AI ENGINEERING SERVICES LIMITED
AIESL MRO TRV, NEAR INTERNATIONAL TERMINAL, TRIVANDRUM, KERALA-695007
AIESL/TRV-MRO/MMD/04-169

SUB: Design, Supply, Fabrication, Erection and Commissioning of Aircraft paint booth at AIESL MRO, Trivandrum, Kerala-695007

NAME & ADDRESS OF THE AGENCY/CONTRACTOR:

M/s……..

Address: ……
……

State: ……..

Country: …….

Phone : ……

Email : …….

Issued by:

GM (E-Co)
AI Engineering Services Ltd.
Trivandrum-695007

Caution:

While every care has been taken to ensure that the contents of this tender are accurate and up to date till date, the entities are advised to check the precise current provisions of extant law and other applicable instructions from the original sources. In case of any conflict between the provisions stipulated in this tender and in the original sources, such as GFR or the prevailing laws, the provisions contained in the extant law and the original instructions shall prevail.

(I) INTRODUCTION

AI Engineering Services Limited, a company incorporated under Companies Act 1956, having it's registered office at 2nd Floor, CRA Building, Safdarjung Airport, New Delhi 110003(hereinafter referred as **"AIESL"**), invites sealed/closed bids under two bid system from eligible bidders (hereinafter referred to as **"Bidder(s)"** meeting the Technical Bid Evaluation Criteria mentioned at **SECTION C** of the Tender document(hereinafter referred to as "Tender") and also complying with terms and conditions of the subject Tender, for **"Design, Supply, Fabrication, Erection and Commissioning of Aircraft paint booth at AIESL MRO, Trivandrum, Kerala-695007".**

(ii) PURPOSE OF THE TENDER

AIESL, a public-sector undertaking for the maintenance of various types of aircraft. AIESL is inviting quotes for **Design, Supply, Fabrication, Erection and Commissioning of Aircraft paint booth at AIESL MRO, Trivandrum, Kerala-695007** from Service Providers (herein after referred to as "SP") which is defined as Service Provider having Three (3) years of experience in this field and completed projects of similar nature (construction project works, framed structural work, construction of paint booths, godowns , community hall, airports/hangar, indoor stadium, factory buildings, and associated services including electrical, plumbing, pneumatic, and fire protection systems) to quote for these services in 2(two) bid tendering process viz. technical bid as per Section C and Price Bid Section-D as per BOQ(Section B work scope),(Hereinafter referred to as "bids") Any additional task desired by the regulatory authorities, on intimation in writing, should be complied with by the Service Provider at no additional cost.

(iii) DISCLAIMER

a) While the document has been prepared in good faith, no representation or warranty, express or implied, is or will be made, or no responsibility or liability will be accepted by AI Engineering Services Ltd. (AIESL) or any of its employees, in relation to the accuracy or completeness of this document and any liability thereof is expressly disclaimed. The RFQ is not an offer by AI Engineering Services Ltd., but an invitation to potential Service provider/organization for submission of their interest for providing services as mentioned in terms and conditions section of this Tender.

This Tender is not an agreement and is neither an offer by AI Engineering Services Ltd. to the prospective bidder(s) or any other person. The purpose of this Tender is to provide interested parties with information that may be useful to them in making their technical and commercial offers pursuant to this Tender.

AI Engineering Services Ltd. to make no representation or warranty and shall have no liability to any person, including any or bidder under any law, statute, rules or regulations or tort, principles of restitution or unjust enrichment or otherwise for any loss, damages, cost or expense which may arise from or be incurred or suffered on account of anything contained in this Tender or otherwise, including the accuracy, adequacy, correctness, completeness or reliability of the Tender and any assessment, assumption, statement or information contained therein or deemed to form part of this Tender or arising in any way in the tender process.

AI Engineering Services Ltd. also accepts no liability of any nature whether resulting from negligence or otherwise howsoever caused arising from reliance of any or bidder upon the statements contained in this Tender. Any information/documents including information/documents pertaining to this Tender or subsequently provided to bidder(s) and/or successful bidder and information/ documents relating to the bidding process; the disclosure of

which is prejudicial and/or detrimental to, or endangers, the implementation is not subject to disclosure as public information/ documents.

No contractual obligation on behalf of AI Engineering Services Ltd., whatsoever, shall arise from the offer process unless and until a formal contract is signed and executed between duly authorized officers of AI Engineering Services Ltd. and the Bidder.

Each Bidder should conduct its own due diligence, investigations & analyses and should check the accuracy, adequacy, correctness, reliability & completeness of the assumptions, assessments & information contained in this Tender and shall obtain independent advice from appropriate sources, at no cost to AIESL.

AIESL in its absolute discretion, but without being under any obligation to do so, may update, amend or supplement the information, assessment or assumption contained in this Tender, from time to time till the close date of the Tender.

The Tender does not imply that AIESL is bound to select a Bidder or to appoint the Successful Bidder and AIESL reserves the right to reject all or any of the Bids without assigning any reason whatsoever at any time.
The Bidder shall bear all its costs associated with or relating to the preparation & submission of its Bids including but not limited to preparation, copying, postage, delivery fees, expenses associated with any demonstrations or presentations which may be required by AIESL, or any other costs incurred in connection with or relating to in Bids. All such costs and expenses shall remain with the Bidder and AIESL shall not be liable in any manner whatsoever for the same or any other costs or other expenses incurred by the Bidder in preparation for submission of the bid, regardless of the conduct or outcome of the bid selection process as contained herein.

CAUTION: While every care has been taken to ensure that the contents of this Tender are accurate and up to date till date, the entities are advised to check the precise current provisions of extant law and other applicable instruction from the original sources. In case of any conflict between the provisions stipulated in this Tender and in the original sources. Such as GFR or the prevailing laws, the provisions contained in the extant law and the original instructions shall prevail.

(IV)NOTICE FOR INVITING TENDER

Tender No. & Name of the Tender	**AIESL/TRV-MRO/MMD/04-169** **"Design, Supply, Fabrication, Erection and Commissioning of Aircraft paint booth at AIESL MRO, Trivandrum, Kerala-695007"**
Pre-Bid Meeting Details	refer CPP portal
Last date of receipt of queries from the prospective Bidders through mail,	refer CPP portal
Estimated Value of Contract	Rs 8.4 crores
Last date/ time for submission of Bids documents **("Due Date/ Time")**	refer CPP portal
Submission of Bids	Through CPP Portal
Date and Time of Opening of Bids	Through CPP Portal
Place of Opening of Bids	CPP Portal
Extension of Due Date/Time	The Due Date / Time of submission and opening of Bids may be extended at any time, at the sole discretion of AIESL and shall be notified on CPPP. No separate press advertisement will be issued by AIESL regarding extension of Bid opening date and Due Date/Time.
Financial Bid Opening	To be notified to technically qualified Bidders through CPPP/ EMAIL which is provided on Technical Bid
Earnest Money Deposit **(EMD)**	INR 2(Two) Lakhs only
Address of Communication for any clarifications regarding Tender Conditions, Scope of Work	Mmd.trv@aiesl.in, efd.trv@aiesl.in, mari.kumar@aiesl.in **Ph. 7593844832/ 9074735297 /9946049576**

Clarifications shall be entertained until one week before closing of Technical bid date.

SECTION A: General Terms and Conditions:

1) Terms and Conditions governing the Bid:

i. AI Engineering Services Limited (herein after referred to as **"AIESL"**), invites Bids on CPP portal (under two bid system) from eligible Bidders meeting the Bid evaluation criteria specified in this Tender, for obtaining the Services as mentioned in Section B.

ii. The Technical and Price Bid Criteria which the Bidder should satisfy for the purpose of the Tender has been mentioned in Section B, C and Section D respectively, hereto.

iii. The tender is non-split able or non-dividable by the service provider.

2) Definitions:

The following words, as used in the Tender shall have the meaning ascribed to them below:

i. The term 'AIESL', shall mean "AI Engineering Services Limited", a company incorporated under Companies Act 1956.
ii. The term "Bidder" shall mean the entity who has submitted the Bid through CPP portal for this Tender through its authorized signatory.
iii. The term "Contract" shall mean the agreement entered between AIESL and the Successful Bidder, confirming its acceptance of the Tender, on the terms and conditions mentioned therein.
iv. The term "Days" shall mean the working days of AIESL.
v. The term "Services" shall mean the services to be provided by the Successful Bidder as mentioned in the Tender.
vi. The term "Successful Bidder" or the "Service Provider"(SP) shall mean the Bidder who has been awarded the Contract to carry out the Services contemplated in this Tender.
vii. The term "L-1" means Bidder with lowest quote, and "L-2" means Bidder with the second lowest quote.

3) SUBMISSION OF BIDS:

i. Bidders must ensure online submission of the Technical Bid and the Price Bid proposals, clearly mentioning the Tender number and Bid type (Technical Bid or Price Bid).
ii. PART I: This shall be named "Technical Bid".
iii. **No Price Bid related information shall be mentioned in the Technical Bid.**
iv. PART II: This shall be named "Price Bid" and shall comprise of Bill of Quantity and Price.

❖ **Technical Bid:**

The Technical Bid as per format at Section C must be submitted separately through CPP portal **before the last date specified in CPPP,** along with the requisite proof of submission of EMD / Bid Security Declaration Form (duly filled and signed) in place of EMD as the case may be. The Bidders must furnish the Technical Bid along with scanned copies of all attachments/documents/information and details

sought / required through documentary evidence, duly signed by the authorized signatory of the Bidder(s) with company seal on all the pages of such documentary evidence and annexure submitted along with Technical Bid, as per the terms of the Tender.

❖ **Price Bid:**

i. Price bid should be submitted strictly as per Format of Price Bid Section D through CPP portal.
ii. If for some reason, the Bid Due Date/Time or the Bid opening date is declared a holiday, then the Bid Due Date/Time or the Bid opening date will automatically stand extended to the same timings of the next working day. In the event of the receipt of the Bid after the Due Date/Time, the Bid shall be rejected. AIESL reserves the right to reject any Bid in part or full or annul the Tender process without assigning any reasons.
iii. The prices in the Price Bid must be clearly typed both in words and figures without any error. If any mismatch of word and the figures the word will be taken for considering bid value.

iv. Bidders are advised to study the Tender carefully. Submission of Bid shall be deemed to have been done after careful study and examination of the tender with full understanding of its implications.

v. The issue of this Tender does not imply that AIESL is bound to select a Bidder. Notwithstanding anything contained in this Tender, AIESL reserves the right to reject any Bid and to annul the Bidding process and/or reject all Bids at any time without any liability or any obligation for such acceptance, rejection, or annulment, and without assigning any reasons thereof. If AIESL rejects or annuls all the Bids, it may, at its sole discretion, invite all eligible Bidders to submit fresh Bids hereafter.

vi. Bidders shall bear their own costs associated with or relating to the preparation and submission of their Bids including but not limited to preparation, copying, postage, delivery Fees, expenses associated with any demonstrations or presentations which may be required by AIESL or any other costs incurred in connection with or relating to their Bid. All such costs and expenses will remain with the Bidder and AIESL shall not be liable in any manner whatsoever for the same or for any other costs or other expenses incurred by a Bidder in preparation or submission of the Bid, regardless of the conduct or outcome of this Tender process

vii. No bidder shall submit more than one Bid against this Tender. In case more than one bid is received only the last submitted bid would be considered.

viii. Bids prepared by the Bidder shall contain all requisite information along with self- attested supporting documents as per details provided in the Technical Bid.

ix. The Price Bid of only those Bidders who are found technically suitable during technical evaluation would be opened.

x. AIESL reserves the right to accept or reject any or all Bids as well as to cancel the Tender, without assigning any reason or without any liability, whatsoever.

xi. If there is an error in a total corresponding to the addition or subtraction of sub totals, the subtotals shall prevail, and the total shall be corrected.

AIESL reserves the right to reject the Tender in part OR full OR annul the whole Tender process without assigning any reason and without any liability on the part of AIESL, whatsoever.

4. OPENING OF BIDS:

i. On the date of opening of Tender only the Technical Bids will be opened. Price Bids of only those Bidder(s) who are qualified after the evaluation of the Technical Bids will be opened. Intimation will be sent to those Bidders who qualify after the evaluation of the technical Bids. No correspondence in this regard will be entertained.

ii. If in the price quoted in the Price Bid, there is a discrepancy between the unit price and the total price (which is obtained by multiplying the unit price by the quantity), the unit price shall prevail and the total price shall be corrected accordingly.

iii. GST Noncompliance: In case the AIESL is not able to claim input GST credit on account of any fault, omission or noncompliance by vendor, The Vendor shall take prompt corrective action to ensure that AIESL is able to claim input GST credit. Till such corrective action is taken the AIESL reserves the right to withhold the payments to the extent of GST credit. However, if the AIESL is not able to claim input GST (in-spite of corrective action taken by vendor), then the AIESL shall reserve the right to permanently withhold payment to the extent of GST and additional interest at the rate of 18% or any other rate prescribed under the GST laws subjected to all undisputed outstanding invoices are cleared.

5. **Pre-Bid Meeting**

   I. Pre-Bid meeting will be conducted at AIESL MRO Trivandrum, Kerala 695007 on 20th day from the Tender uploaded date (if the said day is Saturday/Sunday/ or any Public Holiday, then the same will be on next working day**)**

   II. **Pre-Bid meeting is Mandatory for the bidders who wish to participate in the Tender.**

   III. The representative of bidders must attend the Pre-Bid meeting with structural & design concept drawing and detail work brief.

6. **AMENDMENTS AND EXTENSIONS:**

   Amendments and Extensions, if any, to this Tender will be hosted on the CPPP portal & website of AIESL at www.aiesl.in. The Bidders are, therefore, advised to visit CPPP and AIESL's website regularly till the date of closing of the Tender. In case there is change in Service Details/ Requirement / Terms & Conditions after release of the Tender but before its Due Date/Time, the Bidders who have submitted their Bids shall have an option to re-submit their Bids, if they choose to do so, within the extension period as may be specified by AIESL. For avoidance of doubt, it is hereby clarified that the last Bid submitted by the Bidder will be considered as the final Bid.

7. **TENDER FEE:**

   The Tender is available for down-loading on free of cost basis from e Tender section of AIESL website www.aiesl.in .There is no fee for the Tender Documents.

8. **VALIDITY OF BID, PRICES, GOVT. DUTIES / LEVIES ETC.:**

- The price quoted by the Bidders shall be valid for a period of 180 (One Hundred Eighty) days from the date of Technical Bid opening. Any Bid whose validity is less than 180 (One Hundred Eighty) days shall be summarily rejected.
- The service quantum to be available could vary more than or less than 25% from that as indicated in the Tender to accommodate fluctuations in demand during the contract period. The Bidder must maintain final contractual price during the entire Contract Period.
- The price offered/agreed should remain firm till the completion of the Contract and subject to the terms of the Tender/Contract.
- No request for increase in prices shall be entertained during the Contract Period, except on account of increase in GST or any other Government levy, if imposed by the Govt. of India or airport operator charges, provided the Successful Bidder submits a proof of payment for such increase to AIESL.
- The Bidders should commit to pass on the benefit to AIESL of reduction in statutory taxes, etc., by the Government, during the period of Contract.
- During the Contract Period, if for any reason there is a downward revision in the prices, the Successful Bidder shall pass on the benefits of the same to AIESL.

