'F' insulators made of non-hygroscopic, non-combustible, track resistant and high strength FRP/ SMC/ DMC material and shall be of suitable size and spacing to withstand the dynamic stresses due to short circuit currents.

b) The bus bar system may comprise of a system of main/ auxiliary bus bars run in touch proof bus bar alley.

c) The bus bars shall be made of rectangular cross sections of high conductivity & strength of copper or aluminum as specified in BOQ/ SLD and suitable to withstand with the stresses of fault level as specified or equal to the fault rating of the incomer breaker.

d) The copper bus bars shall be of 99.9% purity and aluminum bus bars shall be of Electrolytic grade E91.

e) The current density of bus bars shall be followed as per below table or as specified in BOQ:

S.No.	Description	Current Density of Bus Bar
1	**For Residential Building**	
i.	Copper Bus Bar	2A/ Sqmm
ii.	Aluminum Bus Bar	1A/ Sqmm
2	**For Non- Residential Building**	
i.	Copper Bus Bar	1.6A/ Sqmm
ii.	Aluminum Bus Bar	0.8A/ Sqmm

f) All bus bars shall be provided with Halogen free heat shrinkable colour coded insulated sleeves with RoHS compliance.

g) All connections to individual circuits up to 63A from the bus bar shall be with PVC insulated Cu flexible conductor as per IS 694, of equal or one rating higher capacity of the respective breaker and above 63A, the bus bars of same material as of main bus bar of the system shall be used.

h) Bus bar nomenclature shall be as defined in below table:

S.No.	Description	To be read as
1	SP	Single Phase
2	SPN	Single Phase and Neutral (Neutral shall be Half of Phase Capacity)
3	DP	Double Phase (Neutral shall be Equal of Phase Capacity)
4	TP	Three Phase
5	TPN	Three Phase and Neutral (Neutral shall be Half of Phase Capacity)
6	TP+2N	Three Phase and Neutral (Neutral shall be 200% of Phase Capacity)
7	4P	Three Phase and Neutral (Neutral shall be 100% of Phase Capacity)

7.1.5 Earthing:

a) All electrical Panels shall have two nos. common G.I. earth bar of 50X6mm for the panels having incomer fault of 50kA and rest all with 32X6mm or as specified conductor throughout of the panel length as per the fault kA rating of main Incomer, at the rear and for wall mounted panel with 2Nos. earth stud at top one at each side.

b) Dedicated copper bus bar strip of 1x32x6 Sqmm 0.5 meter long with 12-15 holes for termination 4 to 25sqmm copper wires in cable Alley mount on 2Nos. Insulators shall be provided in UPS Output Panel only.

c) All hinged doors and compartment shall be earthed with minimum 2.5sqmm cu wire in spiral form for more flexibility.

d) Space Heater & Ventilation fans:

(i) Anti- condensation heaters shall be fitted in each cubicle together with an On/Off isolating switch suitable for electrical operation at 230V AC 50Hz single phase of sufficient capacity to raise the internal ambient temperature by 40 Deg C or as per site condition.
(ii) All the electrical apparatus so protected shall be designed so that the maximum permitted rise in temperature is not exceeded if the heaters are energized while the switchboard is in operation.
(iii) Space heaters shall be provided in each bus bar alley & Relay Compartment.
(iv) Automatically operated, thermostat controlled panel mounted heavy duty exhaust fans in each vertical or wherever required shall be provided to maintain the humidity inside the panel.
(v) Ventilation louvers/ grills shall be provided in all panels to maintain the internal air temperature.

e) Name Plate and Labels:

(i) Suitable engraved white on black/ blue name plates and identification labels made of Aluminum for All Panels and Incoming/ Outgoing Feeders shall be provided.

(ii) The labels shall indicate the feeder no., feeder designation and feeder rating.
(iii) The labels shall be provided at the rear doors of the panel compartment for all the panels having back access.

f) Documentation Pocket:

(i) A pocket inside all the panels shall be made to keep the documents such as GA drawing of the panel etc.

7.1.6 Requirements for TTA:

a) Main distribution boards shall be assembled only by a franchisee of the original manufacturer and approved by the consultant. The certificate copy issued by original manufacturer shall be attached with quotation document for review & acceptance. All major components like enclosures, switchgear components and bus bar supports shall be supplied by OEM manufacturer to franchisee assembler.

b) Panel builder / Assembler / Licensee partner shall have a minimum experience of 10years in the field of switchgear assembly.

c) The main distribution boards shall comply and perform satisfactorily at special design conditions as minimum: Ambient Temperature @ 45ºC & Relative Humidity @ 95% (At 55ºC).

d) All TTA panels shall have sheet steel hinged doors for all compartments and provided with duly interlocked with the breaker for “ON” & “OFF” positions.

e) The external covers provided should have been subjected to minimum mechanical impact of IK09 as per IEC to ensure specified degree of protection.

f) Unless specified / approved otherwise, enclosure system, the switching devices and other components used for assembly of the main distribution boards shall be from original manufacturer. Different manufacturer for the main distribution board enclosure and switching devices will not be accepted / approved.

g) Each panel section (cable compartment) shall be provided with thermostatically controlled panel heater.

h) The Enclosure shall be made out of electro galvanized steel sheets conforming to international specification. Zinc coating shall be provided on the sheets, which shall prevent rust formation during storage and handling for processing, in addition to giving corrosion protection to the finished product.

i) The enclosure system shall be Modular in nature with bolted on construction. Enclosure parts/ kits shall be interchangeable to reduce downtime during modification or maintenance work.

j) The fault level rating of the bus bar system shall be as per the drawings however the minimum short circuit withstand capacity shall be 50KA RMS for 1second.

k) Internal Arc capacity should be 50kA for 0.3 sec or as specified in BOQ whichever higher.

l) The bus bar joints shall be plated or provided with bimetallic washers for dissimilar material. The hardware used at joints shall be as per original manufacturer's recommendation.

7.1.7 Safety Feature and Interlocks:

a) The safety shutter shall be provided in breaker panels, which shall prevent in advertent contact with isolating contacts when breaker is withdrawn from the cradle.

b) Door interlocking shall be provided in each switchgear compartment with a provision of defeat interlock

c) All panel doors shall have provision of padlocking.

d) Insulating barriers shall be provided in all live sections of the panel.

e) There shall be provisions of positive earth connection between fixed and moving portion of the ACB either through connector plug or sliding solid earth mechanism.

f) Earthing bolts shall be provided on the cradle or body of fixed ACB.

g) Arc chute covers shall be provided wherever necessary.

h) In case of draw out type switchgears safety shutters shall be provided to fully cover the live section automatically once the switchgear is being draw out.

i) It shall be possible to bolt the draw out frame not only in connected position but also in TEST and DISCONNECTED position to prevent dislocation due to vibration.

j) There shall be provision for locking the breaker in all three positions.

k) The breaker shall be provided with interlock to prevent the breaker from being withdrawn or replaced except in the fully isolated position.

l) Interlock shall also be provided to prevent the breaker from closing without in service position.

m) Space heater triggered by thermostat shall be provided in cable compartment to avoid moisture.

n) Lamp operated with a door limit switch and a toggle switch shall also be provided in panel compartments along with 6/16A with socket for ease of maintenance.

7.1.8 Microprocessor based Auto Starting/ Auto Load Sharing/ Auto Synchronization:

The auto synchronizing shall be provided as mentioned below and as per BOQ/ SLD/ BOQ.

7.1.8.1 Sequence of operation:

1. Sequence of Operation in Auto Mode

a) Synchronizing panel logic shall be to automatic start Master GENERATOR set (Selected by Microprocessor based generators control and engine management & monitoring package) through cranking relay & close its CB/NIS after verifying frequency and voltage and shall start feeding the essential load.
b) On failure of mains power supply, DG sets shall start (ON) based on demand load available on respective bus before power failure and same shall come on automatically and synchronize on the bus. DG sets shall remain ON depending upon the load monitored on each 11 kV changeover panel and balance DG sets shall stop after their respective cooling cycle. The combined synchronized power should be fed to the incomer bus of 11 kV changeover panel when the generator output reaches 90% of its rated voltage and frequency. As load increases beyond 75% on DG set which is running, other generator will start and synchronize on the same bus. Similarly as load increases further other generators shall start automatically and synchronize on the same bus.
c) As the load increases or decreases accordingly switching ON and OFF of the generator on the synchronizing bus shall continue with the help of microprocessor based generator control package.
d) Auto synchronizing system shall verify the phase angle of all the sets and also compensate for CB closing time by initiating closing of the breaker ahead of the actual predictable synchronism thereby ensuring a phase difference of zero degree. The breaker closing command shall not be given at a phase angle difference of + 4% in any circumstances.
e) The synchronizing system shall operate the generator ISOCHRONOUS mode by setting Droop to Zero. The system shall have a direct analogue interface with the AVR & Governor for direct bias control. No motorized potentiometers shall be acceptable.
f) Failure of any synchronizing module shall not disturb the synchronizing of other generator.
g) Failure of generator control package shall not affect the synchronizing system which shall be independent of each other.
h) System shall also monitor the slip frequency and the Beat Voltage of the machine or system.
i) NIS of master generator shall remain in circuit. In the event of shutting OFF of First Set, NIS of any other generator shall close first before tripping NIS of first set. It shall be possible to alter sequence of generator starting through, manual selection or through generator control package.
j) Active and reactive power shall be made equal on all the machines automatically with the help of ACTIVE LOAD BALANCING System through Governor Control.
k) In event of set failing to Synchronize, Alarm from annunciator shall invite attention of OPERATOR for manual intervention.
l) LOAD MANAGEMENT SYSTEM shall have output contacts for tripping various loads by field wiring and also trip the VCB of different generator and give ALARM for shutting OFF generator in accordance with predefined parameters to avoid under loading, overloading, cascading effect of tripping and unnecessary FUEL WASTAGE.
m) On the removal of load, generator circuit breaker & Bus Coupler CB's shall be switched OFF in preset sequence with time delays to cover DIPS. Generator shall continue to run for 3 Minutes or predefined after generator CB has been switched OFF.
n) It shall be possible to alter crucial setting / time delays through MAN MACHINE INTERFACE (HMI).
o) All auxiliaries to operate system shall be come ON automatically.
p) Engine start stop control system shall be mounted on the generator panel.

Note:-1000VA on-line single phase input / single phase output (230 V) UPS with 30 minutes battery backup to be provided along with the synchronizing panel.

2. Sequence of Operation in Manual Mode

a) In the manual mode master generator set shall be started by pressing ‘Engine Start’ Push Button (PB)
b) When Engine starting push button is pressed cranking relay shall be energized and give starting signal to the engine.
c) After full voltage is build up, breaker of the Master generator shall close manually with the help of breaker control switch.
d) When breaker Control switch is turned to ‘CLOSE’ position, breaker as per following sequence:

(i) PLC/Main Selector Switch shall be in Manual Mode.
(ii) Solo/Parallel Selector Switch being in ‘Solo’ mode.
(iii) With the conditions mentioned above fulfilled and breaker control switch in ‘Close’ position, Neutral contactor shall be energized.
(iv) Closing command to the generator breaker shall be given.

e) In manual mode care shall be taken, to synchronize the follower generator sets with the 'Master' before closing its breaker.
f) For synchronizing the guarantee in manual mode, voltage/frequency raise/low commands shall be given to Alternator/Engine with the help of 'Joy sticks' provided in the Relay/Synchronizing Panel or internally through genset digital controller
g) While synchronizing the generator, manually, all the parameters viz. voltage, frequency and phase rotation shall be monitored with the help of Double voltmeter, Double Frequency Meter and Synchronoscope provided in the Relay/Synchronizing Panel and breaker shall be closed only when all the three parameters are matched properly or internally through genset digital controller.

(i) Active/Reactive load sharing between all the running sets in manual mode shall be managed by raising/lowering voltage/frequency with the help of joy sticks or internally through genset digital controller.
(ii) During the parallel operation of Power Generating sets in 'Manual Mode', Neutral contactor of only master generator shall close. This shall be assured by inter locking the neutral contactors of all the generator.

7.1.8.2 Automatic Generator Sequencing:

Automatic starts & stop gensets based on load or demand load bus. Configurable load bus demand start/stop levels & timers. Online engine priority sequence configurability from any synchronizing unit or PC to equalize run time of DG all DG sets.

7.1.8.3 Control System:

a) All the electrical parameters are monitored centrally through intelligent processing. All the electrical data is brought to the PLC & then PLC controls the complete Synchronizing,

Load Control & Management system. Control, monitoring and data functions shall be provided by.

b) There are two options provided for control, monitoring & data logging functions graphic display terminal along with laser printer.
c) The minimum PC requirements shall be Windows 10 OS, Intel Core i7, 6th Gen, 2GB Graphics,52 X CD ROM, MM Speakers, LAN (Ethernet Port), 2 x USB ports, 2 x COM ports, 1 x Parallel port. SMPS with other standard accessories, 1 No. 32 inch colour PC (latest version), A-4 size Laser Colour Printer and all License version software.

7.1.9 Site Visit and Documentation:

The manufacturer shall visit the site to review the site conditions and shall submit a report complying following points:

a) Possible Height & Width for the Panel.
b) Back access is possible or not.
c) Cable entry will be possible from bottom or from top.
d) If cable entry from bottom, stand will be required or not.
e) If panel is going to be wall mounted, the wall is available or not.
f) Path for movement of transportation of panel is possible or not i.e length, width etc. and the transportation sections shall be designed according.
g) Sufficient space available at front & back after door opening.
h) Sufficient height available above panel for cable drop.

7.1.10 Minimum Documentation for GA submission:

The manufacturer shall provide following documentation along with the GA drawings:

a) General Note and considerations for Construction of the Panels having sheets thickness, IP, bus bar clearance, bus bar size, rating & density with material, base frame, control wiring details etc.
b) Schematic Diagram of the panels
c) BOM with selected make with all component's model no.
d) Bus bar orientation
e) Top/ Bottom and front/ Back/ Side views as applicable.
f) Detail of interconnection bus bar/ cable between the incoming breaker and main bus bar and main bus bar and outgoing breakers.
g) Discrimination chart for all networks.
h) Following certificates shall be submitted along with the GA drawings

(i) Copy of CPRI certification upto 70kA withstand capacity @ 1sec for PTTA Panels.
(ii) Copy of TTA Test certificates shall be submitted by the contractor of selected switchgear manufacturer from the list of approved makes only.
(iii) Certificate for Bus Bar purity, density and RoHS Compliance.
(iv) Certificate for No de-rating up to ambient temp. 50ºC for all breakers and selected components.

7.1.11 Factory Tests:

When all the panels are ready as per the approved GA drawings, the panel manufacturer invites the consultant for panel inspection. The following tests shall be performed at the manufacturer's factory unit.

a) Visual check which covers measurement of dimension, location, number and type of devices etc.
b) Checking as per Bill of Material and Approved GA drawings
c) Functional Check which covers operation of various feeders as per approved GA drawings
d) Operation check for every control function
e) Insulation resistance test and value measurement on power and control circuits before and after high voltage withstand test.
f) High voltage test on power and control circuit as per IS 8623.
g) MV Megger test.

7.1.12 Type Tests for TTA Panels:

The main distribution board and the components as applicable shall be type tested in accordance with the IEC standards to verify the specified fault level withstand capacity from a reputed and approved type testing laboratory and certified by an competent authority.

The following type tests as specified in IEC 61439-1standards shall be carried out on assembly at recognized test laboratories and certificates shall be provided for each type test:

a) Verification of temperature-rise limits (IEC cl.10.10)
b) Verification of Dielectric properties (IEC cl. 10.9)
c) Verification of short- circuit withstand strength (IEC cl. 10.11)
d) Verification of the effectiveness of the protective circuit (IEC cl. 10.5)
e) Verification of clearances and creep age distances (IEC cl. 10.4)
f) Verification of mechanical operation (IEC cl. 10.13)
g) Verification of the degree of protection (IEC cl. 10.3)
h) Verification of mechanical impact (IEC cl. 10.2)

7.1.13 Packing:

The packing shall be accordance with the bidder's standard practice but he shall give full particulars of packing for the approval of the purchaser.
All the parts shall be adequately marked to facilitate field erection.
Boxes and creates shall be marked with the contact numbers and shall have a packing list enclosed showing the parts contained therein.

7.1.14 Installation:

a) The installation work shall cover assembly of various sections of the panels lining up, grouting the units etc. In case of multiple panel switch boards after connecting up the bus bars etc. all joints shall be insulated with necessary insulation tape or approved insulation compound. A common earth bar shall be of appropriate rating as per fault or as specified shall run inside at the back of switch panel connecting all the sections for connecting to frame earth system. All protection and other small wirings for indication etc. shall be completed

before calibration and commissioning checks are commenced. All relays, meters etc. shall be mounted and connected with appropriate wiring.

b) The Rising Mains, bus trunking or wall mounted panels shall be supported such that its weight does not come to the power cable or earthing terminals.
c) All rising mains/ bus trunking enclosures hanged from slab shall be suspended at a uniform height of minimum 2400mm above finished floor level. The layout got approved from the Engineer-in-Charge before erection.
d) If rising mains/ bus trunking is hanged from slab, each section of the enclosure shall be suspended from the ceiling slab with suitable MS suspenders or GI threaded rods and support angles/ channels. The runs shall be neat and route shall be as per the design or as directed by Engineer-in-Charge.
e) A connector assembly for plug in box shall be supplied loose with each section of the rising mains/ bus trunking enclosures for coupling two sections and it shall comprises a rubber locating ring. Bus bar insulating tube and a connector insulating tube.

7.1.15 Testing and Commissioning:

Commissioning checks and tests shall include all wiring checks and checking up of all connections. Following shall be performed at site:

a) Relay/ meters adjustment/ setting shall be done before commissioning.
b) Tightening of all nuts and bolts.
c) Closing of any left out holes to ensure the panel is insect proof and IP compliances.
d) Operational check of all breakers, Contactors, protection devices and instruments
e) Lubrication of all moving parts.
f) Interlock function check
g) Insulation test: when measured with 500V Megger the insulation resistance shall not be less than 100 Mega Ohm.
h) Trip tests and protection gear test.
i) Earth Test

7.1.16 Handing Over Document:

The contractor shall submit a handing over document consisting of following:

a) Operational & maintenance manual.
b) Installation guidelines of all products' data sheets come along with product.
c) As built of GA drawings with wiring diagram and selected product part codes

7.2 LT Switchgears:

7.2.1 Standards and Codes:

The latest amended up to date Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 2003 and Indian Electricity Rules 1956 as amended up to date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

7.2.2 Air Circuit Breaker:

The ACB shall conform to the requirements of IS/IEC 60947-2 and shall be type tested & certified for compliance to standards from–CPRI, ERDA/ any accredited international lab. The circuit breaker shall be suitable for 433 V, 3 phase, 50 Hz supply system. Air Circuit Breakers shall be with moulded housing flush front, draw out type and shall be provided with a trip free manual operating mechanism or as indicated in drawings and bill of quantities with mechanical "ON" "OFF" “TRIP” “CIRCUIT HEALTHY” “SPRINK CHARGE “indications.

ACB should be able to carry Rated current as required in the SLD at the yearly maximum ambient temperature applicable for 50 degree centigrade and as per site condition whichever is higher.

ACB should have an operational designed voltage of 690 V for Ics=100% Icu for Icw=1 Sec.

The ACB shall be 3/4 pole with modular construction, draw out, manually or electrically operated version as specified in SLD. The circuit breakers shall be for continuous rating and service short Circuit Breaking capacity (Ics) shall be as specified on the single line diagram and should be equal to the Ultimate breaking capacity(Icu) and short circuit withstand values(Icw).

Circuit breakers shall be designed to ‘close’ and `trip' without opening the circuit breaker compartment door. The operating handle and the mechanical trip push button shall be at the front of the breakers panel. Mechanical Contact wear indicator shall be mounted directly on the moving contacts to indicate the degree of erosion of the contacts. The ACB shall be provided with a door interlock i.e. door should not be open when circuit breaker is closed and breaker should not be closed when door is open.

All current carrying parts shall be silver plated and suitable arcing contacts with proper arc chutes shall be provided to protect the main contacts. The ACB shall have double insulation (Class-II) with moving and fixed contacts totally enclosed for enhanced safety and in accessibility to live parts. All electrical closing breakers shall be with electrical motor wound stored energy spring closing mechanism with mechanical indicator to provide ON/OFF status of the ACB.

The auxiliary contacts blocks shall be so located as to be accessible from the front. The auxiliary contacts in the trip circuits shall open after the main contacts open. Minimum 4 NO and 4 NC auxiliary contacts or as per BOQ requirement w.r.t Manufacturer shall be provided on each breaker. Rated insulation voltage shall be 1000 volts AC.

7.2.2.1 Cradle:

The cradle shall be so designed and constructed as to permit smooth withdrawal and insertion of the breaker into it. The movements shall be free from jerks, easy to operate and shall be on Pin & Cam type/steel balls/rollers and not on flat surfaces.

There shall be 3 distinct and separate position of the circuit breaker on the cradle. Racking Interlock in Connected/Test/Disconnected Position.

- Connected Position: Main isolating contacts & control contacts of the breaker are Engaged

- Test Position: Main isolating contacts are isolated but control contacts are still engaged
- Isolated Position: Both main isolating & control contacts of the breaker are isolated
- There shall be provision for locking the breaker in any or all of the first three positions.
- The following safety features shall be incorporated:-

a) Withdrawal or engagement of Circuit breaker shall not be possible unless it is in open condition.
b) Operation of Circuit breaker shall not be possible unless it is fully in service, test or drawn out position.
c) All modules shall be provided with safety shutters operated automatically by movement of the carriage to cover exposed live parts when the module is withdrawn.
d) All Switchgear module front covers shall have provision for locking.
e) Switchgear operating handles shall be provided with arrangement for locking in 'OFF' position.
f) Actual Contact Inspection should be possible by removing Breaker from the panel – with mechanism connected to moving contacts of ACB.

7.2.2.2 Protections:

The breaker should be equipped within built battery backup microprocessor LCD display based release to offer accurate and versatile protection with complete flexibility and shall offer complete over current protection to the electrical system in the following five zones:

- Long time protection.
- Short time protection with intentional delay.
- Instantaneous protection.
- Ground fault protection.
- Neutral protection for 4 pole ACBs.

The protection release shall have following features and settings:

a. True RMS Sensing:

The release shall sample the current at the rate of 16 times per cycle to monitor the actual load current waveform flowing in the system and shall monitor the true RMS value of the load current.

b. Thermal Memory:

When the breaker shall reclose after tripping on overload, then the thermal stresses caused by the overload if not dissipated completely, shall get stored in the memory of the release and this thermal memory shall ensure reduced tripping time in case of subsequent overloads. Realistic Hot/Cold curves shall take into account the integrated heating effects to offer closer protection to the system.

c. Defined time-current characteristics:
A variety of pick-up and time delay settings shall be available to define the current thresholds and the delays to be set independently for different protection zones thereby achieving a close-to-ideal protection curve.

d. Trip Indication:

Individual fault indication for each type of fault should be provided by LEDs for faster fault diagnosis. ACB should display last 20 trip history with date time stamping.

e. The release shall meet the EMI / EMC requirements.

f. The setting range of release shall confirm to IEC- 60947 and its applicable sub-parts. All ACBs shall have over temperature protection of release.

All Incomer ACBs shall have temperature rise monitoring at cradle terminals and display thru protection release, LED/LCD display showing all Power & Energy Parameters (Currents, %loading, Voltages, Frequency, PF, Power & Energy (active, reactive & apparent) etc. All incomerACBs shall have following additional protections other than mentioned above:-

- Under and over voltage
- Under and over frequency
- Restricted Earth Fault protection
- Trip Circuit supervision with PS class CT's.
- Undercurrent, (for DG set only)
- Reverse power (for DG set only)
- Phase sequence reversal
- Load shedding and reconnection thru programmable contacts.

Release should have LCD display for Power parameters.

- Release should be able to capture short circuit current on which ACB has tripped. The trip and alarm shall be stored in memory with the date & time stamping along with type of fault and alarm.
- Release should be self-powered.
- Integral Test facility to test healthiness of release and the trip circuitry shall be provided on the Release.
- Programmable digital contact shall be provided with possibility to configure for pre alarm like over load, over temperature etc, and trip functions like OL/SC/EF/OT etc.

7.2.2.3 Safety Features:

- The safety shutter shall prevent inadvertent contact with isolating contacts when breaker is withdrawn from the Cradle.
- The incoming panel accommodating ACB shall be provided with indicating lamps for ON-OFF positions, digital voltmeter and ammeter of size not less than 96 mm x 96 mm, selector switches, MCB for protection circuit and measuring instrument circuits.
- Draw out breakers should not close unless in distinctservice/Test/Isolated positions.
- The insulation material used shall conform to Glow wire test as per
- IEC60695.
- The ACB shall provide in built electrical and mechanical anti-pumping.

7.2.3 Moulded Case Circuit Breaker (MCCB):

7.2.3.1 General:

- Moulded-Case Circuit Breakers (MCCB) shall comply with IEC 60947-1&2 standards.
- Earth Leakage Relay (30-3000mA) with CBCT shall be used for all outgoings MCCB.
- Earth Fault shall be provided for all incoming MCCB.
- MCCB shall be of category A with a rated service breaking capacity (Ics) equal to the ultimate breaking capacity (Icu) on all the ratings.
- MCCB shall have designed operational voltage upto690 V AC (50/60 Hz).
- MCCB shall have a rated insulation voltage of 690 V AC (50/60 Hz)
- Indication lamp ON, OFF, TRIP shall be provided incomer MCCBs and ACB.
- MCCB must be available in Microprocessor (250A and above) / Thermal Magnetic (Up to 200 Amp.) type release.
- All MCCB should be fully rated up to 50 Deg C.
- All thermal magnetic MCCBs up to 160A shall be adjustable thermal and fixed magnetic type and 200A shall be adjustable thermal and adjustable magnetic type (Ir = 0.8 x In to 1.0).
- For microprocessor shall have following characteristics:-
- LI : (Ir=0.4 to 1xIn, Ii=1.5to 8xIn)
- LSI : (Ir=0.4 to 1xIn, Isd=1.5to 8xIn)
- MCCBs shall be permissible for mounting in all 3 axes (Vertical Wall, Laterally Rotated Walland Ceiling& Floor mounting) without any adverse effect on electrical performance. It shall have line load reversibility.

7.2.3.2 Construction & Operation:

- For maximum safety, the power contacts shall be insulated in an enclosure made of a thermosetting material from other functions such as the operating mechanism, the case, the trip unit and auxiliaries.
- MCCBs shall be actuated by a toggle or handle that clearly indicates the three positions: ON, OFF and TRIPPED.
- The operating mechanism shall be designed such that the toggle or handle can only be in OFF position (O) if the power contacts are all actually separated & in OFF position, the toggle or handle shall indicate the isolation position.
- MCCBs shall be equipped with a “push to trip” button in front to test operation and the opening of the poles.
- The MCCB should be have a trip-free mechanism that ensures the trip process is not prevented even if the operating mechanism is blocked or manually held in the "ON” position.
- The Microprocessor Release MCCBs should be equipped with non-saturable type CTs for reliable & accurate protection.
- All microprocessor based MCCBs should have display with battery back-up.
- All microprocessor based MCCBs should have precise current setting in one step.

7.2.3.3 Current Limit & Selectivity:

- MCCBs shall be Current Limiting type.
- MCCBs, the current ratings of which are identical with the ratings of their trip units, shall ensure selectivity in rated current interval 1:1.6

- -MCCBs shall be equipped with a test facility of the Release by a hand-held device.

7.2.3.4 Accessories:

- MCCBs shall have uniform Internal Accessories platform across the range
- MCCBs Door Mounted Extendible Rotary Handle shall have an option of Illumination Kit to indicate three stable mechanism positions (ON, OFF and TRIPPED).
- MCCBs with TMTU Release should have provision for separate Short Circuit Signal facility.
- MCCBs shall be snap fit type to enable safe on-site installation of auxiliaries, voltage releases, signal contacts etc.
- MCCBs should have symbols engraved in the lid of the accessories compartment to indicate possible mounting position of internal accessories.
- The addition of a motor module or manual rotary handle etc. shall not block device settings.
- MCCB shall be equipped with Phase barrier, tinned copper spreaders.

7.2.3.5 Communications:

- All incomers ACBs & MCCBs in main LT panel and distribution panel shall be BMS compatible in open protocol.

7.2.4 Moulded Case Circuit Breaker (MCB):

Miniature Circuit Breaker shall comply with IS/IEC 60898-1:2002& EN 60947-2 or IEC-60947-2. Miniature circuit breakers shall be quick make and break type for 240/415 VAC 50 Hz application with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10 KA at 415 VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting type (Class-3). MCBs shall be classified (C, D ref IS standard) as per their Tripping Characteristic curves defined by the manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values.MCB shall ensure complete electrical isolation & downstream circuit or equipment when the MCB is switched OFF.

The housing shall be heat resistant and having high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP, TPN and 4 Pole miniature circuit breakers shall have a common trip bar independent to the external operating handle.

7.2.5 Meter:

The digital meters shall conform in all respects to International standards –IEC 62053-21-22 or the relevant Indian standards, RoHs compliance with latest amendments thereof.

- All voltmeters and indicating lamps shall be through Control MCB’s.
- Meters and indicating instruments shall be flush type.
- All CT’s connection for meters shall be through Test Terminal Block (TTB).
- CT ratio and burdens shall be according to connected instrument and load.

Digital Multi-Function meter shall be provided in all incomers in main LT panels and distribution panels as shown in SLD, having following characteristics:-

- Digital Electronic multi-function meter with RS-485 port with THD with individual harmonics up-to 31st order and THDi to measure and display the following electrical parameters:-
- Total active energy(KWH/MWH),
- Maximum demand(KVA/MVA)(KW/MW),
- Maximum demand reset count,
- Instantaneous power factor,
- High/Low recording of VLL, VNL, A, Hz, PF, Var, with time stamp.
- K factor V & A to keep check on the losses due to harmonic load current and their effects of transformer heating.
- Load Manager with Demand monitoring and RTC based demand manager.
- Export/Import Net monitoring of Wh, VAH, VArh, inductive/capacitive load hours.
- Auto Scaling Capability in variance of Kilo, Mega, Giga.
- Positive energy accumulation even with CT polarity reversal with reverse lock programmable.
- Byte order option-Field Programmable float/Little Endian/Big Endian data formats.

7.2.5.1 General Requirements:

- CT polarity correction should be possible through Energy Meter for each phase.
- Import/ Export measurement for KWH/ KVARH is required.
- The current inputs shall be configurable at site for measuring x/5/1 A current transformers
- The meters shall be suitable for operation with AC auxiliary power and shall have wide tolerance band of 70V to 300V, 40-70Hz
- The multifunction meters shall have backlit LCD display with power saving mode/ adjustable contrast.

7.2.6 Current Transformer:

Current transformers shall be provided for Distribution panels carrying current in excess of 60 amps. All phase shall be provided with current transformers of suitable VA burden with 5/ 1 amps secondary for operation of associated metering. The CTs shall confirm to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitable to a terminal block which shall be easily accessible for testing and terminal connections. The protection CTs shall be of accuracy class 5P10 and measurement CTs shall be of accuracy class as per SLD.

7.2.7 Residual Current Circuit Breaker (RCCB):

7.2.7.1 System of Operation:

Residual Current Circuit Breaker shall confirm to IEC 61008.RCCB shall work on the principle of core balance transformer. The incoming shall pass through the torroidal core transformer. As long as the currents in the phase and neutral shall be the same, no electro motive force shall be generated in the secondary winding of the transformer. In the event of a leakage to earth, an unbalance shall be created which shall cause a current to be generated in the secondary winding, this current shall be fed to a highly sensitive miniature relay, which shall

trip the circuit if the earth leakage current exceeds a predetermined critical value. RCCB shall be current operated independent of the line voltage; current sensitivity shall be of 30 mA at 240/415 volts AC and shall have a minimum of 20,000 electrical operations.
RCCBs should have a rated conditional short-circuit current of 10 kA.

7.2.7.2 Mechanical Operation:

The moving contacts of the phases shall be mounted on a common bridge, actuated by a rugged toggle mechanism. Hence, the closing /opening of all the three phases shall occur simultaneously. This also shall ensure simultaneous opening of all the contacts under tripping conditions.

7.2.7.3 Neutral Advance Feature:

The neutral moving contact shall be so mounted on the common bridge that, at the time of closing, the neutral shall make contact first before the phases; and at the time of opening, the neutral shall breaks last after allowing the phases to open first. This is an important safety feature, which is also required by regulations.

7.2.7.4 Testing Provision:

A test device shall be incorporated to check the integrity of the earth leakage detection system and the tripping mechanism. When the unit is connected to service, pressing the test knob shall trip the ELCB / RCCB.

7.2.7.5 Switchgear & Protection:

Incomer switchgear shall be TP breaker appropriate rating (minimum 1.8 times the normal current to take care of inrush switching current). Suitable contactor for each step shall be used and must be capable of capacitor switching duty at each step for short circuit protection.

Busbars shall be suitably colour coded and must be mounted on appropriate insulator supports. Power cables used shall have superior mechanical, electrical and thermal properties, and shall have the capability to continuously operate at very high temperatures up to 125 degC.

Internal wiring between main bus-bars, breaker, contactor and capacitors shall be made with 1100 V grade, PVC insulated, copper conductor cable of appropriate size, by using suitable copper crimping terminal ends etc.

Suitable bus links for input supply cable termination shall be provided.

7.2.7.6 Control Circuit & General Protection:

The control circuit shall be duly protected by using suitable rating MCB.

An emergency stop push button shall be provided to trip the entire system (22.5 mm dia, mushroom type, press to stop and turn to reset).

Wiring of the control circuit shall be done by using 1.5 sq.mm, 1100 V grade, PVC insulated, multi-stranded copper control wire.

Inspection terminal strip, number ferruling, labeling etc. shall be provided.

440 V caution board on the panel shall be provided.

8 LIGHT FIXTURES AND FAN

Note: - All the components, materials, accessories of Light Fixtures shall be supplied & designed as per -30o C ambient temperature and 3525 meters MSL. If the specification of items will increase as per the altitude above, the feasible specification shall be followed without cost increase.

The contractor shall submit LM 79 report of the LED Luminaries& LM 80 report from LED manufacture before fixture supplied at site. Driver of the LED fitting should by Potted. The make of LED used shall be Osram/Cree/Nichia/Philips/Lumiled.

All lighting fixtures shall comply the following specifications to meet out the requirement according to relevant CPWD specification/IS code/NBC-2016/ECBC-2017 whichever is high.

- Lumens >certain value as specified in drawings
- Efficacy >100 for indoor lighting fixtures and >120 for highway and outdoor luminaries.
- CRI >80 for indoor lighting and 70 for external lighting
- Power Factor >0.95
- THD <10
- Surge Protection 2.50KV for indoor and 5 KV for outdoor lighting fixtures.
- Operating voltage 150-270 volt.
- Useful life of LED's 50000 hours @ L70

9 EARTHING

This chapter covers the essential requirements of earthing system components and their installation. For details not covered in these specifications IS Code of Practice on Earthing (IS: 3043-1987) shall be referred to.