Note – The site visit is mandatory before bidding, for site visit, Bidders may please contact Mr. Marikumar, In charge, EFD, mari.kumar@aiesl.in / efd.trv@aiesl.in

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9. REJECTION OF BIDS (TECHNICAL BID & PRICE BID):

The Bids are liable to be rejected forthwith without any evaluation on the following grounds:

a) In case both the Technical Bid & the Price Bid is not received through CPP portal.
b) Technical Bid and/or the Price Bid has been received after Due Date/ Time of the tender submission.
c) If only the Technical Bid has been received and the Price Bid has not been received, and vice versa.
d) If the Bid has been submitted without EMD or without declaration as per the eligibility,
e) If any Price Bid or price information is mentioned in the Technical Bid.
f) If the information given in response to the Tender is incomplete, ambiguous, without requisite supporting documents, unverified, unattested and/or the submitted copies are illegible or the material unexplained and/or Bids not received as per the desired formats & Bidding instructions.
g) In case of any variation, in the documents / data submitted by the Bidder in support of the Technical Bid and in comparison, with the original documents during technical evaluation, the Bids of such Bidder would be out-rightly rejected / disqualified during technical evaluation of Tender and EMD would be forfeited.
h) If the price indicated in the Price Bid is Conditional.
i) If the Price Bid is not submitted in the format as described in Section 'D' in the Tender.
j) In case the Bidder being an MSE unit as specified at Clause 13 of Section A, fails to submit a copy of the relevant MSE certificate and the required Bid Security Declaration Form along with the technical bid.
k) If the Bid has been received without the undertaking of acceptance of all terms & conditions.
l) The above list is only illustrative and there can be other relevant grounds of rejection of Bids.
m) **If scanned copies of tender documents duly signed & stamped, towards acceptance of all terms & conditions of tender, are not attached.**

10. AIESL's Rights & Discretions:

AIESL, in its sole discretion and without incurring any obligation or liability, reserves the right, at any time, to:

i. Suspend and/or cancel the Bidding process and/or amend and/or supplement the Bidding process or modify the dates or other terms and conditions relating thereto.
ii. Consult with any Bidder to receive clarification or further information.
iii. retain any information and/or evidence submitted to the AIESL by, on behalf of, and/ or in relation to any Bidder; and/ or
iv. Independently verify, disqualify, reject and/or accept all submissions or other information and/ or evidence submitted by or on behalf of any Bidder.
v. It shall be deemed that by submitting the Bid, the Bidder agrees and releases the AIESL, its employees, agents and advisers, from any and all liability for claims, losses, damages, costs, expenses or liabilities in any way related to or arising from the exercise of any rights and/ or performance of any obligations hereunder, pursuant hereto and/ or in connection with the

Bidding process and waives, to the fullest extent permitted by applicable laws, any and all rights and/ or claims it may have in this respect, whether actual or contingent, whether present or in future.

11. MODIFICATION OF BIDS:

i. The Bidder(s) can modify or withdraw their Bid(s) within the validity period in CPP portal as per the norms.
ii. In case of withdrawal of the Bid, the Bidder is required to withdraw as per procedure of CPPP.
iii. No Bid shall be modified after the Due Date/Time for submission of Bids.
iv. Withdrawal/modification of Bid, during the time mentioned above, shall result in the forfeiture of the EMD submitted by the Bidder.

12. EARNEST MONEY DEPOSIT (EMD):

a) EMD amount is Rs. 2,00,000/-
b) Bidders should make on line payment of Rs: 2,00,000/- (Two lakhs Only) towards **Earnest Money Deposit (EMD)** through the **payment gateway** available on our AIESL portal. Click on the option displayed on the AIESL home page – **"For making any payments** click here**"**
Transaction ID Number must be mentioned on the Section C.
c) The Bidder should mention the Tender number along with his full name and address in the Remarks of EMD.
d) If the Bidder is a MSE unit and claims exemption from submission of EMD in such an event the Bidder must submit a copy of the relevant MSE certificate at the address mentioned in the tender along with the submission of the Technical Bid, for their Bid to be considered as per the Tender.
e) EMD in any other mode other than what is specified above will not be accepted.
f) EMD of unsuccessful Bidders will be refunded without any interest within 45 days of award of the Contract in favor of the successful bidder.
g) EMD of the Successful Bidder will be returned without any interest, after receipt of a Bank Guarantee or DD as Security Deposit against the Contract.
h) EMD of a Bidder will be forfeited if the Bidder withdraws or amends its Bid after the due date, impairs or derogates from the Tender in any respect, or declines to accept or honor the Contract if awarded in his favor within the Bid validity period. If the Successful Bidder fails to furnish Security Deposit within the specified period, its EMD is liable to be forfeited.
i) AIESL reserves the right to reject / not consider the Bid if it has been received without EMD or proof of submission/details thereof or the EMD has been submitted in a mode other than as specified above, or a valid proof of exemption from submission of EMD has not been provided.

13. EXEMPTION / PREFERENCE TO MSE UNITS:

i. As per Public Procurement Policy for Micro and Small Enterprises (MSEs), preference will be provided to MSEs as per the prevailing policy as formulated by Ministry of Micro and Small Enterprise of Govt. of India., MSEs must be registered with any of the following to avail the benefits / preference available vide Public Procurement Policy MSEs Order,2012

(1) District Industries Centers (DIC)
(2) Khadi and Village Industries Commission (KVIC)
(3) Khadi and Village Industries Board
(4) Coir Board

(5) National Small Industries Corporation (NSIC)
(6) Directorate of Handicraft and Handloom
(7) Any other body specified by Ministry of MSME.
(8) Udyog Aadhaar

ii. MSEs participating in the tender must submit the certificate of registration with any one of the above agencies indicating the details of the tendered item along with their bid.
iii. The MSEs registered with District Industries Centers must submit the **Acknowledgement of Entrepreneur Memorandum (EM) Part-II** along with their bid. The MSEs registered with National Small Industries Corporation (NSIC) must submit the valid NSIC registration certificate along with their bid to avail the exception as per the Government MSE norms.
iv. The Micro and Small Enterprises not registered for the trade/item for which this tender is relevant, would not be eligible for exemption / preference.
v. The registration certificate issued from any one of the above agencies must be valid as on close date of the tender.
vi. The MSEs, who have applied for registration or renewal of registration with any of the above agencies/bodies but have not obtained the valid certificate as on close date of the tender, are not eligible for exemption / preference.
vii. EMD is not applicable to MSE unit upon providing valid MSE certificate as per govt rules.
viii. Security Deposit- The Successful Bidder (MSME/Non MSME) will be required to submit the Security Deposit as applicable on the Contract value.
ix. Tender Experience & Turnover eligibility criteria is mandatory to MSE units.
x. Price Preference- This is a single work and cannot be split. The tender will be awarded to L1.

Note: Above policy of extending benefits is meant for procurement of only goods produced and services rendered by MSEs and not for any trading activities by them.

14. <u>SECURITY DEPOSIT (SD) / PERFORMANCE GUARANTEE (PG) :</u>

i. The bidder who qualifies for award of Contract will have to deposit with AI Engineering services Limited 5**% (Five percent) of the total value of the Contract towards interest free Security deposit**, within 2 weeks of receipt of the Contract and/or before of commencement of work through the **payment gateway** available on our AIESL portal Click on the option displayed on the AIESL home page – **"For making any payments** click here**"**
ii. In case of submission of Security Deposit by Bank Guarantee, it may please be noted that the original BG must be forwarded by the Bank directly to AIESL through registered AD (Acknowledgement) as per the detailed procedure which will be advised to the Successful Bidder. The expenses incurred towards submission of Security Deposit / Bank Guarantee will have to be borne by the successful bidder.
iii. Security Deposit if provided by way of Bank Guarantee shall be furnished on non-judicial stamp paper of appropriate value and in the prescribed format.
iv. The Security Deposit / Bank Guarantee will be refunded / returned without interest at end of warranty period against the Contract after adjusting for damages, if any, that may be imposed under the terms of the Contract.
v. Validity of the SD / BG would be till 60 days after the scheduled completion of all obligations under the Purchase Order / Contract.
vi. After the successful completion of the contract, the SD would be converted into a Performance

Guarantee (PG) that would be refunded/ returned by Finance on completion of warranty/ all obligation as under the contract.

vii. The cost of submission of SD or execution of BG/PG would be borne by the successful bidder.

viii. In Case of extension of delivery period under the contract, the validity of the SD/BG should be extended up to 90 days beyond the period of such extension.

ix. Security Deposit (SD) is mandatory for the successful **MSE Units** also.

x. In case, Security Deposit is not deposited as per the terms of the Tender and the Contract, before the commencement of the Services, the bills presented by the Successful Bidder shall not be processed for payment till the time the Security Deposit is deposited by the Successful Bidder.

xi. In the event the Security Deposit is not deposited by the Successful Bidder within 15 days from the date of award of the Contract, AIESL reserves the right to terminate the Contract and re-issue a fresh tender

xii. In case of breach of Contract or violation of any terms of the Contract the Security Deposit shall be forfeited / Bank Guarantee be invoked.

xiii. Such Security Deposit shall not bear any interest and shall be refunded without interest only on successful completion of the Contract and upon fulfillment of all Contractual obligations after warranty period of the Contract.

15. PRICE NEGOTIATION:

As a general norm price negotiation are not to be carried out by AIESL with the bidders. Negotiations, if at all deem necessary and as an exception may be held for better pricing with the L1 bidder only.

16. EVALUATION PROCESS FOR TECHNICAL BID (STAGE 1):

i. The Technical Bids would be first evaluated for compliance. During the evaluation, AIESL reserves the right at its sole discretion to seek whatever information, documents etc. from the Bidder as it may consider necessary for the purpose of evaluation of the Bids.

ii. In the event the Bidder fails to provide any information or documents sought by AIESL, the Bid said Bidder shall be rejected by AIESL. No correspondence in this regard will be entertained

iii. The Bidders who qualify as per the Technical Bid evaluation criteria as mentioned under Section B, C and D, and other requirements of the Tender would be considered for next stage of Tender process, and they would be duly intimated by email.

iv. AIESL authorities may visit the vendor premises or conduct video call with the bidders to understand their work place, office upkeep and to verify the records.

17. EVALUATION PROCESS FOR PRICE BID (STAGE 2):

i. The Price Bids of only those Bidders who qualify under the Criteria as specified in section B & C and complȳ with the other Tender requirements would be opened. The date and time of opening of the Price Bids would be intimated in advance to the Bidders who get qualified in the Technical Bid evaluation, and their authorized representatives only would be permitted to participate in the opening of the Price Bids.

ii. Price Bids should be submitted strictly as per the format given in Section 'D' in the tender hereto. The detailed procedure / method of quoting and criteria for evaluation of the Price Bids has been provided in Section D.

18. NOC FROM REGULATORY AUTHORITIES:

a) Successful Bidder must obtain all NOCs required for the work from the relevant regulatory authorities including but not limiting to Fire authorities, airport authority.
b) AIESL will provide supporting documents to whatever extent possible.
c) It will be the full responsibility of the successful bidder to acquire and produce the necessary documents for NOCs.
d) In case work cannot be executed for want of approvals/ NOCs, AIESL will not be responsible for any payments or refunds. EMD or SD may be forfeited.

19. AWARD OF CONTRACT/AGREEMENT, ACCEPTANCE, COMMENCEMENT / EXECUTION:

The award of Contract shall be subject to fulfillment (in addition to eligibility criteria and the Undertakings as provided under the Tender) of following conditions by the Bidder:

i. The Successful Bidder must convey acceptance of Letter of Award (LOA) within 7 days of receipt of the same and provide their bank details with a cancelled cheque.
ii. The Successful Bidder must obtain all government approvals/ NOCs within 30 days after Acceptance of LOA. In case the bidder is unable to get the relevant approvals /NOC for whatever reasons, the Contract will become null and void.
iii. The Successful Bidder shall complete the Contract within 90 days of acceptance of LOA. The cost towards the preparation, negotiation and execution of the Contract shall be borne by the Successful Bidder.
iv. Please note that this is a service contract and not a manpower contract and the SP will be solely responsible for payment of wages, compliance of applicable labour laws, payment of employee related statutory dues, settlement of disputes with their employees etc. with respect to the employees/service personnel deployed by the SP.
v. CPM/PERT chart of various activities of work to be done so that the work gets completed within the stipulated time. The chart shall be submitted within 15 days from the date of acceptance of the Contract.

20. FRAUDULENT PRACTICES:

AIESL requires that Bidders observe the highest standard of ethics during the Bidding process and execution of contracts. In pursuance of this, AIESL defines, for the purposes of this provision, the terms set forth as follows:

a) **"Corrupt practice"** means the offering, giving, or soliciting of anything of value to influence the action of a public official in the procurement process or in contract execution; and

b) **"Fraudulent practice"** means a misrepresentation of facts to influence a procurement process or the execution of a contract to the detriment of the AIESL and includes collusive practice among Bidders (prior to or after Bid submission) designed to establish Bid prices at artificial non-competitive levels and to deprive AIESL of the benefits of free and open competition.

c) If a bidder is found indulging in corrupt/fraudulent practices, The AIESL will act as follows:

i) Shall 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.
ii. Shall declare a Bidder ineligible and blacklist such Bidder, either indefinitely or for a stated period if it at any time, AIESL determines that the Bidder has engaged in corrupt or fraudulent

practices in competing for, or in executing the Contract.

iii. Shall rescind the Contract forthwith, in case of Successful Bidder adopting fraudulent / corrupt practices during the currency of the Contract.

iv. Bid Security Declaration will be applicable, or Security deposit shall be forfeited, as the case may be in addition to the above-mentioned remedies which AIESL shall have.

21. SUB-CONTRACTING:

The successful bidder shall not sub-contract the work or any part thereof, to any other person, concern, firm or company. Sub-contracting will result in termination of the contract with immediate effect without any liability on AIESL and also without prejudice to any other rights which AIESL may have against the Bidder under the Contract. The successful bidder shall not transfer or assign or sub-let any part of the service or any share of interest in any manner or degree, directly or indirectly, to any third party whatsoever.

22. CONTRACT MANAGEMENT:

Purchase order / Work Order will be released through CPPP/ or manual.

23. PENALTY CLAUSE: -

(i) Penalty for delayed deliveries: The tendered item is required for the purpose of AIESL's use. Time is the essence of this Tender. Project period is of 90 days and in case of delays acceptable to AIESL, the project duration may be extended upto 150 days without penalty for delay.

(ii) Timely delivery therefore, is of utmost importance. In case of delay in delivery, penalty for late delivery will be charged at the rate of 0.5 % per week or part thereof, of the undelivered portion of the goods or services, subject to a maximum of 10% of the value of the contract. In the event of continued delayed supply, AIESL reserves the right to cancel the contract and to take the appropriate necessary action in its interest. This is to be recovered from the security deposit/ Performance Guarantee, or from the amount due to the vendor after due notification to the vendor in advance. There shall be no system of waiver of liquidated damages in the contract and it may be strictly an exception rather than a rule.

(iii) Penalty for substandard/defective quality/short supply: At the time of delivery/acceptance of the work if it is found that the work or items used / delivered are not as per the specifications given in the contract/purchase order then AIESL reserves the right to levy penalty for defective supply up to maximum of 10% of the contract value along with replacement.

(iv) However, in case of exigencies where such items are required to be accepted in spite of deviations from the specifications of contract/PO, then depending on the extent and nature of the deviations, such consignments may be accepted at the sole discretion of AIESL, by imposing an appropriate penalty subject to maximum of 15% of the contract value.

(v) In case of any complaints on the quality issue at the time of use of the items/goods by AIESL, or any other stake holder of AIESL after acceptance of the delivery, then depending on the nature and the extend of the deficiency, AIESL reserve the right to impose an appropriate penalty on the total contract value, subject to maximum of SD on the contract value.

(vi) During work execution, damages caused to AIESL property by successful bidder, cost of restoring will be fully borne by the successful bidder.

(vii) During work execution, any obstruction to the regular functioning at AIESL premises caused by vehicles/items of vendor, penalty of Rs. 5000 per day will be charged.

(viii) The work should be continuous and progressive. Any delay cause should be intimated to the AIESL well in advance before stopping any work. If awarded contractor does not complete the project or leaves the project partially completed/ left a portion of complete project the Bidder shall lose all the SD, retention amount, EMD, with cost involved in the project, materials, along with the imposition of penalty clause of 50 % of the project cost.

24. ERRANT BIDDERS:

In case after Price Bid opening, the L-1 Bidder is not awarded the Tender for reason solely attributable to such L-1 Bidder, for reasons as mentioned in this Tender, thereof leading to retendering, AIESL shall apply clause 9 of the Declarations submitted by such Bidder and such Bidders shall be debarred for a period up to 01(one) year from participation in the next tender for the subject services as well as against any tender enquiry for any service sought by AIESL and its sister concerns at all locations. AIESL further reserves the right to blacklist the Bidder for a period up to 3 (three) years.

25. JURISDICTION:

Any Dispute whatsoever arising out of this Tender shall be subject to the exclusive jurisdiction of the courts of Kerala.

26. OTHER CONDITIONS:

(i) The accident /incident liability during the course of work is the sole responsibility of Service Provider/successful Bidder("SP"), and insurance of the personnel will be under the purview of the Service Provider/successful Bidder alone

(ii) The SP should ensure the safe disposal of the debris and scrap / garbage generated during the execution of said work away from the premises.

27. ZERO DEVIATION:

Bidders are advised to quote strictly as per terms and conditions of Tender and not to stipulate any deviation / exceptions. This is a zero deviation Tender, and no deviation shall be permitted.

28. SUBMISSION OF INVOICE:

Original Final invoice along with commissioning certificate, stability certificate etc as mentioned in scope, duly certified by end user for satisfactory performance to be submitted to MMD, AIESL, Trivandrum for payment purpose as given in the Purchase Order/Work order/ contract

Provision for Progressive payment: -Running account Bill i) Minimum value of RA bill is 40% of the work order value. ii) Maximum Number of RA bill is 2 Nos before the Final Bill submission.

Retention Money: - To be deducted from each RA bill @ 10% of the value of work completion.

The invoice shall be submitted to: (On work completion certificate from AIESL)

AIESL MRO TRV
Material Management Division (MMD) Hangar Unit, TRV-MRO,
Chackai, Trivandrum Kerala – 695007

29. PAYMENT TERMS:

- Payment will be made **within 60 days** from the date of completion of installation and commissioning (or) original invoice, whichever is later. However, if a Successful Bidder is a **MSE** Unit, then the payment will be made within **45 days** from the date of receipt of the item, completion of installation and commissioning (or) original invoice for payment, whichever is later as per the laid down govt. guidelines for MSE bidders
- Payment will be made through ECS mode (or) by Cheque
- The invoices should be submitted as per agreed tender terms & conditions clearly with the breakup along with the supporting documents, failing which may result in delays for payment process until the SP submits the clear and relevant supporting documents.
- Successful bidder is required to submit duly verified Bank Mandate form along with copy of relevant cheque leaf, duly cancelled to enable Accounts to make payment through ECS., NEFT etc on the day of acceptance of LOA by SP.
- TDS shall be deducted by AIESL from the payments, as per the applicable laws.

30. FALL IN PRICE CLAUSE:

The successful bidder should pass on any benefits arising due to lower taxation or change in input cost by virtue of some exemption by government or for any reasons during the contract/order.

31. INDEMNIFICATION:

i. The successful Bidder/Service Provider shall indemnify and keep AIESL indemnified against all liability arising out of any claim, penalty, loss damages or costs actually paid, suffered or incurred by AIESL pursuant to any injury or death to any person or by reasons of any damage to any property belonging to AIESL caused by the Service Provider's personnel deployed for the Services

ii. The Successful Bidder shall indemnify and keep AIESL indemnified from all liability arising out of

   a. any claim, /Penalty, / loss or damages, including costs (including counsel fees and reasonable legal cost) thereof, arising out of any breach or violation by the Successful Bidder of any provisions of any law, including but not limited to the intellectual property rights whether in India or any other country and labor laws governing the employees of the Successful Bidder.

b. The gross negligence, willful misconduct, bad faith, or fraud of the Service Provider or any of its Representatives in connection with the performance of the Services under this Tender;

c. Any breach of any covenant, representation, warranty, or obligation of the Service Provider under this Tender

d. Any violation of applicable law by the Service Provider in connection with the performance of the Services under this Tender

iii. The Successful Bidder shall be solely responsible for any destruction/theft or damage to AIESL property and/or illness, injury, including death that may be suffered by its own employees, contractors, or other representatives for whom it is in law responsible.

32. WARRANTY:

1. The entire paint booth along with each and every component must be built to the standards mentioned in the scope of work, associated notes and safety standards. The Minimum Warranty for quality of Civil Construction repairs/ Works / Workmanship will be ten years from the date of commissioning and hand over to AIESL. In case any defects / damages are noticed or if repairs are necessitated during the warranty period, then the same should be undertaken by the Bidder / Contractor at no extra cost to AIESL. The warranty should be as whole. All items and components included in the project must be covered by a warranty. This warranty should encompass all materials, labor, and any other associated costs required to rectify any issues that arise during the warranty period of 10 years (The Service Provider/ successful bidder shall provide a warranty of **10 (ten) years for the structural works** from the date of commissioning. The warranty for electrical, mechanical and pneumatic components shall be as per the respective OEM's standard terms, unless otherwise specified." All OEM warranty details for the non -structural items to be furnished to AIESL upon Project commissioning and SP/Successful bidder to ensure warranty claims settlement with OEMs) . During the warranty period, the service provider will bear the full cost of labor, materials, and any other necessary expenses for addressing issues related to any defects, without additional charge to the client.
If any products` or services are found to be defective or not in compliance with the warranty, the Service Provider shall, at its own expense, promptly correct or re-perform the services to meet the warranty standards. This shall be the exclusive remedy of the AIESL and the sole liability of the Service Provider for any breach of warranty. The entire structure will be covered under warranty. The SP will be solely responsible for any issues and its resolution.

33. CONFIDENTIALITY:

The Parties (i.e., the successful bidder and AIESL) shall at all times keep confidential, all information acquired in consequence of this proposal, except for information which they may be entitled or bound to disclose under compulsion of law or were requested by regulatory agencies or to their professional advisers where reasonably necessary for the performance of their professional services.

34. TERMINATION:

The Contract may be terminated in the following circumstances:

i. The Contract shall expire10 (Ten) years from the date of execution of the Contract unless renewed or Warranty period whichever is higher.
ii. In case of unsatisfactory performance or breach of any of the clauses of the contract, AIESL shall issue a written notice of 15 days to the Service Provider to rectify the breach and improve the Performance failing which AIESL shall be at liberty to terminate this Contract by providing

15 days written notice to the Service Provider. In such case, the Service Provider shall not be entitled to any compensation whatsoever for costs incurred or to be incurred on this account.

iii. In the event of breach of confidentiality, the Contract can be terminated by AIESL with a notice period of 1 (one) month.

iv. Either Party may terminate the Contract, in the event the Force Majeure Event subsists for a period of more than 90 days.

v. The Parties shall duly comply with their respective obligations during the notice period and thereafter, shall discharge the obligations arising out of the Contract till the termination.

35. EXIT / TERMINATION OF CONTRACT:

i. Notwithstanding the above, AIESL shall also be at liberty to terminate the Contract for any reason including change in situation/circumstances, etc. by providing a 30-day prior written notice to the Service Provider. The Service Provider shall also be at liberty to terminate this Contract by providing AIESL with a 30-day prior written notice. In such an event, the terminated party shall have no right to claim compensation/damages, etc. from the terminating party on account of early termination. However, the party shall duly comply with their respective obligations during the notice period and thereafter, shall discharge the obligations arising out of the agreement till the termination.

ii. In case the Service Provider fails to complete the work as per the contract, they will be debarred from participating in the immediate next tender of similar nature.

Survival of Certain Provisions

The following provisions of this Agreement shall survive any termination or expiration of this Agreement: such as Confidentiality, Indemnification, Liabilities, Penalty, and Dispute Resolution clause.

36. CLAIMS FOR DAMAGES:

- AIESL shall promptly notify the Service Provider of any claims / deficiency on the part of the Service Provider arising under / out of the Contract.

- In case the Service Provider, having been notified by AIESL, fails to take remedial action within the stipulated time as advised, AIESL may take a remedial action without any further notice, at the Service Provider's sole risk and cost. AIESL shall also levy damages /terminate the Contract without prejudice to any other rights which AIESL may have under the Contract or under any applicable laws.

37. FORCE MAJEURE:

Neither the Service Provider nor AIESL (collectively "Parties" and individually "Party") shall be in breach of any obligation under the Contract if it is unable to perform that obligation in whole or part by reason of occurrence of Force Majeure Event.

Force Majeure Event means extraordinary events or circumstance beyond human control such as an event described as an act of God (like a natural calamity, or events such as a war, strike,

riots). The affected Party shall give immediate notice in writing of occurrence of a Force Majeure Event as soon as it occurs (in any case not later than 5 days of information about the occurrence of such an event becoming known to such Party) and shall thereafter keep the other Party informed of the continuation or termination of such event as soon as possible (and in any event within three (3) days of the continuation or termination of such event).

Notwithstanding the occurrence of a Force Majeure Event, the affected Party shall use its best reasonable efforts and due diligence to mitigate the economic and other effects of the event of Force Majeure and shall reasonably allocate its available resources, giving priority to its obligations under the Contract.

The Party so affected shall take all reasonable steps to remedy the failure and reasonably allocate its available resources, giving priority to perform its obligations under the Contract and to keep the other Party informed of the steps being taken to mitigate the effects of an event of force majeure.

If the performance in whole or in part or any obligation under the Contract is prevented or delayed by any reason of subsistence of a Force Majeure Event for a period exceeding 90 (Ninety) days, either Party may at its option terminate the Contract without any financial repercussion on either side.

Notwithstanding the punitive provisions contained in the Contract for delay or breach of Contract, the Service Provider would not be liable for imposition of any such damages so long as the delay and/or failure of the Service Provider in fulfilling its obligations under the Contract solely attributable to the occurrence of a Force Majeure Event.

38. RESOLUTION OF DISPUTES AND ARBITRATION:

Any dispute or difference, whatsoever, arising out of this service agreement shall be referred to the sole arbitration of the General Manager (Engineering)/ CMM, AIESL, Trivandrum or the person appointed by him whose decision shall be final and binding on the parties.

39. NOTICES:

Any notice by one Party to the other pursuant to the Contract, shall be sent in writing to the address specified for that purpose in the Contract.

40. INTERPRETATION:

In the event of any difference in the interpretation of any of the clauses of the Contract, the clarification given by AIESL, Trivandrum shall be final and binding.

41. EXPENSES:

Each Party shall bear its own costs and expenses (including legal expenses) associated with the preparation, negotiation and execution of this Contract and any other relevant documents.

42. SEVERABILITY:

If any clause, section, or provision of this Contract is found to be invalid, illegal, or unenforceable, by the provisions of the applicable law, such invalidity, illegality, or

unenforceability shall not render the remaining clauses, sections, or provisions hereof invalid, illegal, or unenforceable. In such a case, the Parties shall mutually agree and amend this Contract as appropriate, seeking to achieve the minimum extent necessary to make this Contract, legal valid and enforceable.

43. AMENDMENT:

No amendment, modification, variation, or waiver of any provision of this Contract shall be binding or effective unless the same has been made in writing and signed by a duly authorized representative of each of the Parties hereto.

44. GOVERNING LAW:

This Contract shall be governed by, construed, and enforced in accordance with the laws of India.

45. OTHER TERMS & CONDITIONS:

i. It is further clarified that any Bidder signing the Bid and other documents in connection with the Tender must certify whether he signs as:

a) A "Sole Proprietor" of the firm or constituted attorney of such sole proprietor.

b) A partner of the firm if it is a partnership must have authority to refer to arbitration, disputes concerning the business of the partnership either by virtue of the partnership agreement or a power of attorney. In the alternative, the Tender should be signed by all the Partners. Constituted attorney of the firm if it is a Company.

c) Authorized signatory of the firm

ii. Issue / submission of Bid form does not necessarily mean that the Bidder is an eligible Bidder.

iii. Bidder is advised to quote strictly as per terms and conditions of the Tender and not to stipulate any deviation / exceptions.

iv. Our Tender closes on the Due Date/ Time specified in Tender. Bidders must submit their Bids well in time before the scheduled close date and time of the Tender to avoid any last-minute glitches such as postal or courier problems or for any other reasons.

v. AIESL will not entertain last moment request for extension of Due Date/ Time and reserves the right to accept or reject such request for extension at its sole discretion.

vi. The Due Date/Time of Tender may be extended at any time prior to the date of closing of Tender. The closing date of submission of Bids may be extended at any time including after the scheduled date of closing, at the sole discretion of AIESL.

vii. AIESL reserves the right to close the Tender / reject any /all Bids at any stage of Tender at its sole discretion, without any additional cost to AIESL.

viii. AIESL reserves the right not to consider the Bid of any Bidder, blacklist the Bidder for a period up to 3 years, if it is determined / noticed at any stage during the Tender process or after Contract Period that the Bidder has directly or indirectly engaged in any misrepresentation, corrupt, fraudulent, collusive, coercive practice to Bid / obtain the Contract. This will also have an impact on other Contracts / POs, the Bidder may have with AIESL where to AIESL reserves the right to take appropriate actions as deemed fit, in AIESL sole discretion.

ix. AIESL reserves the right to reject/not consider at its sole prerogative the Bids of such Bidders who have been involved in any litigation with AIESL in the last 5 years / ongoing litigation or arbitration with AIESL or have been blacklisted/ debarred by any PSU, Govt. bodies.

x. Bidders are required to declare if they have any ongoing legal disputes with any government

agencies such as Income Tax, EOW etc. In the event of any Suppression/ Misrepresentation of such facts AIESL reserves the right, at its sole discretion, to take appropriate action as deemed fit including but not limited to disqualification of the Bidder and termination of the Contract

xi. Any clarifications sought by AIESL with respect to the Bids submitted by the Bidders will be considered as a part of the Bid and AIESL reserves the right to seek clarifications at any stage of the Tendering process.

xii. If there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail.

xiii. All relevant documents required related to the Services to be provided under this Tender are to be submitted by the Bidders at their own cost.

xiv. Bids should be unconditional. Conditional Bids would not be accepted and are liable to be rejected.

xv. The terms of the Tender and the Contract are CONFIDENTIAL, and anything contained in the tender shall not be disclosed by the Bidders to any third party in any manner, whatsoever.

xvi. Bidder shall give the official mailing address, email, and phone numbers to which all correspondences shall be sent by AIESL. Also, in the event the address of the Bidder is changed, the same shall be intimated to AIESL immediately by the Bidder.

xvii. AIESL reserves the right to annul the Tender process and reject any or all the Bids at any time prior to the award of Contract without incurring any liability to the Bidder(s) or without any obligation to inform the Bidder(s) of the grounds of such annulment/rejection. AIESL further reserves the right to add/delete/modify any one or more of the terms and conditions contained in the Tender or any of the agreements proposed to be entered into by AIESL with the Successful Bidder.

xviii. The Near Relatives of employees of AIESL office who is likely to benefit the Bidder during the award/implementation of Contract are prohibited from participation in this Tender. Near relatives are defined as:

a. Members of Hindu undivided family.
b. Their husband or wife
c. Relatives in the manner as father, mother, son(s), son's wife, daughter(s), Daughter's husband, brothers, brother's wife, sister, and sister's husband.

xix. The Bidder should quote the figures as well as in words the rates and amount in figures only as per the Price Bid format given in Section –D The language for filling Tender Documents shall be in English.

xx. When there is a difference between the rates in figures and in words in Price Bid, the rates which corresponds to, the amount worked out by the Bidder, shall be taken correct as per the following:

a. When the amount of any item is not worked out by the Bidder or it does not correspond to the rate written either in figure or in word, then the rate quoted by the Bidder in words shall be taken as correct.
b. When the rate quoted by the Bidder in figures and in words tallies but the amount is not worked out correctly, rate quoted by the Bidder shall be taken as correct and not the amount.

xxi. All rates shall be quoted on the proper form (i.e., the Price Bid format) of the Tender alone.

Special care should be taken to write the rates and all amounts in figures as well as in words.

46. PARTICIPATION OF THE BIDDERS DURING OPENING OF BIDS:

The Technical Bids shall be opened on CPPP at the below mentioned address or at our HQs.

AI ENGINEERING SERVICES LTD
Material Management Division, AIESL MRO TRV, Chackai, Trivandrum Kerala – 695007

47. AMENDMENTS / CLARIFICATIONS:

Amendments, corrigendum, clarifications if any, and any extensions of the due date of opening of the Bids, as per the requirements of AIESL, will be intimated by hosting the notice on AIESL's website & CPPP only.