9.1 Application:

a) The electrical distribution system in the Department is with earthed neutral (i.e. neutral earthed at the transformer/generator end). In addition to the neutral earthing, provision is made of earthing the metallic body of equipment and non-current carrying metallic components in the sub-station as well as in the internal/external electrical installations.

b) Earthing system is also required for lightning protection, computer installations and hospital operation theaters etc. for functional reasons.

c) Earthing requirements are laid done in Indian Electricity Rules, 1956, as amended from time to time and in the Regulations of the Electricity Supply Authority concerned. These shall be complied with.

d) Application for Internal E.I:

(i) The Every sub-main will have earth continuity conductor to run along with sub-main wiring. In case of 3-phase sub-main wiring two earth continuity conductors shall be provided.
(ii) Every circuit will have its earth continuity conductor to run along with circuit wiring. N case of 3-phase circuit two earth continuity conductors shall be provided.
(iii) Looping of earth is allowed only in case of point wiring.
(iv) When 2/3 power outlets are looped to one circuit, earth looping of these outlets is permissible.

9.2 Types of Electrodes & Material:

9.2.1 Earth Electrodes:

The type of earth electrode shall be any of the following as specified: Plate Earth Electrode

9.2.2 Electrodes Materials and dimensions:

a) Pipe electrodes shall be cut tapered at the bottom and provided with holes of 12mm dia, drilled not less than 7.5 cm from each other upto 2m of length from the bottom.

b) The length of the buried strip or conductor earth electrode shall be not less than 15m. This length shall suitably be increased if necessary, on the basis of the information available about soil resistance so that the required earth resistance is obtained. Prior approval of the Engineer-in-Charge shall be taken for any such increase in length.

c) All hardware items used for connecting the earthing conductor with the electrode shall be of GI in the case of GI pipe and GI plate earth electrodes and forged tinned brass in case of copper plate electrodes.

9.2.3 Earthing Conductor & Sizes:

a) The earthing conductor (protective conductor from earth electrode up to the main earthing terminal/earth bus as the case may be) shall be of the same material as the electrode viz. GI or copper and in the form of wire or strip as specified.

b) The size of earthing conductor shall be as specified in Drawing/ SLD/ BOQ but this shall not be less than the following:

(i) 4mm dia (8SWG) copper wire.
(ii) 8SWG GI wire
(iii) 25mm x 3mm in case of GI strip
(iv) 20mm x 3mm in case of Cu Strip

c) Earthing conductor larger than the following sectional areas need not be used unless otherwise specified:

(i) 150 sq. mm in case of GI
(ii) 100 sq. mm in case of Cu

d) The sizes and cross sections of conductors shall be followed as per table below:

S.No.	Type of Electrode	Material	Size
1	Plate	GI	600mm x 600mm x 6mm thick
		Copper	600mm x 600mm x 3mm thick

Note: Galvanized of GI items shall conform to Class – IV of IS: 4736-1986.

9.2.4 Earth Continuity/ Loop Earthing Conductor & Sizes:

The material and size of protective conductors shall be as per below table or as specified in Drawing/ SLD/ BOQ whichever higher:

S.No.	Size of Phase Conductor	Size of Earth Conductor
1	Upto 6 sqmm	6 sqmm
2	Above 6 sqmm upto 16 sqmm	6 sqmm
3	Above 16 sqmm	Half of the phase conductor

9.2.5 Location for Earth Electrodes:

a) Normally an earth electrode shall not be located closer than 1.5m from any building. Care shall be taken to see that the excavation for earth electrode does not affect the foundation of the building in such cases, electrodes may be located further away from the building with the prior approval of the Engineer-in-Charge.

b) The location of the earth electrode will be such that the soil has a reasonable chance of remaining moist as far as possible. Entrances, pavements and roadways should be avoided for locating earth electrodes.

9.3 Installation:

9.3.1 Electrodes:

a) Artificial Treatment of Soil:

(i) When artificial treatment of soil is to be resorted to, the same shall be specified in the schedule of work. The electrode shall be surrounded by charcoal/coke and salt.

b) Watering Arrangement:

(i) In the case of plate earth electrodes, a watering pipe 20mm dia. Medium class pipe shall be provided and attached to the electrodes. A funnel with mesh shall be provided on the top of this pipe for watering the earth.
(ii) In the case of pipe electrodes, a 40mm x 20mm reducer shall be used for fixing the funnel with mesh.
(iii) The watering funnel attachment shall be housed in a masonry enclosure of the size not less than 30cm x 30cm x 30cm.
(iv) A cast iron/MS from with MS cover, 6mm thick and having locking arrangement shall be suitably embedded in the masonry enclosure.

9.3.2 Earthing Conductor (Main Earthing Lead):

a) In the case of plate earth electrode, the earthing conductor shall be securely terminated on to the plate with two bolts, nuts, check nuts and washers.

b) In the case of pipe earth electrode, wire type earthing conductor shall be secured using a through bolt, nuts and washers and terminating socket.

c) A double C-clamp arrangement shall be provided for terminating tape type earthing conductor with GI watering pipe coupled to the pipe earth electrode. Galvanized “C” shaped strips, bolts, washers, nuts and check nuts of adequate size shall be used for the purpose.

d) The earthing conductor from the electrode up to the building shall be protected from mechanical injury by a medium class, 15mm dia. GI pipe in the case of wire and by 40mm dia, medium class GI pipe in the case of strip. The protection pipe in ground shall be buried at least 30cm deep (to be increased to 60cm in case of road crossing and pavements). The portion within the building shall be recessed in walls and floors to adequate depth in due co-ordination with the building work.

e) The earthing conductor shall be securely connected at the other end to the earth stud/earth bar provided on the switch board by:

(i) Soldered on preferably crimped lug, bolt, nut and washer in the case of wire.
(ii) Bolt, nut and washer in case of strip conductor.

In the case of substations or alternators, the termination shall be made on the earthing terminal of the neutral point on the equipment and/or the earth bus, as the case may be.

9.3.3 Loop Earthing/ Earth Continuity Conductor:

a) Earth terminal of every switchboard in the distribution system shall be bonded to the earth bar/ terminal of the upstream switch board by protective conductors.

b) Two protective conductors shall be provided for a switchboard carrying a 3-phase switchgear thereon.

c) Loop earthing of individual units will not be however necessary in the case of cubicle type switchboards.

d) The earth connector in every distribution board (DB) shall be securely connected to the earth stud/earth bar of the corresponding switch board by a protective conductor.

e) The earth pin of socket outlets as well as metallic body of fan regulators shall be connected to the earth stud in switch boxes by protected conductor. Where the switch boxes by protective conductor. Where the switch boxes are of non-metallic type, these shall be looped at the socket earth terminals or at an independent screwed connector inside the switch box. Twisted earth connections shall not be accepted in any case.

9.3.4 Prohibited Connection:

Neutral conductor, sprinkler pipes, or pipes conveying gas, water, or inflammable liquid, structural steel work, metallic enclosures, metallic conduits and lighting protection system conductors shall not be used as a earthing conductor.

9.4 Earth Resistance:

a) The earth resistance at each electrode shall be measured. No earth electrode shall have a greater ohmic resistance than 5 ohms as measured by an approve earth testing apparatus. In rocky soil the resistance may be up to 8 ohms.

b) Where the above stated earth resistance is not achieved, necessary improvement shall be made by additional provisions, such as additional electrode (s), different type of electrode or artificial chemical treatment of soil etc. as may be directed by the Engineer-in-Charge.

9.5 Marking:

a) Earth bars/ Terminals at all switch boards shall be marked permanently, either as “E” or as specified in Drawing/ SLD/ BOQ.

b) Main Earthing terminal shall be marked “Safety Earth- Do not Disconnect”.

10 HIGH VOLTAGE PANEL

These specifications cover the detailed requirements for supply, installation, testing and commissioning of 11kV THREE HT PANEL BOARD (OUTDOOR TYPE) SF6 VCB Panel.

10.1 Reference Codes and Standard:

The design of the switchgear shall be exclusive and specific responsibility of supplier and shall comply with current good engineering practice, the relevant codes and recommendation, the project specific requirement.
The electrical switchgear and the relevant equipment shall be designed, manufactured and tested according to the latest version of standards as listed below:

IEC 62271-1	Common Specifications for Switchgear & Control gear
IS 13118:1991 / IEC 62271-100	Vacuum Circuit Breakers

IS 3427 / IEC 62271-200	A.C. metal-enclosed switchgear and control gear for rated voltages above 1kV and up to and including 72kV and the IEC Code herein referred
IEC 60129	Alternating current Disconnector (isolators)
IS 2705	Current transformers
IS 3156	Voltage transformers
IEC 60255	Electrical relays
IEC 60529	Classification of degrees of protection provided by enclosures

10.2 Rating:

All panels assembled to form a board shall be suitable for the nominal operation voltage and rupturing capacity as specified and suitable for operation on 11kV 3Phase 50Hz system.

10.3 Material:

a) The HV Panel Board shall be made of CRCA sheet steel.
b) The HV panel shall be floor mounting and free standing type.
c) The sheet thickness shall be of 2mm and gland plate shall be 3mm thick or as mentioned BOQ.

10.4 General Construction Features:

a) Separately door earthed compartments shall be provided for circuit breakers, bus bars, relay & instruments, CT&PT and cable boxes, fully and effectively segregating these from one another so that fault in any one compartment do not cause damage to equipment(s) in other compartment(s).

b) The observation window on the Circuit Breaker compartment door shall be made of special toughened/ laminated glass of at least 6mm thick.

c) The switch board shall have passed internal arc faulted containment testing for each compartment for 1 second at the rated fault current of 21 kA for 11kV.

d) Each HV compartment should have individual exhaust channel/ pressure relief flaps to let out over-pressurized hot gases at the top of the switch board in case of an internal fault.

e) Suitable factory fitted arc duct arrangement shall be provided for vending out the arc out of the switchgear room.

f) Front access doors with single action operator will be provided to the HV circuit breaker compartment.

g) The housing shall be of bolted construction to ensure compact and rigid structure, presenting a neat and pleasing appearance.

h) The Degree of enclosure protection shall be IP-4X for Indoor and IP-5X for outdoor.

i) The panels shall be bolted together to form a continuous flush front switch gear suitable for front operation of board and for extension at both ends.

10.5 General Design Aspects:

The HV panel board shall be designed such that the switchgear, instruments, relays, bus bars, small wiring etc. are arranged and mounted with due consideration for the following:

a) Facility for inspection, maintenance and repairs of testing terminals and terminal boards for ease of external connection.
b) Minimum noise and vibrations.
c) Risk of accidental short circuits and open circuits.
d) Secured and vibration proof connections for power and control circuits.
e) Risk of accidental contact and danger to personnel due to live connections.
f) Mountings at approachable height min. 300mm max. 1800mm from finish floor level.

10.6 Circuit Breaker:

10.6.1 General Arrangement:

The circuit breaker panels shall be complete with the following:

a) Racking in/ racking out mechanism.
b) Isolating plugs and sockets.
c) Mechanical On/Off indicator.
d) Minimum of 4NO and 4NC auxiliary contacts directly operated by the circuit breaker. Additional NO & NC contacts can be provided with auxiliary contractors.
e) Anti- condensation space heaters suitable for operation on 240V 1Phase 50Hz AC for each panel wherever specified.
f) Suitable tripping arrangement.
g) Mechanical counter to assess the total number of operations of the breaker (If asked for specifically).

10.6.2 Type:

The circuit breaker shall be of horizontal/ vertical isolation, horizontal draw out pattern.

10.6.2.1 Breaker Truck:

a) The breaker carriage shall be fabricated from steel, providing a sturdy vehicle for the circuit breaker and its operating and tripping mechanism.
b) The carriage shall be mounted on wheels, moving on guides, designed to align correctly and allow easy movement of the circuit breaker and for removing the carriage for inspection and maintenance purpose.
c) Vacuum interrupters shall be hermetically sealed and shall be designed for minimum contact erosion, fast recoveries of dielectric strength, maintenance free vacuum interrupter, suitable for auto-reclosing.
d) The drive mechanism shall preferably be provided with facility for pad locking at any position namely, “Service”, “Test” and “Fully Isolated”.

e) It should be possible for testing the circuit breaker for its operation without energizing the power circuit in the “Testing” position.
f) The contacts shall be made only after the breaker is inserted into service position.
g) Interlocking should prevent contacts from being disconnected if circuit breaker is tried to be moved from service position.

10.6.2.2 General Features:

Single break contacts are provided in sealed vacuum interrupter.

10.6.2.3 Rating:

The circuit breakers shall be continuously rated as specified with a minimum rated current as specified in BOQ with voltage rating and breaking capacity as specified.

10.6.2.4 Operating Mechanism:

The operating mechanism shall be one of the following as specified:

a) Manually operated spring charged

b) Motor wound spring charged with both mechanical and electrical release for closing.

The operating mechanism shall be trip free.

10.6.2.5 Auxiliary Supply:

External Auxiliary supply shall be made available for charging motors and heaters operation.

10.6.3 Bus bar Section:

10.6.3.1 General Requirement:

The switch board shall be single bus bar pattern with air insulated encapsulated bus bars housed in a separate compartment, segregated from other compartments.

10.6.3.2 Material:

The bus bars shall be of high conductivity electrolytic copper rated as specified in SLD and BOQ whichever higher.
The bus bars shall be sized for carrying the rated and short circuit current without over- heating. Maximum bus bar temperature shall not exceed 95 degree C.
The switchgear and control gear shall be suitable for continuous operation under the basic service conditions indicated below or as per site conditions whichever high:

S.No.	Conditions	Specification
1.	Ambient Temperature	(-5) to (50) Deg C
2.	Relative Humidity	Up to 95%

3.	Altitude of Installation	Up to 1000m above MSL

10.6.4 Circuit Breaker Compartment:

Comprising the with-drawable Vacuum Circuit breaker for 12kV voltage level and all accessories required for its operation. To ensure the integrity of the arc fault containment requirement, the operations must be carried out with the switchgear doors closed i.e. circuit breaker for opening and closing, racking of circuit breaker (or withdraw-able voltage transformer) between service and test position.

Circuit breaker compartment door must be pad lockable.

Access between the circuit breaker (or withdraw-able voltage transformer) and bus bar/ cable compartments shall be made through epoxy encapsulated spout bushings of uniform shape and dimension. Spouts are covered by automatic metal shutters, covering all three phases unless the circuit breaker is in service position.

10.6.4.1 Circuit Breakers:

a) Circuit breaker shall be withdraw-able Vacuum type of floor rolling design. The complete assembly of interrupters, contact pressure springs and HV terminals (top and bottom) shall be type tested for compatibility of design.
b) Vacuum interrupters sourced from China shall not be acceptable even if it is from manufacturer of the CB.
c) The circuit breaker shall be suitable for E2, M2 & C2 (Single Capacitor Bank) class duty. The offered circuit breaker should have valid type tests to support the afore- mentioned duty cycle.
d) The circuit breaker shall be isolated by horizontal racking and positively fixing the unit into any one of the following positions:
e) Service Position: Main & Auxiliary circuit connected.
f) Test Position: Main circuits disconnected auxiliary circuits connected. Circuit breaker in its isolated position shall be completely contained in the apparatus compartment with shutters on main circuit closed and compartment front door closed.
g) Withdrawn Position: Main circuits and auxiliary circuits disconnected. Circuit breaker is removed out of the cubicle.
h) Locking of circuit breaker compartment door shall be possible by means of padlocking.
i) A position indicator switch or viewing window must be provided for visual indication of the circuit breaker position.
j) The circuit breaker control auxiliaries shall be of the plug and socket type.
k) The circuit breaker truck shall ensure earthing in both connected and disconnected positions.
l) An electro mechanical device shall be provided to ensure the auxiliary circuit have been securely connected between the fixed and moving portions of the switchgear, before allowing closing operation of the circuit breaker. The voltage rating of the device shall be same as the voltage used for the closing circuit.
m) Tripping and/ or release coils shall be continuous rated to ensure longer life.
n) The switchgear shall be provided with facilities for full operation from a remote point.
o) Circuit breakers shall be equipped with a motor wound spring stored energy operating mechanism with opening and closing operations independent of the operator, electric close and trip releases, manual on/ off buttons and manual spring charging facilities.

p) It shall be possible to manually charge the circuit breaker operating spring in case of auxiliary supply failure.
q) Mechanical indication of the spring charged condition shall be provided.
r) Circuit breakers shall be provided with a mechanically operated visual indicating device to display the circuit breaker switching state and a mechanical operation counter.
s) The circuit breaker operations of closing and opening shall be possible with the circuit breaker compartment door closed.
t) It shall be possible to trip the circuit breaker locally by mechanical means.
u) Circuit breakers will be provided with at least one spare normally open and one spare normally closed contact, even wired out to terminals for the connection of external wiring.
v) Circuit breakers shall be mechanical latching and electrical and mechanical tripping. The operating mechanism shall be trip-free and shall include an anti-pumping device.

10.6.5 Shutters:

a) Circuit breaker compartment should have automatic shutters, which shall be opened and closed by the mechanical drive of the circuit breaker.

b) The bus bar and circuit spout covers shall be operated independently of each other.

c) Padlock facilities can be provided on the metal shutters.

10.6.6 Current Transformer:

10.6.6.1 General Requirement:

Accommodation shall be provide in the circuit breaker panel to mount one set of three numbers dual core ratio CTs for metering and protection purposes. Access to the CTs for cleaning, testing or charging shall be from the front, back or top of the panel. All current transformers shall comply with IS 2705.

10.6.6.2 Rating:

a) Dual core & dual ratio CTs of suitable burden (but not less than 15 VA) shall be preferred with 1 Amps secondary. CT ratio shall be compatible with the loading pattern on HV side.
b) The CTs shall confirm to relevant Indian Standards. The design and construction shall be robust to withstand thermal and dynamic stresses during short circuit. Secondary terminals of CTs shall be brought out suitably to a terminal block which will be easily accessible for testing and terminal connections. The protection CTs shall be of accuracy class 5P10 of IS 2705- Part III 1992.
c) The metering CTs shall conform to the metering ratio and accuracy class 0.5 for 11kV panel and class 0.2 for 33kV panel of IS 2705-1992.

10.6.7 Voltage Transformer:

10.6.7.1 General Requirement:

A voltage transformer of burden not less than 100VA and of proper ratio as per total system requirement. All voltage transformers shall comply with IS 3156.

The accuracy class for the VT shall be class 0.5 for 11kV and 0.2 for 33kV as per IS 3156 Parts I to III.

The transformer shall be of cast epoxy resin construction. It shall be fixed/ withdraw-able type. Control SP HRC fuses/ MCBs shall be provided on both HV and LV sides.

10.6.7.2 Protection and Tripping Arrangement:

Protection:

a) The relays shall be microprocessor based numerical relays with O/L, E/F and S/C protection. Tripping relay shall be used for tripping signal to the shunt trip coil of circuit breaker operating on 24V/ 30V DC supply/ Power Pack/ 110 Volt VT supply.

b) Alternatively, Power Pack converters fed could be provided. In cases where tripping is fed through PT, VA burden of PT shall be suitably increased depending upon the number of panels and connected controls/ Load etc.

c) 12V/ 24V/ 48V DC output shall be provided through power pack capacity as per system requirement for both protection as well as indications.

Input	:	90-130V
Battery	:	7 AH/ 18 AH/ 22 AH SMF type
Indicator	:	Mains on charger ON fails & DC ON

Relays:

a) The offered relay should be numerical and communicable design and should be of flush mounting design. The relay should be designed for selective protection of feeders in utility and industrial power systems in primary as well as secondary distribution network.

b) The offered relay shall have minimum 5 fault records and 100 event records with date and time stamp. It should have an universal auxiliary supply.

c) The relay shall be communicable on standard Modbus open protocol with at least one communication port. The relay shall offer multi-level password protection to guard against unauthorized access.

d) The relay should have a 2 x 16 character LCD display and support on-line current measurement and display in primary values. The relay should have 3 dedicated LEDs for ready, start & trip and 3 separate LEDs for fault indications.

e) Inrush protection should be a built in feature for stability during transformer energizing. Offered relay should also have built in trip circuit supervision feature.

f) Relay should have minimum of 4 nos of galvanically isolated and freely configurable binary inputs. It should also have 6 nos of binary outputs, out of which a minimum of 2 nos should be of sufficient rating to trip the circuit breaker.

g) Relay should offer 51, 51N, 50-1, 50-2 & 50N.

Control Wiring:

Control wiring shall be carried out with 1100V grade FRLS PVC insulated copper flexible wire and following colour standard.

S.No.	Control Circuits	Size and Colour
1.	AC Voltage Circuit	2.5Sqmm Red, Yellow, Blue and Black
2.	Current Circuit	2.5Sqmm Red, Yellow, Blue and Black
3.	AC Current Circuit	
i.	Phase	2.5Sqmm Red
ii.	Neutral	2.5Sqmm Black
4.	DC Voltage Circuit	
i.	(+)	2.5Sqmm Red
ii.	(-)	2.5Sqmm Black
5.	Grounding	2.5Sqmm Green

Note: The wiring shall be securely fixed and neatly arranged to enable easy tracing of wires. Identification tags shall be fitted at both ends to all power and control wire terminals to render identification easy and to facilitate checking in accordance with IS 375. Necessary terminal blocks and cable entries shall be provided for RTD relay wiring, power supply etc.

10.6.8 Metering Instrument, Panel Accessories (Digital):

10.6.8.1 Metering with RS485 Port:

The digital meters shall conform in all respects to international standards –IEC 62305-21-22 or the relevant Indian Standards, RoHS compliance with latest amendments thereof. MFM shall be provided in all incomers and outgoings as shown in SLD/ BOQ, having following characteristics:

a) Bright LED display with more than 25 Parameters: VLL, VLN, A, Hz, W, PF, VA, Wh.
b) Load hours, run hours, old Wh, Old load hour.
c) Auto scaling capability in variance of kilo, Mega, Giga.
d) High accuracy with class 0.5 for 11kV/ Class 0.2 for 33kV.
e) Positive energy accumulation even with CT polarity reversal with reversal with reverse lock programmable.
f) Password protection for tamer proofing.
g) Site selectable CT/ PT ration.
h) Site selectable CT secondary 1A/ 5A.
i) Input Voltage- 80-300V AC/ DC, 40-70Hz.
j) Seamless integration into any Modbus compatible SCADA Energy Management System (EMS).

10.6.9 Voltage Selection Scheme:

Where a bus coupler is incorporated and only one incomer feeder (out of two available) is intended to be operated at a time, a VT Transfer Relay shall be incorporated to provide necessary potential for metering. This will be necessary when energy metering is done on individual feeders or where VT supply is used for trip circuits. Alternatively PTs shall be provided on both the bus sections (incomers) with individual metering on each incomer.

10.6.10 Instrument Panels:

The instrument panel shall form part of the housing. They shall be preferably of flush mounting type at a maximum height of 1800mm.

Instrumentation:

The panel assembly shall also take care of the following requirements:

a) Lamp indication shall be provided to indicate ON/ OFF (by red green respectively) of switch gear.
b) Panel illumination lamp.
c) Mechanical indicating lamp for spring charged status.
d) Lamp indicating tripping at fault status.
e) Healthy trip supply shall be indicated by clear lamp.
f) Separate fuses/ MCBs shall be provided for lamps, heaters, voltmeters and other instrumentation etc. on each panel.
g) Anti-condensation space heater shall be provided and shall be suitable for operation on 240V, 1Phase, 50Hz AC for each panel.
h) Where there is more than one incomer and bus sections, these shall be castle key interlocked as per interlocking scheme as specified.

10.6.11 Cable Boxes:

Cable boxes shall be situated in a compartment at the rear/ side of the housing as specified.

10.6.12 Cable Entry:

Provision for top (bus ducts preferred for top entry only)/ bottom or such other side entry shall be made as per requirement with sufficient head room for cable termination.

10.6.13 Earthing:

The earthing of the breaker body and moving portion shall be so arranged that the earthing of the non-current carrying structure to the frame earth bar is completed well before the main circuit breaker plugs enter the fixed house sockets.

The entire panel board shall have a common tinned copper earth bar of suitable section with 2 earth terminals for effectively earthing metallic portion of the panels. The frame earthing of panel shall be provided 50x6mm hot dipped GI strip.

10.6.14 Installation:

The installation work shall cover assembly of panels lining up, grouting the units etc. In the case of multi panels switch boards after connecting up the bus bar all joint shall be insulated with HV insulation tape or with approved insulation compound.
Where trip supply battery is installed the unit shall be commissioned, completing initial charging of batteries. All relay instruments and meters shall be mounted and connected with appropriate wiring. Calibration checks of units as necessary and required by the licensee like CTs, VTs Energy Meters etc. shall be completed before pre-commission checks are undertaken.

10.6.15 Testing and Commissioning:

Procedure for testing and commissioning of relay shall be in general accordance with good practice.
Commissioning checks and tests shall include in addition to checking of all small wiring connections, relays calibration and setting tests by secondary injection method and primary injection method. Primary injection test will be preferred for operation of relay through CTs.
Before panel board is commissioned, provision for the safety namely fire extinguishers, rubber mats and danger board shall be ensured. In addition all routine megger tests shall be performed. Checks and test shall include following:

a) Operation checks and lubrication of all moving parts.
b) Interlock function checks.
c) Continuity checks of wiring, fuses etc.as required.
d) Verification of wiring
e) Trip test and protection gear tests.
f) The complete panel shall be tested with 5000V megger for insulation between poles and poles to earth. Insulation test of secondary of CTs and VT to earth shall be conducted using 500V megger.
g) Any other tests as may be required by the Licensee/ Inspector shall be conducted.
h) Where specified, the entire switch board shall withstand high voltage test after installation.
i) Any other test required by the consignee/ inspecting officer.
j) Withstand voltage at power frequency and on auxiliary circuits.
k) Visual inspection, operation of functional locks, interlocks, signaling devices and auxiliary devices.
l) Suitability and correct operation of protections, control instruments and electrical connections of the circuit breaker operating mechanism.
m) Measurement of the resistance of the main circuit.

10.6.16 Quality Control:

The bidder shall submit with the offer, assurance plan indicating the various stages of inspection, the tests and checks which will be carried out on the material of construction, components during manufacture and after finishing, bought out items and fully assembled component and equipment including drives. As part of the plan, a schedule for stage and final inspection within the parameters of the delivery schedule shall be furnished. The Purchaser's or its nominated representative engineer shall have free access to the manufacturer/sub-supplier's works to carry out inspections.

10.6.17 Testing Facilities:

Bidder shall have adequate in house testing facilities for carrying out all routine tests & acceptance tests as per relevant International / Indian standards.

10.6.17.1 Manufacturing Activities:

The successful bidder will have to submit the bar chart for various manufacturing activities clearly elaborating each stage with quantity. This bar chart shall be in line with the Quality Assurance Plan submitted with the offer. This bar chart will have to be submitted within 15 days from the release of the order.

10.6.17.2 Drawings & Documents:

Following drawings and documents shall be prepared based on PURCHASER specifications and statutory requirements and shall be submitted with the bid:

a) Completely filled in Technical Particulars
b) General description of the equipment and all components including brochures.
c) Power flow diagram
d) Foundation plan
e) Bill of material
f) Experience List
g) Type test certificates

11 TRANSFORMER

This chapter covers the detailed requirements for Oil Type Step Down Transformers. The transformer shall be Outdoor Type, Three Phase, 50Hz, copper wound, core type, Delta/ Star, Dyn-11, oil cooled with Off Load Tap Changer.

11.1.1 Reference Codes and Standards:

The transformer shall conform to the following Indian Standard specifications with up-to date amendments:

S.No.	Description	Reference Standard
1.	Fittings and Accessories for Power Transformers	IS:1180- 1 (1989)
2.	Outdoor/Indoor Type Oil Immersed Distribution Transformers Up to and Including 2 500 kVA, 33kV — Specification: Part 1 Mineral Oil Immersed (Fourth Revision).	IS:1180- 1 (2014)
3.	Outdoor type three phase distribution transformers up to and including 100kVA 11 kV Part 1: Sealed type	IS:1180- 2 (1989)
4.	New insulating oils	IS:335 (1993)
5.	Code of Practice for Selection, Installation and Maintenance of Transformers, Part 1:	IS:10028-1 (1985)

	Selection	
6.	Code of Practice for Selection, Installation and Maintenance of Transformers, Part 2: Installation	IS:10028-2 (1985)
7.	Bushings for alternating voltages above 1000 Volts	IS:2099 (1986)
8.	Guide for loading of oil immersed transformer	IS:6600 (1972)
9.	Method of impulse voltage testing	IS: 2070
10.	Gas Operated Relays	IS: 3637 (1966)
11.	Fittings and Accessories for Power Transformers	IS: 3639 (1966)
12.	Power transformers, Part 1: General	IS: 2026-1 (2011)
13.	Power transformers, Part 2: Temperature-rise	IS: 2026-2 (2010)
14.	Power Transformers Part - 3 Insulation Levels, Dielectric Tests and External Clearances in Air	IS: 2026-3 (2009)
15.	Power Transformers Part - 4 Terminal Marking and Tapping's and connections	IS: 2026-4 (1977)
16.	Power Transformers Part - 5 Ability to Withstand Short Circuit	IS: 2026-5 (2011)
17.	Power Transformers Part - 7 Loading Guide for Oil- Immersed Power Transformers	IS: 2026-7 (2009)
18.	Power Transformers Part - 8 Application Guide	IS: 2026-8 (2009)
19.	Power Transformers Part - 10 Determination of Sound Levents	IS: 2026-10 (2009)
20.	ECBC	2017 or Latest as on Date

11.1.2 Transformer Detailed Specifications:

11.1.2.1 Transformer Operation:

a) The transformer shall be suitable for operation on 11kV or 33kV as per BOQ, 3Phase 50 Cycle earthed system.
b) Connected Delta on HV side and Star on LV side with neutral brought out for independent earthing (Vector Group Dyn-11). So as to produce a positive displacement of 30 degree from primary to secondary vectors of the same phase. The neutral of the secondary windings shall be brought out to two separate insulated terminals.

11.1.2.2 Power Supply Parameters:

The transformer shall be capable of continuous operation at specified rating under the following conditions:

Voltage Variation : -7.5% to +7.5% (or as specified in BOQ)

Frequency Variation : 50Hz +/- 5%

The no load voltage ratio of the transformer shall be 11000/433 volts or 33000/433 volts as per BOQ percentage impedance shall be as per IS/ BEE/ ECBC whichever is higher.

11.1.2.3 Climatic Conditions:

The reference ambient temperatures assumed for the purpose of this specification are as follows:

a) Ambient temperature: Maximum +50 Degree C. and minimum -5 Degree C
b) Maximum Daily Average Temperature: 45 Degree C
c) Yearly weighted average ambient temperature: Maximum +38 Degree C and Minimum +3 Degree C.
d) Temperature rise at the above condition and at the altitude not exceeding 1000m.
e) The transformer shall conform to the requirements of temperature rise specified in IS: 1180 latest as on date. Continuously rated for full load, temperature rise not to exceed 50 Degree C by thermometer in oil (55 Degree C by Resistance), over an ambient as specified above.
f) The transformer shall be free from annoying Humming sound or Vibration. The design shall be such as not to cause any undesirable interference with radio or communication circuits.

11.1.2.4 Transformer Material:

The material used in the manufacture of the transformer shall be of the best quality of their respective kind available as per standard specification:

a) The high voltage and low voltage windings shall be made of copper conductors.
b) The insulation material used shall be of insulation class A.
c) The magnetic iron core shall be made of high grade alloy, low loss grain oriented cold rolled steel stampings (CRGO).

11.1.2.5 Transformer Tapping:

a) The tapping shall be arranged on the high voltage windings and off Circuit Tap Changing with rotary links on HV side.
b) The tapping shall be provided for variation on HV side from + 7.5 % to -7.5% in steps each of rated voltage at constant kVA output or as specified in BOQ.

11.1.2.6 Enclosure:

a) The standard construction shall be of 2mm thick weld able mild steel sheet powder coated finish after rigorous cleaning and surface treatment.
b) The transformer shall be provided with adequate provision for ventilation.
c) The degree of protection of enclosure shall be minimum IP: 55.

11.1.2.7 Class of Insulation:

The specification for different class of insulation shall be followed as per below table:

S.No.	Type	Max. Operating Temperature	Material Used
1.	Y	90ºC	Cotton, silk, paper and similar organic material and combination of such material which are not (impregnated) nor immersed in oil.
2.	A	105ºC	Above materials impregnated with Varnish or enamel or oil immersed.
3.	E	120ºC	Comprise inorganic materials such as mica, glass fiber asbestos or Combination of these materials in built up form with binding cement.
4.	B	130ºC	
5.	F	155ºC	Class –B materials when built up with suitable cement or binder.
6.	H	180ºC	Consists of materials or Combination of materials such as mica, glass fiber Silicon elastomer with suitable winding, impregnating or coating substances as silicon resins.
7.	C	Above 180ºC	Materials such as mica Porcelain, glass quartz and asbestos with or without an inorganic binder.

11.1.3 Transformer Oil:

a) The insulating oil used in Transformer shall comply with the requirement of IS: 335.

b) If the transformer is filled up with oil and transported to site, then 10% oil shall be supplied extra in non-returnable containers/ drums suitable for outdoor storage.

c) In case, transformer is sent with-out oil, then full quantity of transformer oil along with 10% extra shall be supplied in non- returnable containers/ drums suitable for outdoor storage.

11.1.4 Transformer Oil Type:

The transformer shall be oil immersed natural air cooled type (ONAN).

11.1.4.1 Transformer Termination:

a) The transformer shall have cable boxes made of 2mm CRCA sheet with suitable glands and 3mm cable sockets for receiving 11kV/ 33kV XLPE cables on the HV side as specified in SLD.

b) On the LT side the transformer shall have a suitable terminal arrangement with extended bus bars to received 415 volt Bus duct with aluminium / Copper bus bars or XLPE Cable or as specified in SLD.

c) The terminal markings shall be clearly and permanently shown. Painted markings are not acceptable. The windings shall be labeled as follows:

High Voltage : 3 Phases and Neutral U V W
Low Voltage : 3 Phases and Neutral u v w n
Terminals U, V, W and u,v,w shall be connected to phases R, Y, B respectively.

11.1.4.2 Temperature Rise Test:

Thermistor sensors shall be embedded in the low voltage winding for warning and tripping, for temperature control. The temperature detectors shall be suitable for 24 volts D.C. Temperature rises shall not exceeding 45 Degree C corresponding to class A over the ambient as demanded above.

11.1.4.3 Painting:

a) All steel surfaces shall be thoroughly cleaned by sand blasting or chemical agents as required, to produce smooth surface free of scales, grease and rust.
b) The steel surfaces after cleaning shall be given a coat of high quality red oxide or yellow chromate primer followed by final coats.
c) The internal surfaces in contact with insulating oil shall be painted with heat resistant insulating varnish which shall not react with and not soluble in the insulating liquid used.
d) The transformer shall be finished with two coats of synthetic enamel paint.
e) The paints shall be carefully selected to withstand tropical heat, rain etc. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.
f) Where the painting is damaged during transit, installation etc., touch up painting shall be done at site.

11.1.4.4 Transformer Fittings and Accessories:

The transformer shall be manufactured in accordance with the requirements as specified in the standards stated above and shall be filled with:

S.No.	Transformer Fitting	Description
1.	Lifting Lugs/ Cover lifting eye bolt	The arrangement of lifting the active part of the transformer without disturbing the connections and also complete transformer lifting lugs shall be provide.
2.	Rollers	Transformer shall be provided with 4Nos. Bi-directional rollers of suitable size corresponding to weight of transformer, fitted on cross channels, to facilitate the movement of transformer (For 100kVA and Above)
3.	Oil Conservator & Radiator	A conservator with radiator assembly. Dimension of the conservator shall be such as to allow change in volume due to change in temp. as required above. It is to be bolted to the top cover and can be dismounted for purposes of transport. It has to be provided with oil level gauge with marking for minimum level and an oil filling hole with a cap, which can be used for filtering of oil. For draining purposes a plug is to be provided. First oil filled transformers shall be supplied.