48. NOTE:

a) The Bidder may modify or withdraw their Bid after the Bid submission but prior to the date/time of opening of Bids subject to SOP for such activities in CPPP, Last modified Bid by the Bidder shall be treated as the final Bid.

b) No Bid shall be modified/withdrawn after the date/time of opening of Bids. Withdrawal of a Bid after the date/time of opening of Bids shall result in application of Bid Security Declaration for duly submitted by the bidder(s) in place of EMD.

c) Bids of the Bidders who have sent such withdrawal notice in writing shall be returned on the day of opening of the Bids in a Sealed condition with note of acknowledgement to that effect from such Bidders.

d) All the pages of the Bid must be mandatorily signed and stamped by the authorized signatory and enclosed along with the supporting documents as required in the Technical Bid.

e) All documents in support of the Bid must be submitted in accordance with the checklist as per Check sheet attached in Section C of the Tender.

f) The Bidders can download the Tender free of cost from CPP portal

g) A senior level group may be appointed for due diligence and the supplier is required to make available their documents or site visit.

h) If at any time after acceptance of the Tender the Company shall decide to abandon or reduce the Scope of the works for any reason whatsoever and hence not require the whole or any part of the works to be carried out, the Engineer-In-Charge shall give notice in writing to the effect to the Contractor and the Contractor shall have no claim to any payment of Compensations or other issues whatsoever, on account of any profit or advantage which he might have derived from the execution of the works in full but which he did not derive in consequence of the foreclosure of the whole or part of the works..

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SECTION B: SCOPE OF WORK

SCOPE OF WORKS FOR AIRCRAFT PAINT BOOTH				
Name of work :Design, Supply, Fabrication, Errection and Commissioning of Aircraft paint booth at AIESL **MRO, Trivandrum, Kerala-695007**				
Sl No	**Description of work**	**Brief Specifications**	**Unit**	**Qty**
1	AIRCRAFT PAINT BOOTH HANGER	**Design, Supply, Fabrication, Erecting and Commissioning of Aircraft paint booth at AIESL MRO TRV.** – suitable for painting the narrow body Aircraft with 13.96m (clear height) along with all accessories and allied works as per technical specifications mentioned. Bidder to provide skilled / specialist manpower/Approved Design Drawings (Plan & Structural)/materials and plant for fabricating, erection and commissioning of paint both (hanger) and allied work. Also, applicable clearance/NOC from the Govt. statutory bodies based on the reference drawing provided. **Description of Shelter** (a) Length of Hangar Inner size 50Mtrs & outer(max) - 55.0Mtr (b) Breadth of Hangar Inner size 42Mtrs & outer(max) - 45.0Mtr (c) Height of Hanger Inner size 13.5Mtrs & outer(max) - 13.96Mtrs above Ground levels per NOCAS. (ends from top of finished floor level)	Nos	01

I. Aircraft Guidelines for Design:

A320 and B737 Aircraft:

Aircraft Height(maximum)	12.55	m
Width	36	m
Length	40	m
Empty weight	41592	Kg
Max all up weight	97000	Kg

II. Key requirements,

1. Floor Strength for Narrow-Body Aircraft

The primary consideration for the floor strength of a hangar is the weight of the aircraft and the load distribution that occurs during maintenance or paint operations. (Match with existing floor at site)

- Aircraft Weight: Narrow-body aircraft, such as the Airbus A320 or Boeing 737, typically weigh between 40,000 kg (88,000 lbs) and 80,000 kg (176,000 lbs) when empty, and can go much higher when fully loaded. Therefore, the floor must be designed to support these loads.
- Point Load vs. Uniform Load:
  - The point loads are the critical factor, as the aircraft's weight is concentrated on specific areas (such as the landing gear).
  - Floor Loading Specifications: The floor design should be based on the landing gear load distribution. For a narrow-body aircraft, these loads may typically range from 20,000 to 50,000 kg at each landing gear point.
  - A typical design strength for the floor in a paint hangar should accommodate over 10 kN per m^2 of concentrated load.
- Material Strength: The floor should be constructed of reinforced concrete or high-strength steel, depending on local soil conditions and aircraft weight. Concrete floors often feature a minimum compressive strength of 30 MPa to 40 MPa.
- Floor Thickness: The thickness of the floor slab is usually around 150 mm to 200 mm (6 to 8 inches) depending on the load distribution, with additional reinforcement to resist concentrated loads. It may also include post-tensioning for added durability.
- Slip Resistance: Since paint and chemicals will often be used in the hangar, the floor must have a non-slip surface to prevent accidents.
- Drainage: Proper drainage systems should be installed, as paint and solvents will need to be cleaned up. Floors are typically sloped to drains to prevent standing water or chemicals.

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2. Building and Structural Requirements

In addition to floor strength, other structural requirements should also be considered:

a. Building Height:

- The hangar height should be sufficient to accommodate the aircraft's wing span and tail height.
- For narrow-body aircraft like the Airbus A320 or Boeing 737, the minimum internal height would typically be around 10-12 meters (33-40 feet).

b. Access and Maneuvering:

- Wide doors and high ceilings to allow for easy maneuvering of aircraft in and out.
- The door size should be at least 30-35 meters (98-115 feet) in width and 10-12 meters (33-40 feet) in height.

c. Ventilation and Airflow:

- A high ventilation system is essential to prevent the accumulation of volatile fumes from the paint and chemicals.
- The HVAC system should be designed to maintain a constant airflow, ensuring proper drying and curing of the paint.
- Air filtration systems, such as high-efficiency particulate air (HEPA) filters, are essential for reducing contamination during the paint process.

d. Lighting:

- High-intensity, glare-free lighting is needed for painting operations.
- The lighting should be uniform, and the color temperature should be designed to reduce any distortion during the paint process, ensuring high-quality results.
- Overhead LED or fluorescent lights can be used, ensuring the minimum 500 lux of brightness for detailed work.

e. Environmental Controls:

- Temperature and humidity control systems are crucial. Paint curing is highly sensitive to these factors, and they should be kept within specific ranges (e.g., temperature 20-25°C (68-77°F) and humidity below 60%).

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3. Safety and Fire Protection:

Given the nature of the materials used in painting aircraft (solvents, fuels, etc.), fire protection is crucial.

- Fire Suppression Systems: The hangar should be equipped with automatic sprinkler systems or water mist systems.
- Explosion-Proof Electrical Systems: Electrical installations should comply with local safety regulations, particularly around the use of explosion-proof equipment in areas where flammable chemicals may be present.

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4. Work and Storage Areas:

The hangar should also include the following features:

a. Workspaces:

- Properly segregated work areas for preparation, masking, and spraying.

b. Storage for Paints and Chemicals:

- Storage tanks for larger volumes of paints and solvents.
- Chemical storage areas should be ventilated and have spill containment systems.

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5. Utility Requirements:

- Water for cleaning and the application process.
- Compressed air for spray painting and cleaning.
- Electrical systems to power the ventilation and lighting systems.

III, SCOPE OF WORK AND TECHNICAL SPECIFICATION

Pre-Engineered/pre-fabricated paint booth Hangar of inner size 42m x 50m having a clear ht of 13.*96* m from finished floor level to the ceiling or bottom of the structure / fitment in the roof technical specification as given herein-after.

Additional specification of required Facilitation:

- Provision of running water in floor for removal of paint strain during painting.
- Pneumatic Air supply pipe line and the out let for the operation of equipment at defined location.
- Air circulatory system- The painting hangar should be fitted with a specially designed extraction system that promotes airflow and significantly reduces environmental contamination. The collected air is treated to remove paint particles and volatile gases via high quality, carbon impregnated filters. Additionally, effluents from the painting process are carefully disposed as per prescribed environmental laws to avoid any form of air and ground contamination.
  Forced ventilation system with dehumidifiers- The painting hangar is fitted with a specially designed extraction system that promotes airflow and significantly reduces environmental contamination. The collected air is treated to remove paint particles and volatile gases via high quality, carbon impregnated filters. Additionally,

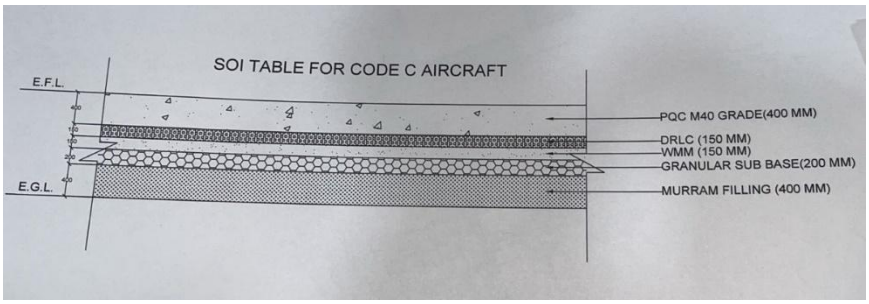
effluents from the painting process are carefully disposed as per prescribed environmental laws to avoid any form of air and ground contamination. The ventilation must be capable of exhausting toxic air while pulling in sufficient fresh air. Furthermore, a proper Hangar/booth has a ventilation system where the flow of air reduces overspray and dust from collecting on the newly painted substrate. 100 fpm air velocity. Ventilation may be provided by extractor fans and filtered air inlets, but the most satisfactory method of maintaining the required conditions is by filtering and cooling the incoming air to a sufficiently low temperature to remove excess moisture. The hangar should be maintained at a slight positive pressure in order to prevent dust and draughts from entering through doors and windows. Mixed flow or hybrid systems: Mixed flow, or hybrid. Systems employ a downdraft flow system over fuselage, wing, and tail. With an additional horizontal air supply introduced along the leading edges of wings. Return air may be taken through either floor trenches or low wall returns or a combination of the two methods. Entrained air supply from areas of the ceiling not over the aircraft platform may be employed in conjunction with the primary air supply.

- Drainage for effective sweep out of water on floor and removal of paints.
- Fire Fighting equipment, Hydrant firefighting & detection system as per drawing in accordance with NFPA 410. All Precautionary measure must be taken to prevent the possibility of fire.
- 3 phase 90 KVA input terminal supply. And other lighting and extra power out let of 220v 1 Ph, 110 V output.
- Temperature and Humidity- should be below 70 %. (The temperature should, generally, be maintained between 15 degrees Celsius and 25 degrees Celsius, with a relative humidity below 75%).
- Water curtain systems utilize a continuous stream of water to capture and remove overspray and airborne paint fumes, thereby creating a cleaner and safer environment for painting operations. Unlike dry filter booths, which rely on disposable paper or mesh filters to trap particles, water curtain booths filter the air by entrapping paint particles in the flowing water. To ensure sustainable and efficient operation, proper design considerations must be made to allow for water recirculation. This includes incorporating sedimentation tanks, filtration systems, and water treatment units to remove paint residues and other contaminants from the water before it is reused. Effective water management not only minimizes environmental impact but also reduces operational costs.
- Illumination- Event lighting with 300 lux

  Hangar/Booths should be properly illuminated so that no shadowing occurs on the parts being painted and all lighting systems and bulbs should be covered and protected against breakage. Electric fans, wiring, switches and motors must be explosion proof and properly grounded to eliminate sparks.

  The surface to be painted must be adequately illuminated hence portable flame proof lamps may be necessary when painting the under surfaces of wings and fuselage. The provision of suitable scaffolding or working platforms will be necessary with large aircraft to ensure the correct application of paint

No naked lights and arcing electrical equipment.



The specifications for this project must comply with the following standards and regulations, to the extent they are referenced or applicable:

- NFPA 410:

Standard on Aircraft Maintenance.

Focuses on fire safety and hazard prevention during aircraft maintenance operations, including hangar design, flammable material handling, and emergency procedures.

- NESHAP:

National Emission Standards for Hazardous Air Pollutants.

Regulates emissions of hazardous air pollutants from industrial and commercial sources to protect public health and the environment.

- OSHA:

Occupational Safety and Health Administration.

Ensures workplace safety and health by setting and enforcing standards, providing training, and conducting inspections.

This specification establishes the materials, mixing, placing, curing, etc, of all types of Cast-in-situ concrete to be used in foundation, underground and above ground structures, floors, etc. Any special requirement as shown or noted on the drawings submitted by the bidder shall govern over the provisions of this specification.

PART – IV

LIST OF APPLICABLE IS CODES AND STANDARDS FOR WORK PROCEDURAL REFERENCE

All work under specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Specifications and Coders of Practice. In case any particular aspect of work is not specifically covered by Specification, any other standard practice, as may be specified by the Engineer, shall be followed:

IS:73 - Specification for Paving Bitumen

IS:269 - Specification for Ordinary Portland Cement, 33 Grade

IS:383 - Specification for Coarse and Fine Aggregates from Natural Sources for

Concrete.

IS:432 - Specification for mild steel and Medium Tensile Steel Bars for Concrete Reinforcement.

IS:455 - Specification for Portland Slag Cement

IS:456 - Code of Practice for Plain and reinforced Concrete.

IS:457 - Code of Practice for General Construction of Plain and Reinforced Concrete for dams and other Massive Structures.

IS:516 - Specification for Methods of Test for Strength of Concrete.

IS:1199 - Specification for Methods of Sampling and Analysis of Concrete.

IS:1200 - Specification for Methods of measurement.

IS:1489 - Specification for Portland pozzolona Cement.

IS:1586 - Specification for Hard drawn steel wire fabric for Concrete Reinforcement.

IS:1786 - Specification for High Strength Deformed Steel bars and wires for Concrete Reinforcement.

IS:1791 - Specification for Batch Type Concrete Mixers.

IS:2062 - Steel for general structural purposes.

IS:2185 - Specification for Hollow Cement Concrete Blocks.

IS:2210 - Specification for Design of Reinforced Concrete shell Structures and Folded plates.

IS:2386 - Specification for Methods of Test for Aggregates for Concrete.

IS:2502 - Code of practice for Bending and Fixing of Bars for Concrete Reinforcement.

IS:2505 - General Requirements for Concrete Vibrators, Immersion type.

IS:2506 - General Requirements for Screed Board Concrete Vibrators.

IS:2514 - General Requirements for Concrete Vibrating Tables.

IS:2722 - Specification for portable Swing Weight Batchers for Concrete (Single and Double Bucket type).

IS:2751 - Code of practice for Welding of Mild steel Bars used for Reinforced Concrete Construction.

IS:2770 - Specification for Method of Testing Bond in Reinforced Concrete.

IS:3025 - Specification for Methods of Sampling and Test (Physical and Chemical)

for Water used in Industry.

IS:3370 - Specification for Code of Practice for Concrete Structures for Storage of Liquids

IS:3550 - Specification for Method of Test for Routine Control for Water used in Industry.

IS:3558 - Code of Practice for use of Immersion Vibrators for Consolidating Concrete.

IS:3696 - Safety Code for Scaffolding and Ladders.

IS:3812 - Specification for Fly Ash for use as Admixture for Concrete.

IS:4031 - Specification for Method of Tests for hydraulic Cement.

IS:4082 - Specification for Recommendation on Stacking and Storage of Construction Materials at site.

IS:4090 - Specification for Design of Reinforced Concrete Arches.

IS:4634 - Specification for Method of Testing performance of Batch- type Concrete Mixes.

IS:4658 - Specification for Form Vibrators for Concrete.

IS:4925 - Specification for Concrete Batching and Mixing plant.

IS:4926 - Specification for Ready Mixed Concrete.

IS:4990 - Specification for plywood for Concrete Shuttering work.

IS:5512 - Specification for Flow Table for use in Tests of hydraulic cement and Pozzolanic Materials.

IS:5515 - Specification for Compaction factor Apparatus.

IS:5891 - Specification for Hand Operated Concrete Mixers.

IS:6452 - Specification for high Alumina Cement for Structural use.

IS:6909 - Specification for Super sulphated cement

IS:7251 - Specification for Concrete Finishes

IS:7320 - Specification for Concrete Slump Test Apparatus

IS:1861 - Specification for Recommended Part-| || - Practice for Extreme Weather Concreting.

IS:7969 - Safety Code for Storage and Handing of Building materials.

IS:8041- Specification for Rapid hardening Portland Cement.

CEMENT

IS:269&IS:1489 IS:455	Ordinary Portland cement, 53 Grade.
IS:8041	Portland Pozzolona Cement.
	Portland Stag Cement.
	Rapid hardening Cement.
IS:8112 IS:12330	High strength Cement.
IS:8043	Sulphate resisting Portland cement.
	Hydropholic Cement
IS:12600	Low Heat Portland Cement.

IS:8112 - Specification for high Strength Ordinary Portland Cement.

IS:8142 - Specification for Determining Setting time of Concrete by Penetration Resistance.

IS:9013 - Specification for Method of Making. Curing and Determining Compressive Strength of Accelerated-cured Concrete Test Specimens.

IS:9077 - Code of Practice for Corrosion Protection of Steel Rails in FB and RCC Construction.

IS:9103 - Specification for Admixtures for Concrete.

IS:10262 - Specification for Concrete Mix Design

IS:12269 - Specification for 53 Grade Ordinary Portland Cement (PartI &III)

IS:1311 - Code of Practice for Non-Destructive Testing of Concrete.

IS:13920 - Code of Practice for Ductile detailing of Reinforced Concrete Structures subjected to seismic forces.

SP23 - Handbook on Concrete Mixes (based on Indian Standards).

Generally, cement shall be obtained from approved suppliers and shall be stored in a waterproof/weatherproof shed in a manner approved by the Engineer. No cement that has been allowed to deteriorate in quality or that has become caked or that has become caked or has perished by dampness or otherwise shall be used on the weight of cement bags as delivered at the mixer and not on their theoretical weight, The bidder should allow in his rates for losses in weight of cement bags in transit and handling. Approved brands shall be Ultratech, JSW, Abuja.

STORAGE:

The bidder shall follow accepted good practice in handling and storing cement. Cement

may be stored on site in moisture proof bulk containers which shall be equipped with venting arrangements.
Cement delivered in bags shall be stored off the ground (at least 15 cms) in dry, well ventilated, weather-proof/ waterproof sheds, arranged in separate consignments as received from the manufacturer so that consumption of cement is insured in the order of receipt, i.e. 'First in First Out' rule. The stacks of cement shall be such that there is easy access for proper inspection and identification. The bags shall be piled not more than 15 bags per pile and placed close together in the pile to reduce circulation of air. Each stack of cement shall be covered with good waterproof tarpaulin or thick polyethylene sheets.

USE:

Cement shall be used in the order in which it is received. Cement in bags in storage for more than 3 months shall be retested before use.

TESTING

In addition to verification of manufacturer's test certificates, the Engineer may opt to carry out following tests:
Tests shall be carried out on cement delivered to the site for fitness, initial and final setting time and compressive strength (IS: 4031) and the results should be approved by the Engineer in Charge before use of the cement in permanent works. Samples shall be taken immediately on receipt of cement at site. The methods and procedure of sampling shall be in accordance with IS: 3535. The Engineer may specify other forms of sampling and tests, if in his/her opinion the cement is of doubtful quality, the costs of such additional tests, shall be borne by the Bidder, if supplied by him.
The decision of the Engineer will be final and binding on the bidder.

FINE AGGREGATE (SAND) (IS: 383)

It shall be river or pit sand or, if permitted by the Engineer, crushed stone sand (produced from crushing stone suitable for concrete aggregate) and all fine aggregates shall be sharp, free from excess fines, loam, earth, vegetable matter, soluble salts and other harmful chemical/organic impurities and shall be clean. If considered by the Engineer as necessary, the same shall be washed. Washing shall be done at least one day before using it in concrete. The aggregate should be stored in such a manner as to avoid contamination.
Fine aggregates acceptable for the works shall normally be in a grading which falls within the GRADING LIMITS as specified in IS: 383.
If grading of fine aggregates can be improved by mixing two verities of sand, the Engineer may at his discretion specify such mixing and may permit the use of crushed sand as one of the two sands forming the mixture. The provisions of two types of sand and their mixing in the specified proportions shall be done at Bidder's Cost.

COARSE AGGREGATE:

Coarse aggregate for the works shall be river gravel or crushed stone obtained from sources approved by the Engineer and shall conform to IS: 383.

Aggregates shall be properly screened and if necessary washed and cleaned before use. Coarse aggregates containing flat or flaky pieces or mica shall be cleaned of such impurities before use.
The grading shall conform to IS: 383 for grading limits for Single Sized coarse Aggregate. Limits for use of single sized coarse Aggregate in various type of structures shall be as follows:

Use	Size
Ordinary plain concrete/Reinforced Concrete foundation	40mm
Slabs and walls 200mm or more in thickness.	20mm to 10mm
Columns and Girders with least dimension under 300mm	20mm to 10mm
Very narrow space	10mm
Mass Concrete	80mm

MINERAL ADMIXTURES:

The Engineer may permit the use of Mineral Admixtures as specified in IS:456. This may be permitted only if

a. the concrete is manufactured in batching plant

OR

b. Ready mix concrete is used.

And provided that uniform blending with cement is ensured

TRIAL MIXES:

The bidder shall be entirely responsible for the design of the concrete mixes. The design is however to be approved by the Engineer before commencing any concreting in the works. The Bidder shall make trial mixes using samples of coarse aggregates: sand, water and cement, typical of those to be used (discarding the first batch).

Where the mix is not designed following proportions shall be used for the concreting: (by Volume)

M-10 - (1:3:6)
M-15 - (1:2:4)
M-20 - (1:1½ :3)

M-25 -
M-30 - } Not recommended by Volume
M-35 -
M-40 -

CONCRETE MIX DESIGN:

Concrete mixes for various specified design strengths shall be worked out by the Bidder, generally as per the requirements of IS: 456/IS: 10262.

The mixes designed by the bidder shall be used on works only after obtaining a written approval of the Engineer. It is to be understood that the mix design shall be entirely the responsibility of the bidder and such approval by the Engineer shall not relieve the bidder of his responsibility in respect thereof.

a) The bidder shall prepare all calculations, tabulations, graphs etc. pertaining to concrete mix designs and / or test results and supply copies of such calculations, tabulations, graphs etc. as required by the Engineer.

b) Either Ordinary Portland or Portland Pozzolana Cement or Sulphate resistant Cement will be supplied. No deviation either in rate or schedule of work will be entertained on this account. The mix design should be based on the use of ordinary Portland Cement/Portland Pozzolana Cement/Sulphate resistant cement. Due regard should also be taken regarding minimum cement specified as above.

c) Bidder shall furnish the cement content assumed for various mixes for approval by the Engineer within One (1) week after award of contract. In case it becomes necessary to use Portland Pozzolana Cement during the course of the work, the bidder shall design fresh mixes and the difference in the consumption of cement due to use of pozzolana cement shall be taken into account for reconciliation purpose also. In all cases the bidder shall make trial cubes from each consignment of cement and test the same before actually using in the work.

Whenever there is a significant change in the quality of any of the ingredients of concrete, the Engineer may at his discretion order the carrying out of fresh trial mixes. All costs for trial mixes and tests shall be to the Bidders account and to be included in the contract rates.

Before commencing the works the bidders shall submit to the engineer for approval full details of all preliminary trial mixes and tests.

When the proportions of the concrete mix have been approved by the Engineer, the Bidder shall not vary the quality or source of the materials or the mix without the written approval of the Engineer.

CONCRETE BATCHING:

Concrete batching shall be as per 1S456.

All tests shall be carried out at regular intervals and records of the results shall be kept at site. Copies of records shall be sent to the Engineer for reference.
To ensure that the grading of the aggregate remain the same as the grading to which the mix design is based, sieve analysis shall be carded out regularly and charts showing the results shall be prepared. Copies of these information shall be kept at site and supplied by the bidder as instructed. If change in grading is unavoidable the mix shall be redesigned and got approved.
Record of theoretical and actual consumption of cement shall be maintained by the bidder for each work separately and regularly.

MIXING:

Concrete mixing shall be as per 1S456.

Each time the work stops, the mixer shall be thoroughly cleaned & when the next mixing commences, the first batch shall have 10% additional cement at no extra cost to the Owner to allow for loss in the drum.
Regular checks on mixer efficiency shall be carried out as directed by the Engineer as per IS:1791. Should any mixer at any time produce unsatisfactory results, leak mortar or cause waste of materials, its use shall be promptly discontinued until it is repaired. Blades shall be replaced on showing signs of wearing down.

HAND MIXING:

Normally hand mixing shall not be permitted except in special cases (such as far away isolated places, if allowed by the engineer). When hand mixing is authorized by the Engineer, it shall be done on a water tight platform. The materials shall be turned at least three times after the water is added and until the batch is homogeneous in appearance and color.

Batching Plant where used shall conform to IS:4925.

Concrete shall be poured and consolidated in its final position within half an hour of mixing. Tampering with concrete which has partially hardened, i.e. remixing with or without additional cement, aggregate or water, shall not be permitted.

TRANSPORTATION, PLACING, COMPACTION:

Transportation, placing, compaction of concrete shall be as per IS456.

Before depositing the concrete, all debris and dirt shall be removed from the space to be occupied by concrete. Concrete shall not be placed until the formwork, placement of reinforcement, embedment's etc. have been checked and approved by Engineer. The formwork shall be sufficiently rigid. During the placing and compaction of concrete, care shall be taken to ensure that there is no loss of water from concrete and no segregation

takes place. The method of placing and compaction employed in any particular section of the work shall be to the entire satisfaction of the Engineer.

To ensure bond and water tightness between old concrete surface and the concrete to be placed, the surface should be cleaned and roughened. The bonding old and new concrete should be done by applying the cement slurry after thoroughly watering the old concrete surface and removing all loose particles.

Unless otherwise approved, concrete shall be placed in single operation to the full thickness of slabs, beams and similar members and shall be placed in horizontal layers not exceeding 1 M. deep in walls, columns and similar members. Concrete shall be placed continuously until completion of the part of the work between construction joints or as directed by Engineer.

Concreting shall not be started unless the Electrical conduits or any other piping wherever required are laid by the concerned agency. The Civil Bidder shall provide all the facilities, and maintain coordination of work with other agencies engaged in electrical and such other works as directed by the Engineer.

Where concrete is placed on soil, it shall be placed only on firm undisturbed ground. Any concrete that is placed on a well compacted fill shall have the prior approval of the Engineer. Concrete shall not be placed in standing water on sub grade or in foundation excavation.

The concrete after being laid shall be compacted by means vibrators of approved type under proper supervision as directed by the Engineer in Charge. Vibration shall not be confined only to the top surface, but the whole mass of concrete shall be well vibrated until the dense mass assumes jelly like appearance and consistency. Water just appearing on surface shall be avoided. Care should be taken to avoid segregation and formation of air bubbles. Vibration shall be accomplished by means of "spud" type internal vibrators with flexible shaft of 6000 vibration / min. The vibrator shall not be left in any position for more than 5 sec. The Immersion type vibrators shall be inserted in a vertical position at intervals of about 600 mm and fully worked around reinforcement, embedded fixtures and into corners of formwork without directly coming in contact with reinforcement steel and formwork. Over vibration shall not be permitted.

After concrete has been placed, it shall be spread, if necessary and thoroughly compacted by approved mechanical vibration to maximum subsidence without segregation and thoroughly worked around shape. Vibrators shall not be used for pushing concrete into adjoining areas. Vibrators must be operated by experienced persons. In thin members with heavy congestion of reinforcement or other embedment, where effective use of internal vibrator is, in opinion of the Engineer, doubtful, in addition to immersion vibrators the bidder may have to employ form vibrators the bidder will additionally employ screed vibrator as per IS:2506. Hand tamping may be allowed in rare cases, subject to the approval of the Engineer. Care must be taken to ensure that the inserts, fixtures, reinforcement and formwork are not displaced or distorted during placing and

consolidation of concrete.

The rate of placement of concrete shall be such that no cold joint is formed and fresh concrete is placed always against green concrete which is still plastic and workable. No concrete shall be placed in open, during rains. During rainy season, no placement in the open is to be attempted unless sufficient tarpaulins of other similar protective arrangement for completely covering the still green concrete from rain is kept at the site of placement. If there has been any sign of washing of cement and sand, the entire affected concrete shall be removed immediately. Suitable precautions shall be taken in advance to guard against rains before leaving the fresh concrete unattended. No accumulation of water shall be permitted on or around freshly laid concrete.

The whole process starting from the mixing of concrete to the placing and compaction shall not take more than 20 min. The process shall be completed before the initial setting takes place.

All chutes, pipes and other placing equipment shall be kept dean and free from coatings of hardened concrete by cleaning and thoroughly flushing, with water after each run, and water used from flushing shall be discharged clear of the concrete already in place.

No concrete shall be deposited until the Engineer has inspected the forms, reinforcing steel, inserts, hollow day tile units, sleeves, etc, and given permission to place. Concrete, shall be deposited only in the presence of representative of the Engineer. In very hot weather precaution shall he taken to see that temperature of wet concrete does not exceed 38 deg. C while placing. During cold weather, concreting shall not be done when the temperature falls below
4.5 deg. C. During hot weather (atmospheric temperatures above 40 deg. C) or cold weather (atmospheric temperatures below 5 deg. C), the concreting shall be done as per the procedure set out in IS 1761.

Rock at foundation level or construction joint of concrete kept moist for at least 72 hours prior to placement. Concrete will be placed always against surface but never on pools of water. In case the foundation cannot be dewatered completely, special procedure and precaution, as directed by the Engineer will have to be adopted.

EXTREME WEATHER AND UNDERWATER CONCRETING:

Concreting shall not be deposited under water if it is practicable to de- water the area and place concrete in the regular manner. The concrete shall contain at least 10% more cement than that required for the same mix placed in dry conditions, the quantity of extra cement varying with conditions of placing with prior written permission of the Engineer. The volume of coarse aggregate shall not be less than 11/2 times nor more than twice the fine aggregate and slump not less than 100 mm nor more than 180 mm. Where found necessary to deposit any concrete under water, the method, equipment, materials and mix shall first be got approved by the Engineer. Concrete shall be deposited continuously until it is brought to required height. While depositing, the top surface shall

be kept as nearly level as possible and the formation of heaps shall be avoided. The concrete shall be deposited under water by one of the approved methods such as tremie method, drop buckets, bags, groutings etc. as per details given in IS: 456. If it is necessary to raise the water after placing the concrete, the level shall be brought up slowly without creating any waves or commotion tending to wash away cement or to disturb the fresh concrete in any way.

CURING SHALL BE DONE AS PER IS456:

Heavy loads shall not be placed on or moved across floor slabs until curing is complete. Care shall be taken to prevent floor surface from being marred during curing period. For freshly laid concrete, formwork shall not be jarred.

Concrete placed under water shall be protected from failing earth during and after placing. Walking on concrete shall not be permitted for at least twenty-four hours after it has been placed in the forms and for such additional length of time as the Engineer may direct.

CONCRETE CUBE TESTS AND SLUMP TEST:

The quality of hardened concrete will be verified by the following procedure:
The Engineer shall select random batches of concrete or examination without warning the bidder and sampling will generally be done at the point of discharge from the mixer.

Standards:
The Cube Test procedure is governed by standards like:

- IS 516:1959 (Indian Standard for Methods of Tests for Strength of Concrete).
- ASTM C39/C39M (Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens) for international reference.
  The slump test procedure is governed by standards like:
- IS 1199:1959 (Indian Standard for Methods of Sampling and Analysis of Concrete).
- ASTM C143 / C143M (Standard Test Method for Slump of Hydraulic-Cement Concrete).
- BS EN 12350-2 (European Standard for Testing Fresh Concrete).

  Additional Testing:
- The AIESL Engineer reserves the right to request any additional tests at any time to ensure that the concrete meets the necessary performance requirements and standards for its intended applications (e.g., structural elements, foundations, pavements, etc.).
- If additional tests are required, the bidder will be responsible for the associated costs, and these costs must be borne by the bidder as part of the project.

ACCEPTANCE CRITERIA:

The sampling, testing and "Criteria of Acceptance" for concrete shall be as per IS:456.