4.	Air Release Valve	An air release valve on top of the tank covers to facilitate the release of the entrapped air while filling of oil.
5.	Breather	An indicating dehydrating silica gel breather of sufficient capacity along with breather pipe of suitable size.
6.	Drain valve with plug	Oil drain valve of size as per relevant IS with plug at the bottom of the tank.
7.	Diagram, Terminal Making and Rating Plate	One diagram, Terminal Making and rating plate indicating the details of transformer connection, diagram vector group, tap changing diagram etc. conforming to IS: 1180
8.	Thermometer	Dial type thermometer (150 mm dia) and electrical contacts for electrical alarm at high temperature (For 100kVA & Above)
9.	Explosion Vent with diaphragm	Explosion vents or pressure relief device of sufficient size for rapid release of any pressure that may be generated within the tank and which might result in damage to the equipment. The device shall operate at a static pressure less than the hydraulic test pressure for transformer tank. The vent shall be designed such that in the event of an explosion, rain, sand or any other foreign bodies are prevented from getting into the tank. The vent shall be positioned so as to direct the explosion safety into the oil pit.
10.	Filter Valve	Valve for filtration, drainage and filling etc. with necessary plugs in the tank.
11.	Buchholz Relay	Oil & Gas actuated relay equipment shall be double float type having contacts which close following oil surge or under incipient fault condition. Buchholz relay shall have contact for alarm and trip. (For Transformers 800kVA and above)
12.	Oil Temperature Indicator	Oil temperature indicator shall have contacts for alarm and trip.
13.	Winding Temperature Indicator	Winding temperature indicator shall have contacts for alarm and trip.
14.	Off Circuit Tap Changer	The tap changer shall be provided with position indication and locking arrangement.
15.	Marshalling Box	Dome shaped or slopping fabrication marshalling box of suitable size minimum 3mm thick CRCA sheet outdoor type IP:55 to terminate the control cables of thermometer and buchholz relay.
16.	Earthing Terminals	Two separate earthing terminals consisting of bolts of not less than 20mm are to be provided at the sides of the tank on both sides for body earthing.
17.	HV Box	HV cable box shall be suitable to receive 3Core XLPE cable as per SLD & requirement.

18.	LV Box	LV cable box shall be suitable to receive 3.5Core XLPE cable (s) or Busduct as per SLD & requirement.
19.	PT100 Platinum Resistance Thermometers Sensors	1 set of sensor in each LV windings wired up to the winding temperature scanner.The instrument shall have two sets of adjustable contracts for alarm and trip. Instruments shall have scanner to read and show temperature of all three phases sequentially.
20.	Other Miscellaneous Fittings & Accessories	Jacking Pads with haulage holes. Oil Surge relay for OLTC.Shut off valves for OLTC oil surge relay. Access windows for OLTC connection. Extra Neutral earthing for NGR earthing.PRV with trip contact. Oil Filter Valve. Image Coil Mercury Contact Auxiliary CTS .Calibration devices Two number electrical contact each capable of operating at 5A Ac at 230Volts supply.

11.1.5 Painting of Transformer:

a) All steel surfaces shall be thoroughly cleaned by sand blasting or chemical agents as required to produce a smooth surface free of scales, grease and rust.

b) The steel surfaces after cleaning shall be given a coat of high quality red oxide or yellow chromate primer followed by final coats.

c) The internal surface in contact with insulating oil shall be painted with heat resistant insulating varnish which shall not react with and not soluble in the insulating liquid used.

d) The transformer shall be finished with two coats of synthetic enamel paint.

e) The paints shall be carefully selected to withstand tropical heat, rain etc. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

f) Where the painting is damaged during transit, installation etc. touch up painting shall be done at site.

11.1.6 GA Drawings:

The GA drawings with following certification and details shall be provided prior to the final call to the factory inspection:

a) General Note and considerations for Construction of the Transformer with material, base frame etc.
b) Schematic Diagram & Control Diagrams
c) BOM with selected make with all component's model no.
d) Necessary Design details and dimensions.
e) Paint Details
f) Elevations and Back/ Side views as applicable.
g) Details of HV/ LV and Marshalling box.
h) Rating and diagram plate.

i) OLTC & RTCC Panel details.
j) Transformer Foundation.

Following table shall be filled by the Manufacturer:

S.NO.	SHORT DESCRIPTION	QUOTED DATA
1.	Make	
2.	Service	
3.	KVA rating	
4.	Rated voltage	
i.	HV	
ii.	LV	
5.	Rated frequency (Hz)	
6.	Max. Temperature	
7.	Connections	
i.	HV	
ii.	LV	
8.	Tapping	
i.	Range	
ii.	Tap Step	
9.	No load loss on rated voltage & Frequency (Watt)	
10.	Load loss at rated voltage	
11.	Type of cooling	
12.	Insulation class	
13.	Terminal arrangement	
i.	HV	
ii.	LV	
14.	Impedance rated voltage freq.75 deg. C.	
15.	Fitting and accessories	
16.	Total weight of transformer	
i.	Wt. of copper Winding	
ii.	Wt. of Tank & fittings	
iii.	Total Weight.	
17.	Protection class of enclosure	
18.	Overall dimensions of the transformers	
i.	Length (mm)	
ii.	Width (mm)	
19.	Applicable standard	
20.	Regulation of Transformer	
i.	At 0.8 power factor	
ii.	At unit power factor	
21.	Foundation Detail	
22.	Quantity of oil	
23.	Efficiencies at unit power factor and 0.8 power factor at 100%, 75%, 60% and 50% load.	

i.	At Unit Power Factor	
a.	At 100% load	
b.	At 75% load	
c.	At 60% load	
d.	At 50% load	
ii.	At 0.8 Power Factor	
a.	At 100% load	
b.	At 75% load	
c.	At 60% load	
d.	At 50% load	
24.	Load at which maximum efficiency occurs	
25.	Maximum efficiency at above load.	
26.	Neutral current of transformer for restricted earth fault protection.	

11.1.7 Transformer Testing:

Prior to acceptance and dispatch of the transformer, the user/ client reserves the right to witness the routine tests at manufacturer's work place at manufacturer/ contractor cost for up to 2 People.

The transformer shall be subjected to the following routine and other tests prescribed in relevant IS. All the Test results video recordings, Certificates and reports shall be submitted to the client for approval prior to dispatch.

The tests shall be performed before cable jointing or connecting the bus duct.

Routine Tests

a) Physical Inspection for breakages/ damages/ orderliness.
b) Insulation test between HV to earth and HV to MV with 5000 volts Megger.
c) Insulation test between MV to earth with 500 volts Megger.
d) Measurement of winding resistance of all windings on all tap positions.
e) Ratio polarity and phase relationship
f) No load and load losses
g) Impedance Voltage
h) No load and load current
i) Insulation resistance
j) Induced over voltage withstand
k) Separate source voltage withstand
l) Temperature Rise Test within manufacturer's work only (If required, extra cost shall be paid)
m) Di-electric strength of transformer oil.
n) Buchholz relay operation by simulation test. (For Transformers 800kVA and Above)
o) Noise level measurement, in accordance with IEC Publication 551 using a precision sound level meter conforming to IEC Publication 651. In addition the test shall be repeated with narrow band filters for the harmonic frequencies from 100Hz up to 350Hz.
p) Vacuum Test

q) In case the transformer oil test is not satisfactory, the oil shall be filtered till proper di-electric strength of oil is obtained.

Type Tests:

Transformer manufacturer must possess and produce type test certificate/ CPRI or other approved test for same rating or higher as per IS and copy of type test shall be made available to the client/ inspector. Test certificates for following mentioned tests must be required:

a) Temperature Rise
b) Impulse Voltage withstand

11.1.8 Packing:

The packing shall be in accordance with the bidder's standard practice but he shall give full particulars of packing for the approval of the purchaser. All the parts shall be adequately marked to facilitate field erection. Boxes and creates shall be marked with the contact numbers and shall have a packing list enclosed showing the parts contained therein.

11.1.9 Installation:

The transformer shall be installed as per the manufacturer's instruction manual and shall conform to the requirements of relevant IS and other reference codes. Unloading, storing, installation and commissioning shall be performed in presence of OEM representative and report shall be submitted to the client. Following shall be the part of the installation:

a) The transformer foundation shall be casted as per the required of OEM.
b) Un-packaging shall be done carefully.
c) When the shifting of the unit(s) required for installation from the place of storage, lifting lugs shall be used to avoid any imbalance.
d) Verification shall be done for transit damages/ availability of all items including accessories, operating handles, instruction manuals, drawings, test certificates etc. and necessary actions to be taken.
e) Assembling of different sections/ units shall be done when sent separately.
f) Positioning & Alignments of the units shall be as per the GFC/ Contractor's Shop Drawings.
g) Grouting/ securing to the floor/ base channels etc. for stable installation.
h) The arrangement shall be such as to permit removal of the transformer without dismantling the bus duct/ cable installation.
i) The transformer wheels (If demanded) shall be locked by suitable locking arrangement to avoid accidental movement after testing and commissioning.
j) All necessary safety precautions shall be followed for the equipment as well as personal as per relevant IS.
k) Final touch up shall be done for the damaged painting portions with the required type and thickness of the paint.
l) Earth connection of the unit shall be made as per IS.
m) All joint and connections shall be checked for the proper tightness.
n) Proper supporting/ protection arrangement to the cables/ units etc. to avoid undue stress on the termination joints.

o) Necessary instruction/ information/ caution/ name plates for easy operation and maintenance shall be provided.
p) Performance pre-commissioning checks and ensuring proper functioning of all the systems as required at his own cost.
q) Any other satisfactory commissioning the equipment/ system if required by Engineer-in-Charge.
r) Necessary documentation as per the requirement from Operation and Maintenance of Client's team and Engineer-in-Charge.
s) Transformer shall be mounted on rails provided as part of foundation/ soak pit construction. The wall of the soak pit below the transformer shall be raised by min 300mm above FGL to prevent water from nearby areas entering the soak pit. Rail top may be at the same height as the top of soak pit wall (FGL +300mm). Cable trenches with pre cast shall be provided in transformer yard for power cables and control cables.

11.1.10 Pre-Commissioning Tests:

In addition to the tests at manufacturer's premises, all relevant pre-commissioning checks and tests shall be done at site before energizing the transformer. Following tests shall be performed:

a) Physical inspection for breakages/ damages/ orderliness.
b) Insulation resistance test use of 5000V megger between HV to Earth and HV to MV.
c) Insulation resistance test use of 500V megger between MV to earth.
d) Winding resistance of all the windings on all tap positions.
e) Voltage ratio test shall be carried out by applying low voltage on HT side and measuring the voltage between phases and phase and neutral on the LT side for every tap setting.
f) Di-electric strength of transformer oil.
g) Buchholz relay operation
h) On commissioning of the transformer the following readings shall be taken:
i) LT Side voltages at all tappings
j) Temperature rise under no load conditions.

11.1.11 Test Certificates:

Following test certificate shall be submitted by the agency:

a) Test certificate for the routine/ acceptance tests.
b) Test certificate for the type tests
c) Test certificates for the site tests including di-electric strength of transformer oil.

11.1.12 Drawings and Documentations:

The following drawing & documents (3sets) shall be furnished along with the transformer:

a) Foundation details as per actual site survey and vetted by civil engineer.
b) Installation, operation & maintenance manuals with satisfactory instructions.
c) General layout including the dimensions & BOM.
d) Details of after sales services.
e) Electrical Control wiring drawings.
f) Any other, if any, as per site requirements.

g) Test certificates for the site tests including di-electric strength of transformer oil.

11.1.13 On Load Tap Changing Mechanism (OLTC):

Each transformer shall be provided with an On Load Tap Changing Mechanism. This shall be suitably designed for:

a) Local manual as well as local and remote electrical operation.
b) Remote electrical operation from control room through RTCC Panel.
c) Interlock it shall not be possible to use the electric drive when manual gear is in use and it shall be possible to use only one electrical control at a time. Operation of the local or remote control switches shall cause one tap movement only until the control switch is returned to the off position for the next operation.
d) The local electrical control switches shall be mounted in the outdoor cubicle.
e) The tap change equipment shall be so designed that if the mechanism is stuck in an intermediate position.

12 DIESEL GENERATOR

This chapter covers the General Specifications of the equipment and Materials for the DG Sets, their testing and/or inspection as may be necessary before their dispatch from their respective works, their delivery at site, all preparatory works, assembling, installation and adjustments, commissioning, final testing, putting into operation and handing over of the complete system.

For Detailed Specification of D.G. Set of Electrical works (Based on DSR 2018) mentioned in SOQ shall be as per CPWD General specification for electrical works Part VII (D.G SET) 2013. (corrected up to the last date of submission/uploading of bid).

13 SOLAR

For Detailed Specification of Solar system of Electrical works (Based on DSR 2019) mentioned in SOQ shall be as per CPWD General Specification for Delhi Schedule of Rates &Delhi Analysis of Rates (E&M)(Item for Solar PhotovoltaicPower Plant). (Corrected up to the last date of submission/uploading of bid).

Particular Specification of HVAC works

1. **SECTION-01**
   Standard specifications

2. **SECTION-02**
   Noise & vibration controls

3. **SECTION-03**
   Standard specifications of hot water oil fired boilers

4. **SECTION-04**
   Standard Specification of Scroll Compressor Based Water To Water Heat Pump Units

5. **SECTION-05**
   Standard Specification of Air Cooled Scroll Heat Pump

6. **SECTION-06**
   Standard specifications of pump Sets & variable speed pumping System

7. **SECTION-07**
   Standard specification of air & dirt separator

8. **SECTION-08**
   Standard specification of piping work & valves

9. **SECTION-09**
   Standard specification of PE-X Piping and components

10. **SECTION-10**
    Standard specification of electrical motors & starters

11. **SECTION-11**
    Standard specification of thermal & acoustic insulation

12. **SECTION-12**
    Standard specification of double skinned air handlers

13. **SECTION-13**
    Standard specification of air circulation system

14. **SECTION-14**
    Standard specification of propeller & inline fans

15. **SECTION-15**
    Standard specification of kitchen dry scrubeer unit

16. **SECTION-16**
    Standard specification of Geothermal and fittings

17. **SECTION-17**
    Standard specification of painting work

18. **SECTION-18**
    Standard specification of running in period & gurantee

19. **SECTION-19**
    Technical data to be furnish by the bidders

20. **SECTION-20**
    List of makes

21. **SECTION-21**
    Basis of design

SECTION-01

STANDARD SPECIFICATION

1) SCOPE OF WORK

The complete scope of work shall cover supply, erection, testing and commissioning of the entire HVAC system as detailed under specification.

2) BASIS OF DESIGN

The entire system has been based and designed on climatological data available as given under basis of design and scheme.

3) TERMS AND DEFINATIONS

The followings terms have been used in the tender specifications, drawings etc.

ISI.	Bureau of Indian Standards.
ASHRAE	American Society of Heating Refrigeration & Air-conditioning Engineers, USA.
ASME.	American Society of Mechanical Engineers.
ASA.	American Standard Association.
B.S.	British Standards.
CMH.	Cubic Meter per Hour.
USGPM.	US Gallons per minute.
IGPM.	Imperial Gallons per Minute.
RPM.	Revolutions per Minute.
BTU/Hr.	British thermal unit per Hour.
Kcal/Hr..	Kilo Calories per Hour.
HZ.	Hertz.
H.P.	Horse Power
Kg/Cm2..	Kilo Gram per Square Centimeter.
SAG	Supply Air Grills.
SAD.	Supply Air Diffuser.
SAF.	Supply Air Filters.
FD.	Fire Damper.
VCD..	Volume Control Damper.
RAD.	Return Air Damper.
FAD.	Fresh Air Damper.
RH.	Relative Humidity.
DB.	Dry Bulb Temperature.

WB. Wet Bulb Temperature.

MV. Mechanical Ventilation.

DP. Drain Point.

4) The codes, regulation as detailed below shall be followed in this contract :-

1.	Safety code for air-conditioning (Revised) amendment 1	IS 659: 1964 (reaffirmed 1991)
2.	Safety code foe mechanical Refrigeration	IS 660: 1963 (reaffirmed 1991)
3.	Testing of refrigeration Compressors	IS 5111: 1993
4.	Air cooled heat exchangers (Amendment 1)	IS 10470 : 1983 (Reaffirmed 1991)
5.	Packaged Air-conditioner (Amendment 1991)	IS 8148 : 1976 (Reaffirmed 1991)
6.	Hermetic compressors 1983(Reaffirmed 1991)	IS 10617: Part I, II & III
7.	Suppliers data sheet for clean Air equipment (laminar flow)	IS 12357: 1998
8.	Thermostats for use in Refrigeration etc.	IS 11338: 1965 (Reaffirmed 1991)
9.	Code of practice for design and Construction of flue chimneys	IS 11338: 1965 (Reaffirmed 1991)
10. (Reaffirmed 1991)	Metal Duct Work	IS 655: 1963
11.	Steel for general structural Purpose	IS 2062: 1992
12.	Piping Work BS: 3601	IS 1239 Part I & II 1990 / 1992IS &
13.	Welding	IS: 3589
14.	Refrigeration	as per ASHRAE / ISI Air conditioning & Refrigeration Air-conditioning institute Standards
15.	Hot Dip Zinc Coated Steel Tubes	IS 4736: 1968

16.	Gate Valves for Water lines	IS 778: 1980
17.	Copper Alloy Gate Globe Check Valve for water lines	IS 778: 1980
18.	Butterfly Valve	IS 13095: 1991
19.	Steel Pipe flanges	IS: 6392
20.	Gaskets	IS 638: 1979 (reaffirmed 1993)
21	Mild steel tubes & fittings	IS 1239 Part I & II
22.	Dual plate Check Valve for Water Lines	AP: 194
23.	Colour code for the identification Of pipe lines	IS 2379: 1963
24.	Specific requirements for the Direct switching of the individual motors.	IS 4064 (Part II) 1978
25.	PVC insulated (HD) Electric Cables for working voltage up Including 1100 Volts.	IS: 1554 (Part I)
26.	HRC Cartridge fuse links Upto 650 Volts.	IS 2208: 1976
27.	Starter	IS 8554 (Part I) 1979
28.	Inspection and testing of Installation	IS 732 (Part III) 1979
29.	Galvanized steel wire for fencing	IS 277: 1977
30.	Three phase induction motors	IS: 325
31.	PVC insulated (heavy duty) Cables for working voltage Up to 1.1. KV and up to 11 KV Grade respectively.	IS 1554: 1981 Part I & II
32.	Code for practice for electrical Wiring installations.	IS 732: 1989
33.	Code for practice for earthing	IS 3043: 1966
34.	Horizontal centrifugal pumps	IS: 1620
35.	Centrifugal fans (1st. Division) (Reaffirmed 1991)	IS 894: 1987

36.	Wrought aluminium & aluminium Alloy sheet and strip for general Engineering purposes	IS: 737
37.	Mild steel tubes, tubular and other Wrought steel fittings.	IS : 1239
38.	Bourdon tube pressure and vacuum Gauges	IS: 3624
39.	Glossary of terms used in refrige-Ration and air-conditioning.	IS : 3615
40.	Code for practice for standard for Selection of standard worm and Helical gears.	IS: 7403
41.	Three phase induction motors.	IS: 325
42.	Specification for single phase small A/C & universal motors	IS: 996
43.	Specifications for flame proof motors	IS: 2148
44.	Circuit breaker A.C	IS 2516: 1980 Part I & II
45.	Contactors for A.C for voltage Upto 1100 V.	IS 2959: 1975
46.	Low voltage switch gear and control Gear assemblies.	IS 8623: 1993 Part I & II
47.	Code of practice for selection of starters for AC induction motors	IS 3914
48.	Specification for cables glands	IS 4821
49.	Code for selection, installation & Maintenance of switch gear and Control gear.	IS 10118: 1982 Part I to IV
50.	Conduits for electrical installations	IS 9537: 1981 Part I to IV
51.	Permissible limits of noise level For rotating electrical machines.	IS 12065: 1987
52.	Code of practice for installation And maintenance of motors	IS 3106: 1966
53.	Bourdon tube pressure and vacuum Gauges	IS: 3624
54.	Code of practice for selection of	IS: 7403

	Standard worm and helical gear boxes	
55.	Mild tubes, tubular and other Wrought steel fittings	IS: 1239
56.	Electrically welded steel pipes For water, gas and sewage.	IS: 3589
57.	Gum metal gate, globe and check Valves for general purposes.	IS: 778
58.	Wrought aluminum and aluminum Alloy steel and strips for general Engineering purposes	IS: 737
59.	HRC cartridge fuse links up to 650 volts	IS: 2208
60.	PVC insulated (heavy duty) electric Cables for working voltage up to & Including 1100 watts	IS: 1554 (Part I)
61.	Method for testing Panel type air (Reaffirmed 1991) Filters for AC purposes.	IS 7613: 1975
62.	Unbounded glass wool for thermal Insulation (1st. Revision)	IS 3690: 1974
63.	Expanded polystyrene for thermal 1984 (reaffirmed) Insulation purposes (1st. revision)	IS 4671:
64.	Propeller type AC Ventilation fans	1IS 2312: 1967 (reaffirmed 1991)
65.	Electrical axial flow fans (Reaffirmed 1991)	IS 3588: 1987

SAFTEY CODES

1.	The following IS codes shall be followed:	
2.	Safety code for mechanical refrigeration	IS 660
3.	Safety code for air conditioning	IS 659
4.	Safety code for scaffolds & ladders	IS 3696
5.	Code of practice for fire precaution in Welding & cutting operations	IS 3016
6.	Code for safety procedures and practices In electrical works	IS 5216
7.	Code of practice for safety and health Requirements in electrical & gas welding And cutting operations	IS 3696

INSPECTION

All shop drawings & technical data shall be prepared by the Contractor & to be approved by the HVAC consultant before execution .

END OF SECTION-01

SECTION-02

NOISE AND VIBRATION CONTROLS

1) The contractor must take all necessary precautions to have minimum noise generation and its transmission. Minimum vibration as permitted by IS relevant code shall be ensured. A few points for guidance only are given below:

2) Vibration isolation pads of suitable thickness commensurate to loading for isolation of vibration shall be provided under all pumps, axial flow fans etc. in consultation with manufacturer for proper selection of vibration isolators

3) Vibration isolation springs of suitable size to suit the weight of hot water generator if recommended by the manufacturer for elimination of vibrations shall be provided as suitable for type& model of HWG.

4) Flexible conduit connections of minimum diameter of 50mm to motors shall be provided. All loops should be large enough to allow connections to remain flexible.

5) All conduit connection where conduits are 60mm or larger shall be made of 1.2 meters minimum length conduit installed in the shape of U and grossly slack to provide maximum vibration isolation.

6) Operating clearance of 40mm shall be kept between the base and the inertia base.

7) All Hot Water pumps shall be bolted and grouted to the inertia base which in turn shall be supported on suitable vibration isolation rubber pads duly sandwitched with 20G GI sheets. Concrete inertia blocks shall be formed of suitable thickness and of adequate mass.

8) The floor supported piping shall be mounted on pipe supports with 7.5mm ribbed neoprene pads between the base plate of the pipes and the floors.

9) All items suspended from false ceiling shall be isolated on separate hangers.

10) In case of conduits, pipes & tubes the annular space between construction and penetrating element shall be sealed with sand cement plaster.

11) The contractor shall take all other precautions or shall make his own arrangements even if not specified in the tender documents for eliminating high noise levels & shall minimize vibrations in all mechanical equipment's without any additional cost.

12) All materials and equipment shall conform to the relevant Standards and shall be of the approved make and design. Makes shall conform to list of approved makes. All equipment shall operate under all conditions of load with acceptable standard for sound and vibration. In case of rotating machinery sound or vibration noticeable outside the room in which it is installed, or annoyingly noticeable inside its own room, shall be considered objectionable. Such conditions shall be corrected by the Contractor at his own expense.

13) The Contractor shall verify the sufficiency of the size of the shaft openings, clearances in wall cavities and suspended ceilings for proper installation of grilles,diffusers, controls, insulation, pre-molded / site pipe section, conduits, cables etc. The Contractor shall locate all equipment which must be serviced, operated or maintained in fully accessible positions. The exact location and size of all access panels, required for each concealed control damper, valve or other devices requiring attendance, shall be determined by the Contractor.Access panel shall be standardized for each piece of equipment/device/accessory and shall be clearly nomenclature / marked.

14) Where the manufacturer has furnished specific instructions, relating to the material and equipment used in this project, covering points not specifically mentioned in these documents, manufacturer's instructions shall be followed in that case.

15) All the PEX piping shall be laid with adequiate spacing in accordance with winter load & staple accordingly.

.

END OF SECTION-02

SECTION -03

STANDARD SPECIFICATION OF OIL FIERD HOT WATER GENERATOR

BOILERS

The diesel Fired hot water generator will be packaged.The Heat exchanger, consisting of two closely wound, helical, concentric coils, arranged to give three passes on flue gas side & made out of ERW tubes confirming to BS: 3059 part I suitable for high temperature. One double jacketed air casing with an aluminium radiator to enclose the heat exchanger coil and to serve as an integral "Combustion Air Pre-heater".

AUXILIARIES

1) Pressure Jet Burner Assembly suitable for oil firing with stepless Modulation mechanism.
2) Diffusion type, down firing burner assembly
3) Combustion air fan with drive motor assembly.
4) Dust protected pre-wired unit mounted air cooled control panel housing a burner management system, switch gear consisting of contactors, overload relays, fuses and MCB etc…
5) Hot water pump suitable for high temperaure operation, directly to an electric motor, mounted on a common base frame.
6) Pressurided Expansion tank to take care of expansion of water, is with gauge glass assembly, level switch, level contoller, safety valve, Pressure switch & Nitrogen gas train assembly.
7) Makeup pump with drive motor assembly along with above expansion tank.
8) Fuel pump with dirve motor assembly.
9) Air Fuel Oil Regulator assembly

PIPING

Piping from gas to burner inlet.

MOUNTINGS AND FITTINGS

1) Set of Isolating needle valves for pressure indicating instruments.
2) Fuel Oil Line Duplex filters on fuel oil line at the inlet of fuel pump.
3) Y stariner on fuel oil line between fuel pump and burner.
4) Non Return Valves on fuel pump outlet
5) Non Return Valve on modulation and circulation line
6) Fuel oil regulating valve for burner modulation
7) Burner solenoid valve.

HOT WATER LINE

Spring loaded safety relief valve for mounting on Hot water outlet line.

INSTRUMENTS, CONTROLS AND SAFETIES

1) Burner programmer with matching flame sensor
2) Hooter mounted on control panel for audible safety alarm.

FUEL OIL LINE

1) Fuel pressure gauge on bypass line from burner.
2) Fuel oil pressure gauge at burenr inlet.

HOT WATER LINE

1) Temperature controller for stepless burner modulation on Hot Water outlet of the heater.
2) Temperature indicator-cum- switch for burner ON-OFF cycle, on Hot Water inlet of the heater.
3) Temperature indicator-cum-switch for high Hot Water temperature alarm & interlock with burner, on Hot Water outlet temperature of the heater.
4) Pressure gauge at Hot Water inlet of the heater.
5) Pressure gauge at Hot Water outlet of the heater.
6) Differential pressure switch connected across Hot Water inlet and outlet of the heater for low flow alarm & interlock with burner
7) Pressure switch for high water pressure alarm & interlock with burner, on Hot water outlet of the heater.

ON EXPANSION TANK

1) One Gauge glass on expansion tank with isolation valve.
2) Level switch for low level alarm & interlock with burner, on Expansion tank.
3) Level controller for maintaining water level in the expansion tank, by operating make up pump on/off. Pressure switch for high pressure alarm on tank & interlock with burner.
4) Spring loaded safety relief valve on the expansion tank as mechanical safety against high pressure.
5) vent valve on the expansion tank to vent air to atmosphere
6) Pressure gauge on the expansion tank for indicating the pressure on expansion tank.
7) Nitrogen gas train assembly to reduce the pressure from high to low. The components of the gas train are Isolation valve, Pressure gauge with isolation valve, PRV & NRV.

FUEL OIL LINE

1) Inlet and outlet of fuel oil filter.
2) Fuel pump pypass connection.
3) Outlet of Non Return Valve on burner bypass line.
4) Drain connection on 'Y' strainer on fuel oil line.
5) Inlet and outlet of fuel pumping skid

HOT WATER LINE

1) Inlet and Outlet flanges of Hot water circulating pump.
2) Inlet and outlet flanges of headers of the heater.
3) Inlet and outlet of safety relief valve.
4) Inlet and outlet connections of Exapanion vessel.
5) Vent connection on expansion tank.
6) Safety valve outlet connection on expansion tank.
7) Drain connection on expansion tank.
8) Makeup inlet conenction on expansion tank.

AIR AND FLUE GAS

1) Suction of blower
2) Flue gas outlet flange on the heater

ELECTRICALS

1) Terminal connectors on control panel, instruments & motors, for complete details please refer electrical wiring diagram
2) Specification of water in the system:
3) Hardness - < 5 ppm
4) pH - 9.5 - 10
5) Oxygen - zero ppm
6) Phosphates - 20 - 30 ppm
7) Sulphites - 20 - 30 ppm
8) Total Dissolved Solids (TDS) - < 500 ppm
9) High Speed Oil (HSD)
10) Net Calorific Value - 10,500 Kcal/Kg
11) Flash Point - 32ºC Water Content - 0.05% Vol.(Max.)
12) Kinematic Viscosity - 2.5 cst @ 50ºC
13) Pour Point - 5ºC
14) Sediment - 1% Wt Max.
15) Sulphur –0.005 % /Wt Max.
16) 415 AC Volts ± 6%, 50 Hz ± 3%, 3 Phase, 4 Wire System and 240 AC Volts ± 6%, 50 Hz ± 3% and 3 phase for control circuit

HEATER CONSTRUCTION

1) Tube Material BS 3059 PART I, ST 320, ERW
2) Jacket Carbon Steel -HR- IS -1079
3) Expansion Tank – Carbon Steel IS 2062, GRA-A
4) Thermal Efficiency – HSD 90% ON NCV
5) Burner Control - 0-33% on –off, 33% to 100 Stepless
6) Maximum Outlet temperature 160 Deg C to 170 Deg C of flue gases
7) Ambient Conditions for boiler selection – minus 35°C

8) The entire package will be suitable to with stand test pressure of 9 Kg/cm2 and working pressure of 6 Kg/cm2.The following accessories fittings control, and valves will be mounted on the hot water generator.

9) The fuel gas outlet port will be approx. 500 dia. or as per manufacturers standard. Thefront and back panels of the hot water generators will be open- able type so as to facilitate servicing and maintenance of the hot water generator & tubes.

10) The max height of the hot water Generator including its base frame and mountings should not be more than 2.5 meters.

11) The unit will be suitable for working at ambient temp of - 35°C and should have enough space to avoid any damage due to freezing during shut down period (Night) when the ambient temp would be less than minus 35°C

12) The conractor shall select the boilers with a resistance of antifreeze.

FLUE GAS CHIMNEY AND THE CONNECTION PIECES BETWEEN CHIMNEY AND THE HOT WATER GENERATORS.

1) The chimney will be self supporting free standing type MS construction duly insulated from outside with fiber glass with starbond coating as per technical specification of insulation.

2) The insulation will be starbond coated after installation.The MS chimney will be 800 mm ID approx.or as per manufactures selection & Height as per site condition

3) The lower portion of the chimney will be constructed from MS plate of 6mm thickness (approx. Minimum length 5 meter) the middle portion will be made from MS plate of 5mm thickness (approx. Minimum length 5 meters) and the balance top portion will be made from 4mm thick MS plate.

4) Each section will be jointed to other section with minimum 20mm thick MS flange with high temp Gasket and tensile bolt and nuts in an engineering like manner

5) The Chimney will have a secured fixed canopy on top to avoid falling of any foreign material into the chimney.

6) The bottom portion will have a door for entry of man for cleaning & maintenance purpose. After fabrication of each section the chimney will be painted with epoxy primer paint from inside and outside.

7) There will be provision for connection of this chimney with three hot water generator flue gas outlets of 600mm dia or higher as per the recommendations of the hot-water generator manufacturer and at a suitable height.

8) The connection piece of the chimney between the main chimney and hot water generator will be made for 6mm MS sheet / pipe duly painted and insulated in the same manner as stated above and will be of dia. as recommended by hot water generator.These connection pieces will be suitably supported from the ground.

9) Days Service Oil Tanks # 3 Nos ,990 Litres with pumping & valves

MS rectangular type suitable capacity tanks will be constructed of 5mm MS sheet suitably welded on to MS angle iron 50mm x 50mm x 6mm frame work & bracing. The tanks will be suitable for mounting on a stand or on wall. The tank will be complete, with inlet, out let, over floor and drain connection. The oil level indicators, air vent and manhole with covers will also be provided, the tank will have arrangements for heating LDO. The heater will not come in direct contact of LDO and the heater will be so placed that heater could be replaced at any time without loss of LDO. The heather will be controlled by a thermostat.The max height of the tanks will not be more than 1 meter.

10) Bulk Oil storage Tanks # 2 Nos ,8k Litres with pumping & valves

MS rectangular type suitable capacity tanks will be constructed of 5mm MS sheet suitably welded on to MS angle iron 50mm x 50mm x 6mm frame work & bracing. The tanks will be suitable for mounting on a floor. The tank will be complete, with inlet, out let, over floor and drain connection. The oil level indicators, air vent and manhole with covers will also be provided, the tank will have arrangements for heating LDO. The heater will not come in direct contact of LDO and the heater will be so placed that heater could be replaced at any time without loss of LDO. The heather will be controlled by a thermostat.The max height of the tanks will not be more than 1.2 meter.

11) Glycolstorage Tanks # 2 Nos ,990 Litres with pumping & valves

MS rectangular type suitable capacity tanks will be constructed of 5mm MS sheet suitably welded on to MS angle iron 50mm x 50mm x 6mm frame work & bracing. The tanks will be suitable for mounting on a stand or on wall. The tank will be complete, with inlet, out let, over floor and drain connection. The glycol level indicators, air vent and manhole with covers will also be provided.The max height of the tanks will not be more than 1.2 meter.

END OF SECTION-03

SECTION-04
STANDARD SPECIFICATION OF SCROLL COMPRESSOR BASED WATER TO WATER HEAT PUMP UNITS

HEATING CAPACITY

1) The Heat Pump System should be capable of operation on a water-to-water basis. The Heat Pump when operating on water-to-water basis should use the geothermal energy source for the chilled water line. At all the times chilled water load through ground source loop will be required to enable generation of Hot Water on the other loop

2) The Heat Pump System should be based on a closed circuit primary hot water flow of 45 °C out of the unit with 40 °C return for normal operation pattern &The heat pump should be capable of generating Hot Water upto 58ºC&shall be EUROVENT/AHRIcertified

3) The system shall contain Scroll Compressor, braze-welded stainless steel AISI 316 plates insulated by a shell of closed-cell foam material Evaporator, Braze-welded stainless steel AISI 316 plates insulated by a shell of closed-cell foam material Recovery Heat Exchanger, Microprocessor control panel and Electronic Expansion Valve (EEV) all of which shall be contained within the cabinet of the unit.

4) Unit shall work in following mode as mentioned below:

.

TECHNICAL FEATURES

HEAT PUMP UNIT

This is an innovative non reversible heat pump unit, available in 4-pipe versions to respond to the needs of our large customer base in a customized manner. These machines use R410a/ R134a/eqvt refrigerant liquid and are fitted with scroll compressors. The use of a green refrigerating fluid like the R410a/ R134a/eqvt and the high energy efficiency features of these units allow you to make a choice which assures great energy savings.