If the concrete produced at site does not satisfy the above strength requirements, the Engineer will reserve the right to require the bidder to improve the methods of botching, the quality of the ingredients and redesign the mix with increased cement content if necessary. The bidder shall not be entitled to claim any extra cost for the extra cement used for the modifications stipulated by the Engineer for fulfilling the strength requirements specified.

If from the test results it appears that some portion of the works has not attained the required strength, the Engineer may order the testing of the suspected as well as adjacent portions of the structure. Such testing shall be at the Bidders cost. The Engineer may also reject the work and order its demolition and reconstruction at the bidder's cost.

If the strength of concrete in any portion of the structure is lower than the required strength, but in the opinion of the engineer demolition is not necessary, the Bidder shall be paid a lower rate for such lower Strength concrete as determined by the Engineer.

QUALITY CONTROL:

Bidder shall exert proper quality control at the various stages of concrete production and placement.
As frequently as Engineer may require, testing shall be carried out in the field for:

1. Moisture content of sand

2. Moisture content of aggregates.

3. Silt content of sand

4. Grading of sand

The bidder shall provide and maintain all items, (until the works are completed) equipment and staff required for carrying out these tests. The Bidder shall grant the Engineer or his representative full access to this laboratory at all times and shall produce the (supply & demand) complete records of all tests carried out in site. Alternatively, the Bidder may also avail of the services of the local testing laboratory with prior approval of the engineer.

CONSTRUCTION JOINTS:

Construction joints shall in general conform to the relevant clauses of IS:456.

When the placing of concrete is interrupted and a construction joint is formed, provision

shall be made for interlocking with the succeeding layer by the embedment or saturated wooden blocks or strips, smoothened on four sides to facilitate their removal Prior to the next pour the wooden pieces shall be loosened and removed in such a manner as to avoid damage to the Concrete.

Such construction joints, if the bidder feels are necessary, shall be approved by the Engineer and shall be so located and formed as to least impair the strength and the appearance of the structure.

They shall be made in the positions as specified or as approved. Such joints shall be truly vertical or horizontal as the case may be except that in an inclined or curved member the joints shall be strictly at right angles to the axis of the member.

Construction joints shall be rebated to an approved profile and an approved water stop shall be placed in the joints when specified.

Construction joints shall be made horizontally in the foundations and 75 mm below the lowest beams soffit at the head of columns. Concrete in the ribs and slab of small tee and other beams shall be placed in one operation but for large beams concrete in the rib upto a level 25mm below the slab, soffit shall be placed first. Concrete in haunches or splays on beams or braces and concrete in the head of adjoining position of the column shall be placed at the same time and at junction of walls and slabs shall be placed at the same time as that in the slab. Construction joints in slab and beams shall be located at one third span and keyed and dowelled as specified.

COLD JOINT:

An advancing face of a concrete pour, which could not be covered by fresh concrete before expiry of initial setting time (due to an unscheduled stoppage or delay on account of breakdown in plant, inclement weather, low rate of placement or any other reason), is called a cold joint. The Bidder should always remain vigilant to avoid cold joints.

If however, a cold joint is formed due to unavoidable reasons, the following procedure shall be adopted for treating it: -

If concrete is so green that it can be removed manually and if vibrators can penetrate the surface without much effort, fresh concrete can be placed directly against the old surface. The old concrete should be covered fresh concrete as quickly as possible and the joint thoroughly and systematically vibrated.

In case concrete has hardened a bit more than (a) but can still be easily removed by a light hand pick, the surface will be raked thoroughly and the loose concrete removed completely without disturbing the rest of the concrete in depth. A rich mortar layer 12 mm in thickness, will be placed on the cold joint fresh concrete shall be placed on the mortar layer and the joint will be thoroughly and systematically vibrated penetrating the vibrator deep into the old layer of concrete.

In case the concrete at the joint has become so stiff that it cannot be remoulded and mortar or slurry does not rise inspite of extensive vibration, the joint will be left to harden for at least 12 - 24 hrs. It will then be treated as a regular construction joint, after cutting the concrete to required shape and preparing the surface.

FINISHING OF CONCRETE:

On stripping the formwork, all blowholes and honey combing observed shall be brought to the notice of Engineer. The Engineer may, at his discretion allow such honeycombing or blowholes to be rectified by necessary chipping and packing or grouting with concrete or cement mortar. If mortar is used, it shall be 1:3 mix, or as specified by Engineer. However, if honeycombing or blowholes are of such extent as being undesirable, the Engineer may reject the work totally and his decision shall be final and binding. No extra payment shall be made for rectifying these defects. All humps and uneven faces shall be rubbed smooth with the help of carborundum stone.

The surface of non-shuttered faces shall be smoothened with a wooden float to give a finish equal to that of the rubbed down shuttered faces. Concealed concrete faces shall be left as from the shuttering except that honeycombed surface shall be made as detailed above. The top faces of slabs not intended to be surfaced shall be leveled and floated to a smooth finish as the levels or falls shown in the drawings or elsewhere. The floating shall not be executed to the extent of bringing excess fine materials to the surface.

The top faces or slabs intended to be covered with screed, granolithic or similar finishes, shall be made rough when wet with wire brush. Faces of concrete intended to be plastered shall be roughened by approved means to form a key.

PROTECTION OF CONCRETE:

Care shall be exercised to protect the completed concrete from damage by subsequent construction operation. No equipment shall be run over the complete slabs until they are at least two weeks old, special case shall be taken on concreting in hot weather. The forms must be thoroughly wetted first before the concrete is placed and the exposed surface of the concrete shall be kept continually damp, by sprinkling for two days.

CRACKS:

If cracks, which in the opinion of the Engineer may be detrimental to the strength of the structure, developed in concrete construction, the bidder at his own expense shall test the slab or other construction as specified in Special Conditions. If under such test loads the cracks develop further, the bidder shall dismantle the construction, carry away the debris, replace the construction and carry out all consequential work thereto, at his cost.

If any cracks develop in the concrete construction, which in the opinion of the Engineer have suffered damage either in appearance or stability owing to such cracks. The Engineer's decision as to the extent of the liability of the Bidder in the above matter shall be final and binding.

DEFECTIVE CONCRETE:

Should any concrete be found honeycombed or in any way defective, such concrete shall on the instruction of the Engineer be cut out by the Bidder and made good at his own expenses.

EXPOSED FACES, HOLES AND FIXTURES:

On no account shall concrete surface be patched or covered up or damaged concrete rectified or replaced until The Engineer or his representative has inspected the works and issued written instructions for rectification. Further to observe this procedure will under that portion of the works liable to rejection; in which case it will be treated as rejection which has failed to meet specified strength requirements.

APPROVAL BEFORE CONCRETING:

Pour card system to be followed. No concreting shall be carried out by the Bidder until the Engineer or his representative has inspected formwork and reinforcement and certified in writing that concreting may proceed. Any concrete poured without such prior written approval shall be cut out and removed by the Bidder at his own cost.

CONCRETE FOR FLOORING ON GRADE:

Concrete for flooring on grade shall be over well packed stone metaling /PCC levelling course or on earth as specified with or without reinforcement, placed in alternate bays not exceeding more than 6M x 3M or as specified including hacking the joints or adjacent bays. The water cement ratio shall not exceed 0.4 and cement content shall not be less than 320 kg /M 3 of finished concrete. The stiff mix shall be thoroughly vibrated and finished to receive the floor finish.

PRECAST CONCRETE:

All provisions, not specifically excluded and not in conflict with provisions of Section 2: Concrete and Formwork, Section: 4 Reinforcement and Section 7: Structural Steelwork shall apply to precast concrete.

CASTING:

All precast units shall be cast on suitable bed or platform with firm foundation and free from wind. Bidder shall be responsible for the accuracy of the level or shape of the bed or platform.

EMBEDMENT:

Bidder shall not do concreting unless Electrical conduits, pipes, fixtures etc. wherever required, are laid by the concerned agency. Embedded items shall be placed and maintained in correct position while concreting. Embedded items shall be properly anchored to develop required strength.

STRIKING FORMS:

Side shutters shall not be struck in less than 16 hours after depositing concrete and no precast unit shall be lifted until the concrete reaches a strength of at least twice the stress to which the concrete may be subjected to at the time of lifting.

CURING:

All precast work shall be protected from the direct rays of the sun for at least 7 days after casting and during that period each unit shall be kept constantly watered or preferably completed immersed in water if the size of the unit so permits.

EXPANSION AND ISOLATION JOINTS:

Expansion and isolation joints in concrete structures shall be provided at specific places as per details indicated on the drawings. The materials and types of joints shall be as specified herein after, if not, otherwise mentioned in the drawings. In case of liquid retaining structures, additional precautions shall be taken to prevent leakage of liquids as may be specified on the drawings or as directed by the Engineer. All materials are to be procured from reliable manufactures and must have the approval of the Engineer. Where it is the responsibility of the Bidder to supply the material, the Engineer may demand test certificates for the materials and /or instruct the Bidder to get them tested in an approved laboratory free of cost to the Owner. Joints shall be formed true to tine, level, shape, dimension and quality as per drawings and specifications.

Prior approval of the method of forming the joints should be obtained from the Engineer before starting the work.

GROUTING UNDER MACHINERY OF STRUCTURAL STEEL BASES:

If required, grouting under base plates of machines or structural steel etc. shall be carried out by the Bidder. In general, the mix shall be 1 (one) part cement and 1 (one) part sand and just enough water to make it flow as required. The areas to be grouted shall be cleaned thoroughly with compressed air jet and /or with water in locations where accumulated surplus water can be removed. Where directed by the Engineer, 6 mm down stone-chips may have to be used in the mix. Surface to be grouted shall be kept moist for at least-24 hours in advance. The grout shall be placed under expert supervision, so that there is no locked-up air. Edges shall be finished properly.

NON-SHRINK GROUT:

Non-shrink type grout using cementitious base material shall be from approved manufacturer and shall be free flow type. The minimum compressive strength of the grout shall not be less than 650 kg/cm^2. The grout material shall be expansive to ensure the full contact between the base plate and grout. It should not shrink during setting process. Necessary formwork shall be used around the portion to be grouted. The water cement ratio shall be as per manufacturer's specification and in no case shall be more than 0.18. To achieve the workability for the minimum horizontal flow of 1000 mm, when the grout is poured from one end, necessary plasticizers may be added as recommended by the manufacturer. These additives / admixtures shall be added by the manufacturer only and shall not be added by the bidder at site in the ready-mix grout.

HYDROGEN FREE NON-SHRINK GROUT:

Hydrogen free non-shrink grout when specified in B.O.q., may be nitrogen generating type with minimum compressive strength as specified (for recommended vendor / brand information's, refer to Data Sheet 'B'). The grout shall have controlled expansion characteristics and shall be capable of being applied in thicker layers. It shall also be impact and vibration resistant. Mixing with water and application procedure shall be all as per manufacturer's instructions.

NON-SHRINK EPOXY GROUT:

Grout shall be a 100% solids system with the ability to be placed in flow able state. Non shrink Epoxy shall have a minimum allowable compressive strength of 800 kg/cm2 at 7 days as determined by tests on 50 mm cubes as per ASTM C579, Method B. Epoxy grouts whose resin component has an SPI rating higher than II shall not be used, due to potential local atmospheric contamination making the installation area hazardous.

The grout surfaces shall be made completely dry prior to grouting.

Epoxy grout component ratios shall not be changed from that recommended by the manufacturer. No solvents or thinners shall be added to the mix. The grouts are usually supplied in a 3-pack form consisting of: Resin, Hardener, and Aggregate (Filler).

WATERPROOFING OF CONCRETE STRUCTURE:

General
Water proofing of concrete structures shall be done by either suitable extraneous treatments like applying paints, fixing bitumen felts etc. or internally by suitable design of the concrete mix, addition of suitable admixtures in the concrete or mortar at the time of mixing and /or installing water bars at the joints.

The design, material and workmanship shall conform to the relevant IS Codes where applicable. The Engineers approval of the materials shall be obtained by the Bidder before procurement. If desired by the Engineer, test certificates for the materials and samples

shall be of best quality available indigenously, fresh clean and suitable for the duties called upon.

If it is found after water/ liquid is leaking, the bidder shall carry out rectification work by injection method or any other method as directed by the Engineer at no additional cost to the Owner.

WATERPROOFING ADMIXTURES:

a) In concrete: The admixtures shall be procured from reliable and reputed manufacturers and approved by the Engineer. The method of application and other details shall conform to the manufacturer's specification and / or as instructed by the Engineer. The Bidder shall have the services of the manufacturer's supervisor at no extra cost to the Owner to supervise the work, if desired by the Engineer.

b) Plaster: The concrete surface, to be plastered, shall be hacked to Engineer's satisfaction, cleaned thoroughly and kept wetted for 24 hrs. The plaster shall be in cement sand mortar mixed in proportion varying form 1:1 to 1:4 by volume along with the approved waterproofing admixture and laid in appropriate thickness and in layers not exceeding 15 mm layer or as per manufacturer's specification. The additive shall be of quality and type approved by the Engineer. If desired by the Engineer, the Bidder shall have the work supervised by the manufacturer's supervisor at no extra cost to the Owner. On completion, the plastered surface shall be cured continuously for a minimum period of 14 days like concrete.

SUPPLY AND SPECIFICATION OF READY-MIX CONCRETE (RMC):

Ready Mix concrete (RMC) to be supplied by the Bidder in grades as required at site. In such cases, the bidder shall inform the Owner well in advance and inform the Engineer in writing / prescribed form his requirement time, date and quantity. It is to be noted that RMC, on arrival at site, shall be immediately pumped to the location of pouring. Pumps and hoses to be supplied by RMC vendor. In case of any delay occurring because of site of pouring being not ready, thus resulting in rejection of RMC because of initial set or otherwise, the entire cost of the rejected batch shall be borne by the Bidder.

RMC to be supplied by the Bidder as per contract shall be supplied from reputed approved supplier. Approval for such supplies shall be given by the Engineer after bidder supplies all information about the supplier as required by the Engineer.

Bidder shall obtain from the manufacturer the test certificates for all materials forming RMC including details of concrete mix design and submit for Engineer's approval.

FORMWORK:

If it is desired by the Engineer, the bidder shall prepare, before commencement of actual work design and drawings from licensed engineer for formwork and get them concurred

by AIESL.

Formwork for concrete shall be of plywood, steel, good seasoned timber of other approved materials, property designed easy to remove and clean and shall give smooth and even surface after removal thereof. It shall be sufficiently tight to prevent loss of cement slurry from the concrete.

As far as practicable, clamps shall be used to hold the forms together. Where use of nails is unavoidable, minimum no. of nails shall be used.

All joints and holes in the formwork shall be caulked with putty, jute cloth or other approved materials to the satisfaction of the Engineer. The inner face of the shuttering shall be cleaned and thoroughly wetted or greased with approved material. Care shall be taken that such coating is kept free from contact with the reinforcements. All formwork shall be leveled and aligned and all rubbish, particularity, chippings, wood shavings, saw dust and adhering grout shall be removed from the interior of the forms by compresses air or any other approved method before the concrete is placed. Good quality shuttering oil to be used. Burnt black oil will not be permitted.

The bidder shall obtain approval of the Engineer as to the design, fabrication, and erection of the formwork. Form and false work shall be designed to withstand the load pressure determined by the expected rate of deposition of concrete and considering a live load of 145 kg/sq.m. Where such loads are critical.
Wherever it is specified on the drawings that concrete surface will be left untreated, the pattern of joints in the formwork shall be subject to the approval of the Engineer, and no extra will be paid for special care in shuttering.

Temporary openings shall be provided at columns and wall forms and other places to facilitate inspection and cleaning. Before concrete is placed, all forms shall be carefully inspected to ensure they are property placed sufficiently rigid and tight and approved by the engineer before or during the placing of concrete, the work shall be stopped until the defects have been corrected.

All corners and angles shall be formed with 45 deg. Mouldings to form chambers or fillets on the finished concrete as directed by the Engineer.

Formwork shall be cambered at center (at free end for cantilevers) as described below, unless otherwise shown or specified. Deflection readings of various elements shall be taken as directed below:

Type of Member	Compression steel Percentage of tension steel	Camber Coefficient
Simple span	0 50%	0.666 0.037

Continuous OR restrained span	0 50%	0.032 0.020
Cantilever span	0	0.086

Camber (in cms.) = 2.54 K x L/D Where K = Camber coefficient
L = Length of member in meter. D = Depth of member in Metres.