OPERATION

4-pipe unit

The 4-pipe multifunctional unit produces hot water on primary loop while chilled water got circulated in the ground which may use horizontal, vertical, or submerged surface water closed loops

ELECTRONIC THERMOSTAT VALVE

Energy savings, precision, and comfort all delivered as standard, with the electronic thermostat valve that continuously adjusts the power delivery and it also offers the following advantages:

1) Fast, high precision adjustment of refrigerant flow;
2) Fast arrival of the unit at steady-state conditions;
3) Superheating value remains constant in variable thermal load conditions;
4) Efficient operating conditions of the compressor, especially in the presence of low room temperatures;
5) Wide working range with consequent extension of the unit's operating limits.These properties result in enhanced performance of the unit and make it possible to obtain very significant energy savings.

BODY

Self-supporting frame consist of load bearing frame made of Epoxy polyster powder coated

COMPRESSORS

Hermetic scroll type compressor connected in Tandem or Trio, complete with thermal protection inside the electric engine, Oil Level Sight Glass, Oil equalization line and rubber anti-vibration mounts.

REFRIGERENT

Multi Functional Units of higher efficiency with widest capacity based on latest environ-friendly R410a/ R-134 /eqvt Refrigerant.

Ground Source Heat Exchanger

Braze-welded stainless steel AISI 316 plates insulated by a shell of closed-cell foam material. In evaporator mode, a temperature probe acts as safety guard against freezing. Flow switch fitted as standard. Enhanced for use with R410a/ R134a, improves the efficiency of the unit and at the same time reduces size and refrigerant requirements.

RECOVERY EXCHANGER

Braze-welded stainless steel AISI 316 plates insulated by a shell of closed-cell foam material. Flow switch fitted as standard. Enhanced for use with R410a/R134a, improves the efficiency of the unit and at the same time reduces size and refrigerant requirements.

REFRIGERANT CIRCUIT

The refrigerant circuit includes: feeding plug on fluid and suction line, fluid sight glass, dehydrating filter, electronic expansion valve with pressure external equalizing, liquid accumulator, and solenoid valves on fluid line, pressure transducer, high and low pressure controllers and safety valve.

ELECTRICAL PANEL

The panel includes:

1) Main power disconnect switch;
2) Power circuit and control circuit fuses;
3) Compressor contactors;
4) Microprocessor to control the following functions:

I) Water temperature adjustment, with inlet water control on system return branch;

II) Anti-freeze protection;

III) Compressor operation timers;

IV) Automatic compressor start-up sequence;

V) Alarm signals;

VI) Alarm reset;

VII) Potential contact for remote alarm signals;

Alarm log recording;

5) Digital display of:

VIII) Inlet and outlet water temperature;

IX) Temperature and differential settings;

X) Alarm description;

XI) Hour meter operation and number of unit, compressor and pump (where present) start-ups;

CONTROLS AND SAFETY DEVICES

1) Manual reset high pressure switch;
2) Automatic reset high pressure switch-managed safety device with limited thresholds;
3) Automatic reset low pressure switch-managed safety device with limited thresholds;
4) High pressure safety valve;
5) Anti-freeze probe on evaporator outlet;
6) Compressor thermal cut-out devices;

DOUBLE SET POINT

It is possible to set two set point temperatures by microprocessor for the production of cold water and for hot water. Unless otherwise indicated when ordering, the default values for the production of chilled water are 12/7 Deg C and 15/10Deg C. The set points in any case be within the operating limits of the unit. The change between the first and second set point can be done by keyboard or digital input.

BMS CONNECTIVITY:

The heat pump should have necessary hardware for monitoring on through BMS system

TESTING

The units are factory-tested and supplied complete with oil and refrigerant.

7) FACTORY TESTING

Theheat pumps will be factory run tested for 4# point testing @100%,75%,50% & 25% load at AHRI condition before dispatch .The run test certificate shall be produced by Contractor before dispatch in the presence of NHIDCL & hvac consultant .

END OF SECTION-04

SECTION-05

STANDARD SPECIFICATION OF AIR COOLED SCROLL HEAT PUMP

Compact Air-cooled scroll Heat Pump unit working on energy efficient refrigerant R-410A. Unit shall be EUROVENT/AHRIcertified. Heat Pump should be capable to operating from -20 deg C to 40 Deg C Ambient Temperature.

UNIT FRAME

Modular, galvanized sheet structure with self-supporting frame, with removable panelling lined with sound absorbing expanded polyurethane mattingwith baked-on polyester-powder coating providing excellent weather resistance fitted with stainless-steel threaded fasteners.

COMPRESSORS

Multiple hermetic scroll compressors (Copeland/ Bitzer) with vapour injection shall be connected in tandem and suitable for R-410A refrigerant equipped with oil sight glass, internal Klixon thermal circuit-breaker, crankcase heaters, contactors and oil-equalizing line.

AIR COOLED CONDENSERS WITH AXIAL FAN

1) The Condenser should be made with finned pack coils with copper tubes and aluminium fins. Anti-Ice circuit should be installed at base of each coil which will prevents ice formation in the lower part of the coil and therefore allows the unit to operate even with extremely harsh temperatures and with high humidity levels. Condenser should be coil protection mesh

2) The Anti-Ice Circuit should shut off by a solenoid valve managed by the controller of the unit to ensure this is running only when the coils work as evaporator and only when the external air temperature makes it really necessary.

3) Units shall be coupled to the innovative direct driven AC axial. The fan motor should have fan speed control for condensation control to enable trouble free operation during varying ambient condition.

4) The fan should include and should supplied with safety guard.Moreover, through a 0-10V analogical signal sent to every fan, the microprocessor allows to control the condensation through continuous air flow regulations on variation of the outdoor air temperature and a consequent sound emission reduction..

EVAPORATOR

1) The units shall be supplied with a braze-welded stainless steel plate heat exchanger,. Insulated with a closed cell expanded material coating and equipped thermostat con- trolled anti-freeze heater to protect it from ice formation when the unit is not running. The hydraulic manifold is provided with a flow switch and a probe for measuring the temperature of the return water flow.

REFRIGERANT CIRCUIT

1) The circuit includes: liquid line shut-off valve, suction separator, fluid accumulator, economizer, charge connection, liquid line sight glass, filter dryer, Electronic expansion valve, safety valve, pressure transducers to relay information on high and low pressure values and relative condensing and evaporating temperatures for display on the controller, high and low pressure switches, anti-ice circuit with solenoid valve.

2) The pipes of the circuit and the exchanger are insulated with extruded closed-cell expanded elastomer

ELECTRONIC EXPANSION VALVE

The use of this accessory is particularly indicated for units that operate in very unstable heat load conditions or in unstable functional mode, as in the case of joint management of air conditioning and production of high temperature water. Use of the electronic thermostatic valve in fact allows to:

1) maximize the heat exchange to the evaporator
2) minimize response times on load variation and on operative conditions
3) optimize the regulation of the over-heating
4) guarantee maximum energy efficiency

Defrost Cycle: For defrost management, the control of the unit should uses a sliding intervention threshold, depending on the pressures inside the unit and the external air temperature. By putting together all this information, the control should identify the presence of ice on the coil and activates the defrosting sequence only when necessary, so as to maximize the energy efficiency of the unit. Sliding management of the defrost threshold should ensures that, as the absolute humidity of outdoor air decreases, the frequency of the defrost cycles gradually decreases because they are carried out only when the ice formed on the coil actually penalizes performance.

The defrost cycle should be fully automatic, during the initial stage, a defrost should be carried out by cycle reversal with fans stopped. When the frost on the coil has melted sufficiently, reverse ventilation is activated, that is, with air flow in the opposite direction to that of normal operation, so as to facilitate the ejection of condensation water and detached ice. When the coil is clean, ventilation is reversed again and the unit resumes operation in heat pump mode.
The combination of the sliding intervention threshold allows the number and duration of defrost cycles to be optimized and reduced to the minimum.

POWER PANEL

The power panel includes:
1) Main switch;
2) Automatic Circuit Breakers on the auxiliary circuits and power circuits;
3) Fan contactors;
4) A microprocessor controlling the following functions:
5) Regulation of inlet water temperature;
6) Antifreeze protection;
7) Compressor timing;
8) Automatic rotation of compressor starting sequence;
9) Alarms;
10) Alarm reset;
11) Setting the unit's capacity steps;
12) Common alarm contact for remote warning;
13) Forced steps at pressure limits.
14) Alarm log recording ("black box" function)
15)
16) Information shown on display:
17) Inlet water temperature.
18) Temperature and differential settings.
19) Explanation of alarms.
20) Pressure values

21) External Air Temperature
22) Compressor working hours counter
23) Power supply [V/f/Hz]: 400/3~/50 ±5%.

CONTROLS AND SAFETY DEVICES

1) Manually resettable high pressure gauge;
2) Antifreeze probe on each evaporator outlet;
3) Chilled Water/Hot water temperature probe (located at evaporator discharge);
4) Mechanical vane-operated flow switch;
5) Compressor and fan over temperature protection.

FACTORY FITTED MAIN ACCESSORIES

1) Modbus/Bacnet card
2) Rubber type anti-vibration mounts
3) Water filter
4) Condensation control with fan speed regulator

TESTING

All units are factory tested and supplied complete with oil and refrigerant charge.Computer Software generated technical data sheet should be attached with the offer..

NOISE LEVEL

The heat pump should be designed for Low noise Operation. The noise level of the heat pumps should not be more than 55 dBA (sound pressure values measured at 10 meters distance from the unit in free field and at nominal working conditions, in compliance with ISO 3744)

FACTORY TESTING

At least 2 # heat pumps will be factory run tested for 4# point testing @100%,75%,50% & 25% load at AHRI condition before dispatch .The run test certificate shall be produced by Contractor before dispatch in the presence of NHIDCL & HVAC consultant .

DUCT COWL WITH HEAVY Al BIRD SCREEN, Al GRAVITY LOUVERS

The each heat pumps fan shall be installed with pre two coat of primer & then painted duct Cowl with bird screen & gravity louvers .The thickness of duct cowl shall be MS 3.0 MM site / factory fabricated with free standing supports.

END OF SECTION-05

SECTION -06
STANDARD SPECIFICATIONS OF PUMP SETS

PUMP SETS

This section deals with supply, installation, testing and commissioning of water pump sets conforming to general specification and suitable for the duty selected as indicated in Schedule of Equipment,. The type, capacity and size of pumps shall suit the parameters as per bill of quanitity. The Pumps selected should have high efficiency which should be supported by selection charts and curves.

END-SUCTION/HORIZONTAL SPLIT CASING PUMP SETS :-

End Suction Centrifugal Pump of the back pull /horizontal split casing out design as per ISO 2858 or DIN 24255 shall be selected for water re-circulation duty. Pump shall be furnished complete with flexible coupling (spacer type).The pump casing shall have heavily ribbed construction, suction and discharge branches with raised face, drilled to BS 4504 PN-16 or equivalent. The impeller made of bronze shall be double shrouded, single entry, radial flow type. It shall be hydraulically balanced to minimize axial thrust. The stuffing box shall be factory fitted with mechanical seal.

A minimum of the following accessories shall be provided with each pump:-

Air vents Cocks.

Lubrication fittings and seals.

The construction of End Suction pumps shall be as follows and as per IS 1520.

Duty	water
Casing	Cast Iron
Impeller	Bronze
Shaft	Stainless Steel
Bearings	Ball Bearing
Base Plate	MS
Speed (Synchronous)	1500 RPM
Motor	TEFC
Mechanical seal	Factory fitted

The impellers of pumps shall be statically and dynamically balanced.

1) The capacity of motor shall be at least 15% in excess of BHP requirement of pump & shall be as per Standard Specifications, Detailed calculation for selection of pumps shall be provided by the Tenderer.

2) The installation of pumps shall be carried out by the contractor as per manufacturer recommendations. The pumps shall be mounted on concrete foundations with vibration isolator's sandwiched between foundation and floor. As far as possible, the pump sets shall be factory aligned and if necessary site alignments shall be done by experienced and trained person. The pumps shall be installed in a manner that would allow maintenance without causing damage to the insulation.

STANDARD SPECIFICATIONS OF VARIABLE SPEED PUMPING SYSTEM

VARIABLE PUMPING SYSTEM

This section deals with supply Erection, testing and commissioning of variable pumping system confirming to general specification and suitable for the duty selected as indicated in Schedule of Equipments / Materials, The type, capacity and size of pumps shall be as selections given under this SECTION upported by selection charts and curves. The pumps shall be used for air-conditioning applications.

VARIABALE SPEED PUMPING SYSTEM

This section includes the following:

1) Variable Speed Pumping Package
2) Individual Components
3) Pump Control Panel
4) Adjustable Frequency Drive
5) Sensor Transmitters
6) Sequence of Operation

THE FOLLOWING REFERENCES HAS BEEN BROADLY CONSIDERED WHILE DESIGNING VARIABLE PUMPING SYSTEM.

A. Hydraulic Institute

B. ANSI - American National Standards Institute

C. NEMA - National Electrical Manufacturers Association

D. UL - Underwriters Laboratories Inc.

E. ETL - Electrical Testing Laboratories

F. CSA - Canadian Standards Association

G. NEC - National Electrical Code

H. ISO - International Standard Organization

I. IEC - International Electro technical Commission

THE FOLLOWING SUBMITTALS SHALL BE SUBMITTED, BUT NOT LIMITED TO THE LIST GIVEN BELOW BY THE HVAC CONTRACTOR FOR APPROVAL.

1. System summary sheet.

2. Sequence of operation.

3. Shop drawing indicating dimensions, required clearances. and location and size of each field connection.

4. Power and control wiring diagrams.

5. System profile analysis including variable speed pump curves and System curve.The analysis shall also include staging points.

6. Pump data sheets.

The submittals must be specific to this project only & general submittals will not be acceptable.

QUALITY ASSURANCE

The pumping package supplier 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 supplier.

All function of the variable speed pump controller shall be tested at the factory prior to shipment and it shall test all inputs, outputs and program execution specific to this application.

AC contractor shall comply with all section of this specifications relating to packaged pumping system. Any deviations from this specification shall be bid as alternate clearly defined in writing. If exceptions are not defined clearly the contractor shall be bound by these specifications only.

MANUFACTURED UNITS

Furnish and install as shown on the plans Variable Speed Pump controller.

The control system shall include as, a minimum, pumps, the programmable logic pump controller, adjustable frequency drive(s) and remote sensor / transmitters.

The pumps, variable speed pump logic controller, adjustable frequency drives and remote sensor / transmitter (s) shall be shipped as individual components to the job site.

Pumps, logic controller, adjustable frequency drives, sensor / transmitters and related equipment shall be installed.

Line voltage power wiring shall be installed by the HVAC contractor as shown on the field connection drawings and wiring diagrams supplied with the pumping package.

Low voltage (24 VDC and 115 VAC) wiring shall be installed by the controls HVAC Contractor as shown on the field connection drawings and wiring diagrams supplied with the pumping package.

COMPONENTS

PUMP LOGIC CONTROLLER

The Technologic pump logic controller assembly shall be listed by and bear the label of under writer's Laboratory, Inc. (Canadian Standards Association (CSA) listing available upon request). The controller shall meet Part 15 of FCC regulations pertaining to class a computing devices. The controller shall be specifically designed for variable speed pumping applications.

The controller shall function to a proven program that safeguards against Damaging hydraulic conditions including:

Motor overload Pump flow surges

Hunting

End of Curve.

The pump logic controller shall be capable of accepting 4 discrete analog inputs from zone sensor / transmitters indicated on the plans. The analog input resolution shall be 12 bit minimum, and the controller shall scan each analog input a minimum of once every 500 milliseconds. The use of a multiplexer for multiple sensor inputs is not acceptable. All sensor / transmitter inputs shall be individually wired to the pump logic controller for continues scan and comparison feature.

The pump logic controller shall select the analog input signal which has deviated the greatest amount from the set point. The selected signal will be used as the command feedback input for a closed loop hydraulic stabilization function to minimize hunting.

The hydraulic stabilization program shall utilize a proportional-integral-derivative control function. The proportional, integral and derivative values shall be user adjustable over an infinite range. The scan can compare rate then selects the command set point and process variable signal shall be continuous and automatically set for optimum performance. Each sensor shall be scanned at least once every 500 milliseconds.

The pump controller shall be capable of controlling pumps in parallel as described in point 7B.64 of this section Sequence of Operation

The pump logic controller shall be self-prompting & all messages shall be displayed in plain English. The following features shall also be provided.

1) Multi-fault memory & recall.
2) On – Screen help functions
3) LED pilot lights and switches
4) Soft-touch membrane keypad switches.

The variable speed pumping system shall be provided with a user friendly operator interface complete with membrane switches and numeric keypad. Display shall be no less than four lines with each line capable of displaying up to twenty characters. The human interface panel shall display the following values :

1) Flow in GPM (requires optional flow meter)
2) Pump On/Off Status
3) Pump % Speed
4) Temperature in degree F or C
5) Individual Alarm Conditions
6) Trouble shooting diagnostics
7) User adjustable parameters such as alternation, PID, set points, etc.

The pump controller shall communicate to the Building Automation System (BAS) by both hard-wired and serial communications.

The following communication features shall be provided to the BAS in “hardwired” form via 4-20 mA analog signals and digital outputs:

1) Remote system start / stop (dry contact supplied by BAS)
2) Failure of any system component (qty. 1, relay output from pump controller)
3) Process variable (qty. 1, 4-20ma analog output supplied by pump controller)
4) AFD speed (qty. 1, 0-10 VDC analog output supplied by pump controller)
5) Optional : Pump on / off status (qty. 3 relay output supplied by pump controller)

The following communication features shall be provided to the Building Automation System via an RS-485 port.

1) All sensor process variable.
2) Individual zone set points.
3) Individual pump failure.
4) Individual pump on / off status.
5) Individual AFD on/off status.
6) AFD speed.
7) Individual AFD Failure.
8) AFD bypass status (if automatic)
9) Individual sensor failure.

The pump logic controller shall be supplied by the pump supplier and the . Enclosure shall be conforming to NEMA 1.

ADJUSTABLE FREQUENCY DRIVE.

1) The adjustable frequency drive (s) shall be pulse width modulation (PWM) type, microprocessor controlled design.

2) The AFD, including all factory installed options, shall have CSA approval.

3) AFD shall utilize a diode bridge rectifier to convert three phase AC to a fixed DC voltage. Power factor shall remain above 0.95 regardless of speed or load. AFDs employing power factor correction capacitors shall not be acceptable.

Insulated gate bipolar transistors shall be used in the inverter SECTION to convert the fixed DC voltage phase adjustable frequency AC output. A DC line reactor shall be provided to minimize harmonic and current distortion of the input power line.

The following customer modifiable adjustments shall be provided:

a. Accel time : 0.1 to 1800 seconds
b. Decel time : 0.1 to 1800 seconds
c. Minimum frequency : 0HZ
d. Maximum frequency : 120 HZ
e. Analog input filter : 0.1 to 10 seconds
f. Analog outputs filter : 10 to 1 gain.
g. Overload protection : 70 % - 100% to full load current.

vi) Speed reference signal shall be customer selectable for 1-10 VDC or 4-20 MA.

vii) The AFD shall be capable of displaying the following information in plain English via a 40 character alphanumeric display:

a. Frequency
b. Voltage
c. Current
d. Kilowatts per hour

e. Fault identification
f. Percent torque
g. Percent power
h. RPM
i. Setting of O/L protection

- The AFD controller shall be suitable for elevation upto 1000 meters above sea level.

SENSORS / TRANSMITTER

To Provide 4 nos. field mounted differential pressure sensor transmitter(s) as indicated on the plans. Unit shall transmit as isolated 42Ma designed indicative of process variable to the pump logic controller via standard two wire 24 DC system. Unit shall have stainless steel wetted parts with 0.25" male NPT process connections. It shall be protected against ratio frequency interference and shall have a water tight, NEMA 4 electrical enclosure capable of withstanding 200 PSI static pressure with a 0.5" NPT conduit connection. Accuracy shall be within 025% of full span.

SEQUENCE OF OPERATION

i) The system shall consist of a Technologic pump logic controller, multiple pump / AFD sets with manual and automatic alternation and pump staging.

ii) The pumping system shall start upon the closure of customer's contact when the pump logic controller Mode of Operation selector switch is in the REMOTE position.

iii) When the pump logic controller selector switch is in the LOCAL position, the pumping system shall operate automatically.

iv) Sensor / transmitters shall be provided as indicated on the plans.

v) Each sensor / transmitters shall send a 4-20Ma signal to the pump logic controller, indicative of process variable condition.

vi) The pump logic controller shall compare each signal to the independent, engineer / user determined set points.

vii) When all set points are satisfied by the process variable, the pump speed shall remain constant at the optimum energy consumption level.

viii) The pump logic controller shall continuously scan compare each process variable to its individual set point and control to the least satisfied zone.

ix) If the set point cannot be satisfied by the designed lead pump, the pump logic controller shall initiate a timed sequence of operation to stage a lag pump.

x) The lag pump shall accelerate resulting in the lead pump(s), decelerating until they equalize in speed.

xi) Further change in process variable shall cause the pumps to change speed together.

xii) When the set point criteria can be safely satisfied with fewer pumps, the Technologic pump logic controller shall initiate a timed destage sequence and continue variable speed operation.

xiii) As the worst case zone deviates from set point, the pump logic controller shall send the appropriate analog signed to the AFD to speed up or slow down the pump motor.

xiv) In the event of a system differential pressure failure due to a pump of AFD fault, the Technologic pump logic controller shall automatically start the next variable speed pump / AFD set in sequence and continue variable speed operation.

xv) In the event of the failure of a zone sensor / transmitter, its process variable signed shall be removed from the scan / compare program. Alternative zone sensor / transmitters, if available, shall remain in the scan / compare program for control.

xvi) The zone number corresponding to the failed sensor / transmitter shall be displayed on the operator interface of the pump logic controller.

xvii) In the event of failure to receive all zone process variable signals, all AFDs shall maintain 100% speed, reset shall be automatic upon correction of the zone failure.

xviii) PUMP or AFD fault shall be continuously scrolled through the display on the operator interface of pump logic controller until the fault has been corrected and the controller has been manually reset.

END OF SECTION - 06

SECTION-07

STANDARD SPECIFICATION OF COMBINED AIR & DIRT SEPARATOR

1.0 CONSTRUCTION

Deaerator-dirt separator. Flanged connections, complete with Brass drain valve 1” F (from DN 50 to DN 150), 2” F (from DN 200 to DN 300). Complete with a set of concentric metal mesh surfaces to create the swirling motion required to facilitate the release of micro-bubbles and dirt to the surfaces.

Epoxy resin coated steel body. Brass automatic air vent valve body. Stainless steel internal element. PP float. Brass float guide and stem. Stainless steel float lever and spring. EPDM hydraulic seals. Medium water and non-hazardous glycol solutions excluded from the guidelines of EC directive 67/548; maximum percentage of glycol 50%. Maximum working pressure 10 bar. Working temperature range 0–110°C. Particle separation rating down to 5 µ. For flanged and weld-end models DN 50 (from DN 50 to DN 150). Working temperature range 0–100°C.

Floor brackets for sizes DN 200 (from DN 200 to DN 300).

The third party TNO certification is required for the separation of air & dirt with given limits

END OF SECTION-07

SECTION-08

STANDARD SPECIFICATION OF PIPE WORK AND VALVES

1.0 GENERAL

All piping work shall conform to quality standards and shall be carried out as per specifications and details given hereunder:

2.0 PIPES

The pipes and valves shall be of approved make given in the NIT.

Water pipes shall be “C” Class M.S. E.R.W. Black pipes and shall conform to IS: 1239 (Part-I) – 1991 & IS: 3589 – 1991 with latest amendments.The wall thickness of “C” Class M.S. E.R.W.Black pipes as per IS: 1239 (Part-I) and flanges thickness as per IS: 6392 (Table-17) shall be as follows:

Sl. No.	Nominal Pipe Dia in mm	Wall Thickness of Pipe in mm	Thickness of Flanges in mm
1.	25	4.00	16
2.	32	4.00	16
3.	40	4.00	16
4.	50	4.50	18
5.	65	4.50	18
6.	80	4.80	20
7.	100	5.40	20
8.	125	5.40	22
9.	150	5.40	22
10.	200	6.00	24
11.	250	6.00	26
12.	300	6.00	28

3.0 FITTINGS

3.1 The dimensions of the fittings shall conform to I.S. 1239-69 Part-II unless specified otherwise in specifications.

3.2 All bends in sizes up to and including 150 mm dia, shall be ready made of heavy duty, mild steel of same class as specified for pipes.

3.3 All bends in sizes 200 mm and larger dia shall be fabricated from pipes of the same dia and thickness, with a minimum of five sections, each segment making a 17deg bend and having a minimum centre line radius of 1.5 times diameter pipe diameter.

3.4 All fittings such as branches, reducers etc. in all sizes shall be fabricated from pipes of the same dia and thickness, and its length should be at least twice the dia of the pipe.

Blank ends are to be formed with flanged joints and 6 mm thick blank between flange pair for 150 mm and over in case where, a future extension is to be made, blank end discs of 6 thickness are to be welded on, with additional cross stiffeners from 50 mm x 50 mm x 5 mm MS heavy angles, for sizes up to 350 mm, all ends larger than 400 mm Dia shall have dished ends.

4.0 FLANGES

4.1 All flanges shall be of mild steel as per I.S. 6392/71 and shall be steel slip-on-type, welded to the pipes, flanges thickness shall be to suit class-II pressures.

4.2 Flanges may be tack welded into position, but all final welding shall be done with joints dismounted. 5mm thick Neoprene gaskets shall be used with all flanged joints. The gaskets shall be fiber-reinforced rubber as approved by the Engineer-in-Charge. Special adhesive compound shall be used between flanges of steam, air and gas lines.

4.3 Flanges shall be used as follows:

4.3.1 Counter flanges for equipment having flanged connections.

4.3.2 Flanged pairs shall be used on all such equipment, which may require to be isolated or removed for service e.g. pumps, Air washer units etc.

4.3.3 All threaded valves shall be provided with nipples and flanged pairs on both sides to permit flange connections, for removal of valves from main lines for repair/replacement.

5.0 VALVES

5.1 BUTTERFLY VALVES

5.1.1 The butterfly valve shall consist of cast iron body of IS 210FG220 preferably in two piece construction.

5.1.2 The disc shall consist of disc pivot OF SG iron IS 1865 Gr. 400/12 and driving stem shall be made of SS AISI 410 and in one piece centrally located conforming to IS 13095.

5.1.3 The valve seat shall be synthetic material nitrile suitable for water duty. It shall line the whole body and should be field replaceable/integrally moulded.

5.1.4 The disc should move in slide bearings on both ends with 'O' ring to prevent leakage.

5.1.5 The handle should have arrangement for locking in any set position.

5.1.6 The valve should be suitable for 16 Kg/Sq.M working pressure.

5.1.7 All the valves above 32 mm Dia shall be butterfly type.

5.2 GATE/GLOBE VALVE

5.2.1 All gate valves and Globe valves shall be of gun metal screwed type, and shall have non rising type spindle, conforming to class 2 of I.S. 778 and shall be with I.S.I. marking and certification and tested upto a pressure of 21 kg/sq.cm.

5.3 CHECK VALVE

5.3.1 All Check valves upto 50 mm dia shall be of GM screw type and shall be conforming to I.S. 778 and of I.S.I marked and certification.

5.3.2 All check valves above 50 mm shall be wafer type dual plate.

5.3.3 The body of check valve shall be of cast iron of grade IS 210 FG 220.

5.3.4 The flap shall be made of SS AIASI 304 or SG iron IS 1865GR 400/12.

5.3.5 The hinge and stop pin shall be of SS AISI 304/410 and spring shall be SS AISI 304/316

5.3.6 The valve shall be suitable for 16-kg/sq.-cm. Working pressure and shall be factory tested at 21-kg/sq. cm.

6.0 BALANCING VALVES

6.1 The balancing valves shall be capable of measuring, regulating and isolating the flow.

6.2 The balancing valves up to 40 mm dia shall be of gunmetal screwed type and 50 mm dia. And above shall be C.I double-flanged type confirming to B.S. 1452 or equivalent specifications.

6.3 The balancing valves shall be made of stainless steel AISI 410. All other internals shall be non-corrosive material preferably of forged brass.

6.4 The port opening shall permit precise regulation of flow rate, by accurately measuring the pressure drop across the port.

6.5 The valve shall be complete with two ports for connections to a mercury manometer, to measure the pressure drop, as well as drain port.

6.6 The spindle shall have a shielded/concealed locking screw to avoid the tempering of the setting after balancing.

6.7 The valves must have easily accessible pressure drop measuring facility.

6.8 The balancing valve shall have indication of number of turns on hand wheel preferably digital type.

6.9 The balancing valve shall be used in lieu of butterfly/gate/globe valves and shall be suitable for working at 16 kg/sq.cm working pressure.

7.0 PID/2 Way Modulating/Flow Control Valve

7.1 The Self balancing flow control valves shall be pressure independent, 2-way, modulating type to accept input signals from the control system.

7.2 Each Air Handling Unit shall be provided with a 2 Way Pressure Independent cum Balancing cum Control Valve integrated in a single Body.

7.3 Diaphragm based delta p controller shall ensure 100% valve authority & linear characteristics at all loads and setting. The cartridge is not acceptable.

7.4 Control - Valve shall be equipped with electronic modulating gear type actuator which can accept either 4(0)-20mA / 2(0)- 10V DC signals. Operating voltage for actuator shall be 24V AC (thermal/wax not acceptable).

7.5 All Valve actuators shall be microprocessor based with self-calibrating feature.

7.6 Valve Actuator combination shall be able to give logarithmic control characteristic to achieve linear control.

7.7 Actuator shall be able to work against pump head or maximum closing pressure.

7.8 For Manual override, it shall not involve opening of actuator body.

7.9 Each Valve shall have a stepless adjustable maximum flow limitation as per the designed flow rate of coils.

7.10 The balancing shall be done only in the valve not in the actuator so that in case of actuator failure the balancing is not lost and easily accessible.

8.0 STRAINERS

8.1 The strainers shall either be pot type or 'Y' type with cast iron or fabricated steel body, tested upto pressure applicable for the gate valves as shown on the drawings.

8.2 The strainer's screen shall have a perforated bronze sheet of 22-gauge thickness with 3 dia having an area of 60% perforation and with a permanent magnet, to catch iron fillings.

8.3 All pump shall have suction guide with strainer in pump suction.

9.0 JOINTING

9.1 All pipelines shall be welded type.

9.2 Square cut plain ends will be welded for pipe up to and including 100 mm dia.

9.3 All pipes 125mm dia. or larger will be bevelled by 35 Deg. for welding.

10.0 MISCELLANEOUS

10.1 Proving all piping, required to make the apparatus connected, complete and ready for regular and safe operation, unless otherwise noted, connect all apparatus and equipment in accordance with manufacturer's standard details, as approved by the Engineer-in-Charge.

Consult drawings and specifications to determine number and requirements of all items of equipment, requiring piping, such as bend, drain, relief etc., wherever equipment is provided with connections for such piping.

10.2 Providing valves and capped connections for all low points in piping system, necessary or required for draining systems. Provide for all risers isolating valves and drain valves to permit repairs without interfering with the rest of the system.

10.3 During construction, temporarily close, open ends of pipes with sheet metal caps, where necessary, or required to prevent debris from entering piping system.

10.4 Support piping independently of all equipment so that the equipment is not stressed by the piping weight or expansion.

10.5 To facilitate the maintenance, repair and replacement.

10.6 Unions, if used, shall be flanged, as required, where indicated and in connections to all equipment, apparatus, and specialties requiring disconnection for repairs or replacement, locate unions between shut-off valves and equipment as directed by Engineer-in-Charge.

10.6.1 Provide shut-off valves where indicated and for individual equipment, units at inlet and outlet, to permit unit removal for repairs, without interfering with the remainder of the system Additional shut-off valves shall be provided as required to enable all systems to be fully sectionalized. By-pass and stop valves shall be provided for all automatic control valves as specified.

10.6.2Arrange piping for maximum accessibility for maintenance and repair, locate valves for easy access and operation. No valves shall be installed with handles pointing down, unless unavoidable.

10.6.3 Cut the pipes accurately according to measurements, established at building and work into place without springing or forging.

10.6.4 Pipe supports shall be adjustable for height and primer coated with rust preventive paint and finish coated with gray paint, both as approved by Engineer-in-Charge. Spacing of pipe supports shall not be more than that of specified below:-

10.6.5

Nominal Pipe Size mm	Spacing (Meters)
15	1.25
20&25	2.00
32,30,50 & 65	2.50
80,100 & 125	2.50
150 & ABOVE	3.00

10.6.6 Extra supports shall be provided at the bends and at heavy fittings like valves to avoid undue stresses on the pipes. Pipe hangers shall be fixed on walls and ceiling by means of metallic approved dash fasteners.

10.6.7 Insulated pipe shall be supported in such a manner as to not to put undue pressure on the insulation.

10.6.8 Where pipes are to be buried under ground following procedure and specifications to be adhered. The top of the pipes shall not be less than 75 Cms. from the ground level. Where this is not practical permission of Engineer-in-Charge shall be obtained from burying the pipes at lesser depth.

The pipes shall be surrounded on all sides by sand cushions of not less than 15 cms. After the pipes have been laid and top sand cushions provided, the trench shall be refilled with the excavated soil, excess soil shall be removed from the site of work by the Contractor.

Apply a coat of bitumen.

Fix the tarfelt sheet with the help of bitumen, followed by another thick coat of bitumen.

11.0 HANGERS & SUPPORTS

11.1 Hangers and supports shall be provided and installed for all piping and tubing wherever indicated, required or otherwise specified. Wherever necessary, additional hangers and supports shall be provided to prevent vibration or excessive deflection of piping and tubing.

11.2 All Hangers and supports shall be made of steel or other durable and non- combustible materials, galvanized or plated. Wood wire or perforated strap iron shall not be used as permanent hangers or supports.

11.3 Hangers shall be supported from fabricated structural steel secured with expansion bolt in reinforced concrete slab/beams. Similarly, pipe racks shall be fabricated with structural steel and secured with expansion bolts in RCC slab/beams.

11.4 No hangers shall be secured to underside of lightweight roof decking and lightweight floor glass.

11.5 Mechanical equipment shall be suspended midway between steel joints and panel points.

11.6 Drilling or punching of holes in steel joist members will not be permitted.

11.7 All nuts, bolts and washers shall be of G.I only.

11.8 all Hot water piping in A.C. plant room and other areas shall be duly supported with high density polyurethane foam (P.U.F.) supports of block type so as to provide insulation as well as take load of piping. These supports would be fixed with rubber sheet and clamps. Placing of these supports are as per design parameters keeping in mind the load factor of bare pipe plus fluid weight and vibratory movement of the pipes. Suggested distance for placing these supports as mentioned in 9.6.4.

12.0 SLEEVES

12.1 Where pipes pass through floors, provide galvanised steel pipe sleeves 50 mm larger than outside diameter of pipe. Where pipes are insulated, sleeves shall be large enough to ample clearance for insulation.

12.2 Where pipes pass through outside walls or foundations, the space between pipe and sleeve shall be caulked with lead wood and oakum.

12.3 The center of pipes shall be in the center of sleeves and sleeves shall be flush with the finished surface.

13.0 ARRANGEMENT AND ALIGNMENT OF PIPING

13.1 All piping shall be arranged and aligned in accordance with the drawings as specified. Where special conditions are encountered in the field, the arrangement and alignment of piping shall be as directed by the Engineer-in-Charge.

13.2 The piping shall be installed in a uniform manner, parallel to or perpendicular to walls or ceilings, and all changes in directions shall be made with fittings. The horizontal piping shall be run at right angles and shall not run diagonally across rooms or other piping. Wherever possible all piping shall be arranged to provide maximum headroom.

13.3 All piping shall be installed as directly as possible between connecting points in so far as the work of other trades permits. Where interference occurs with another trade whose work is more difficult to route, this Contractor shall re route his pipes as required to avoid interference, at the discretion of the Engineer-in-Charge.

13.4 All piping shall be carefully installed to provide for proper alignment, slope and expansion.

13.5 The stresses in pipe lines shall be guided and pipes shall be supported in such a manner that pipe lines shall not creep, sag or buckle.

13.6 Anchors and supports shall be provided wherever necessary to prevent any misalignment of piping.

13.7 Small tubing for gauges, controls or other equipment installed on any apparatus shall not be coiled nor excessive in length, but shall be installed neatly, carefully bend at all changes in direction, secured in place and properly fastened to equipment at intervals to prevent sagging.

13.8 The piping shall be grouped wherever practical and shall be installed uniformly in straight parallel lines in either vertical or horizontal positions.

15.0 TESTING

15.1 In general, tests shall be applied to piping before connection of equipment and appliances. In no case shall piping equipment or appliances be subjected to pressures exceeding their test ratings.

15.2 The tests shall be completed and approved before any insulation is applied. Testing of segments of pipe work will be permitted, provided all open ends are closed, with blank-offs or flanges.

15.3 After tests have been completed the system shall be drained and flushed 3 to 4 times and cleaned of all dust and foreign matter. All strainers, valves and fittings shall be cleaned of all dirt, fillings and debris.

15.4 All piping shall be tested to hydraulic test pressure of at least one and half times the maximum operating pressure but not less than 10 Kg/Sq. cm for a period of not less than 24 hours. All leaks and defects in the joints revealed during the testing shall be rectified to the satisfaction of the Engineer-in-Charge, without any extra cost.

15.5 All the piping systems shall be tested in the presence of the Architect or Engineer-in-Charge or their authorized representative. Advance notice of test dates shall be given and all equipments, labour, materials required for inspection and repairs during the test shall be provided by the Contractor. A test shall be repeated till the entire systems are found satisfactory to the above authority. The tests shall be carried out for a part of work if required by Engineer-in-Charge in order to avoid hindrance in the work of the insulation Contractor.

15.6 The Contractor shall make sure that proper noiseless circulation is achieved through all piping systems. If due to poor air bond, proper circulation is not achieved, the Contractor shall bear all expenses for carrying out the rectification work including finishing of floors, walls and ceiling damaged in the process of rectifications.

15.7 The Contractor shall provide all labour and materials to make provision for removing water and throwing it at the proper place during the testing or/and after the testing to avoid damages to employer or other Contractors properties. Any damages caused by the Contractor to the employer or other Contractors' properties, shall be borne by the Contractor.

16.0 AIR VENTS

16.1 Air vents for purging of air trapped in piping system shall be provided at the highest point. Globe valves of the size indicated below shall be provided

Pipe Size	Valve Size
Upto 100mm	25mm dia
Above 100mm	40mm dia

17.0 DRAIN PIPING

17.1 The drain piping shall be medium class galvanized steel as per IS 1239/1979.

17.2 The fittings shall be forged with screwed connections.

17.3 The gate valves shall be of gun metal as described earlier.

17.4 Pipe crosses shall be provided at bends, to permit easy cleaning of drain line.

17.5 The drain line shall be provided up to the nearest drain trap and pitched towards the trap along with a P-Trap at the bottom of each vertical drainpipe.

17.6 Drain lines shall be provided at all the lowest points in the system, as well as at equipment's, where leakage of water is likely to occur, or to remove condensate and water from pump glands.

18.0 PAINTING

18.1 All pipes supports, hangers, etc. shall be given two coats of Zinc Chromate or Red Lead primer.

18.2 All pipes, which are not to be insulated, shall then be given one coat of finish paint, of a type and colour, as approved by the Engineer-in-Charge.

19.0 PRESSURE GAUGES/THERMOMETERS

19.1 Water Pressure Gauges

Water pressure gauges 100mm dia made out of stainless steel SS-304 all parts are made from copper alloy and stainless steel to prevent from corrosion attack. Dial shall be in white colour and number shall be in the black and red colour for the visibility, gauges shall have 'A' stainless steel 'U' tube of 15mm dia x 400mm in length both side threaded with stainless steel nut, A ball valve shall be provided at one end of tube for protecting gauge during testing of system.
These gauges shall be provided at all following locations:

a) Boilers /Heatpumps : Inlet and outlets.

b) All pumps : Suction & discharge.

All pressure gauges shall be complete with globe valves and confirming to IS: 3624.

19.2 Industrial Type Thermometer

V-Form industrial type body shall be aluminium alloy anodised in black or gold coloured surface. The casing shall be adjustable side way of reading from the front. The glass capillary shall be triangular in shape with blue mercury filled in the glass for better visibility, scale of reading shall be range -10 to 100 c graduation of scale shall be 1 in both reading cooling& heating application.

Thermometer shall be suitable for 15mm connection.Thermometer for hot line shall have long stem, so that thermometer is removable without damaging the insulation.
The thermometers of suitable range/length shall be provided at the following locations:

a) Boilers /Heat pumps: Inlets and outlets in separate wells.

END OF SECTION 08

SECTION 09
STANDARD SPECIFICATION OF PE-X PIPING WITH COMPONENTS

RADIANT COOLING/HEATING PIPING

PE-Xpipe with an oxygen diffusion layer of EVOH (ethylene vinyl alcohol), with a water installation - Cross-or oxygen diffusion resistance as per DIN 4726. These under floor heating pipes are suitable for Coupler/Q&E and Compression fittings as well as coupler and compression sleeve joining method with application class of 4+5/ 6 bar. Junction of manifold pipe with MS pipe shall be as per manufacturer recommendation.

MECHANICAL & THERMAL PROPERTIES

- The PE-X pipe shall be of high density 0.938 g/cm3 with anti-oxygen vapour barrier suitable for pressurized distribution of hot water in heating and cooling radiant panel systems.

- The coefficient of linear expansion should be .00014 m/moC at 20o C & .000205 m/moC at 100o C as per DIN 53752 and thermal conductivity of pipe shall be 0.35 W/moC at 20o C as per DIN52612 and specific heat of 2.3kJ/kgoC.

- Max design temperature: 90°C. Malfunction temperature: 100°C. Design pressure 6/8 bar at 90°C/70°C.

- Fire class: E according DIN EN 13501

- The PE-X pipes shall be installed on EPS insulation with texture foil laid above slab. PE-X pipe is embedded in the screed. Wherever specified pipe shall be lifted as required using wire mesh and base frame arrangement.

DURABILITY

- PE-X pipe shall conform to DIN EN ISO 15875-2: 2003 in terms of working life. The durability curves of PE-X pipes shall be linear. The PE-X pipes shall be produced according to the Engel method and have a service life of at least 100 years with a warranty certificate of minimum 10 Years.

MEMORY EFFECT

- If the pipe is kinked, PE-X pipe shall have same physical and chemical properties as during production. After cooling, the kinked section shall be completely disappeared and no harm shall occur to the PE-X base pipe.

COMPRESSION FITTINGS

- The compression fittings should withstand the test pressure of 2 Bar and Maximum working pressure of 6 Bar. Adaptors shall be used while installing the manifolds and piping.

MANIFOLDS WITH FLOW METERS (OPTIONAL) AND TOP METER

- The body of manifold should be made of reinforced fibreglass and thermal resistant polymer. The manifolds shall be modular type with push fit which will give versatile solution and allow multiple connections and high water capacity as per the site requirement. The manifold shall be with flow meters and top meter for balancing.

- Manifold flowmeter modules for 1,3,4,6 loops, capable of combining max. 12 loops, for connection with basic kit, connection right or left with flat sealing, or connection from below with optional elbow- set, supply with Topmeter for balancing, shut-off and flow view.

- Maximum working pressure shall be 6 bar and maximum working temperature shall be 60°C

- Max. Water quantity per distributor 3.5 m3/h, KVs value for supply/return valves of 1.2 m3/h. Manifold shall be suitable for installation of actuator on return loop connection.

- The intermidate manifold connection piece shall be 1'piece-sealing connection for distribution manifolds. They shall be complete with air vent, drain cock and temperature gauge with self-sealing connection.

MANIFOLD MAY BE PROVIDED WITH INTEGRATED THERMOMETER.

CABINET BOX

- For attachment of manifolds on rigid support, it shall be fitted in a lockable cabinet which shall be made of SS306. All visible parts shall be powder coated in white colour (RAL 9010) or otherwise approved by client. The manifold cabinet shall be box type. It shall be powder coated and manufactured from minimum 18G thick sheet which should be able to withstand the load of manifold and other accessories. The manifold box shall have modular manifold for supply & return. The box shall be fixed in the area as shown in the drawing. Size of manifold shall be strictly as per drawings covering manifold as well as vertical pipes going into floor. It shall be locally fabricated and powder coated.

- PE-Xa pipe shall be routed from manifold into flooring through 2mm Flexible polyethylene/PVC conduit or OEM recommended arrangement of suitable size as per PE-Xa pipe size. Conduit shall be clamped onto slotted C-channel complete as per typical details in drawing. C channel shall be anchored into RCC wall.

MANIFOLD KIT

- Manifold kit shall be including brackets, flat sealing screw connection pieces with swivel nut, thermometer and end pieces with manual air vent, filling and draining tap and a by-pass.

- Multi bend support made of galvanized steel shall be used as bend support for the pipe at the manifold.
- Couplers along with compression sleeves made of brass for joining PE-Xa pipes shall be used.
- Q&E coupling rings or equivalent couplers for connection of PE-Xa pipes with two oval rings, made of brass may also be used.

MANIFOLD CONNECTION KIT

- The hot water line shall be connected through a factory assembled complete DZR Brass kit, which consists of 3- Ball valves (Supply, Return & Bypass), Y-type strainer with drain cock & Pressure Independent control valve (PICV/PID) with modulating actuator OR ON/OFF actuator as per BOQ . Helical stainless steel 304 flexible connectors shall be provided along with the kit. The Valve kit shall be supplied with an insulation kit made of Expanded Polypropylene (EPP) to avoid damage by condensation or water. The FCU link complete valve kit shall be rated to PN 16 pressure rating and being tested at 40 bars for the temperature up to 100 C.
- One set of 20mm size shall be able to cover flow rates of 0.01 to 0.35 L/s, and 25mm shall cover flow up to 0.65 L/s.
- The valve kit along with Flexible connectors, insulation box and control valve actuators shall be supplied by single manufacturer.

SLAB TEMPERATURE SENSOR

- Single-point concrete slab temperature sensors capable of measuring temperatures ranging from 0oC to 80oC with accuracy of ±0.2°C suitable for concrete thickness of 100mm - 200mm. Sensor shall have either NTC thermistors or RTD elements. Sensor shall be hermetically sealed and moisture proof. Dissipation factor of thermistor shall not be more than 2.2 mw/K. Thermal time constant shall be less than 10 seconds.
- Sensor shall be provided with communication cable for transferring the information with minimum 20 meter length. Length of cable should be modified as per location of DDC panel.

COMMISSIONING

- Prior to installation the workers to be briefed with basic knowledge of the technology and proper communication to be ensured to understand the installation instructions.
- Instructions to be given about all accessories to handle them in a proper and safe way. The workers to be trained at least for 4-6 hours before they start installation.
- Basic training on the safety and health aspects of their jobs.
- Site Safety Standard was discussed to avoid accidents and injuries.

INSTALLATION

- Manifold locations should be marked in exact position as per the drawing with a temporary support (with wood or iron rods).

- Isolate the walls of rooms/area by using edging strip so that energy from one area should not transfer to other area.
- Isolate the slab by using insulation over slab as per specifications so that the energy cannot transfer at slab level.
- Seal the insulation joints by using tape.
- Lay PE texture foil over insulation to avoid physical contact of screed with insulation & also pattern is imprinted on texture foil to maintain spacing between PE-X pipes supply and return line.
- If pipe is not to be laid over insulation directly, proper lifting arrangement shall be adapted to maintain uniform vertical between insulation and pipe. In SFRC floor, pre-cast concrete spacers pieces of dimensions as per drawing and BoQ shall be laid uniformly over full span with PE-Xa pipe passing through the hole provided during casting of spacer. Once inspection by PMC is done, only then casting of floor shall be initiated. Lifting arrangement shall be strictly as per drawing detail and schedule of quantities.
- Fix the manifold to the temporary support, In the way of supply should be on top and return in bottom.
- Mark all four sides maintaining 100-200mm distance from the walls and beams to lay the PE-Xa pipe as loops.
- Place the PE-X pipe on the uncoiler for easy pipe pulling.
- Stretch the flexible PE-X pipe to their full length to place the pipe on the texture foil or any other specified measure for laying of pipe.
- Fix the PE-X pipe the manifold on supply according to the module drawings maintaining the specified space pipe to pipe. Pipe shall be fixed using Couplers/Q&E expansion tool with heads M12. By using pipes clips securing pipe onto insulation or base frame, 2 clips per 1mtr of pipe length shall be standard. Clipping system can be as per site conditions if pipe is not directly secured into insulation instead lifted using special arrangements. Or reinforcement mesh to be provided with bar spaced as per designed pipe spacing and the pipes to be tied with the bars with ties
- After completing the loop laying, get the PE-X pipe up to the manifold and fix the end to the return to complete the loop.The PE-X pipe supplied and installed for each circuit shall be single length without any joints. The length of the PE-Xa pipe for each circuit shall be more than 100 meter. The pipe shall be installed on the plastic tracks at pitch of 100mm.
- Follow the same process for all loops and other manifolds also.
- Cove the manifold ends (for both supply and return) with some packing tape to avoid the dust entering in to the manifold.
- Once the manifolds fixing and looping of PE-X pipe is done, then it is ready for the pressure test. To make a pressure test for manifold, fill the manifold all loops with water first.

WATER FILLING

- Fix one pressure gauge and one ball valve to the return side manifold and one ball valve to the supply.
- Make sure all the supply and return valves are closed.

- Potable water is introduced into the supply line through a temporary connection.
- Now open the first loop supply and let water passes through the loop and after a few seconds open the return valve to flush the water from return side.
- Hold it for few minutes and close the return first and then supply completely to avoid air gaps.
- If the water entered in to the supply and not coming from the return, then there is some loop interchange while installation (if that happens please recheck all loops and make necessary changes).
- After flushing the first loop, then open the second loop supply line and let potable water enters in that loop and hold it for few seconds to fill that entire loop and open the return valve to flush.
- While flushing, please do it for few minutes until the complete air in the loop exhausted and you get a constant flow of water without any air gaps
- Fill the water for all loops of manifold in the same procedure.
- After filling the water in all loops then the manifold is ready for pressure test.

WATER PRESSURE TESTING

- First of all, close all the loops (supply and return) before you start the pressure test. Connect a pressure gauge to the supply side and ball valve at both supply and return ends. Close the ball valve of both supply and return.
- Loops need to be purged of air in turn by flushing the water through each loop. Connect the water supply to the supply line and open the supply ball valve.

  all constituents are also under allowablel limit as per manufacturer' requirement.
- Before feeding water in to the manifold, make sure that only soft water of pH value is around 7 andNow open the first loop supply and wait for few minutes so that water fills up in that circuit. Now open the return valve slowly and let air in the loop completely exhaust.
- After few minutes of bleeding, close the return ball valve and continue with water supplying to build up the pressure in the loop.
- Start increasing the pressure with an external pump or with manual pressure equipment following the pressure gauge and build up the pressure up to 6 bar.
- When the needle of the pressure gauge reaches 6 bar, close the supply ball valve also and let the 6 bar pressure remains in the loop.
- After that open the second loop supply ball valve, ones the loop is filled with water open the return line to bleed the water.
- Then close the return and continue with water supplying to build up the pressure in the loop.
- Start increasing the pressure with an external pump or with manual pressure equipment following the pressure gauge and build up the pressure up to 6 bar.
- Now close the supply ball valve also and let the 6 bar pressure remains in the loop.
- Follow the same procedure to build up the pressure of 6 bar in other loops and to all manifolds.
- To ensure all loops has been pressurized open all supply loop valves and increase pressure up to 6bar and close the supply ball valve.
- Maintain that 6 bar pressure. Check pressure every 5 hours and then enter in pressure log , duly witnessed by client/PMC.

- Pressure falls because of pipe expansion usually 0.5 to 1.5 bar depending up on the loop length.
- If the pressure falls more than 2bar then there is a leak. If in that case leak should be identified and make necessary changes and recheck of all joints.
- Make a note of this test in pressure test document with manifold numbers, number of loops, pressure of 6 bar and test starting time and end time.
- Once the pressure tests are completed, after 48 hours the pressure of the manifold should put down to 3bar for screeding and maintained at 3 bar while screeding.

LEAKAGE IN PIPE

- The whole loop with flawed/leaked pipe shall be replaced completely with new pipe circuit

FLUSHING OF RISER PIPE`

- Complete rising pipes shall be flushed out before connecting it to the manifolds. Flushing shall be done for the complete riser loop for 2 or 3 times.
- First and second time water introduced into the riser line may be normal water but it should be clean and clear.
- Third time flushing shall be done with potable water.
- Water flushing shall be done until the inlet water comes in transparent in color.
- The purpose of flushing is to avoid the dirty water with metal pieces (comes while welding the riser pipe joints) entering in to the manifolds.
- Once the above process is completed, riser pipes shall be connected to the manifolds and run the radiant cooling system as per designed water temperature.

END OF SECTION 09

SECTION 10
STANDARD SPECIFICATION OF ELECTRICALS MOTORS & STARTERS

1.0 SCOPE

1.1 The scope of this section comprises supply, erection, testing and commissioning electrical equipment's, and wiring installation conforming to these specifications and in accordance with the requirements and Schedule of equipment.

1.2 The HVAC electrical panel, earhting, wiring etc suitable for HVAC equipments shall be as per specification given under electrical package.

2.0 ELECTRIC SUPPLY

2.1 Electric supply system shall be AC 415V ± 10% variation, 3 phase, 4 wire, 50 Hz with solidly earthed neutral.

2.2 A.C 220 V ± 10%, single phase, 50 Hz with neutral electric supply wherever specified shall be provided.

MOTOR-

GENERAL

3.1 The rating of motors shall be in accordance with the Technical Schedule of Equipment's. Where the equipment supply needs a high rating motor, the Contractor shall clearly point out and make his offer accordingly with justification.

3.2 The motors shall conform to IS:325 with latest amendment. The motor shall be rated for continuous duty at its maximum output with IE3 rating.

3.3 Frame shall be of close grained cast and the starter and the rotor core shall be built of low-loss high permeability steel sheet laminations. The winding shall preferably be pre-formed coils and baked in position. The squirrel cage rotor shall preferably be of die -cast aluminium. Ventilation shall be by means of fans - integrally built and designed - to give maximum ventilation with quiet operation.

3.4 The frame size of the motor shall conform to IS: 1231 with vibration limits as per IS: 4729 with latest amendment. The insulation of motor shall be class B as per I S: 325 with latest amendment unless specified otherwise.

4.0 SQUIRREL CAGE MOTORS

4.1 Up to 5.5 KW these shall be started direct on line and beyond 5.5 KWon Star Delta or (auto transformer starting where so specified). When started on Star Delta, the starting current of the motor shall not exceed 1.5 times the rated current when started direct on line, the starting current of the motor shall not exceed 4.5 times the rated current.

All motors installed indoors shall be TEFC with degree of protection IP 44 while motors installed out door shall be weatherproof with degree of protection IPW 55 as per IS 4691.

It shall be the responsibility of the Contractor to supply the motors and starters to satisfy the local regulations pertaining to the limitation on the starting current and indemnify the NHIDCL from all liabilities arising out of any objections raised by the local authorities in this regard.

5.0 INSTALLATION

5.1 The motor and its driven equipment shall be installed on a common foundation. Flexible coupling shall be provided in the case of direct drive and V belts in the case of belt drive. The alignment of the motor and the driven equipment shall be carried out conforming to IS:900 with latest amendment. The motor insulation resistance, as measured by a 500 V meggar shall be more than 1 Mega ohm. In case it is less than this value, the motor shall be dried as per IS 900.

5.2 The three phase motor shall be earthed at two separate places as per with latest amendment. The area of cross section of each earth conductor, if GI strip shall be equal to that of phase conductor it if were of copper, minimum area of cross section of each conductor earth shall be as per clause 20.1 under subheading “Earthing”. The cable connection for the motor shall have enough flexibility for adjustment during alignment etc. The connection shall be such that it shall prevent any vibration on the motor to be passed on to the cable conductor by use of proper size cable gland etc.

5.3 All moving parts shall be provided with proper safety guards.

6.0 STARTERS (GENERAL)

6.1 The material used in the starter shall generally conform to IS 13947 Part II and IS 0544 Part I for D.B.L., Part 2 for S.D.J and Part three Rotor starter with latest amendment.

6.2 All starters shall be totally enclosed, metal clad, dust proof and vermin proof, solenoid operated, air break type and shall be suitable for the specified system and the ambient conditions.

6.3 Starters shall be provided with built-in manually reset thermal overload relays on all the three phases with adjustable elements for overload protection, manually reset single phase preventors, sufficient extra contacts for interlocks, indicating lamps and Ammeters.

6.4 Starters for Squirrel cage induction motors shall be provided with push button and shall be suitable for remote operation in the case of A.H.U., pumps or other equipments as specified. The ‘no -volt coil’ of the starters shall be 220 volts whenever any controls or safety devices are connected in the starter circuit otherwise standard 415 volts coil may be used.

6.5 The starters to be provided for the different types and rating of the motors shall be as follows:-

For slip ring motors - stator Rotor starter.

For Squirrel Cage Motors upto 5.5 KW - Direct on Line starter.

For Squirrel Cage Motors above 5.5 KW up to 37 KW- Automatic Star Delta starter.

For Squirrel Cage Motors above 37 KW - Soft Starter / closed transition star Delta starter / auto transformer starter / part winding starter.

6.6 STATOR ROTOR STARTER

These starters shall have an air operated stator switch or oil immersed rotor resistance switch.

The stator switch shall be complete with trip free mechanism. The rotor starter handle shall not reset on tripping unless returned to off position. The resistance winding of the motor switch shall be of non corrosive material with low thermal coefficient and matching the resistance of the motor winding.

6.7 AUTOMATIC STAR DELTA STARTER

These Starters shall have heavy duty air break contactors of suitable ratings along with an adjustable timer of automatically switched with motor connections from star to Delta connections.

Each starter shall be complete with adjustable overload relays on all three phases and under voltage release. The starters should be “Hand Reset” type.

The “No Volt Coil” shall be 230 volts rating, wherever any controls of safety device are connected in the starter circuit otherwise standard 415 volts coil may be used.

6.8 DIRECT-ON-LINE STARTERS

These starters shall have a heavy duty air break contactors of suitable ratings.

Each starter shall be complete with adjustable overload relays on all three phases, single phase preventing device and under voltage release. The starters should be Hand Reset Type.

6.9 SOFT STARTER

The soft starter shall be with the following modes of operation:-

Soft Start

In this method motor shall be raised to an initial torque value which should be adjustable between 5% 90% of locked rotor torque. The motor voltage then gradually increase during the acceleration ramp time. Which is also to be adjustable from 2 to 30 seconds.

Soft Start with Selectable Kick Start

A kick start or boost shall be provided for current pulse of 500% of full load current and adjustable between 0.4 to 2 seconds.

Current Limit Starting

It is necessary to limit the maximum starting current adjustable between 50 to 500% of full load ampere.

Across the Line Starting

This mode shall be provided for applications requiring across the line starting.

7.0 FIREPROTECTION

All cables and wires for mechanical ventilation system incase fire shall be with fire survival cable under the scope of electrical package.
The HVAC panel & cabling from HVAC panel to equipments is in scope of this package.

END OF SECTION 10

SECTION-11

STANDARD SPECIFICATION OF THERMAL / ACCOUSTIC INSULATION

1.0 THERMAL INSULATION-FIBER GLASS WOOL WITH FIRE RATED STAR BOND COATED / EQUIVALENT AS PER BELOW DETAIL

SCOPE

The scope of this section comprises the supply and application of insulation conforming to these Specifications.
Insulation material shall be non toxic , chemically inert , non combustible, non ignitable, shall have zero ozone depletion potential, zero calorific value no heat evolution and shall be inherently proof against rotting , mould and fungal growth and attack by vermin.
The materials shall comply with following standards.
BS 476: Part 4 – Non Combustible (as per new NBC 2016)
BS 476: Part 5 – Not easily Ignitable (Class P)
BS 476: Part 6 – Fire propagation Index (I<12)
BS 476: Part 7 - Surface spread of flame (Class 1)
The material should comply with Class'O' fire rating as per BS 476 part 6&7.
The product to be able to work effectively at ambient temperature range of -100ºCto150 ºC

6.0 Boiler Room Acoustic Insulation

Acoustic Insulation Product
Glass Wool insulation boards
Density: 70 to 80 Kg/m3
Thickness: 25 mm
Lamination: One Side FSK & Other side Black Glass Cloth
Size: 3M x 1.2 M or 1.2M x 0.6M

Specification:
Acoustic Board should be applied on walls and ceiling to provide superior acoustic absorption.

The insulation should conform to non-combustibility, Class-P (not easily ignitable), Class 1(surface spread of flame - NIL), and Class 'O' rating as per BS 476 standards.

Installation guidelines:
The surface of the wall and roof should be cleaned properly and Acoustic board has to fit directly on the wall of the room and roof with the help of screw (2 inch) and GI washers (3 inch x 3 inch).

The Acoustic board should be placed in such a way that black glass cloth is visible from inside the room. Complete as required and as per specifications.

7.0 INSULATION OF PIPES

Hot water shall be insulated with rigid Glass wool preformed pipe section. The insulation material shall be confirmed these specifications.The Fiberglass wool insulating material shall be applied for hot Water pipes as under.
Rigid pre-formed molded sections of fiberglass wool having a uniform density of 80 Kg/m3.
And thermal conductivity shall not be more than 0.033 W/mK at 25º C mean temperature. The material for piping insulation shall be factory laminated one side with Aluminum foil on the outside, and fused to the insulation material, as specified. The Aluminum foil shall extend by a minimum 50 mm on one side of the pipe section along the length to seal all longitudinal joints. Bonding of insulation material shall be with adhesive used for setting the insulation shall be vapour proof adhesive.The thickness of insulation material shall be selected with diameter of pipe as below.

Pipe Dia (NB)	Thickness (MM)
20 -100	25
100-150	40
150-250	50
300 -450	65
450 & above	75

8.0 METHOD OF INSULATION APPLICATION:

1. Pipes shall be thoroughly cleaned with wire brush and rendered free from all foreign matter and grease and primer coated as in item piping.

2. The pipe should be inspected and all joints should be sealed against leakages.

3. Two coats of Solvent Base Adhesive MAGIK 81-10 /equivalent shall be applied on the cleaned pipe surface.

4. Fiberglass wool rigid sections shall be fixed tightly to the surface.All joints to be sealed properly.Fixing and sealing compound shall be MAGIK 81-10 /equivalent All joints of Aluminum foil shall be sealed properly by means of 75 mm wide self adhesive aluminium tape of approved make.

5. Dip 100-200 gram m² thick glass fiber (7 mil thickness) fabric PARAFAB-GFC/equivalent in to MAGIK 30-36 AF/equivalent and wrap over the insulation.

6. Press gently by hand to avoided wrinkles in dipped fabric, and make surface smooth.

7. Apply 1st coat of adhesive (M-30-36 AF) /equivalent by brush after curing the dipped fabric.

8. Apply final coat of adhesive (M- 30-36 AF)/equivalent by brush once 1st coat is cured

9. The total spread of adhesive (M- 30-36 AF)/ equivalent shall be not less than 1.2 m² per kg with three coats.

9.0 INSULATION OF VALVES AND FITTINGS IN HOT WATER LINE

All valves, fittings, flanges, strainers etc. in the Hot water line shall be insulated in the same manner as described above for Hot water pipes with above detailed thick uniformly cut pieces from slabs of glass wool with vapour barrier with starbond coating as detailed above. Care should be taken to ensure that no damage would be caused to the insulation when valves or strainers are operated.

10.0 PUMP AND ACCESSORIES

All Hot water pumps and accessories shall be insulated with 75mm thick glass wool insulation with above manners.

11 INSULATED EXPANSION TANK CLOSED TYPE

The expansion tank shall be of steel construction of vertical type. Expansion tank shall have internal diaphragm and be pre-charged to system fill pressure of approximately 30 psig, AMSE approved for at least 100 psi working pressure and complete with line size lock shield inlet valve and air charging valve.

Pressurized Expansion Tanks shall be vertical & shall have a buttly membrane separating air & water.

The tank accepts the expansion of water volume & the air pressure increases. When the Boiler starts again, water in the system expand& the tank provides the volume of water to the system ensuring that hot water pumps shall never be starved of water.

Air pressure in the tank shall be checked once in two years after draining water from the tank.The air pressure should not be less than the static.

Air shall be filled by hand pump or portable compressor through the air valve. The only moving part in the system is bladder which shall have a normal life of 5 years. It is recommended to plan & check the bladder after 5 years for leakage.

For checking the bladder for leakage, the tank shall be isolated from the system & water from Expansion Tank shall be drained off by opening the drain plug. The flanges on top & bottom and the bladder shall be removed & checked for leakage by soap bubble test.
.Expansion tank shall be insulated with 80mm thick expanded polystyrene in two layers of equal thickness. The tank shall be internally two coats of epoxy paint. The

method of application of insulation shall be same as described for insulation of piping. The final finish shall be done with 0.5mm thick aluminum sheet cladding.

12 SPECIFICATION OF PRESSURISATION UNIT

Automatic pressurization unit consists of (1W + 1S) pump running at 1450 RPM; a Control Panel & Pressure switch.
The unit shall be designed to operate automatically & maintain pressure in the hot water line.The pressure shall be set on the pressure switch & pump starts & stops on the basis of the line pressure. Any leakage in the hot water line would reduce the pressure & pump would start to make up the lost water.The control panel has a feature of alternating the working pump ensuring that both pumps are in use.
The unit shall have a built in Sediments Separator to remove Sediments from incoming water & to protect the pump.
The pumps shall be low speed bronze pumps to ensure long trouble free & low noise operation. Four Sensors shall be provided in makeup water tank. Lower most sensors in the tank shall prevent dry running of pumps. Upper most sensors shall give an indication of over flow.
The control panel shall be programmed to operate the pumps when water level is between two middle sensors.
If makeup water is given from a large overhead tank, all the sensors except over flow can be shorted. The Unit shall operate but without dry running protection.

13 Adhesive for Pipes:-

Application:-
Bonding Fibrous Glass & other types of Insulation to the Interior or Exterior of Metal Duct Systems | Bonding Open Cell Insulation to GI | Bonding Open Cell Insulation to MS Pipe | Bonding Open cell Insulation in Underdeck | Bonding NBR Insulation to GI | Bonding Polystyrene Insulation | Bonding Polyurethane Insulation | Bonding Acoustic duct lining.

Specifications Standard
ASTM E 84/ UL 723, MIL -A -3316C, NFPA 90A & 90B, ASTM C916, Flame:0 & Smoke :0

For adhesive for Glass Wool/Mineral Wool Insulation
Bonding of insulation material shall be with Fire rated Classified Adhesive Grade only (M 81-10)/equivalent Adhesive used for setting the insulation shall be conforms to Flame:0 & Smoke :0 .
For adhesive duct Insulation with Nitrile Rubber FR Grade

Low VOC (MAGIK 85-23)/equivalent synthetic elastomer-based adhesive should be used to seal the Nitrile rubber on ducts. Adhesive should be non-flammable in dry form, tested as per ASTM E-84 and minimum solid 22 to 24% with heat, water & chemical resistance. Adhesive's application method strictly as per adhesives manufacturer's technical data sheet. The VOC compound of adhesive should be not more that 10g/liter when tested as per SCAQMD 304-91and VOC limit , Low emitting materials.

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Insulation Protective Coating for Chiled/Hot Water Pipe:

All insulated chilled water pipe insulation shall be coated (M 30-36AF)/equivalent ,Anti-Fungal insulation protective coating in conjunction with 7mil non-combustible certified Parafab GFC woven fiber glass cloth, tested as per ASTM D-5035-11, ASTM D 1777-64 and ASTM D 3776-09, finally finished with 2 layers of Insulation protective coating to provide omplete seal against air and moisture/resistance against mechanical impact, scratch, weather resistance with the properties of mold, fungus and bacterial resistance. The coating shall be comply with fire norms. Surface flame spread should be 0 and smoke developed should be also 0, coating should also comply with NFPA 90A & 90B- 25/50 for parameter and the VOC level of the coating should ,VOC level should be below than 50 gram/litter and it should also comply the guidelines of MIA 3316C- Class 1 & Grade A.

Insulation Protective Coating for Duct

All insulated Duct shall be coated with MAGIK 30-36AF/equivalent, Anti-Fungal insulation protective coating in conjunction with 7mil non-combustible certified Parafab GFC woven fiber glass cloth, tested as per ASTM D-5035-11, ASTM D 1777-64 and ASTM D 3776-09, finally finished with 2 layers of Insulation protective coating to provide complete seal against air and moisture/resistance against mechanical impact, scratch, weather resistance with the properties of mold, fungus and bacterial resistance.The coating shall be comply with surface flame spread should be 0 and smoke developed should be also 0,coating should also comply with NFPA 90A & 90B- 25/50 for parameter and the VOC level should be below than 50 gram/litter and it should also comply the guidelines of MIA 3316C- Class 1 & Grade A.

END OF SECTION-11

SECTION-12

STANDARD SPECIFICATION OF DOUBLE SKINNED AIR HANDLERS & VFD

A DOUBLE SKINNED AIR HANDLERS

1.0 SCOPE

This section deals with supply, installation, testing and commissioning of floor / ceiling mounted type air handlers.

THE AIR HANDLING UNITS

The area shall be served by several AHUs. Air handling units provides air to the areas and maintains the required temperature and humidity conditions in the controlled and un-controlled areas.
Particular attention shall be paid to ensure reasonably low and acceptable noise level as detailed below. If it is found more after installation, the Vendor has to arrange for replacement/repair the same.
The fan in the AHUs unit shall be mounted on anti-vibration mountings, which will be designed to achieve desired DB level.
The coil should be suitably brazed during manufacture to withstand all handling stresses. The bracing should be of hot dip galvanized material. The coil support frames should also be of galvanized iron.
All the Air handling units shall be hanged or placed in the AHU Room above the concrete block.