TOLERANCES SHALL BE AS PER IS 456:

The bidder shall submit his design and detailing of formwork before starting the work for the approval of the Engineer. The number of props, their sizes and location shall be such as to be able to safely carry the full dead load and construction loads. However, approval of the Engineer to this effect shall not relieve the bidder of his responsibility for proper work and safety.

All formwork for beams, slabs, ring wall and similar members shall be so designed and erected that the sides can be removed without disturbing the soffit and its supports. Vertical props shall be supported on wedges or sole plates or by any other suitable means whereby the props can be gently lowered while commencing the removal of shuttering. Column shuttering shall not be more than 2.5 M in height per piece if not otherwise approved by the Engineer.

The stripping time for the shuttering and formwork shall in general conform to the provisions in the relevant clauses of IS. 456.

V . ESTIMATED QUANTITY OF WORK : to be filled by the contractor and submit along with the design drawing in tech bid.

Sl.no	Description & Specifications	UNIT	QTY
1	Mobilization and Demobilization of all necessary plants, equipments, properly calibrated instruments, piling rigs and hammers, trucks, cranes and other necessary modes of transport for material handling. Materials to be furnished by bidder, posting qualified personnel, skilled and unskilled labour etc. to site of work, arranging kentledges and all other equipments, set ups required for conducting the various types of erecting and commissioning all plants and equipment essential for operating the contract. Rate shall also include various designs of concrete mixes that may be required from time to time.		
2	Providing and constructing vertical piles by boring through all kinds of soils by Rotary piling method as specified & 6mm thick steel liner (to be supplied by bidder) up to top of socketing and filling the bore with M30grade Ready Mix Concrete (RMC), using Portland Pozzolana Cement as instructed by the AIESL Engineer, with a minimum cement content of 400 kg/cu.m. of concrete and with water cement ratio (including the water contained in the aggregates not exceeding 0.45) etc. all as specified, inclusive of concreting minimum 600mm above specified cutoff level, cutting off piles including necessary excavation at the specified level including bending of reinforcement steel for pile cap etc. complete in all respects. Rate shall also be inclusive of breaking of existing concrete surface, if any for reinforcing pile caps if any. NOTE: 6mm thick steel liner pipes shall be supplied by bidder only. Necessary cutting, welding including driving the same into the soil etc. required for the liner shall be in Contactor's scope of work. (Note: Empty boring and reinforcement shall be measured separately). The above to be executed for 600 mm pile.		
3	Empty boring for vertical piles, measured from the working level to cut off level plus 600mm above the cut off level for 600 mm dia. Pile.		
4	Providing, supplying and transporting, handling, cleaning, cutting, bending, tack welding lap joints in longitudinal bars, assembling, tying, binding with soft annealed 16 gauge black iron wire (supply included), placing and maintaining in position high yield strength steel bars (Fe500) CRS (Corrosion resistant steel re-bars) Reinforcement conforming to IS:1786.		
5	Carrying out routine cyclic vertical load test on single vertical working pile as per IS 2911 with loading equal to one and half times the proposed safe bearing loadings including all necessary arrangements such as jacks, measuring devices, structural framework for platform, kentledge, excavation up		

	to cut off level and backfilling all complete as required for 600 mm dia. pile		
6	Carrying out routine lateral load test on vertical piles as per IS:2911 with loading equal to one and half times the proposed safe bearing loads including all activities as mentioned in above item. For this test, two working piles shall be used and jacked apart all complete as required for 600 mm dia. Pile.		
7	Carrying out routine pull out load test on vertical working piles as per IS :2911 with loading equal to one and half times the proposed safe bearing loads including all activities as mentioned in above item for 600 mm dia. pile		
8	Carting away, stacking, spreading and leveling bored/ excavated soil within AIESL MRO up to total lead of 1000 M. Bidder to make arrangement for any temporary approach to the bored/ excavated soil dumping area, if required and the rate for this item shall be inclusive of same. No extra payment shall be made on a/c of construction of any temporary approach to soil dumping area.		
9	Excavation in ordinary soil including clay black cotton soil, soft & hard murrum, sand, gravel, soil containing small pebbles, rubble, boulders, removable without breaking/blasting, etc. which can be loosened manually or mechanically operating tackles such as pick shovels, front loader (as defined in IS: 1200) etc. for all types of foundations, Test pits, pile caps or any other substructure, including shoring, strutting, dewatering by pumping if required, removal of vegetation, shrubs, etc., backfilling as per specification with excavated earth and disposal of surplus earth including vegetation, shrubs etc. beyond the initial lead of 500 M up to total lead of 1000 M. from the nearest edge of excavation area. The rate shall include all tools, tackles, supervision, transport and incidental expense, overhead & profit, etc. as per Section of tech. Specification, up to and including a depth of 2M below existing level.		
10	Providing, mixing, placing in position, plain cement concrete of M10 (1:3:6) grades as per IS:456 under foundations, floors etc. including compaction by vibration, curing, using 40 mm down aggregate all including form work but excluding reinforcement steel.		
11	Providing, mixing, placing in position RCC of grade M30 Ready Mix Concrete (RMC) using Portland Pozzolona Cement / OPC cement & 20 mm down coarse aggregate as per IS:456 in foundations, Pile cap, ring beam etc. including compaction, vibration, curing and finishing all including shuttering / form work but excluding reinforcement steel. Bidder to note that only Ready-Mix Concrete (RMC) from		

	approved RMC source will be allowed. No site made concrete is allowed.		
12	Supplying and placing in position reinforcement bars in RCC works as per drawing and specifications including preparation and obtaining approval of bar bending schedule, straightening, decoiling and rust, cutting, bending to required shape, binding with soft annealed 16 guage black iron wire in position (supply included) etc. all for Tor Steel reinforcement bars Fe 500 CRS (Corrosion resistant steel re-bars) grade conforming to IS 1786: 1985.		
13	MURRUM FILLING: Supplying and Filling murrum obtained from approved quarries or equivalent quality free from all organic vegetation and foreign matter including all royalities, taxes, handling and transportation to site, stacking the same by the side of trench if required, spreading in layers not exceeding 150 mm thick, watering, compacting by mechanical means by vibratory compactor, testing at various stages to obtain minimum of 95% modified proctor maximum laboratory dry density, removing the surplus material etc. complete as per direction of site engineer.		
14	Providing, transporting, fabricating, aligning and fixing in position using templates anchor bolts of required dia. and lengths as shown on drawings including anchor plates, hooks, washers, washer plates nuts and check nuts, etc. complete as per drawings, specifications & directed by ENGINEER-IN-CHARGE.		
15	RCC M20 Grade mix for plinth beam of size 23x60 cm including cost of materials, labour charges, curing etc. complete.		
16	RCC M20 Grade mix for covering the fabricated columns of described size using 20mm course aggregate including necessary shuttering, compacting etc. complete.		
17	Reinforcement for Plinth beam, Columns (Grade:- FE 550, Make:- Vizag / Kalliyath) bend, tied, removing rust and placed in position (Minimum Steel Qty:- 80 Kg/m3).		
18	Plain cement concrete 1:2:4 using 20-25 mm nominal size broken stone 10 cm thick below Plinth beam for attaining a hard surface including cost of materials, labour charges, curing etc. complete.		
19	Plain cement concrete 1:2:4 using 20 - 25 mm nominal size broken stone 15 cm thick for flooring, mixing by mechanical means, ramming and levelling and watering etc. complete.		
20	Brick masonry in CM 1:6 using good quality semi- wire- cut Bricks of size 22 X10 X 8 cm or nearest higher available size around the building for a suitable height as directed by the engineer in charge including cost of all materials, labour charges and curing etc complete.		

21	Providing and applying 15mm thick smooth finish plaster to inside and outside of the wall in C.M.1:4 in two layers using coarse sand and fine sand at all levels, including surface preparation, staging, scaffolding, roughening, curing, etc., complete as per specifications and as directed by ENGINEER-IN-CHARGE AIESL.		

NOTES

1. The above mentioned work should be as per the drawing submitted to the authority.
2.The rate includes the cost of all consumables and hire charge of all tools and plants, and labour required for the work including all incidental charges (such as electricity, labour insurance) etc. The rate should also include the Scaffolding required for the purpose of the required width and height. No extra payment towards scaffolding will be paid in any case
3. Inclusive of all cost of relevant approval/ NOC/ plan/structural drawing/certification from all Govt. Statutory bodies.

PART–B

SPECIFICATIONS:

INTENT OF SPECIFICATIONS

These Technical Specifications cover the technical requirements for the design, engineering, fabrication, manufacture, transport, Supply, Construction, and Erection / Installation of Complete Structural and Architectural Works.

The Technical Specification is intended for the general description of the works, quality and workmanship. These Technical Specification are however, not intended to cover the minute details of Works and Workmanship. The execution of Works and the Workmanship shall be according to the description given in the schedule of items, drawings prepared by the bidder, Released for Construction drawings and relevant Indian standard Codes. In absence of relevant Indian standards Codes, the execution of Works and Workmanship shall be according to the best prevailing engineering practices and / or to the recommendations of relevant British and / or American standards and / or to the Instructions of Engineer-in-charge.

SCOPE

It covers design, engineering, manufacturer, transport, supply, erection of various pre-engineered components like structural steel including all other fittings / fixtures like purlins, flashing, bracing & Anchor Bolts, etc., for big span structures or aircraft hangers.

The broad scope shall cover but not be limited to the following Structural steel Works for PEB:

Complete Engineering Design and preparation of drawings for construction of Pre-engineered buildings including furnishing of design, working drawings, calculations, data sheets, records and getting the same approved from the buyer/engineer in charge, testing and quality assurance, inspection and quality checks, setting and layout and levels, safety measures and inspection etc.

Manufacturing, testing at garage, Painting at garage, Supply, Transportation, Receipt, Unloading and Storage at Site, Handling, Erection and Commissioning at Site of Pre-engineered Steel Structure, furnishing of design, working drawings, calculations, data sheets, records and getting the same approved from the Owner / Consultant, testing and quality assurance, inspection and quality checks complete. The Scope of Pre-engineered Steel Structure includes various components of structural steel sections, internal including all fittings / fixtures like purlins, flashing, bracing & Anchor Bolts, Nuts, Washer, permanent bolts with templates etc. complete.

Providing all labor, supervision, materials, consumables, fuel, construction equipment, tools and plants, supplies, transportation, all sampling, testing and quality assurance, providing necessary facilities and equipment to Engineer in charge for carrying out the inspection and quality checks, setting out layout and levels, safety measures, carrying out erection in a mechanized manner, storage, repair / rectification / maintenance until

handing over, furnishing of design, working drawings, calculations, data sheets, records, etc. complying with statutory provisions, Approvals if any and applicable laws etc.

Covering all incidental items not specifically mentioned but reasonably implied and necessary for successful completion of the work.

Preparation and submission of all construction drawings (Layout, Architectural, color scheme and Structural) required for the complete execution of the works, material selection and material take off. SUFFICIENT DETAILING SHALL BE DONE IN ALL DRAWINGS SO THAT NO DIFFICULTY IS FACED BY ENGINEER IN CHARGE DURING EXECUTION. Architectural drawings including preparation Animated Computer model in 3D Max.

After award of work Bidder/Bidder should submit, design Basis Report for approval of Engineer in Charge. On the approval of the same the detailed design & drawing of the buildings to be submitted. All the copies are to be submitted in 3 sets of hard copies & a soft copy.

Bidder/Bidder may depute their Structural engineer at site during placing of Anchor Bolts before casting of concrete, Erection of columns and beams etc. The appointment order along with proof of experience not less than 10 years in the industry in similar kind of works is mandatory along with the tender documents.

CODES AND STANDARD

IS Code Practice for General Construction in Steel : (IS:800-2007)
IS Code Practice for Hot rolled sections and plates : (IS:2062)
IS Code of Practice for Cold Form : (IS:801-1975)
IS Code of Practice for Design Loads Part-3 : (IS:875-1987)
IS Code of Practice for Earth Quake Loads Part-1 : (IS:1893-2002)
American Welding Society Specification : (AWS D1.1.98)
American Institute of steel construction : (AISC)
Metal building manufactures association : (MBMA) Manual of steel construction, 9th edition
The 1996 edition of low-rise building system manual.

MATERIAL OF CONSTRUCTION

Built up Section from high tensile steel grade as per ASTM A572 Grade-350, 345MPa.

Hot rolled secondary members for channels, angles, pipes confirming ASTM A572, Grade350, 250MP / IS: 2062, Gr. A, 250Mpa.

Cold formed secondary member conforming to ASTM A570M grade 3 50, 340Mpa / IS513, IS801.

Anchor bolts for foundation-ASTM A 36M / IS 2062.

Bracing and sag rods to conform to IS 2062, Gr. A, 250Mpa / ASTM A36, 250Mpa. Minimum dia. for sag rods shall be 16 mm.

Primary connection bolts- High strength bolts, ASTM A325-ANSI 18.2.3.7/18.2.3.6 M.
Secondary connection bolts – Machine bolts ASTM, A307 / IS: 1367 CLASS 4.6 (part 1 to 3).

Self-drilling self-tapping screws – AS3566.1-2202 corrosion resistance class 3 or equivalent.

Wind ties, if required, shall be minimum flat of size 40 mm x 6 mm.

Structural steel where ever not mentioned shall conform to Grade 'A' of IS: 2062

DESIGN CRITERIA

Loads-

Live Load-Live Load on roof and frame shall be 0.75kN/m^2 as per IS-875 Part-2

Dead load-Dead load on roof shall be min. 0.15kN/m^2

Earthquake load-As per IS 1893 (Part-1) – 2002.
Importance Factor & Response reduction as per IS 1893 Part IV.

Wind load as per IS 875 Part 3, 1987

Other Loads-Design of all structures shall also consider any other relevant stresses imparted to the structure due to variation in daily and seasonal temperature, water label, erection and maintenance loads, creep shrinkage etc.

Wind and seismic forces shall not be considered to act simultaneously.

Individual members of the frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion etc. resulted from the most critical combinations of loads as specified below.

LOAD COMBINATON:

Strength load combination for buildings with or without equipment shall be:

1.5* Dead Load + 1.5* Live / Imposed Load

1.5* Dead Load + 1.5* Live / Imposed Load + 1. 5* Piping/Firefighting Load

1.5* Dead Load + 1.5* (Wind / Seismic Load) 0.9* Dead Load + I.5*(Wind / Seismic Load)

1.2* Dead Load + 1.2* Live/Imposed Load + 1.2* Piping/Firefighting + 1.2* (Wind / Seismic load)

Service load combinations for general buildings shall be: 1.0* Dead Load + 1.0* Live/Imposed Load

1.0* Dead Load + 1.0* Live/Imposed Load 1.0* Piping/Firefighting Load
1.0* Dead Load + 1.0* (Wind/ Seismic Load)

1.0* Dead Load + 1.0* Piping/Firefighting Load + 0.8*(Wind/ Seismic Load)

1 .0 * Dead Load + 0.8* Live/Imposed Load + 0.8* Piping/Firefighting Load + 0.8*(Wind/ Seismic Load).

Permissible stresses for different load combinations shall be taken as per relevant IS Codes.

GENERAL

Angle/Rod bracing for roof and wall is considered.

Main frame column base considered as pinned support.

Built up & Hot rolled sections to be designed as per Manual of Steel Construction, 9th edition, American Institute of Steel Construction (AISC) & IS: 800.

Cold formed members to be designed as per 1996 Edition of Cold-Formed Steel Design Manual, American Iron and Steel, Institute (AISI), IS: 801&
IS: 513.

Welding shall be applied in accordance with: American Welding Society (AWS D1.1.98) Structural Welding Code – Steel. IS: 800, IS: 813 & IS: 816.