AIR HANDLING UNITS SPECIFICATION

o.	Description	Specification
1	AHU Type	Recycle / Double skin,Thermal break type, Single Decker

2	Installation	Location as per AC layout plan
3	AHU Construction	Standard
4	AHU panel thickness	Minimum 40mm thick
5	Outer and inner skin material thickness	Outer skin will be 0.8mm pre plasticized GI. Inner skin 0.8 mm plain GI with thermoacoustic panels with open cell material except mineral wool
6	Outer skin finish shade color	Pre Painted
7	Core insulation material	CFC free Polyurethane Foam
8	Density of insulation material	40 ±2 kg/m³ for AHU in AC area with thermal break profile
9	AHU SECTION [frame] material	Extruded aluminum
10	AHU Section [frame] material thickness	1.6 mm
11	AHU corners	Rounded corners / No sharp edges
12	Panel fixing method and screw projection.	Conceal screw in panel with plastic cap on screw head
13	AHU lifting arrangement	Shall provide by vendor as per center of gravity.
14	AHU base frame	Vendors standards and as per AHU weight-GSS
15	AHU internal coving	Inside coving required, Pen radius
16	Door Requirement	Access doors for fan section, coil section & filter section
17	Door Type	Positive Pressure side-inside open able Negative Pressure- Outside open able
18	Door sizes	To enable easy Filters removal.
19	Door hinges and locking system	Min 2 Hinges per door with self locking system
20	Door gasket material	Neoprene or equivalent gasket of suitable thickness.

21	Door tightness against water and air	Air tight door
22	Any Holes in AHU panels	To be seal for air tightness
23	Cooling and hot coil connection side	Opposite side of the access door
24	Limit switch	Manufacturer shall provide dust and oil free heavy duty limit switch for blower access door.
25	Light	Shall provide the industrial Marine light inside the blower section with suitable heavy protection.
26	Type of blower	DIDW Forward /backward curved centrifugal fan/ Plug fans
27	Blower construction	Standard
28	Blower construction material	Shall make out of galvanized sheet steel finished with polyester powder coating / equally efficient material
29	Fan performance and balance quality	Performance - As per AMCA210 standard “Laboratory Methods of testing fans for rating” Balancing quality – As per AMCA204 standard.
30		
31	Blower efficiency	Fan will be selected for the maximum efficiency at lower RPMFor Forward curve Min. 60% & Backward curve Min. 70%
32	Suitable for VFD	Above 6000 CFM all AHU are with VFD
33	Blower drive	Direct driven / V Belt Drive
34	Electrical supply	The motor shall be suitable for 3 phase 415 Volt +/- 10% 50 Hz frequency (Suitable for india electric standard)
35	Motor Pole	4/6/2 Pole , IE -3 Motor
36	Motor terminal box	Easy for electrical connection and maintenance.
37	Blower outlet velocity	NMT 610 M/Min.
38	Filter fixing arrangement	Flange/Box type filter fix with wing nuts
39	Gap between the Filter frame and AHU	Avoid the gap by using the rubber gasket, filled with Silicon sealant

40	Filter access door size	Able to remove the filters easily
41	Cooling coil design parameter	Coil air face velocity – should not more than 155 MPM Temperature difference 6.63°C (Chilled water coil inlet temperature : 6.67°C ,outlet temperature : 13.3°C) Pressure drop across the coil : Not More Than 0.5 kg/cm²
42	Cooling Coil Row Deep & Certification	6RD For AHU
43	Cooling coil tube material	Copper
44	Tube gauge	26 SWG—Standard 27 G
45	Tube size	OD-12.7 mm
46	Fin material	Hydrophilic coated blue fins
47	Finmaterial thickness	37 SWG
48	Fin per 50 mm	22-26 Nos
49	Coil header material	Copper
50	End connection of header to connect the water piping	With threaded MS socket and flange.
51	Coil testing pressure	21 kg/cm²
52	Cooling coil tray material	SS 304
53	Cooling coil tray construction	Sandwiched type and multi slope towards drainage hole—With 13 mm thick nitrile insulation
54	Drainage pipe material	SS 304
55	Drainage pipe	U trap drawing to be provided by vendor.
56	Drainage pipe end	Threaded connection
57	Drainage pipe size	Not Less Than 40mm

58	AHU noise level @ 1 meter away from AHU	Not more than 65 db FOR CS AHU & 72 db for FM AHU
59	Mixing Box	If Required
60	AHU accessories and mountings	All the air filters and dampers shown in the typical AHU GA drawing will be in the scope of AHU manufacturer. All the magnehelic gauges with housing across the air filter will be in the AHU manufacturer's scope.
61	**PRE FILTERS**	
a)	Frame	Aluminium anodized.
b)	Type	Box type.
c)	Media	Non woven synthetic supported by HDPE mesh on
		one side and aluminium mesh on the other side.
d)	Sealing of Media	By means of epoxy
e)	Efficiency	90% down to 10 micron particle size.
63	Humidifier Section	Yes , for Ceiling / Floor mounted AHUs to be provided

7.0 Specification of Ultrasonic Humdifier:-

Ultra sonic humidifier(for air handling units) in 22 G GI sheet enclosure suly epoxy painted complete with 1.3mm thick stainless steel (SS-304) tank with float valve, openable top rubber gasket, top openable with SS bolts, Electronic Humidistat, mist output nozzle drain, water makeup, overflow and drain connections. The transducers shall be interlocked with float switch, supplied with humidifier and humidistat. Humidifiers will have its own control panel mad of minimum 18 G CRCA sheet step down transformer, etc. Ultrasonic humidifier shall be complete with level switch for upper and lower level with solenoidal valve and filter assembly, step down transformer with automatic voltage, Controller, ON/OFF switch with light, control module and cooling fan for control circuit. Necessary potential free contacts shall be provided for BMS operation. Ultrasonic humidifier should be BMS compatible. Note: Price of pipe connecting ultrasonic humidifier to AHU shall be included in ultrasonic humidifier cost.

The humidifier shall have 10% margin over rated capacity & with necessary heating arrangement to maintain the temperature of water above 20 ºC.

C VARIABLE SPEED DRIVE (VSD)

1 Air quantity flow control

The VSD System shall function to supply variable air quantity in the air-conditioned area in response to the load variations including that due to variations in ambient conditions and filter cleanliness conditions, to maintain the inside designed temperature, RH and pressure conditions in conjunction with the humidifier and re-heaters. During the day hours, as per the time interval selected, the VSD System shall regulate the speed of the AHU to maintain the temperature within maximum designed temperature and positive air pressure inside the air-conditioned area. The positive air pressure shall be maintained by keeping a difference of minimum 15% in the airflow between the supply and exhaust air. However, under any circumstances during the day hours, the air flow rate will not fall below the 60% of the rated CFM of the AHU or 15 air changes, whichever is higher.Due to the clogging of the air filter if the inside temperature conditions are not achieved even at 100% AHU speed then the VSD will close an N.O. contacts to activate an alarm. The VSD shall have the provision to switch over to the manual mode as and when required. The system shall comprise of dedicated Variable Speed Drives (VSDs) designed for HVAC applications to accept 2 feedback signals (from temperature sensor installed in the AC area and programmable timer controller) and have 2 programmable set points (inside temperature conditions, and 60% of the normal CFM condition as stated above) using HVAC terminology, to regulate the speed of the AHU motors in response to the variations in load and filter cleanliness conditions to maintain temperature and Air flow differential in supply and exhaust conditions.

In case, any additional sensor (s) including wiring etc are required to meet the system requirements the cost of that shall be deemed to be included in the cost of the VSD. The VSD control shall have:

a) RFI (Radio frequency interference) filters for EMC (Electro magnetic compatibility) compliance.

b) Voltage Vector Control technology to generate advanced sinusoidal output voltage, 100% true RMS value of the fundamental voltage at rated speed and nominal torque, cause no motor de-ration and keep motor temperature limits within permissible class B limits.
c) Displays in user‘s friendly Alpha Numeric Characters for all operating parameters, programming parameters and faults.
d) Built in energy meter.
e) Built in run time counter.
f) Local control panel (key pad)

The system shall also comprise a suitable programmable timer & PLC with required electronic components, to allow 2 feedback signals (Temperature & Minimum CFM) to be passed on to the VSD during the day hours. In the night hours only one signal from the programmable timer shall go to the VSD to run it at pre-determined reduced speed. The room/ space air temperature and air flow shall be sensed by a temperature and air flow transmitters, which shall generate suitable DC signal to provide feedback to the VSD, which in turn shall regulate the speed of the AHU fan to maintain the designed conditions as described above.

VSD shall be designed, with built-in PID controller, control panel (keypads & display), IP 20 enclosure for use on standard centrifugal fans. The VSDs should not cause any de-ration of the connected motors and must ensure that class B temperature levels of the connected motors are never exceeded. The display should be in alpha-numeric characters and programming facility should be in user-friendly HVAC terminology.The VSDs should be able to accept up to 2 feedback signal from temperature & air flow transmitter simultaneously and to program 2 set points in it.

The system shall also have following features incorporated:

a) Heat sink over temperature protection
b) Under voltage protection
c) Over voltage protection
d) Alpha-numeric display facilities
e) ON indication
f) Trip indication
g) Selectable display of various parameters line voltage, frequency, speed, power, torque, motor temperature percentage, VSD temperature percentage, KWH.
h) Raise and lower speed push button in local mode.
i) Frequency range variation from 0 to 50 Hz.
j) Remote start and stop facility including indications there of with necessary hardware and terminal blocks, including toggle switch etc. to over ride remote start & stop at the time of maintenance/ repairs.
k) Off delay facility through timer or PLC with 30 sec to 120 sec. time delay, to be connected to air flow switch.
l) Safeguard facility against single phasing.
m) Tripping of AHU blower motors in response to the fire alarm signal from AFAS.
n) Inter locking of Exhaust and AHU blowers such that power supply gets fed to exhaust blower only when the supply air flow is there.

END OF SECTION –11

SECTION-13

STANDARD SPECIFICATION OF AIR CIRCULATION SYSTEM

Air Distribution

This section covers the general design, materials, construction features, manufacture, shop inspection and testing at contractor's works, delivery at site, installation, testing, commissioning and carrying out performance test at site of Air Distribution system.

1.0 Material Requirement

Ducting shall be fabricated from Galvanised steel sheet (GSS). GSS duct shall be Factory Fabricated of approved make, zinc coated conforming to IS 277 coating grade 120 or better. Galvanizing shall be class VIII – light coating of zinc, nominal 120gm/sq.m surface area and Look Forming Quality prime material along with mill test certificates.

Only new, fresh, clean (unsoiled) and bright GI sheets/Aluminimum shall be used. The consultants reserve the right to reject-summarily sheets not meeting these requirements.

Samples of sheet from each lot selected at random by consultant shall be subject to approval and shall be tested for thickness and zinc coating at contractor's expenses.

2.0 Construction Features
Gauges, Bracing By Size Of Ducts For Factory Fabricated Ducts As Per Smacna:-

All ducts shall be factory fabricated from galvanized steel of the following thickness, as indicated as below:

3.0 For Ducts with external SP upto 250 Pa (ESP upto 25mmWg)

TABLE-1

Rect. Ducts	**PRESSURE 250 Pa TOILET VENTILATION FANS DUCT WORK**						
G.S.	**Duct Section Length 1.2 m (4 ft)**						
Maximum				**Joint Type**	**Joint reinforcement with tie rods**	**Reinforcement at 600mm from joint with tie rods**	**Duct support with MS angle and**
Duct Size (mm)	**Gauge**		**Fastner**				

							GI threaded rod of 10mm dia.
1-500	26		3/8"	C&S/ 4-Bolt TDC/TDF	Nil	Nil	40x40x3
501-750	26		3/8"	C&S/ 4-Bolt TDC/TDF	Nil	Nil	40x40x3
751-900	26		3/8"	4 Bolt TDC / TDF	Nil	Nil	40x40x3
901-1200	24		3/8"	4 Bolt TDC /TDF	Nil	Nil	40x40x5
1201-1300	22		3/8"	4 Bolt TDC /TDF	Nil	MPT	40x40x5
1301-1500	22		3/8"	4 Bolt TDC /TDF	Nil	MPT	40x40x5
1501-1800	20		3/8"	4 Bolt TDC /TDF	Nil	MPT	40x40x6
1801-2100	20		3/8"	4 Bolt TDC /TDF	JTR	MPT	40x40x6
2101-2250	18		3/8"	4 Bolt TDC /TDF	JTR	MPT	40x40x6
2251-2400	18		3/8"	4 Bolt TDC /TDF	JTR	Nil	40x40x6
2401-2700	For duct sizes above 2400mm, follow site fabricated specifications						

TABLE-2

Rect. Ducts	**PRESSURE500Pa FOR ALL AHUS DUCT WORK**						
G.S.	**Duct Section Length 1.2 m (4 ft)**						
Maximum							**Duct support with MS angle and GI treaded rod of 10mm**
Duct Size (mm)	**Gauge**		**Fastener**	**Joint Type**	**Joint reinforcement with tie rods**	**Reinforcement at 600mm from joint with tie rods**	

							dia.
1-500	26		3/8"	C&S/ 4-Bolt TDC/ TDF	Nil	Nil	40x40x3
501-700	26		3/8"	C&S/ 4-Bolt TDC/ TDF	Nil	Nil	40x40x3
701-900	24		3/8"	4 Bolt TDC/ TDF	Nil	Nil	40x40x3
901-1200	22		3/8"	4 Bolt TDC/ TDF	Nil	MPT	40x40x5
1201-1500	20		3/8"	4 Bolt TDC/ TDF	Nil	MPT	40x40x5
1501-1800	20		3/8"	4 Bolt TDC/ TDF	JTR	MPT	40x40x6
1801-2100	20		3/8"	4 Bolt TDC/ TDF	JTR	2 Nos.MPT	40x40x6
2101-2250	18		3/8"	4 Bolt TDC/TD F	JTR	2 Nos.MPT	40x40x6
2251-2400	18		3/8"	4 Bolt TDC/ TDF	JTR	Nil	40x40x6
2401-2700	For duct sizes above 2400mm, follow site fabricated specifications						
	JTR	G.I. JOINT TIE ROD THREADED ,12MM DIA					
	MTR	G.I. MID PANNEL TIE ROD THREADED ,12MM DIA					

Note- 1 Openingfor JTR/MPT at duct surface shall be sealed properly using washers and sealant.

4.0 <u>Gauges, Bracing By Size Of Ducts ForSite Fabricated Ducts As Per BIS:</u>

a) **Site Fabricated Duct**

b) Duct Materials

c) Ducting Material : GSS

d) All ducts shall be fabricated from galvanized steel sheets of the following thickness

TABLE 1

Duct Size			**Type of Joint**	**Bracing / flange size (mm)**	**Suspension rods size for Hangers (mm)**	**Supports GI (mm)**	**Distance between supports**
00 - 450	26		GSS Slip	-	10	40x40x3	2.0M
451 – 600	24		MS/GSS Flanges	-	10	40x40x3	2.0M
601 – 750	24		MS/GSS Flanges	25x25x3	10	40x40x3	2.0M
751 – 1200	22		MS Flanges	25x25x3	10	40x40x3	2.0M
1201 – 1500	22		MS Flanges	40x40x3	10	40x40x5	2.0M
1501 – 1800	20		MS Flanges	40x40x3	10	50x50x6	2.0M
1801 – 2200	20		MS Flanges	40x40x3	10	50x50x6	2.0M
2201>above	18		MS Flanges	40x40x5	10	50x50x6	2.0M

Longitudinal seams shall be Pittsburgh lock type at corners as shown on sheet. Longitudinal joints shall not be provided for rectangular ducting at locations other than corners, except where larger side of duct exceeds 2500mm. longitudinal joints of ducting having side larger than 2500mm other than corner shall be grooved or standing seam as shown.

All circumferential joints shall be GI angle flanged joints.

Flanges used for transverse joints shall be joined with each other with Galvanised Steel (GS) bolts, washers and nuts. The bolts shall be of minimum M8 size and the spacing between bolts shall be maximum 150 mm for low-pressure system.

For transverse angle flanged joints, neoprene gasket (3mm uncompressed thickness and width equal to flange face) adhered to the flange face shall be used. The boltholes in gasket shall be the same as bolt diameter and shall be punched prior to insertion of gaskets.

Angles shall be riveted to the ducts at 300mm centres. (Maximum).

All ducts shall be factory made using lock forming machine. No site fabrication ducts are accepted.

5.0 Transformation

Duct transformation shall be used to change the shape of duct and shall be made for easy and noiseless flow of air. Maximum slope of transformation shall be 1:4

6.0 Ends, Offsets and Branch Connections

All bends, offsets and branch connections shall be made for smooth and noise less flow of air and minimum pressure drop. In case of full radius elbow optimum ratio of centreline radius of elbow to duct dimension of 1.25 shall be considered. However, due to space constraint shorter radius constraint shorter radius elbow or square elbow with guide vanes may be provided. Contractor shall furnish the details of guide vanes i.e. number of vanes, location etc. in the drawing.

All curved elbows shall be provided with air turning vanes consists of curved metal blades or vanes arranged so as to permit the air to make abrupt turns without appreciable turbulence.

All right angle elbows shall be provided with double thickness aerofoil turning vanes extending over at least 50 percent of the while curvature of the elbow. The turning vanes shall have a flange covering the whole base be riveted to the duct at not more than 60 mm centres.

Every duct tap-off from supply and return air duct shall be complete with opposed blade volume contract damper. A splitter damper or volume control damper shall regulate the flow of air to the branch duct.

7.0 Duct Supports and Hangers

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Volume control dampers shall be provided in every branch duct from individual main ducts. Volume control dampers shall also be provided in branch duct from main connecting to individual supply / exhaust air outlets, and inlets, fresh air intake duct, etc.

7.1 Steel Wire Rope Hangers& Supports:

Wire Hangers shall be used to suspend all static HVAC Air Distribution services.

Wire Hangers should consist of a pre-formed wire rope sling with a range of end fixings to fit various substrates and service fixings, these include a ferruled loop, permanently fixed threaded M6 (or M8, M10) stud, permanently fixed nipple end with toggle, at one end or hook or eyelet, cladding hook, barrel, wedge anchor, eyebolt anchor or any other end fixture type or size as per manufacturers recommendation and design. The end fixings and the wire must be of the same manufacturer with several options available. The system should be secured and tensioned with a Hanger self-locking grip at the other end. Once the grip is locked for safety purpose unlocking should only be done by using a separate setting key

and should not be an integral part of the self-locking grip. Only wire and/or supports supplied and/or approved, shall be used with the system.

a. Wire Hangers should have been independently tested by Lloyds Register. APAVE, TUV, UL NEBS, CSA, ADCAS, Intertek, ECA, and SMACNA, approved by ULC and CSA and comply with the requirements of DW/144 and BSRIA – wire Rope Suspension systems. Wire rope should be manufactured to BSEN 12385: 2002

b. The contractor shall select the correct specification of wire hanger to use for supporting each particular service from table 1 below. Each size is designated with a maximum safe working load limit (which incorporates a 5:1 safety factor).

The correct specification of wire hanger required is determined using the following formula.

Weight per meter of object suspended (kg) X distance between suspension points (m) = weight loading per Hanger suspension point (kg).

Where the installed wire rope is not vertical then the working load limit shall be reduced in accordance with the recommendations give in the manufacturer's handbook.

The contractor shall select the correct length of wire rope required to support the service. Lengths from 1-10m lengths. Specials can be made, check with manufacturer. No in–line joints should be made in the rope.Table. 1

Wire (Gripple) Hanger Safe Working Loads		
size	**minimum breaking load of Wire Rope**	**working load limit (kg/lbs)**
No. 1	80kg/176 lbs	0-10 kg / 0-22 lbs
No. 2	260kg/572 lbs	10-45 kg / 23-100 lbs
No. 3	580kg/1276 lbs	45-90 kg / 101-200 lbs
No. 4	1500kg/3300 lbs	90-225 kg / 210-495 lbs
No. 5	2160kg/4752 lbs	225-325 kg / 496-715 lbs
No. 6	2500kg/5500 lbs	325-500 kg / 715-1100 lbs

The standard range of Hanger Kits should contain galvanized high tensile steel wire rope or stainless steel wire rope as per the application, the minimum specification is as above and should be manufactured to BS 302 (1987), BSEN12385. **Comply with manufacturer's load ratings and recommended installation procedures.**Note the testing is done to the minimum breaking load of the wire thus giving a minimum safety factor of 5: 1.**Ducting Supports:**

a. All ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with hangers formed of galvanized steel wire ropes and galvanized steel angle/channel or a pair of brackets, connected by galvanized steel wire hangers under ducts, rigid supports may be

provided at certain interval if need be**.** The spacing between supports should be not greater than 2.4 meter. All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through galvanized steel insert plates or Toggle end wire fixing left in slab at the time of slab casting. Galvanized steel cleat with a hole for passing the wire rope hanger shall be welded to the plates. Trapeze hanger formed of galvanized steel wire rope shall be hung through these cleats. Wherever use of metal insert plates is not feasible, duct support shall be through dash/anchor fastener driven into the concrete slab by electrically operated gun. Wire rope supports shall hang through the cleats or wire rope threaded studs can be screwed into the anchor fasteners. In case of PEB structure Loop and Catenary system can be used based on the site conditions as per approved suspension system drawings.

8.1 All horizontal ducts shall be adequately secured and supported. In an approved manner, with trapeze Hangers formed of galvanized steel wire rope in a cradle support method (refer to typical drawings) under ducts at no greater than 3000mm centre, for 3001mm-above appropriate size angle along with neoprene pad in between the duct & MS angle should be used with prior approval. All vertical duct work shall be supported by structural members on each floor slab. Duct support shall be through dash / anchor fastener driven into the concrete slab by electrically operated gun. Hanger wires shall then hang around the ducting. Rigid supports shall be used in conjunction with wire rope hangers to assist with alignment of services where recommended for by the manufacturer. Rigid support must also be used in conjunction with wire rope hangers with duct work at each change of direction or connection or as per approved drawings. Support ducting in accordance with Schedule I at the end of this Section. Any other solution can be used based on manufacturer's recommendation on site conditions after prior approval. In cases of Spiral ducting the wire can be wrapped directly around the ducting without the need for a spiral ducting clamp for sizes above 1100 a cradle support should be provided, refer to manufacturer's recommendations.

8.1.1 Ducting over furred ceiling shall be supported from the slab above or from beams after obtaining approval of Construction manager. In no case shall any duct be supported from false ceiling Hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other Contractor's work in the building. All supports of pipe shall be taken from structural slab/wall by means of fastener.

Catenary Supports: Refer to manufacturer's recommendations on Catenary supports with C-clip, special care should be taken with tensioning of the wire and angles at which the installation of services are made**.**

8.1.2 Stainless Steel Supports should be available for food, chemical and High Corrosion areas near coastlines.
Refer to manufacturers catalogue and installation guide for further technical information.**Comply with manufacturer's load ratings and recommended installation procedures.**

Schedule I: Duct Hanger Schedule

For Duct with external SP upto 250Pa

Maximum Duct Size(mm)	Guage	Minimum no of hanger required
1-750	26	1to 2
751-1000	26	2
1001-1200	24	2 to3
1201-1500	24	3
1501-1800	22	3 to 4
1801-2100	20	3 to 4
2101-2700	18	4

For Duct with external SP upto 500Pa

Maximum Duct Size(mm)	Guage	Minimum no of hanger required
1-600	26	1to 2
601-750	26	2
751-1000	24	2 to3
1001-1200	22	3 to 4
1201-1300	20	3 to 4
1301-1500	18	4
1501-1800	18	4
1801-2100	18	4
2101-2250	18	4 to 5
2251-2400	18	4 to 5
2401-2700	18	4 to 5

All support Selection of support shall be based on duct sizes & gauges are for reerence only.

Notes: All supports are considered at 2400 mm interval in above table and may vary as per the design but should not be greater than 2400mm.

8.2 Desertification fans, Air Conditioning Units, Plenum Boxes

All units shall be adequately secured and supported in an approved manner using wire hangersuspension Y fit solution as per manufacturers' recommendation with prior approval.

Rigid Supports:

Rigid supports if required in conjunction with wire hangers shall be of steel, adjustable for height and Zinc chromate primer coated and finish coated black. Where supports and clamps are of dissimilar materials, a gasket shall be provided in between. If the MS angle at the bottom if required as per design should be as per following table:

Longer size	**Type of Joints**

of Duct	
Up to 750	25x25x3 mm L angle with M8 nuts & bolts
751-1000	25x25x3 mm L angle with M8 nuts & bolts
1001-1500	40x40x5 mm L angle with M8 nuts & bolts
1501-2250	50x50x5 mm L angle with M10 nuts & bolts
2251 & above	50x50x6 mm L angle with M10 nuts & bolts

MATERIAL FOR ROUND DUCTING: - FACTORY FABRICATED

SCOPE

The Specification covers the general design material , construction features , manufactures ,shop inspection & testing at manufacture's work ,delivery at site , installation testing commissioning & carrying out performance test at site of air distribution system. All ducts shall be factory fabricated. The accepted factories are listed in the approved list of makes.

CODES & STANDARDS

The design material ,construction features ,manufactures ,inspection ,testing & performance of air distribution system shall comply with all currently applicable statues regulation , codes & standards in the locality where the system is to be installed nothing in the specification shall be constructed to relieve the contractor of this responsibility . In particular, the air distribution system shall conform to the latest edition of following standards:
IS 277 Galvanized Steel Sheets (Plain & Corrugated)
SMACNA HVAC system –Testing adjusting & balancing
UL181 Factory made air ducts & connectors
UL555 Fire dampers
ASHRAE 70 method of testing for rating the performance of air outlets & inlets

MATERIAL REQUIREMENT:

Ducting shall be fabricated of galvanized steel sheet & stainless steel

a) GSS duct shall be lock forming grade , zinc coated conforming to IS 277 coated grade 120 GSM

CONSTRUCTION FEATURES:

Fabricated detail shall be generally in accordance with the detail given here under:

ROUND DUCT:

A. Dead End caps / Blank off shall be dish type.
B. Round duct thickness in mm/G for GSS shall be given below:
C. Slip type coupling shall be used for transverse joints & shall be joined with each other with Al 3mm to 5mm POP RIVERTS.
Up to 600mm 3mm POP RIVERTS

Above 600mm 5mm POP RIVERTS

D. Duct shall be forming using lock forming machine.

S.NO	Gauge	ROUND DUCT DIAMETER(mm)	Up to65mm WC static pressure positive
			Spiral Seam (mm thick/Gauge)
1	24G	Up to 200mm dia	24
2	24G	201 to 350mm dia	24
3	24G	350 to 600mm dia	24
4	22G	601 to 900mm	22
5	20G	901 to 1250mm	20
6	18G	1251 to 1600	18

Round duct shall have longitudinal or spiral seam as specifies above

The spacing between supports should not be greater than 2.5meter.

All duct supports shall be desiged as per sesmic zone design consideration factors .

8.3 VOLUME CONTROL DEVICE

The opposed blade volume control device shall be made of 60micron Powder Coated extruded aluminum construction in black anodised finish. Opposed blades shall be pivoted to extruded aluminum frame with Nylon bushes. Specially designed blade shall have an overlapping lip which shall ensure a tight closure.

9.0 FRESH AND EXHAUST AIR INTAKE LOUVERS WITH BIRD SCREEN

The fresh air intake louvers at least 50mm deep will be made of G.I. construction. Bird / insect screen will be provided with the intake louvers. The blades shall be inclined at 45 degree on a 40mm blade pitch to minimize water ingress. The lowest blade of the assembly shall be extended out slightly to facilitate disposal of rain water without falling on door / wall on which it is mounted.

The intake louvers shall be provided with factory fitted aluminum construction volume control dampers in black anodized finish with pre filter and wire mesh.

NOTE: In case angle iron supports are not feasible to be installed for supporting the ducts due to height constraint then the contractor shall support the ducts with M.S flats of at least double the thickness of the angle iron supports.

10.0 THE SUPPLY AND RETURN AIR GRILLS

The supply and return air grills shall be made of 60micron Powder coated extruded aluminum sections. The supply air grills shall be provided with screw operated opposed blade volume control device made of extruded aluminum in black anodized finish.

All grills shall have soft continuous rubber / foam gasket between the periphery of the grills and surface on which it has to be mounted. The colour of grills shall be as per the approval of the Engineer in Charge.

11.0 LINEAR SUPPLY AND RETURN GRILLS

The linear continuous supply / return air grills shall be made of 60micron Powder coated extruded aluminum construction with fixed horizontal bars. The thickness of fixed bar louvers shall be 5mm in front and the flange shall be 20mm wide with round edges. The register shall be suitable for concealed fixing and horizontal bars of the grills shall mechanically crimped from the back to hold them.

The colour of grills shall be as per the approval of the Engineer in Charge. The volume control device made of extruded aluminum construction in black anodized finish shall be provided in supply air duct collars only.

12.0 FRONT FIXED BAR REAR ADJUSTABLE LOUVERED GRILLS.

The grills shall be made of 60micron Powder coated extruded aluminum construction with front fixed horizontal bar at 0 degree inclination with one way or two way deflection with rear vertical individually adjustable louvers in black shade mounted on Nylon bushes to hold deflection setting under all conditions of velocity and pressure.

The colour of grills shall be as per the approval of the Engineer in Charge. The volume control device of extruded aluminum construction in black anodized finish shall be provided in supply air duct collars.

13.0 SQUARE / RECTANGULAR CEILING DIFFUSERS

The square / rectangular ceiling diffusers shall be made of 60micron Powder coated extruded aluminum construction with flush fixed pattern. The diffusers shall have Anti-Smudge ring and spring loaded removable central core in various pattern for air flow direction. The diffusers shall be mounted by concealed screw fixing arrangement. The volume control device of extruded aluminum construction in black anodized finish shall be provided in supply air diffusers. The colour of diffuser shall be as per the approval of the Engineer in Charge.

13.2 JET DIFFUSERS

The Jet Diffusers shall be made of 60micron Powder coated aluminium construction. These diffusers are with reversible cores for long / short throw patterns. For long throw it shall be at Jet made while for small throw diffuser mode shall be utilized.The Jet diffusers shall be used for large spaces preferably industrial application.

14.0 VOLUME CONTROL DEVICE

The opposed blade volume control device shall be made of 60micron Powder Coated extruded aluminum construction in black anodized finish. Opposed blades shall be pivoted

to extruded aluminum frame with Nylon bushes. Specially designed blade shall have an overlapping lip which shall ensure a tight closure.

15.0 Inspection and Testing

Duct dimensions shall be checked based on the duct layout drawings duly approved by the Architects.

The ducts, branches, elbows etc. shall be inspected and the joints and connection shall be checked before these are assembled in position. After assembly the system shall be checked for tightness, vibration and noise.

Changes in direction shall be made with elbows with an inside radius equal to the width of the duct, where possible, but where space does not permit this radius, sharper or right – angle bends within inside radius not less than 1 of the duct width which may be used with double thickness aerofoil turning vanes. The turning vanes shall have a flange covering the whole base and they shall be riveted to the duct at not more than 75 mm intervals. Insecurely fitted turning vanes shall be rejected. All changes in dimensions and shape of ducts shall be done in a gradual manner and to approval.

Ductwork shall be free from waves or buckles and the sheet metal is to be machine – bent to ensure neat and accurate fabrication. If double thickness aerofoil shape internal stiffeners are fitted, the original ‘cross sectional area of duct shall be maintained.

Full sized standard sheets of the gauges specified are to be used and any patched or made-up pieces of duct work are liable to be rejected. Joints between flanged connections shall be fitted with neoprene rubber gaskets of 5 mm thick.

All duct surfaces behind diffusers, registers and grilles shall be painted Matt black.
Duct joints and seams shall be made air tight by use of sealants acceptable to local authority.

Test points shall be provided at the discharge of each fan and at each individual zone of the duct work system. Test points shall consist of 25 mm diameter sockets fitted with sealing plugs which can be removed for the fitting of measuring devices. Test points shall be insulated as for the ductwork and shall be provided with identification labels.

Rectangular risers should be free supported by angles or channels secured to the sides of the duct flanges with bolts or sheet metal screws or blind rivets. The Supporting angle or channel should be freely resting over the slab cut-out. Riser support intervals should be limited to one storey height.

Ducts shall have support on either side of elbow within two feet and for branch connection it shall be within four feet.

To ensure the air tightness, minimum 25% of ducts shall be checked for leakages after completion of installation but before applying insulation as per SMACNA tables given below:

Table 4.1 – Applicable Leakage Classes C_L
(Reference: HVAC Air Duct Leakage Test Manual – SMACNA)

Duct Class	½", 1", 2" w.g.	3" w.g.	4", 6", 10" w.g.
Rectangular duct	24	12	6
Round duct	12	6	3

Appendix E – Leakage Factor F in CFM/100 sq. ft. duct
(Reference: HVAC Air Duct Leakage Test Manual – SMACNA)

Pressure P w.g.	Leakage Class (C_L)				
	Class 3	Class 6	Class 12	Class 24	Unsealed Class 48
½	1.9	3.8	7.6	15.3	30.6
1	3	6	12	24	48
2	4.7	9.4	18.8	37.7	75.4
3	6.1	12.2	24.5	49.0	98.0
4	7.4	14.8	29.5	59.0	118.1
5	8.6	17.1	Leakage Factor $F = C_L \times P^{0.65}$		
6	9.6	19.2			
7	10.6	21.2			
8	11.6	23.2			
9	12.5	25.6			
10	13.4	26.8			

16.0 Balancing

The air distribution system shall be tested and balanced so that the requisite temperature and air flow are maintained throughout the space to be air-conditioned or ventilated.

During start-up phase, Contractor shall make all arrangement for drilling or plugging of all test opening or holes, adjustment of VCDs, adjusting of fan speed to obtain specified flows, obtaining actual motor ampere readings, and all related functions to ensure the proper operation of all systems.

Test holes for system commissioning shall be minimum 20mm diameter to accept a standard pitot tube of 8mm diameter and each hole shall be fitted with an effective removable type seal. Location of test holes shall be decided by Contractor in consultation with Contractor / Engineer.

All instruments required for testing and balancing of air distribution system shall be provided by the Contractor.

Complete air balance report shall be submitted for scrutiny and approval. Four copies of the approved balance report shall be provided with completion documents.

Splitter damper and VCD adjustments shall be permanently marked after air balancing is complete so that these can be restored to their correct position if disturbed at any time.

17.2 **Data Sheet for Ducting**

CHECKLIST AND PERFORMANCE TEST DATA TO BE PROVIDED AFTER INSTALLATION

S/No	Description	O.K	Needs Attention	Not Applicable	Remarks
1.	Duct Work clean ?				
2.	Fire Dampers open ?				
3.	Access doors closed ?				
4.	Lined ducts ?				
5.	Flexible duct connected, ok				
6.	System balanced				
7. a 8. B	Short circuiting or other Air Distribution problems ? Note locations.				
	VCD provided as per spec.				
9.	VCD all open and adjusted ?				
10.	Supply / Return / Exhaust outlets / Inlets balanced ?				
11.	Noticeable flow of Air				
12.	Air balance report details				
13.	Turning vanes provided in elbows.				
14.	Test witnessed and certified				
15.					

17.3 Test Certificate for Ducting System															
Client	**Project Title**					**Design Consultant**					**ARCH/MEP Consultant**				
GENERAL															
Name of Job															

Building Ref.														
PART 1 - PHYSICAL DETAILS:														
A. Section of Ductwork to be Tested														
B. Drawing Number														
C. Pressure Classification														
D. Test Static Pressure														
E. Leakage Factor														
F. Surface Area of Duct Under Test														
G. Maximum Permitted Leakage														
PART 2 - PARTICULARS:														
A. Duct Static Pressure Reading														
B. Type of Flow Measuring Device														
C. Calibration Certificate No.														
D. Range of Measurement of Flow														
Measuring Device														
E. Reading of Flow Measuring Device														
F. Interpreted air Flow Leakage Rate														
G. Duration of Test (Normally														
15 Minutes)														
Width and Depth or	**Periphery**				**Length**				**Area**					
Diameter	**Millimetres**				**Meters**				**Square Meters**					
Millimeters														
					WITNESSED BY CONSULTANT									
SIGNATURE														
NAME														

The spacing between supports should not be greater than 2.5meter

18.0 PAINTING

All ducts collar / shoot behind the grills / diffuser shall be given at least two coats oil black enamel paints.

19 INSTALLATION

All ducts shall be installed generally as per tender drawings, and in strict accordance with approved shop drawings to be prepared by the Contractor:-

The Contractor shall provide and neatly erect all sheet metal work as may be required to carry out the intent of these Specifications and Drawings. The work shall meet with the approval of NHIDCL's site representative in all its parts and details

All necessary allowances and provisions shall be made by the Contractor for beams, pipes, or other obstructions in the building, whether or not the same are shown on the drawings. Where necessary to avoid beams or other structural work, plumbing or other pipes, and conduits, the ducts shall be transformed, divided or curved to one side (the required area being maintained) all as per the site requirements.

If a duct cannot be run as shown on the drawings, the contractor shall install the duct between the required points by any path available in accordance with other services and as per approval of NHIDCL's site representative.

All ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with trapeze hangers formed of galvanized steel rods and galvanized steel angle/channel or a pair of brackets, connected by galvanized steel rod under ducts**.** The spacing between supports should be not greater than 2.0 meter. All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through galvanized steel insert plates left in slab at the time of slab casting. Galvanized steel cleat with a hole for passing the hanger rods shall be welded to the plates. Trapeze hanger formed of galvanized steel rods shall be hung through these cleats. Wherever use of metal insert plates is not feasible, duct support shall be through dash/anchor fastener driven into the concrete slab by electrically operated gun. Hanger rods shall then hang through the cleats or fully threaded galvanized rods can be screwed into the anchor fasteners.

Ducting over furred ceiling shall be supported from the slab above, or from beams after obtaining approval of NHIDCL's site representative. In no case shall any duct be supported from false ceiling hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other contractor's work in the building.

Where ducts pass through brick or masonry openings, it shall be provided with 25mm thick TF quality expanded polystyrene around the duct and totally covered with fire barrier mortar for complete sealing.

All ducts shall be totally free from vibration under all conditions of operation. Whenever ductwork is connected to fans, air handling units or blower coil units that may cause

vibration in the ducts, ducts shall be provided with a flexible connection, located at the unit discharge. Flexible connections shall be constructed of fire retarding flexible heavy canvas sleeve at least 8cm long securely bonded and bolted on both sides. Sleeve shall be made smooth and the connecting ductwork rigidly held by independent supports on both sides of the flexible connection. The flexible connection shall be suitable for pressure at the point of installation.

Duct shall not rest on false ceiling and shall be in level from bottom. Taper pieces shall taper from top.

END OF SECTION-12

SECTION-13
STANDARD SPECIFICATION OF FIRE DAMPERS

100 This Section deals with supply, erection and commissioning of fire dampers and box type dampers, conforming to general specification and suitable for duty selected,

2.0 MOTORISED COMBINED SMOKE & FIRE DAMPERS - SPRING RETURN TYPE

a. All supply and return air ducts at AHU room crossings and at all floor crossings or as indicated in the drawings shall be provided with Motor operated Fire & smoke damper of at least 90 minutes rating. These shall be of multi-leaf type and provided with Spring Return electrical actuator having its own thermal trip for ambient air temperature outside the duct and air temperature inside the duct. Actuator shall have Form fit type of mounting, metal enclosure and guaranteed long life span. The dampers shall meet the requirements of NFPA90A, 92A and 92B. Dampers shall have a fire rating of 1.5 Hrs. in accordance with latest edition of UL555 and shall be classified as Leakage Class 1 smoke damper in accordance with latest edition of UL555S. Actuators used shall be UL listed.

b. Each damper shall be supplied with factory mounted sleeve of galvanized steel of thickness as per SMACNA and of minimum 400mm long or as specified in schedule of quantities depending up on the wall thickness. The damper shall be fitted in to sleeve either using welding or self tapping screws. All welded joints shall be finished using heat resistance steel paint. UL listed and approved Silicon sealant shall be applied at all corners as well as at joints between damper frame and sleeve. Damper Frame shall be a roll formed structural hat channel, reinforced at corners, formed from a single piece of 1.6mm galvanized steel.

c. Damper blades shall (equivalent to 2.0mm thickness strength) roll formed using min 1.0mm thick single piece of galvanized sheet. Bearings shall be of stainless steel fitted in an extruded hole in the damper frame. Blade edge seals shall be silicone rubber and galvanized steel mechanically locked in to the blade edge (adhesive type seals are not acceptable). Side Jam seals of stainless steel and Top and bottom seals of galvanized steel shall be provided. All galvanized steel used shall be with minimum 275 gm / sqm Zinc coating. Bigger size Dampers shall be supplied in multiple modules of sizes not exceeding in dimensions of certified module, jack shafted together. Multiple actuators shall be provided for large dampers with higher torque requirements as prescribed in UL.

d. The electric actuator shall be energized either upon receiving a signal from smoke detector installed in AHU room supply air duct / return air duct. Electric Actuator of suitable Torque and as approved by UL shall be factory mounted and tested. The actuator shall be suitable for230V AC supply. In addition actuator shall have elevated temperature rating of 350 deg.F. Electric Actuator shall have been energized hold open tested for a period of at least one year with no spring return failure. Each fire/smoke damper shall be equipped with a heat actuated release device which shall allow controlled closure of damper rather than instantaneous to prevent accident (Electrical fusible link). The damper shall be equipped with a device to indicate OPEN and CLOSE position of Damper blades through a link mounted on the damper blade.

e. Each damper shall be provided with its own control panel, mounted on the wall and suitable for 230 VAC/ 24 V supply. This control panel shall be suitable for spring return actuator and shall have atleast the following features:

- Potential free contacts for AHU fan ON/ Off and remote alarm indication.

- Accept signal from external smoke / fire detection system for tripping the electrical actuator.
- Test and reset facility.
- Indicating lights / contacts to indicate the following status:
- Power Supply On
- Alarm
- Damper open and close position.

f. Actuators shall be mounted on the sleeve by the damper supplier in his shop and shall furnish test certificate for satisfactory operation of each Motor Operated Damper in conjunction with its control panel. Control panel shall be wall mounted type.

g. It shall be HVAC Contractor's responsibility to co-ordinate with the Fire Alarm System Contractor for correctly hooking up the Motor Operated Damper to Fire Detection / Fire Management System. All necessary materials for hooking up shall be supplied and installed by HVAC Contractor under close co-ordination with the fire protection system contractor.

h. HVAC Contractor shall demonstrate the testing of all Dampers and its control panel after necessary hook up with the fire protection / fire management system is carried out by energizing all the smoke detectors with the help of smoke.

i. HVAC Contractor shall provide Fire retardant cables wherever required for satisfactory operation and control of the Damper.

j. HVAC Contractor shall strictly follow the instructions of the Damper Supplier or avail his services at site before carrying out testing and installation at site.

k. Fire/smoke damper shall be provided with factory fitted sleeves; however, access doors shall be provided in the ducts within AHU room in accordance with the manufacturer's recommendations.

l. The Contractor shall also furnish to the NHIDCL, the necessary additional spare actuators and temperature sensor (a minimum of 5% of the total number installed) at the time of commissioning of the installation.

END OF SECTION-13

SECTION -14
STANDARD SPECIFICATION OF PROPELLER & INLINE FANS

1. PROPELLER FAN

Propeller fan shall be direct-driven, three or four blade type, mounted on a steel mounting plate with orifice ring.

a. Mounting Plate shall be of steel construction, square with streamlined venturi inlet (reversed for supply applications) coated with baked enamel paint. Mounting plate shall be of standard size, constructed of 12 to 16 gauge sheet steel depending upon the fan size. Orifice ring shall be correctly formed by spinning or stamping to provide easy passage of air without turbulence and to direct the air stream.

b. Fan Blades shall be constructed of aluminium or steel. Fan hub shall be of heavy welded steel construction with blades bolted to the hub. Fan blades and hub assembly shall be statically and dynamically balanced at the manufacturer's works.

c. Shaft shall be of steel, accurately ground and shall be of ample size for the load transmitted and shall not pass through first critical speed thru the full range of specified fan speeds.

d. Motor shall be energy efficient standard (easily replaceable) permanent split capacitor or shaded pole for small sizes, totally enclosed with prelubricated sleeve or ball bearings, designed for quiet operation with a maximum speed of 1000 rpm for fans 60 cm dia or larger and 1440 rpm for fans 45 cm dia and smaller. Motors for fans shall be suitable for 220 ± 6% volts, 50 cycles single phase power supply.

e. Accessories : The following accessories shall be provided with propeller fans:

   i) Wire guard on inlet side and bird-screen at the outlet.

   ii) Fixed or gravity louvers built into a steel frame at the outlet.

2. INLINE FANS

7.1 Circular Inline Fans

Circular inline Centrifugal duct fan shall be a straight through radial fan. It should be compact. Motor shall be energy efficient.

The fan shall cope with high pressure and long duct runs, whilst still operating at an acceptable sound level.

The circular inline fans should be moisture resistant and should be approved for installing in humi or damp environments. The fans should be rated IP-44 when installed in a duct system. The casing should be manufactured from pre galvanized steel. Automatic thermo – contact shall open up if the temperature within the motor windings becomes excessive. Fan should be equipped with CE certified external rotor single phase asynchronous motor.

7.2 Cabinet Inline Fans(Above 500 CFM capacity)

The Cabinet of the cabinet inline fans should be manufactured in 20 gauge galvanized steel complete with inlet and outlet spigots. The Mounting brackets and access panel should be fitted as per manufacturer standard. The impeller of the fans should be with high efficiency forward curved DIDW type. The scroll of the fans should be fabricated with galvanized sheet steel. The motor of the fans shall be Squirrel cage induction type with bearings swealed for

life. The motor shall be energy efficient suitable for single phase electrical supply. The cabinet of the fan shall be of double skin construction with 20 gauge GI outer skin with 25 mm glass wool wrapped tissue paper and covered with 20 gauge perforated GI sheet from inside.

END OF SECTION-14

SECTION-15
STANDARD SPECIFICATION OF KITCHEN DRY SCRUBBERUNIT

A. DRY SCRUBBERS

1.1 **SCOPE**

The scope of this section comprises the supply, erection, testing and commissioning of DIDW double skinned casing with blower along with dry scrubbers comprising of electrostatic sections manual wash, for use in kitchen exhaust / grease / exhaust air treatment.

1.2 **TYPE**

The unit shall be CE certified and of the type as indicated on Drawings

1.3 **CAPACITY**

The air-moving capacity of unit shall be as shown on Drawings

1.4 **TECHNICAL PARAMETERS**

The unit shall provide minimum efficiency of 90% or better for single pass base on ASHRAE test method. Multiple units can be joined together for the specified air capacities.The system shall be suitable to connect to fan section with average velocity of not more than 3.2 m/s, considering the cross sectional area of the ESP CELLS in the unit.

1.5 **EQUIPMENT SPECIFICATIONS**

The unit shall be designed and constructed and supplied by a manufacturer specializing in the research, design and manufacture of products specified in this section with a minimum of three years of documented experience, and capable of issuing complete catalog data on the total product.

1.6 UNIT HOUSING

Housing shall be minimum 1.2 mm thick zinc coated steel construction to protect against rust and corrosion.Each section shall include single door access, located one side of the

unit.The access door shall be mounted on steel hinges and secured with adjustable, gasket sealed lever latches allowing for component access and removal.All doors shall have gasket to prevent air and water leakage.Doors to charged high voltage components shall be equipped with electrical interlocks,for interconnection into the primary power supply, to prevent access when the components are energized.The housing shall be furnished completely assembled for ease of shipment and installation between each section, a permanent 1/8" thick gasket shall be installed to prevent leakage.The bottom drain pan under ESP section containing integral washing systems shall be pitched downward 1/4"per foot minimum toward a 3" NPT drain nipple.

1.7 BASE CONSTRUCTION

The sections are to be mounted on a structural C-channel or floor mounting or ceiling suspension.Lifting lugs shall be incorporated in the base channel to allow for rigging, if ordered.

1.8 FINISH

The external casing finish shall be a durable industrial grade semi gloss baked-on epoxy ester, not less than 3 mil minimum thickness.

1.9 ELECTROSTATIC PRECIPITATOR MODULE

The electronic air cleaner shall be the two-stage dual voltage plate type cells, rated at not less than 90% efficiency as per the ASHRAE test standards for dry particulate. The collection cells shall be in Single Pass arrangement to provide for maximum collection efficiency.

1.10 IONIZING COLLECTION CELL

Ionizing-Collecting cell(s) shall be of one-piece construction minimum 13.38" inches deep in direction of airflow. All support framing, end plates and ionizer ground electrodes shall be 0.090 inch thick aluminum. Both repelling and collector plates shall be 0.020 inch thick aluminum, minimum 230 mm deep in direction of airflow and rigidly retained in place with tubular spacers and tie rods. Spacing between plates shall be no less than 6 mm. Ionizing electrodes shall be heavy duty tungsten wire, rigidly supported both vertically and laterally. High voltage support insulators shall be have made of Teflon including center hole, glazed to enhance dielectric strength and retard tracking.

1) Each cell shall weigh not more than 15 kg with at least 9 ionizing wires

2) Maximum number of collection plates up 55 numbers per ESP cell.
3) Minimum collection plate area per 1000 CMH of air flow thru ESP Cell Should not less than 1.8sqmt
4) Not less than MERV 15

11 **POWER SUPPLIES**

Power supplies shall be 100% solid state, CE certified. operate on 200 to 240 VAC, 50 HZ, 1 Phase input and provide a dual high voltage output of (+) 12 to 13 KVDC for the ionizer and (+) 6.0 to 6.5 KVDC for the collector. A regulated output of up to 5.5 MA shall be supplied to maintain the specified collection efficiency. Integrally mounted electrical interlocks shall be provided to prevent access to the high voltage components without first interrupting the primary input power. The power supply shall operate over a temperature range of -32 degrees F to 140 degrees F, be self-protecting and accommodate an LED light indicating the performance status of the ionizing/collecting cell. High voltage output leads shall be sealed and a bleed resistor incorporated to remove stored electrical charge where the power supply(s) are de-energized. Module of capacity above 3000 CFM shall be equipped with Pulse width modulating (PWM) to maintain the specified collection efficiency by maintaining a constant charge in the event of Low/High Voltage from source thus ensuring that the unit functionality is not affected with these voltage fluctuations. Power Consumption should not be more that 50 watts per ESP cell.

All power supply components shall be designed for ease of mounting and servicing. High voltage power cables shall be of one continuous length, splicing is not acceptable.

Arc Suppression & Auto Restart

The power pack shall incorporate a short circuit arc protection with automatic power restoration system to prevent overload. Should arcing takes place (due to collection cells being loaded with contaminants or should there be a fault in the unit), the power pack shall be able to automatically cut off the supply to stop the arcing and reset after a few seconds. This is to prevent and drastically reduce the risk of fire from continuous arcing.

BMS (Building Management System) interface

The power supply (pack) shall have a 2 wire dry contacts (NO/NC) for remote link to Building Management System. This is for performance indication of the air cleaning system. Should there be a fault or if service is required, the dry contacts close and a signal is sent to the building BMS System. Should there be multiple units, all the dry contacts can be looped into a set of signal. This ensures proper monitoring of the status of each unit.

Performance Indicator Lights

There shall be 2 LED lights (Green & Red) installed on the access door of the unit to indicate the status of the air cleaning system.

1.12 **STATIC PRESSURE DROPS**

The pressure drop shall not exceed the following (inches H_2O):

ESP Section (Including Metal Mesh pre filter)	0.2 - 0.32

The ESP section must have an internal pre filter.

External losses for ductwork, exhaust hoods, manufacturing equipment with associated entry losses, kitchen hoods, etc. Must be added with the above internal equipment losses to calculate total fan static pressure required.

Flexible Duct Specification

1. **General:**

The scope of this section comprise supply, installation, testing and commissioning of flexible ducting conforming to these specification and in accordance with requirements of drawings and schedule of quantities.

2. **Duct Materials:**

Un Insulated Flexible duct

2.1 Wherever specified, uninsulated flexible duct shall be made of Aluminum/Met Foil permanently bonded to a coated spring steel wire helix. Duct shall be in tear and puncture resistant construction.

Insulated Flexible Duct

2.2 Wherever insulated flexible duct are specified inner core for the same should be made of double lamination of polyester film permanently bonded to a coated spring steel wire helix. Blanket of fibre glass insulation of R 4.2 (RSI - 0.76 m2K/W) having density of 24 kg/m3 and thickness of 25 mm shall be wrapped over the inner core & covered with tear and abuse resistant outer jacket cum vapour barrier made of Pure Aluminum Foil.

3. **Installation:**

Care must be taken to install all the flexible duct in fully extruded position and bends made with adequate radius as per manufacturer recommended practices.

3.1 **Hangers and Supports**

The flexible duct must be installed fully extended to produce optimum results.
The maximum allowable sag, between any two adjacent suspension points, should not exceed 50 mm per meter.

The distance between any two adjacent suspension points may vary from 1.50 to 3.00 meter, depending upon the type of flexible duct in use.

Flexible ducts mounted above suspended ceiling should always be independently supported. Ducts mounted in these locations are susceptible to damage whenever ceiling panels need to be periodically interchanged, unless they are separately supported.

3.2 **Bending Radius**

All bends should be made as large as possible and should have a radius of not less than the diameter of the duct in use. This reduces un-favorable pressure losses and is particularly important for metal based products which are more susceptible to stress rupturing. Double bends should be avoided, however if un-avoidable, ensure that each radius is not less than R = 2 x D.

3.3 **Straps**

Ideally the hanging straps should supports the flexible duct with a minimum of half the circumference surface in contact, and without reducing the effective inside diameter of the duct. It is also recommended that the minimum width of material to be used for the hanging straps should be at least 25 mm.

3.4 **Flexible Duct to Conventional Duct Connection**

Extra care should be taken when making connection to fixed conventional ducts, etc., and ensure that they do not become too stressed. An additional support is recommended to obviate this potential problem.

Metal based flexible duct products are particularly prone to fracturing due to stress caused as a result of sharp connection.

Connections to ceiling illumination “troffer boxes” should be served in the most direct manner similar to that described for conventional ducts.

Too many bends, when connecting to “troffer boxes” and / or any other type of air supplying component, may result in excessive pressure loss and the generation of noise.

3.5 Longer Length Installation

In the event where extreme length of flexible duct is to be installed, round duct connectors made of galvanised sheets of at least 30 cm long should be used to connect the duct at every distance of 10 meters. Use metal or galvanised hangers as recommended (point 3) to support the point where connectios are made. Light railing is a good alternative hanging support when using long length of flexible duct.

3.6 Direct Contact

It should be emphasized that the flexible duct must not be in direct physical contact with un-insulated heating or hot process pipes. If in the event where such situation cannot be avoided, additional 1” thick insulation should be wrapped around pipes that are in contact with the duct.

END OF SECTION-15

SECTION-16
STANDARD SPECIFICATION OF GEOTHERMAL SYSTEM WITH COMPONENTS

GEOTHERMAL PIPING

PE-X100 pipe with two pipe arrangement and factory fitted connection at the botton. These pipes are testing with 20 bars pressure and confirmed to be used for easy connection and jointing with other plastic coupler for connections (PE 100). Each two-pipe arrangement called 'Probe' must be 100 – 120 metres in length.

MECHANICAL & THERMAL PROPERTIES

The PE-X 100 probe must be suitable for going inside the ground vertically upto a depth of 100 metres. The pipe shall be of high density 0.938 g/cm3

INSTALLATION PROCESS

The two loop pipes must have a spacer to ensure that the pipe doesn't touch each other while being lowered down in the ground. Also an additionl weight needs to be attached at the bottom so that the pipes can be pushed easily into the bore hole.

The bore hole must be 150 MM wide with PVC pipe casing and 100 metre depth. The bore hole must be done in one single instance so as to ensure no collapse of the same. The probes must be then installed immediately.

From each bore hole PE 100 pipe must be used using a Tee connection which would then be connected to the heat pump. The pipes need to be connected in parallel and not in series.

A pump arrangement for water circulation upto 100 metres depth must be arranged and connected to the primary side of the water- water heat pump.

FITTINGS

All fittings need to connect to withstand test pressure of 2 bar – upto 20 bar.

All manual connection must be accessible to the maintenance team and connection to the manifold must be done for smooth connection of probes to the heat pump.

MANIFOLD

Plastic manifold must be used to connect probes on their supply and return side. These manifolds must be plassed such that it is accessible.

COMMISSIONING

- Prior to installation the workers to be briefed with basic knowledge of the technology and proper communication to be ensured to understand the installation instructions.
- Instructions to be given about all accessories to handle them in a proper and safe way. The workers to be trained at least for 4-6 hours before they start installation.
- Basic training on the safety and health aspects of their jobs.
- Site Safety Standard was discussed to avoid accidents and injuries.

WATER PRESSURE TESTING

- First of all, close all the loops (supply and return) before you start the pressure test. Connect a pressure gauge to the supply side and ball valve at both supply and return ends. Close the ball valve of both supply and return.
- Loops need to be purged of air in turn by flushing the water through each loop. Connect the water supply to the supply line and open the supply ball valve.

all constituents are also under allowablel limit as per manufacturer' requirement.

- Before feeding water in to the manifold, make sure that only soft water of pH value is around 7 and Now open the first loop supply and wait for few minutes so that water fills up in that circuit. Now open the return valve slowly and let air in the loop completely exhaust.
- After few minutes of bleeding, close the return ball valve and continue with water supplying to build up the pressure in the loop.
- Start increasing the pressure with an external pump or with manual pressure equipment following the pressure gauge and build up the pressure up to 6 bar.
- When the needle of the pressure gauge reaches 6 bar, close the supply ball valve also and let the 6 bar pressure remains in the loop.
- After that open the second loop supply ball valve, ones the loop is filled with water open the return line to bleed the water.
- Then close the return and continue with water supplying to build up the pressure in the loop.
- Start increasing the pressure with an external pump or with manual pressure equipment following the pressure gauge and build up the pressure up to 6 bar.
- Now close the supply ball valve also and let the 6 bar pressure remains in the loop.
- Follow the same procedure to build up the pressure of 6 bar in other loops and to all manifolds.
- To ensure all loops has been pressurized open all supply loop valves and increase pressure up to 6bar and close the supply ball valve.
- Maintain that 6 bar pressure. Check pressure every 5 hours and then enter in pressure log , duly witnessed by client/PMC.
- Pressure falls because of pipe expansion usually 0.5 to 1.5 bar depending up on the loop length.
- If the pressure falls more than 2bar then there is a leak. If in that case leak should be identified and make necessary changes and recheck of all joints.
- Make a note of this test in pressure test document with manifold numbers, number of loops, pressure of 6 bar and test starting time and end time.
- Once the pressure tests are completed, after 48 hours the pressure of the manifold should put down to 3bar for screeding and maintained at 3 bar while screeding.

LEAKAGE IN PIPE

- Each leakage must be checked and repaired to ensure leak proof installation of probes as well as the connection pipes.

END OF SECTION-16

SECTION-17

PAINTING WORK

This section deals with painting of various equipment / material supplied under this contract.

It gives basic guidance for painting as specified below:-

a) **Application**: The original colour of all equipment's like Hot water generator/heat pumps machines, air-handling units etc. which if get damaged during transportation or during installation shall be painted in original shade with the two coat of paint to give a final finish.

b) All chilled water pipes shall be painted as per standard code of practice and arrows shall be marked to indicate direction of flow of water.

COLOUR SCHEME FOR THE EQUIPMENTS / MATERIALS

i)	Heat pumps/Boilers	---	As Per Manufacturer's Standard.
ii)	Pump-sets	---	Battle ship gray
iii)	Hot water pipes	---	Light blue
iv)	Direction of flow of water	---	Black arrows
v)	Electrical panels/sub-panel/	---	Light gray powder coated
vi)	Cable trays	---	Cadmium Plated
vii)	Supports for ducts	---	Silver
viii)	AHUs &Fans	----	As per Manufacturer's

END OF SECTION – 17

SECTION-18
RUNNING IN PERIOD & GUARANTEE

1.0 RUNNING IN PERIOD & DATE ACCEPTANCE

1.1 After the installation work has been completed by the contractor, he will conduct tests and make adjustments as may be necessary to satisfy himself that the plant including low side equipments is capable of continuous running.There after he will offer to the department a running-in period of 7 days subject to a minimum aggregate of 120 hrs. At his cost.All the compressors shall be run by rotation. The plant will be operated and a log of all parameters will be maintained during this the period. The contractor will be free to carry out necessary adjustment during this period without stopping the plant. The plant will be said to have successfully completed the running –in-period, if no break down or abnormal/unsatisfactory operation of any machinery occurs during this period.After this the plant will be made available for beneficial use. After the plant has operated without any major breakdown/trouble for the above specified running -in-period it shall be taken over by the department subject to guarantee clause mentioned below. This date of taking over of plant after trouble free operation during the running-in-period shall be the date of acceptance.

1.2 Any loss of refrigerant or oil during the running in period shall be made good by the contractor free of charge.

1.3 Capacity test of the heat pumps may be carried out as and when conditions become stabilized.

1.4 Seasonal testing may be carried out as & when outside conditions become suitable.

1.5 Seasoned Test: Contractor shall offer the plant for 3 seasonal test rum.Once during worst summer, next during, worst monsoon and last during winter.Each test run to be given for 3 consecutive days at 8-10 hours per day and should be able to maintain inside conditions as specified.

2.0 GUARANTEE

2.1 The contractor shall guarantee the complete system to maintain the specified conditions under all conditions of ambience and internal loads. Also the inlet/outlet temperatures at the specified flow of water in the heat pumps unit shall be guaranteed.

2.2 All equipments shall be guaranteed during DLP&taking over of the installation by the Department against unsatisfactory performance and/or breakdown due to defective design, material, manufacture, workmanship or installation. The equipment or component or any part thereof so found defective during the guarantee period shall be repaired or replaced

free of cost to the satisfaction of the Engineer-in-Charge. In case it is felt by the department that undue delay is being caused by the contractor in doing this, the same will be got done by the department at the risk & cost of the contractor. The decision of Engineer-in-charge in this regard shall be final.

2.3 Any leakage of refrigerant and/or oil due to defective design, manufacture, workmanship or installation during the guarantee period shall be made good by the contractor free of charge.

2.4 If the defects are not removed within a reasonable time, the NHIDCL may arrange to do at Contractor's risk and cost without prejudice to any other rights.

3.0 DATA MANUAL AND DRAWINGS TO BE FURNISHED BY THE CONTRACTOR

4.1 The contractor shall furnish detailed technical literature, pamphlets and performance data, computerized selection of chilling unit and blowers for EIC's approval before start of the particular work.

4.2 Drawings for approval on award of the work:

The contractor shall prepare & submit the following drawings and get them approved from the Engineer-in-Charge before the start of the work:-

Ducting drawings showing sizes, locations of dampers, air-terminators.

Plumbing drawings showing the layout of entire piping, dia& length of pipes, valves and isometric drawings showing connections to various equipment.

Drawings including section, showing the details of erection of entire equipments including their foundations, water basin for the cooling towers etc.

Layout drawings of the equipment to be installed in various rooms such as plant room, AHU rooms, hot water generator room, cooling tower and other equipment.

Electrical wiring diagrams for all electrical equipment and controls including sizes and capacities of the various cables and equipment.

Dimensioned drawings of all electrical and control panels.

Drawings showing the details of all insulations and vapour barrier works, and

Drawing showing details of supports for pipes, cable trays etc.

Any other drawings relevant to the work.

6.0 EXTENT OF WORK

6.1 The work shall comprise of entire labour including supervision and all materials necessary to make a complete installation and such tests and adjustments and commissioning as may

be required by the department. The term complete installation shall not only mean major items of the plant and equipment covered by specifications but all incidental sundry components necessary for complete execution and satisfactory performance of installation with all layout charts whether or not those have been mentioned in details in the tender with document in connection with this contract.

6.2 Minor building works necessary for installation of equipment, foundation, making of opening in floors and restoring to their original condition, finish and necessary grouting etc. as required.

7.0 INSPECTION AND TESTING

7.1 Initial Inspection at Manufacturer's works

7.1.1 Compressor

Salient features such as model, capacity control, provision of crank, case heaters, type of lubrication etc. shall be verified against the requirements visually without opening the compressors.

Manufacturer's internal test certificates shall be scrutinized to check compliance with the requirements as specified in the order.

Free running test shall be carried out at the speed for which the motor is available with manufacturer but the speed shall not be less than that specified in contract. This test shall be carried outfor 30 minutes in open space. During this running test following operations are to be noted:

Manual operation of capacity control.

Lubrication oil pressure.

A.Pneumatic test pressure test at 21 Kgf/Sq.cm. for casing of compressor.

Vacuum test for the compressor for 0.5mm.Kg.

7.1.2 Condensers

Salient features like number of tubes, inside diameter of tubes (from which the gauge of the tube can be verified) No. of passes, material of fins, length of condenser, provision of fittings like safety valve, water, gas connection shall be verified during stage inspection. The tube thickness shall be checked.

Manufacturer's internal test certificate shall be furnished and it shall be valid against contract requirements.

Pneumatic pressure test at twice the normal condensing pressure for gas side of condenser.

Hydraulic test at 10 Kgs./Sq.cm. for water side of the condenser.

7.1.3 Heat pumps

Salient features like type of heat pumps, inside diameter of tubes (from which the gauge of the tube can be verified) material of tubes, type material and number of fins, wherever applicable length of heat pumps and provision of fittings to be verified against requirements specified in the contract during stage inspection. The tube thickness shall be checked.

Manufacturer's internal test certificate shall be furnished and it shall be checked as per the contract requirements.

Pneumatic pressure test at twice the normal condensing pressure for gas side of condenser.

Hydraulic test at 10 Kg/sq.cm. For water side of heat pumps.

7.1.4 Heat pumps Unit

Full load shall be carried out to verify the capacity and I KW/Ton.

7.2.1 Air Handling Unit

Salient features such as model, size, physical dimension, and other details of various sections, fan motor details, fan dimensions etc. shall be verified against the contract requirements.

Manufacturer's internal test certificate for the motor and air handling unit shall be furnished and scrutinized as per contract requirements.

Test certificate for static and dynamic balancing of the fan/blower should be furnished.

Salient features like, type, material, No. and gauge of fins and tubes and No. of rows of cooling coil shall be furnished and verified with reference to contract requirement during stage inspection.

Hydraulic pressure to the extent of 10 Kgf/sq.cm. Shall be applied to cooling coil and this pressure should be maintained for 1 hour and no drop should be observed indicating any leaks.

7.3 Initial Inspection at Site

7.3.1 Ducting

The sheet used for ducting shall be checked for physical test at site. The physical test should include the sheet thickness and bend test as per relevant IS specifications.

Class of GSS sheet as per IS 277 may be got tested from a laboratory to verify that Same meets the contract requirements.

7.3.2 Pumps

Salient features such as model and make shall be checked as per contract requirements.

The manufacturer's test certificate with Sr.No. Head, discharge will be furnished and verified against contract requirements.

7.3.4 Switch Gear, Control Gear and Measuring Instruments.

They should be specified make. For air circuit breaker manufacturer's test certificate shall be furnished by contractor and the same shall be verified as per contract requirements.

7.3.5 Electric Motors

Electric Motors should be specified make, manufacturer's test certificate for electric motor shall be furnished.

7.3.6 Pipes and Valves

It should be checked that the same is as per makes specified in contract.

Dimensions including weight shall be checked for pipes against the requirements of
Contract.

7.3.7 Insulation and Acoustic Lining

7.3.8 Physical verification for thickness and make should be made as per contract before application of insulation.
Manufacturer's test certificate for density should be furnished. 7.3.8

Work at Site – General

All electrical items shall be subjected to inspection at any stage during manufacturing activity. Routine electrical test as per relevant codes. Inspection of Manufacturer's test certificate.

Pressure testing of pipe fit used for the refrigerant and water services.

Pressure testing, leak testing of complete piping network for chilled water, condenser water, hot water, and refrigerant/services.

Vacuumising and gas/oil charging /topping up for refrigeration system.

Checking of electrical circuits (Power & Controls) andchecking functioning of controls of refrigerant systems and other circuits of Refrigeration Plant.

Checking of calibration of controls and instrumentation.

Checking of assemblies for electrical control panel, instruments panels, local panels (dimensional and functional) annuncitor panels etc.

Inspection of complete electrical installation at site.

Installation of main equipment's like compressor, condenser, ice reserve coil.

Performance testing of complete Air conditioning plant as perspecifications.

7.3.9 The above inspectionprocedure is given for general guidance and information of vendorsand inspection of purchaser/consultant is strictly not limited to these and Inspection Engineer of purchaser/consultant will have full right to have detailed inspection at any stage right from placement of order to completion of project as desired by Inspection Engineer. Co-ordination of inspection agency of purchaser/consultant with his factory/sub-vendor's factory/erection site will be his sole responsibility of successful vendor after placement or order for complete air-conditioning plant covered under these technical specifications.

7.4 Final Inspection

After completion of the entire installation as per specification in all respects, the AC contractor shall demonstrate trouble free running of the AC equipments and installation for a period of minimum 120 hours of running as detailed under para 3.1.

After the trial run as para (i) above, the AC contractor shall offer the plant for the seasonal test, namely test for summer or monsoon season whichever occurs earlier. The test results shall be furnished.

The input KW of the unit/TR at full load shall also be checked against contract requirement.

Pressure drops across heat pumps and condenser at specified flow rates shall be checked.
All instruments for testing shall be provided by the AC contractor. The accuracy of the instruments shall be as follows:

Temperature liquid in glass thermometer having the accuracy plus or minus 10 deg.C as per IS: 4825.

Wet bulb temperature: whirling psychrometer conforming to IS: 6617.Scale Error: 0.2 deg.C plus or minus 0.1 deg.C.

Pressure Gauge: With the accuracy of plus or minus 1% for maximum scale value from 10 to 90%, and plus 1.9% for maximum scale value on rest of the scale conforming to IS: 3695.

Water flow meter: Water flow shall be measured using the arrangement installed as per Schedule of Work.

The equipment capacity computation shall be done from above test results.

7.5 Testing Requirements and Procedure

7.5.1 Balancing of all air and water systems and all tests as called for in the agreement shall be carried out by the contractor in accordance with the agreement. Performance tests of individual equipment and control shall be carried out as per manufacturer's recommendation.Alltests and balancingshall be carried out in the presence of the representative of the department Engineer-in-Charge.

7.5.2 Air Systems

Systems are to be balanced by first adjusting the total flow at the fan, then by adjusting main dampers and branch dampers. Only final minor adjustments are to be made with register and diffuser dampers.Balancing of the air system shall be accomplished without causing objectionable air noise.Basically the following tests and adjustments are required.

Test all fan systems to provide proper cfm/cmh.

Adjust fresh air, return air and exhaust dampers to provide proper air quantities in all modes of control.

Test and record fresh air, return air and mixed air temperature at all air handling units Test and record data at all coils after air and hydronic systems are balanced.Measure wet and dry bulb temperature on cooling coils.

Make point tube transverse at all main supply and return ducts to set proper air quantities. Adjust all zone and branch dampers to proper CFM.

Test and adjust each register, grills, diffuser or other terminals equipment to within 5% of design air quantity. Each opening shall be defined on the test report by size, manufacturer's model, room location, design cfm and actual CFM. Outlets shall be adjusted to minimize objectionable drafts.

Test and record static pressure drop across all filters and major coils.

7.5.3 Water System

Systems are to be balanced by opening all valves, closing all by-pass and setting all mixing valves to full coil flow. Water systems shall be cleared of air.Verify that the system has been properly cleaned, flushed and treated before testing. Basically, the following tests and adjustments are required.

Test and adjust all pumps to deliver the proper gpm. Record rpm, motor amperage, discharge and suction pressure. Pumps shall operate without objectionable noise or

cavitation. Plot actual pump and system performance points on manufacturer's pump curves.

Check all expansion tanks for proper filling pressurization. Verify operation of automatic fill and relief valves.

Check the operation of all automatic valves.

Test and adjust correct water flow through heat pumps, major items of equipment and main water circuit. The balancing valves, provided on the equipment shall be used for adjustment.

Check capacity output of heat pumps and set water flow rate for proper data.

Check and adjust each coil to provide proper gpm. Record water and air temperature changes and water pressure drop.

Set pressure drops across coil by-pass to match coil full-flow pressure drop.

7.5.4 Unit capacity in Tons Refrigeration shall be computed from the temperature readings, pressure readings and water/flow measurements. Flow measurements shall be preferably through flow meters. Pumps shall be tested for the discharge head, flow and BHP.

7.5.5 Reports

Provide 3 copies of the complete balancing and testing reports to the department. Report shall be neatly typed and bound suitable for a permanent record. Report forms shall contain complete test data and equipment data as specified.

7.5.6 Final documentation

The contractor shall leave the system operating in complete balance with water and air quantities as shown on drawings. Set stops in all balancing valves and lock all damper quadrants in proper position.Secure all automatic damper and valve linkages in proper positions to provide correct operating ranges.Proper damper positions shall be marked on ducts with permanent indication. Notify the department of any areas marginal or unacceptable system performance.

The above tests and procedures are mentioned herein, for general guidance and information only, but not by way of lamination to the provisions of conditions of contract and design/performance criteria.
Upon commissioning and final hand over of the installation, the contractor shall submit (within 4 weeks) to the Engineer-in-Charge 6 (six) portfolios of the following indexed and bound together in hard covering binder (300 x 450 mm.)

Comprehensive operation and maintenance manual.

As built drawings including one set on compact disc and two sets of reproduction drawings of the same showing therein the modification and correction during the course of execution.

Test certificates, consolidated control diagram and technical literature on all controls.

Equipment warranties from manufacturers.

Technical documents and descriptions accordingly to which the work was carried out.

Set of certificates of testes performed for various works.

Commissioning and testing reports.

Rating charts for all equipment.

Log books as per equipment manufacturer's standard format.

List of recommended spares and consumables.

At the close of the work and before issue of final certificate of completion by Engineer-in-Charge, the contractor shall furnish a written guarantee indemnifying the department against defective materials and workmanship for defects liability period.The contractor shall hold himself fully responsible for reinstallation or replace free of cost to the department.

Any defective material or equipment supplied by the contractor.

Any material or equipment supplied by the department which is proved to be damaged or destroyed as a result of defective workmanship by the contractor.

Completion certificate shall be issued to the contractor on completing the formalities at stated above.

The plant is deemed to have been taken over from the date of completion certificate is issued to the contractor.

8.0 COMPLIANCE WITH REGULATIONS AND INDIAN STANDARDS, INDEMNITY & INSURANCE

8.1 Conformity with statutory Acts, Rules, Standards and Codes

ASW2

All components shall conform to relevant Indian Standard Specifications, wherever existing, amended to date.

All electrical works shall be carried out in accordance with the provisions of Indian Electricity Act, 1910 and Indian Electricity Rules, 1956 amended to date. They shall also conform to CPWD General Specifications for Electrical Works, Part-I: Internal, 1994 and Part-II: External, 1994 and Part IV (Sub-Station) as amended to date.

8.2 Safety Codes and Labour Regulations

All relevant safety procedures outlined in the safety codes shall be complied with.

In respect of all labour employed directly or indirectly on the work for the performance of the air conditioning contractor's part of the work, the contractor at his own expense, will arrange for the safety provisions as per the statutory provisions, I.S.I. recommendations, factory act, workman's compensation act, CPWD code and instructions issued from time to time. Failure to provide such safety requirements would make the tenderer liable for penalty of Rs.50/- for each violation.In addition the Engineer- in-Charge, shall be at liberty to make arrangements and provide facilities as aforesaid and recover the cost from the contractor.

The contractor shall provide necessary barriers, warning signals and the safety measures while laying pipe lines, ducts etc. or wherever necessary so as to avoid accident. He shall also indemnify CPWD against claims for compensation arising out of negligence in this respect. Contractor shall be liable, in accordance with the Indian Law and Regulations for any accident occurring due to any cause. The department shall not be responsible for any accident occurred or damage incurred or claims arising there from during the execution of work.The contractor shall also provide all insurance including third party insurance as may be necessary to cover the risk. No extra payment would be made to the contractor due to the above provisions.

9.0 VERIFICATION OF CORRECTNESS OF EQUIPMENT AT DESTINATION

The contractor shall have to produce all the relevant records to certify that the genuine equipment from the manufacturers has been supplied and erected.

9.1 The contractor shall provide all equipments, instruments, labour and such other assistance required by the Engineer-in-Charge for measurement of the works, materials etc.

10.0 STORAGE OF MATERIALS/EQUIPMENT

Plant room/Air handling unit room, if ready can be used for storage of materials/equipment brought to site by the contractors. Watch and ward of the same shall be the contractor's responsibility. In case the plant room space is not readily available, it shall be contractor's responsibility to make his own temporary structure at site with approved location from the department at his own cost.

11.0 WORKS TO BE DONE BY THE CONTRACTOR

The following works are deemed to be included in the scope of contractor.

Foundations bolts and vibration isolation spring/pads for foundation of equipment.

Suspenders and brackets for suspending/supporting ducts, pipes and cables trays.

Excavation and refilling of trenches wherever the pipes are to be laid directly in ground including necessary base treatment and supports.

Sealing of all floor slab, wall openings provided by the department or contractor for pipes and cables from fire safety point of view after laying of the same.

Painting of all exposed metal surfaces of equipment and components with appropriate colour.

Making good the damages caused during installation and restoring the same to their original finish.

Floor/wall supports for pipes and ducts.

Providing wooden/metallic frame for fixing grills/diffusers.

Making opening in the wall for passage of pipes/cables.

Make up water tanks/connectionsnear cooling towers if necessary.

Drain points in AHU Room and in the vicinity of cooling towers.

Floor and slab openings wherever required for laying of pipes, cables and ducts.

Opening in walls for passage of ducts and return air only.

Supports structure / foundation / pre cast PCC Blocks for boilers, heatpumps, pumps, AHUs etc.

Any other work as necessary for functioning of the system

END OF SECTION -18

SECTION 19
TECHNICAL DATA

(TO BE FURNISHED BY CONTRACTOR IN METRIC SYSTEMFOR EIC APPROVAL)

Please mention the make and country of origin of all the equipment.

1.0 HEAT PUMPS

Kindly attach the following:

1.Computer Selection of the Unit :
2. Details of safeties and protection. :
3.Detailed functions of Micro Processor Controller. :

2.0 COMPRESSOR

a)Manufacturer Name :
b)Model :
c)Type of Compressor Hermatic /Semi Hermatic/Open :
d)No.of Compressor per Machine :
e)Nominal capacity of each compressor in TR :
f)Actual capacity of each compressor in TR Operating Conditions :
g)Saturated Suction Temperature Deg.C :
h)Saturated Discharge Temperature Deg.C :
i)Max.RPM :
j)Mode of Start :
k)Refrigerant used :R-134 A
i)Qty. of Refrigerant used :

m) Power Consumption IKW/TR :

	Reduced Entering Cond Water Temp.	Constant Entering Water Temp.
At Full Load 100%		
90% :		
80% :		
70% :		
60% :		
50% :		

n) NPLV of the M/C :
o) Type of capacity control :
p) Range of capacity variation :
q) Safety devices & controls :
r) Monitoring Devices :
s) Type of bearings :

3.0 MOTOR(COMPRESSOR)

a) Make of Motor :
b) Type of Motor :
c) Motor KW :
d) Class of Insulation :
e) R.P.M :
Type of starter (Star Delta or Part Winding) :
Electrical characteristics Voltage/
Frequency Fluctuations permissible :
h) Full load current (Amp) :
i) Starting current (Amp) :

4.0 COOLER

a) Manufacturer Name :
b) Model :
c) Type of cooler :
d) Water Flow LPM :
e) No. of Passes :
f) Water Temperature OutDeg.C :
g) Water Temperature in C :
h) Pressure Drop in Mt. Of water :
i) Cooling Capacity Kcal/Hr. :
Fouling factor MKS
Type of vibration
Isolator for Rotary
Screw Water chilling
Machine recommended
Bymanufacturer. :

5.0 OVERALL SIZE OF HEAT PUMP MACHINE

a) Overall dimensions MM :
b) Opening Wt. Kg. :
c) Service Clearance required in mm

6.0 HEAT PUMP MACHINE

a) Operating Conditions :
b) Actual Capacity of water
Heat pumps at above
Operating conditions :

7.0 HOT WATER PUMP SETS

a)	Make	:
b)	Type	:
c)	Model	:
d)	Discharge (LPM)	:
e)	Head (Mt.)	:
f)	Efficiency	:
g)	Brake Horse Power	:
h)	Horse Power of motor	:
i)	Make/Type of motor	:
j)	Type of starter	:
k)	Impeller Diameter (mm) & Material	:
l)	Material of Bearing & Seal	:
m)	Type of Bearing	:
n)	Speed (RPM)	:
o)	Material of Shaft	:

VARIABLE SPEED SECONDARY CHILLED WATER PUMPING SYSTEM

I Secondary Chilled Water Pump

a)	Manufacturer	:
b)	Type/Model	:
c)	Capacity (USGPM) for SCHWP indicate capacity at varying speed	:
d)	Head (M)	:
e)	Efficiency (%)	:
f)	Pump (RPM)	:
g)	B.H.P.	:
h)	Motor (HP)	:
i)	Motor Make	:
j)	Current Characteristics	:
k)	Motor Efficiency & Class of insulation	:
l)	Bearing Material	:
m)	Impeller Material	:
n)	Shaft Material	:
o)	Type of Water Seals	:
p)	Vibration Isolation	:
q)	Operating Weight (Kg)	:
r)	Overall Dimensions (M) (LxWxH)	:

II Adjustable Frequency Drive for Variable Speed Secondary Chilled Water Pump

a)	Make/Country of Origin	:
b)	Model No.	:
c)	Type	:
d)	Motor Rating	:

e) Maximum Output :
f) Slip Compensation :

g) Energy Save Mode :
h) PID Controller :
i) Interface with BAS :
j) Fault Indication :
k) Historic Fault and Parameter Log :
l) Key & Display :
m) Dimensions (mm) :

III AFD by Pass

a) Make / Country of Origin :
b) Model No. :
c) Type :
d) Motor Rating :

IV Pump Logic Controller

a) Make / Country of Origin :
b) Model No. :
c) Microprocessor :
d) Radio Interference Standards :
e) Power Supply :

V Differential Pressure / Sensors / Transmitters

a) Make / Country of Origin :
b) Model No. :
c) Type :
d) Sensing Element Material for Pressure & Flow Rate :
e) Maximum Static Pressure :
f) Power Supply :
g) Degree of Protection :

8.0 PRIMARY CHILLED WATER PUMP SETS

a) Make :
b) Type :
c) Model :
d) Discharge (LPM) :
e) Head (Mt.) :
f) Efficiency :
g) Brake Horse Power :
h) Horse Power of motor :
i) Make/Type of motor :
j) Type of starter :
k) Impeller Diameter (mm) & Material :
l) Material of Bearing/Seal :
m) Type of Bearing :
n) Speed (RPM) :

o) Material of Shaft :

9.0 CONTROLS

Makes

	Three way Mixing Valve With Actuator (Part of BMS work)	:
b)	Pressure gauge	:
c)	Thermometers	:

10.0 PIPES

a)	Make	:
b)	Class	:

11.0 VALVES

Make

a)	Check Valve	:
b)	Butterfly Valve	:
c)	Balancing Valve	:
d)	Y-Strainer	:

11.1 Material/Gauge/Perforation ofbasket& Make

i)	Pot Strainer	:
ii)	Suction strainer	:

12.0 GRILLS/DIFFUSERS/DAMPERS

Please indicate make/material/gauge of the following:

			Make	Material
a)	Duct Dampers	:		
b)	Grills/Diffusers	:		
c)	Fire Dampers	:		
d)	Smoke & Temperature Sensor	:		

13.0 DUCT INSULATION

a)	Manufacturers Name	:
b)	Material	:
c)	Density Kg. Per Cmt	:
d)	Thermal Conductivity Kcal/Hr.Deg.C	:

14.0 DUCT LINING

a)	Manufacturers Name	:
b)	Material	:
c)	Density Kg. Per Cmt	:
d)	Thermal Conductivity Kcal/Hr.Deg.C	:

15.0 PIPE INSULATION

a)	Manufacturers Name	:
b)	Material	:
c)	Density Kg. Per Cmt	:
d)	Thermal Conductivity Kcal/Hr.Deg.C	:

16.0 ELECTRICAL ACCESSORIES

Panel Manufacturer's name

DOUBLE SKINNED AIR-HANDLING UNITS **:** fan selection & vendor tds

FILTER SECTION

Make

Type of Filters

No. of Filters

Size of Filters

Air Velocity through Filter EPM

Efficiency of Filter %

D. FAN & FAN MOTOR

Make of Fans & Motor

Type of Fan

No. of Fan

Width and dia of fans (mm)

Type of Blade

Air Quantity CMH

Static Pressure in wg

Fan Discharge Velocity

Type of Balancing

Brake Horse Power in HP

Hose Power of Motor in HP

Motor RPM

Fan Speed

Type of Drive Ball Driven/Direct Driven

PERFORMANCE TEST READINGS

The Test Readings shall be recorded on hourly basis during the summer/ monsoon seasons after commissioning of AC System at site as per the Performa indicated below.

1.0 OUTSIDE DESIGN CONDITIONS

a) Season :

b) Dry bulb tempDegree C :

c) Wet bulb temp Degree C :

2.0 INSIDE DESIGN CONDITIONS IN EACH AREA

a) Dry bulb temp Degree C :

b) Wet bulb temp. Degree C :

c) Relative Humidity % :

3.0 COMPRESSOR

a) Suction temp. Deg. C :

b) Suction pressure Kg/Sq.cm :

c) Discharge temp. Deg.C :

d) Discharge pressure Kg/Sq.cm :

e) R.P.M. of compressor :

4.0 COMPRESSOR MOTOR RATING AT VARIOUS LOADS

a) Motor current - AMPs :

b) Voltage - AMPs :
AC LOAD STATUS

5.0 EVAPORATOR

a) Water flow rate LPM :

b) Entering water temp. Deg.C :

c) Leaving water temp Deg.C :

d) Pressure drop through evaporator Kg/Sq.cm (PSI) :

100% load TR of M/CCurrent Drawn by M/C

AIR HANDLING UNIT

a) Air quantity CFM :

b) Air velocity ft/min. :

Entering air temperature DB/WB C :

d) Leavingair temperature DB/WB C :

e) Entering water temp. C :

f) Leaving water temp C :

g) Entering water pressure Kg/Sq,cm :

h) Leaving water pressure Kg/Sq.cm :

7.0 MOTOR DRIVE FOR AIR HANDLING UNIT

a) Actual voltage/current :

8.0 CHILLED /HOT WATER PUMP

a) Flow rate LPM :

b) Suction pressure Kg/Smt :

c) Discharge pressure Kg/Sq.cm :

d) Actual voltage/current :

All electrical panels/cables/starters/single phase presenter etc. shall be tested as per standard code of practice.

END OF SECTION 19

FINISHES MATRIX (Special Type-4 Quarters)

The indicative Finishes Matrix for Special Type-4 Staff Quarters buildings shall be as follows:

Ground Floor & First floor

1. **Entrance Lounge**
   a. Entrance Lobby Flooring :- Vitrified Tile Flooring of approved make and design with 100 mm high vitrified tile skirting duly matching the flooring tile joints
   b. Entrance Lobby Walls :- All walls shall be finished smooth with cement putty. The finish shall be with two coats of acrylic emulsion paint with over a coat of primer.
   c. Entrance Lobby Ceiling :- Wooden Decorated Ceiling as per drawing
2. **Living/all bed rooms**
   a. Flooring :- Vitrified Tile Flooring of approved make and design with 100 mm high vitrified tile skirting duly matching the flooring tile joints
   b. Walls :- All walls shall be finished smooth with cement putty. The finish shall be with two coats of acrylic emulsion paint with over a coat of primer.
   c. Ceiling :- Wooden Decorated Ceiling as per drawing.
3. **Toilets**
   a. Toilet Floor:- Anti skid Ceramic Tiles of approved brand and design
   b. Toilet Walls :- Glazed Ceramic Tiles upto False Ceiling of approved brand and design
   c. Toilet Ceiling:- Calcium silicate False Ceiling
4. **Kitchen**
   a. Flooring:- Anti skid Vitrified tile flooring of approved brand and design
   b. Walls :- Glazed ceramic tiles upto 600 mm height over the kitchen counter & maintain the same level on other exposed walls
   c. Ceiling:- Calcium silicate false ceiling
5. **All External Wall Surfaces of the building**
   a. Pebble Dash Plaster in approved pattern to create designs and finished with two coats of exterior emulsion paint over a coat of cement primer.
6. **Terrace Floor:-**
   a. Terrace Flooring :- Heat Absorption ceramic tile flooring finish laid over 20mm thick cement mortar bed .The tile flooring shall be laid after providing/making the terrace water-proof treatment and thermal insulation over deck treatment protected with cement concrete 1:2:4 to create slopes.
   b. Terrace Walls:- 18mm Plaster in two coats (12 mm and 6mm thick) + Two coats of Acrylic Smooth Exterior Paintover a coat of cement primer
   c. Terrace External Face Of Walls:- Pebble Dash Plaster in approved pattern to create designs and finished with two coats of exterior emulsion paint over a coat of cement primer and wet cladding with stone tile as per elevation
7. **Common passage area**
   a. Floor:- Kota Stone Flooring with 25 mm thick Kota stone slabs of approved size laid over minimum 20mm thick bed mortar
   b. Walls:- 18mm Plaster in two coats (12 mm and 6mm thick) + Two coats of Acrylic

a. 12mm thick cement plaster finished with floating coat of neat cement + two coats of waterproof cement paint

10. **FPS Ducts**

a. Two coats of water proof cement paint over 12mm thick cement plaster

11. **Staircase:-**

a. Tread :- 25 mm thick Pre- Polished Kota Stone in single piece with edge nosing
b. Riser :- 15 mm thick Pre Polished Kota Stone
c. Landing :- 25 mm thick Pre Polished Kota Stone
d. Inner face of S/c walls :- Two coats of Emulsion paint over a coat of cement primer
e. Skirting on the sides of stair case flights and landing:- With 8-10mm thick Kota Stone

12. Windows/Ventilators:

a. All windows and ventilators shall be of uPVC with mahagony shade(wood grain finsh) of approved make designed to withstand the maximum wind pressure of Leh.

b. The profiles of uPVC sections mentioned in the BoQ are minimum sizes. All glazed panels of the windows shall be provided with double glazed units comprising 5 mm thick glass on either side with 10 mm thick air gap. The DGUs shall be processed from reputed glass processors. All sliding windows shall be provided with three track outer profile to accommodate two sliding glazed shutters and one shutter with mosquito/bug screen mesh of approved make.The uPVC windows/ventilators shall be provided with complete heavy duty hardware and shall be provided with drainage vents.The contractor shall submit shop drawings for all windows and ventilators for approval of Engineer-in-Charge before procurement. The bottom panel of full height uPVC windows in balconies shall be provided with 6 mm thick laminated PVC sheet with wood grain finish laminate on both sides.

13. Doors:

a. All door shutter of rooms as well as toilets shall be with 37 mm thick factory made laminated flush door shutters. The shutter shall be with BIS marked 35 mm thick flush door shutter with commercial ply on both sides laminated with 1 mm thick laminate (HPL) on both sides . The shutter shall be provided with concealed teak wood beading on all sides ,ss hinges ,cylindrical lock/Mortice lock with lever handle on both sides of sides along with sets of two/three keys , tower bolts, floor door stopper, PVC bush on rear side at bottom etc. complete. The door hardware shall be of approved make. An eye-piece shall be provided in all main doors. The main doors shall also be provided with stainless steel 300x16 mm size aldrop in addition to cylindrical/mortice lock.

14. Kitchen Platform:

a. All kitchens shall be modular kitchens.They shall be provided with 600 wide 18 mm thick polished granite slab with facia on the front edge .The cabinets of the kitchen (under counter) shall be as per the tender drawings and all inside cutlery and storage baskets made of ss 304 grade of approved brand shall be provided. The overhead storage cabinets over the platform shall be as per the tender drawings. Chimney of approved model over the gas stove of approved make along with exhaust pipe shall be provided in all kitchens.

15. Radiant Heating System:

a. The radiant heating system shall be provided in all bed rooms/internal passages of the flat/toilets/kitchen/balconies.

16. External Plant room :

a. The plant room shall be underground as shown in the tender drawings with RCC walls

b. The flooring of the plant room shall be 62 mm thick cement concrete flooring with top 12 thick comprising hardener.

c. The outer RCC walls of the plant room (on both sides) shall be provided with polymer based water proofing

WMM on compacted sub-grade.

18. Landscaping: As per approved drawings.

19. Internal Roads : As per approved drawings.As per approved drawings. The pavement width of BT road shall be 4.50m with 0.75 m wide footpath on either side of the road. The foothpath shall be with 60 mm thick M30 grade interlocking paver blocks laid over a bed of sand.

20. Under ground Water tank : As per approved drawings

21. Cupboards : With 19 mm thick plywood on all sides and 12 mm thick on rear side laminated with 1.00 mm thick lamination on all surfaces of plywood. Plywood shall be conforming to BIS 710. The cup boards shall be provided with all hardware/fitting etc. complete as per approved drawings

Note:

1. **The details furnished above are indicative only and the contractor shall execute all other items of the project as specified in the tender drawings and approved drawings submitted by him .**
2. **The colour scheme shall be as approved by Engineer-in-Charge.**

FINISHES MATRIX (STAFF HOSTEL)

Ground Floor :-

1. Entrance lobby

a. Entrance Lobby Flooring :- Vitrified Tile flooring with tiles of size 800x800 mm of approved make and pattern(double charged)

b. Entrance Lobby Walls :- Front glazed wall: Semi-unitized structural glazing with powder coated aluminum mullions and transom frame work and double glazed unit vision panels (6 mm glass +12 mm air gap+ 6mm glass).The structural glazing system shall be provided with spandrel panels all floor levels. The entrance glass door shall be provided with 12 mm thick double leaf toughened glass door shutters supported on floor springs . The door shutters shall be provided with required patch fittings, lock fittings, 450 mm long H-handles and gasket for air-tightness.
The other walls shall be smooth finished with wall putty and two coats of acrylic emulsion paint over a priming coat.

c. Entrance Lobby Ceiling :- Wooden Decorated false Ceiling of approved design

2. **Entertaining &reading/ dining hall/Guest Lounge**

a. Flooring :- Vitrified Tile flooring with tiles of size 600x600 mm of approved make and pattern(double charged) (In kitchen and passages, the flooring shall be with 25 mm thick Polished Kota stone).

b. Walls :- All walls shall be plastered (with 12 mm thick cement plaster in CM 1:6) and smooth finished with wall putty and two coats of acrylic emulsion paint over a priming coat (All walls of kitchen shall be provided with glazed ceramic tile dado from floor level upto lintel level)

with wall putty and two coats of acrylic emulsion paint over a priming coat (All walls of kitchen/pantry/laundry/washing area shall be provided with glazed ceramic tile dado from floor level upto lintel level).

c. Kitchen store : The kitchen store shall be provided with adequate storage facilities in form of RCC shelves

4. **Rooms**

a. Flooring :- Vitrified Tile flooring with tiles of size 600x600 mm of approved make and pattern(double charged)

b. Walls :- All walls shall be plastered and smooth finished with wall putty and two coats of acrylic emulsion paint over a priming coat

c. Ceiling :- Wooden Decorated false Ceiling of approved design

5. **Toilets**

a. Toilet Floor:- Anti skid Ceramic Tiles

b. Toilet Walls :- Glazed Ceramic Tile dado upto False Ceiling

c. Toilet Ceiling:- Calcium silicate false ceiling

First To Second Floor :-

6. Executive rooms

a. Flooring :- CC flooring over-laid with inter-locking rigid core wooden flooring having natural teak veneer at the top surface in living and bed rooms. Vitrified tile flooring in balcony.

b. Walls :- All walls of living room shall be plastered and smooth finished with wall putty and two coats of acrylic emulsion paint over a priming coat.
Wall paneling in the bed room of the Executive suite upto false ceiling level with 10 to 12 mm wooden planks with natural teak finish of approved size and internal wooden framework.
The wall paneling shall be polished with melamine polish of required shade matching the wooden flooring. The substrate walls behind the wall paneling shall be plastering and painted with water proof cement paint

c. Ceiling :- Wooden Decorated false ceiling of approved design

7. **Rooms**

a. Flooring :- Vitrified Tile flooring with 600x600mm size vitrified tiles (double charged) of approved makes & pattern

b. Walls :- All walls shall be plastered and smooth finished with wall putty and two coats of acrylic emulsion paint over a priming coat

c. Ceiling :- Wooden Decorated false Ceiling of approved design

8. **Gymnasium Rooms**

a. Flooring :- Vitrified Tile flooring with 600x600mm size vitrified tiles (double charged) of approved makes & pattern

b. Walls :- All walls shall be plastered and smooth finished with wall putty and two coats of acrylic emulsion paint over a priming coat

a. Terrace Flooring :- Heat Absorption ceramic tile flooring finish laid over 20mm thick cement mortar bed .The tile flooring shall be laid after providing/making the terrace water-proof treatment and thermal insulation over deck treatment protected with cement concrete 1:2:4 to create slopes.

b. Terrace Walls:- 18mm Plaster in two coats (12 mm and 6mm thick) + Two coats of Acrylic Smooth Exterior Paintover a coat of cement primer

c. Terrace External Face Of Walls:- Pebble Dash Plaster in approved pattern to create designs and finished with two coats of exterior emulsion paint over a coat of cement primer and wet cladding with stone tile as per elevation

11. **Common passage area**

a. Floor:- Kota Stone Flooring with 25 mm thick Kota stone slabs of approved size laid over minimum 20mm thick bed mortar

b. Walls:- 18mm Plaster in two coats (12 mm and 6mm thick) + Two coats of Acrylic Smooth Exterior Paintover a coat of cement primer

12. **RCC Water Tank Floor And Walls**

a. Anti Bacterial Ceramic Tiles

13. **<u>Plumbing ducts inner face</u>**

a. 12mm thick cement plaster finished with floating coat of neat cement + two coats of waterproof cement paint

14 **FPS Ducts**

a. Two coats of water proof cement paint over 12mm thick cement plaster

15. **Staircases:-**

a. Tread :- 25 mm thick Pre- Polished Kota Stone in single piece with edge nosing

b. Riser :- 15 mm thick Pre Polished Kota Stone

c. Landing :- 25 mm thick Pre Polished Kota Stone

d. Inner face of S/c walls :- Two coats of Emulsion paint over a coat of cement primer

e. Skirting on the sides of stair case flights and landing:- With 8-10mm thick Kota Stone

16. Windows/Ventilators:

a. All windows and ventilators shall be of uPVC with mahagony shade(wood grain finsh) of approved make designed to withstand the maximum wind pressure of Leh.

b. The profiles of uPVC sections mentioned in the BoQ are minimum sizes. All glazed panels of the windows shall be provided with double glazed units comprising 5 mm thick glass on either side with 10 mm thick air gap. The DGUs shall be processed from reputed glass processors. All sliding windows shall be provided with three track outer profile to accommodate two sliding glazed shutters and one shutter with mosquito/bug screen mesh of approved make.The uPVC windows/ventilators shall be provided with complete heavy duty hardware and shall be provided with drainage vents.The contractor shall submit shop drawings for all windows and ventilators for approval of Engineer-in-Charge before procurement. The bottom panel of full height uPVC windows in balconies shall be provided with 6 mm thick laminated PVC sheet with wood grain finish laminate on both sides.

17. Doors:

a. All door shutter of rooms as well as toilets shall be with 37 mm thick factory made laminated flush door

The main doors shall also be provided with stainless steel 300x16 mm size aldrop in addition to cylindrical/mortice lock.

All door frames shall be with well seasoned ,knot-free kail wood of cross section size 125x75 mm finished with required shade melamine polish.

The shaft/panel room doors shall be of same specification with vision panel of size 300x300 mm.

18. Kitchen Platform:

a. All kitchen platforms shall be modular kitchens. They shall be provided with 600 wide 18 mm thick polished granite slab with facia on the front edge .The cabinets of the kitchen (under counter) shall be as per the tender drawings and all inside cutlery and storage baskets made of ss 304 grade of approved brand shall be provided. The overhead storage cabinets over the platform shall be as per the tender drawings. Chimney of approved model over the gas stove of approved make along with exhaust pipe shall be provided in all kitchens.

19. Radiant Heating System:

a. The radiant heating system shall be provided in all Executive Rooms, Rooms, balconies of rooms, reception lounge, kitchen, dining hall, recreation room, gymnasium ,laundry, all attached toilets and other rooms of the building.

20. External Plant room :

a. The plant room shall be underground as shown in the tender drawings with RCC walls

b. The flooring of the plant room shall be 62 mm thick cement concrete flooring with top 12 thick comprising hardener.

c. The outer RCC walls of the plant room (on both sides) shall be provided with polymer based water proofing treatment with 12 mm thick cement plaster in CM 1.:4 . The finishing on the inner side wall surfaces and ceiling of plant room shall be with water proof cement paint of required shade.

21. Shuttle/Badminton courts in the front court yard: As per approved drawings and industry standards including Nets complete.

22. Car Parking: As per approved drawings. The flooring of car parking shall be with heavy duty 60 mm thick M30 grade interlocking cement concrete paver blocks laid over a bed of 50 mm thick sand. The base shall be 150 mm thick WMM on compacted sub-grade.

23. Landscaping: As per approved drawings.

24. Internal Roads : As per approved drawings. The pavement width of BT road shall be 4.50m with 0.75 m wide footpath on either side of the road. The foothpath shall be with 60 mm thick M30 grade interlocking paver blocks laid over a bed of sand.

25. Under ground Water tank : As per approved drawings

26. Cupboards : With 19 mm thick plywood on all sides and 12 mm thick on rear side laminated with 1.00 mm thick lamination on all surfaces of plywood. Plywood shall be conforming to BIS 710. The cup boards shall be provided with

SAMPLEGUARANTEEBOND

Thisagreementmadethis.....dayof.....twothousand.....between M/s.....(here-inaftercalledtheGuarantoroftheonepart)andthe **Executive Director(P), National Highways and Infrastructure Development Corporation Limited, Regional Office, Ladakh** here-inaftercalledtheGovernmentoftheotherpart).

WhereasthisagreementissupplementarytothecontractTheContract)dated .....madebetweentheGuarantoroftheonepartandGovernmentoftheotherpart,where-bythe Contractor, inter alia, undertook to render the buildings and structures in the said Contract recited, completely ..... *[write item of guarantee like termite-proof/ waterandleak-proof.]*

AndwhereastheGuarantoragreedtogiveaguaranteetotheeffectthatthesaidstructurewillremain termite-proof/water-proof for **ten(10)years** to be reckoned from the date after the defect liability period prescribed in the contractexpires.

During this period of guarantee the Guarantor shall make good all defects and for that matter, shall replace at his risk and cost ..... *[write the component : such as such wooden members as may be damaged by termites,]* and in case of any other defect being found he shall render the building ..... *[write the component : such termite-proof]* at his cost to the satisfaction of the Engineer-in-charge, and shall commence the works of such rectification within seven days from date of issuing notice from the Engineer-in-charge calling upon him to rectify the defects, failing which the work shallbegotdonebythe NHIDCL bysomeotherContractorattheGuarantor'scostandrisk,andinthe later case the decision of the Engineer-in-charge as to the cost recoverable form the Guarantor shall be finalandbinding.

ThatiftheGuarantorfailstoexecutethe ..... *[write the component : such anti-termitetreatment] waterproofing*orcommitsbreacheshere-underthen the Guarantor will indemnify NHIDCL/Employer and his successors against all loss, damage, cost, expense or otherwisewhichmaybeincurredbyhimbyreasonofanydefaultonthepartoftheGuarantorinperformance and observance of this supplemental agreement. As to the amount of loss and/or damage and/or cost incurredbytheNHIDCL/Employer,thedecisionoftheEngineer-in-chargewillbefinalandbindingontheparties.

Inwitnesswhere-ofthesepresentshavebeenexecutedbytheObligor.....andby.....forandonbehalfofthe NHIDCL ontheday,monthandyearfirstabove written.

Signed,sealedanddeliveredby**OBLIGOR**inthepresence of–

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SignedforandonbehalfofNHIDCL by.....inthepresenceof.

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Volume - II

Bill of Quantities

EPC CONTRACT

Tender Inviting Authority: Executive Director (P),National Highways & Infrastructure Development Corporation Limited , RO-Ladakh

Name of Work: Construction of 8 nos. Special T4 Staff Quarters and Staff hostel at Geyser Palace site, Leh in the Union Territory of Ladakh

RFP No: /RO-Ladakh/2021-22

Name of the Bidder/ Bidding Firm / Company :	

PRICE SCHEDULE

(This BOQ template must not be modified/replaced by the bidder and the same should be uploaded after filling the relevant columns, else the bidder is liable to be rejected for this tender. Bidders are allowed to enter the Bidder Name and Values only)

Sl. No.	Item Description	Quantity	Units	Estimated Rate excluding GST in Rs. P	TOTAL AMOUNT excluding GST in Rs. P	TOTAL AMOUNT excluding GST In Words
1	**Construction of One building block having two Special T4 staff quarters at Geyser Palace site,Leh**including all types of Civil work, Architectural work, Interiors work,Electrical work, PHE works,Radiant Heating System work,Solar Water Heating System, Fire Fighting work etc. complete in all respects as per the scope of work, finishes matrix,tender drawings, special conditions of contract and as per the approved design, drawings	4	Nos			INR ---------- ---- Only

2	work, Architectural work, Electrical work, PHE works, Radiant Heating System works,Solar water heating and lighting system, Fire Fighting work etc. complete in all respect as per the scope of work, finishes matrix,tender drawings, special conditions of contract and as per the approved design, drawings and specifications	1	Nos			INR ---------- ----- Only
	External civil work,pneumatic water supply, drainage services, external electrical installations like lighting,sub-station (transformers etc.),DG sets,earthing ,Fire fighting system, underground water sumps for fire water and domestic requirements,Bio-digestors for sewage treatment, Radiant Heating Plant with complete system comprising heat pumps, boilers, HSD tanks, ventilation/heating, pumps, hot water tanks, piping network etc., internal roads of the site along with necessary road markings & signages, foot paths,car parking, borewells , CCTV Surveilance system for staff hostel, solar compound lighting, shuttle/badminton courts, landscaping and hardscaping etc completeas per the scope of work, finishes matrix,tender drawings, schedule of quantities,special conditions of contract and as per the approved design, drawings and specifications	1	Job			
4	**Comprehensive Annual Maintenance of Radient Heating System, DGs ,Lift and Sub-station for a period of four years starting from the next day of end of defect liability period**	4	year			
Total in Figures						
Quoted Rate in Figures			**Select**		0.00	INR Zero Only
Quoted Rate in		**INR Zero Only**				