PERMISSIBLE DEFLECTIONS

The permissible vertical deflection for structural steel members shall be as specified below:
For Primary Span / 180
For Secondary Span / 150
Steel Structure simple span Beam shall be Span / 240.
Steel Structure for cantilever span Beam shall be Span / 120.
Permissible horizontal displacement at crane level / eaves level shall be Height / 150. Permissible Deflection for Purlin shall be Span / 150. Permissible Deflection for Side Runner Shall be Span / 150.
Permissible Deflection for Chequered Plate/Grating shall be Span / 200 or 6 mm, whichever is lower.

REVIEW OF DESIGN AND APRPOVED GOOD FOR CONSTRUTION

DRAWINGS

Complete structural design and construction drawings shall get reviewed by Engineer in Charge in detail before taking up any fabrication / manufacturing activity.
For all structures, requisite number of prints of design calculation and working drawing shall be sent to Owner / Consultant for approval and site for construction.
The installation of fall arresters should be considered at the initial stage of load calculation

and design, with drawings created accordingly. The anchor point arrangement should be planned as part of this process.

SURFACE PREPARATION OF STRUCTURAL STEEL

Surface Preparation: The surfaces to be painted shall be shot blasted as per SAE 2.5.
The following specification shall be used for painting of structural steel work.

PAINTING ON STRUCTURAL STEEL

Painting for structural members shall be one or more coat of Red Oxide primer and 2 or more coats of Synthetic Enamel Paint of approved brand having thickness of 90–100-micron DFT at site.

POINTS TO BE OBSERVED DURING PAINTING WORK

Primer and paint shall be compatible to each other and should be from the same manufacturer. The approved manufactures by AIESL are Berger, Asian and Nippon.
The recommendation of the paint manufacturer regarding mixing, matching and application must be followed meticulously.

Technical representative of paint manufacturer should be available at site as and when required by Engineer in Charge for their expert advice as well as to ensure that the painting work is executed as per the instruction of paint manufactures. Paints and primers shall be supplied at site in original container with factory seal otherwise such paints and primers shall not be allowed to be used. Mode of application i.e. by spray, brush or roller shall be strictly as per recommendation of paint manufacturer. Painting materials must be used before the expiry date indicated on the containers. Number of coats and DFT per coat must be strictly followed as indicated above. If the desired DFT is not achieved for primer and finish paints in two coats (each), bidder shall be required to apply extra coat (s) to achieve the desired DFT without any extra cost to buyer. Color shade for each coat of primer and finish paint must be different to identify the coats without any ambiguity. Shade for the final finish coat shall be decided by AIESL authority/Engineer in Charge at site. All painting materials must be accompanied by manufacturers test certificates. However, buyer has any doubt regarding quality of materials, he shall have the right to direct bidder to get the doubtful material tested or and provided (by bidder) testing agencies for which no extra payment shall be made to the bidder and the charges shall deemed to be covered in the unit rates quoted for fabrication and erection of structural work.

ERECTION AND SETTING OF STEEL STRUCTURE

The erection of steel work shall be in accordance with Bureau of Indian Standard Specifications Nos. IS-800 and IS - 816.

The bidder shall be responsible for the suitability, safety and capabilities of all plant and equipment used for erection.

Prior to starting erection of fabricated structure, defects if any shall be rectified. The bidder shall give to the buyer not less than 24 hours' notice of his intention to set out or give levels

for any part of works, in order that arrangements may be made for checking. Bidder shall provide all necessary arrangements and assistance, which the buyer may require for checking the setting out.
The bidder shall erect the structural steel members in position, to dimension, and levels, as in relevant drawings and shall take care to see that component parts are not interchanged. Girders, stanchions etc., must rest fairly on their beds and will not be taken as erected until completely plumbed, aligned leveled, bolted or welded and strengthened, in every respect. The camber, if any, is to be maintained as shown in relevant drawings.

Particular care should be taken to ensure free expansion and contraction wherever provided in the relevant design / drawings or so directed on site.

While erecting, the holes in different component parts of structure should be made concentric with the use of drifts before any service bolts are fitted. No drifting shall be allowed except for bringing together several parts forming a member but the drifts must not be driven with such force as to disturb or damage the metal above the holes. Hammering of bolts to make holes concentric shall in no case be allowed. No nuts should be allowed to become loose and no unfilled bolt-holes are to be left in any part of the structure unless otherwise specified in the relevant drawings. Welding should be adopted wherever specified in the drawings. Wooden rams or mallets shall be used in forcing members to position, in order to protect metal from injury or shocks, chipped edges shall be finished off smooth and all concave surface rounded off.

All erection tools and plants viz. derricks, cranes etc. will have to be provided by the bidder as required in the erection work. All erection devices must be removed after the work is over, in such a way that no damage is done to the erected structures. Any damages, in this respect must be rectified by the bidder at his own cost.

The maximum tolerance for line and level of the steel work shall be + 3.0 mm on any part of the structure. The structure shall not be out of plumb more than 3.5 mm on each 10 M. Section of height and not more than 7.0 mm per 30-meter section. These tolerances shall apply to all parts of the structure unless mentioned in the drawings issued for erection purposes.

Sl. No	Description of items	QTY	unit
1	Structural Pre- fab (Apollo/TATA) building of carpet area 45 x 52 x 13.96m. Roof area 52 m x 52 m.	As required/ based on drawings	
2	Roof Sheet - sandwich panel of 0.40 mm bottom & 0.30 mm top, (make JSW/Metenco /Koreapuff), PU 50 mm for covering the top.	As required/ based on drawings	

NOTE

- The entire structure, including roofing, must be completely leak-proof from all sides. There should be no water leakage, splashing, or drips from the walls or ceiling to the floor below.

PART–C

About existing concrete bedding with in the area of new construction.

The existing concrete bedding (size: 20m x 30m) within the area may be designated for use as part of the paint booth area. The bidder is responsible for ensuring that the area is sufficiently reinforced to meet the required loading standards (PCN) for the prolonged parking of A320 and B737 aircraft. The maximum weight for which the bedding should be designed is 55,000 kg.
Alternatively, the bidder may choose to dismantle the existing concrete bedding and construct a new foundation. The cost for this work must be included in the bid.
The bidder's responsibilities include:

1. Assessment of Existing Concrete Bedding:
    - The concrete bedding (20m x 30m) needs to be assessed to determine if it is strong enough to support the weight of the aircraft.
    - The bidder must ensure that the bedding can withstand max Weight (AUW) of 55,000 kg.
    - The strength and load-bearing capacity of the concrete must be verified against the required Pavement Classification Number (PCN) standards, which take into account factors like aircraft weight, tire pressure, and traffic load.
2. Modification/Strengthening (if applicable):
    - If the existing concrete is found to be insufficient, the bidder must propose solutions to strengthen the foundation. This could involve reinforcing the current structure or adding additional materials to meet the required load-bearing capacity.
    - The solution needs to be designed to handle the sustained weight of the aircraft without cracking or failing over time.
3. Dismantling and New Foundation (if necessary):
    - If the existing concrete is not deemed feasible for the required load-bearing, the bidder can choose to dismantle the area and lay down a new foundation.
    - This new foundation must meet all loading standards and ensure a proper, long-lasting surface for aircraft parking.
    - The cost for dismantling and rebuilding the foundation should be accounted for and included in the bid price.
4. Compliance with Standards:
    - The bidder is responsible for ensuring compliance with all relevant industry standards and regulations, including those related to aircraft parking and structural integrity.
5. Consideration for Long-Term Use:
    - The solution should also account for the long-term durability of the area, ensuring that the concrete can handle prolonged parking of these aircraft over an extended period, including weather and environmental factors.
6. Cost Responsibility
    - All costs related to testing, settlement checks, remedial actions, and strengthening the concrete area, as well as any necessary modifications to meet the standard for prolonged aircraft parking, will be borne by the bidder. These costs should be included as part of the overall project.

The attached drawings should be referenced by the bidder to ensure the proper understanding and execution of the project.

CONCRETE (approximately -400MM thick)
BASE COURSE (1:4:8 MIX) and approximately 0.75M thickness

Detail of present concrete area in the compound

Flooring Specifications for Paint Booth Hangar

The flooring specifications for the paint booth hangar are crucial for ensuring the safety, functionality, and long-term durability of the facility. The flooring must be designed to accommodate both the structural load of the building as well as the aircraft load. Given that the flooring will support the weight of aircraft, particularly empty aircraft, the following guidelines and requirements should be considered when preparing the flooring design.

Requirements for Flooring Design:

1. Aircraft Load Consideration:
    I) The flooring must be capable of supporting the load of an aircraft, as this is the primary operational load during aircraft parking and maintenance.
    II) For example, the maximum load for designing the bedding is 55,000 kg.
2. Structural Load:
    I) The flooring should be designed to withstand not only the aircraft loads but also the structural load of the hangar, including any additional weight from equipment, workers, and other operational factors.
    II) This design should ensure that the subfloor can handle loads over time, ensuring stability and minimizing settlement or damage.
3. Flooring Material:
    I) The flooring material should be high-strength concrete (or other suitable materials) that is capable of withstanding the stresses from the aircraft's weight, movement, and any other mechanical load during operations.
    II) Concrete Mix Design: The concrete should have the appropriate strength for the intended use, with specific attention to factors such as compressive strength and durability under wear and tear from aircraft movement, maintenance equipment, and heavy-duty operations.
    III) Non-Slip Surface: The surface of the flooring should be non-slip to prevent accidents when personnel are walking on the floor or when equipment is moving.
4. Floor Thickness and Reinforcement:
    I) The thickness of the floor slab should be sufficient to distribute the loads from the aircraft and the hangar operations evenly.
    II) Reinforcement: The concrete must be reinforced with steel rebars or other appropriate reinforcement methods to prevent cracking and to ensure that the floor can withstand dynamic loads, such as the movement of the aircraft.

5. Load Distribution:

I) The design must ensure that load distribution from the aircraft is efficiently transferred through the flooring and into the underlying structural elements.
II) This may involve adding load-distribution layers or reinforcing the areas beneath the aircraft's wheels to prevent localized damage.

6. Settlement Testing and Mitigation:
   I) The flooring design should include provisions for testing the settlement of the concrete floor over time, ensuring it can withstand the stresses of continuous heavy loads without significant deformation.
   II) Any necessary mitigation/remedial measures (e.g., additional reinforcement or leveling techniques) should be planned for early in the design process to address potential settlement concerns.
7. Flooring Finish:
   I) The final finish of the flooring should be smooth, easy to clean, and resistant to staining, particularly from oils, solvents, and other chemicals commonly found in aircraft maintenance areas.
   II) The finish should also allow for easy marking of aircraft parking spots and maintenance zones.

Design Submission by L-1 Bidder:

- Specialist Input: The design for the flooring must be submitted by the successful L-1 bidder and duly designed by a specialist in structural engineering, taking into account both aircraft and building loads.
- Design Specifications: The L-1 bidder must provide comprehensive flooring specifications, including:
  I) Concrete mix design and compressive strength requirements.
  II) Floor thickness and reinforcement details.
  III) Load distribution calculations and considerations for aircraft wheel load.
  IV) Non-slip finish and cleaning requirements.
  V) Ventilation and drainage provisions for the flooring (important in paint booth operations).
  VI) Testing procedures for the concrete strength and settlement.
- Approval: The submitted design will need to be reviewed and approved by the relevant authorities or engineers to ensure that it meets all the necessary safety and operational standards.
- The flooring may consider existing concrete bedding (size: 20m x 30m) or the bidder may choose to dismantle the existing concrete bedding and construct a new foundation. The cost for this work must be included in the bid.
- The floor finish should be as per the AIESL requirement.

Sl.No	Description	Specification	unit	QTY
1	Levelling, Rolling & Compacting the hanger floor area using Mechanised Roller in required area.	Single pass using mechanised roller after proper levelling with excavator		
2	Supply & Filling of Red Earth or balance excavated soil and Compacting with Mechanised Roller in required area.	Compacted Thickness-6''/10cm/100mm		
3	Rolling the Running hanger floor to a levelled surface by Power Roller.	4" thick rubble has to be layered and rolled prior to power rolling.		
4	Excavation for laying of water pipe line for connecting to Sprinklers with 1.5'' ASTM pipes, return filling, ramming and removing of surplus soil.	Heavy Duty 1.5'' ASTM pipe.		
5	Supplying, providing & constructing 230mm thick brick masonry for drain around hanger floor in cement mortar 1:4 using approved quality bricks of minimum strength of 35 kg/cm² including scaffolding, curing racking the joints, curing, etc., complete as drawing, specifications and as directed by ENGINEER-IN-CHARGE	200 mtr covered 6''X6'' (150cmX150cm) wide PCC drainage ratio 1:2:4. Average depth-6''(150cm)		
14	Providing and applying 15mm thick smooth finish plaster to inside face of drain in C.M.1:4 in two layers using coarse sand and fine sand at all levels, including surface preparation, staging, scaffolding, roughening, curing, etc., complete as per specifications and as directed by ENGINEER-IN-CHARGE. All drains should be connected to ETP plant.	Bidder has to arrive the quantity as per site requirement		

PART– D

MEP – SYSTEM

ELECTRICAL

1) SCOPE

The proposal under this part is to give complete Electrification of block with all the required LT installation, Lighting and Power outlets.
The scope of works including the supply, installation, testing and commissioning of the following items.

- Supply, install, test and commission distribution boards as shown in the drawings conforming to enclosed technical specification.
- Supply and install cable trays as shown in the drawings conforming to enclosed technical specification.
- Supply, install, test and commission final circuits for lighting and small power requirements by providing approved appropriate size conduits, wires and wiring accessories as per drawings conforming to govt. norms.
- Supply, install, test and commission light & fixtures as per technical specification, to attain maximum efficacy as per GRIHA norms.
- Preparation of shop drawings before executing works at site, preparation of GA arrangement drawings, obtaining the technical catalogues and GA drawings from manufactures, providing client with necessary maintenance coaching and planning, preparation of final as-built drawings, liasoning with all statutory authorities, getting initial and final approvals, getting power sanctions, power allocation, connection, arranging final inspections, testing and commissioning and handing over the installed system
- Any other works deemed necessary and needs to be done for the successful completion of the project not mentioned above will also be a part of the scope of works.
- Specifications to be followed for execution of work - As per govt. General Specification for Electrical Works.

PART I (Internal), PART II (External) - 2007	General Specification for Electrical Works, with latest amendments.
PART I (Internal) - 2013	General Specification for Electrical Works, with latest amendments
PART IV (Substation) - 2013	General Specification for Electrical Works, with latest amendments

2) TECHNICAL SPECIFICATION

A) DISTRIBUTION BOARDS

Bidder's scope is to supply at site, store, handle, assemble, install, connect, test and commission the required MCB vertical and horizontal distribution boards complete with all MCCB, residual current circuit breakers, miniature circuit breakers, bus and interconnection assemblies, terminals, covers, doors, locking arrangement, required supporting and fixing arrangement and other accessories in compliance with the relevant rules, regulations standards, codes of practice and requirements of the Client and as per govt. norms. SPN DBs shall Conform to IS 8623-1 & 3, IEC 61439-1 & 3

All vertical TPN DBs shall conform to IS 8623-1 & 3, IEC 61439-1 & 3, with provision for MCCB incomer. IK 09 with double door for DBs. CRCA sheet steel, powder coated, ready to use DBs provided with insulated vertical phase bus-bars, neutral bar's with shroud's, earth bar's, sticking saddles, cement spill protector, color-coded interconnecting wire set, cable ties, blanking plates and circuit identification labels with provision for 4 Pole MCCB as incomer and SP/TP MCBs as outgoings as per schematic drawing.

All DBs shall be with reversible doors, with DB door flush finish to the wall, adjustable neutral links. The fault level of the DBs shall be as per the schematic layout. All DBs shall be with provision to add DIN rail single phase multifunction meters for Energy Management and with provision to provide surge arrestor equipment as per specifications provided in the schedule of items. All DBs shall be neatly dressed with wires and all circuits shall be properly marked and identified and ferruled. Each DB shall be properly labelled with sheet steel lamination. All DBs shall be IP43 with metal doors.

B) EARTHING CONDUCTORS

All earthing conductors shall be of high conductivity copper and shall be protected against mechanical damage and corrosion. The connection of earth electrodes shall be strong, secure and sound and shall be easily accessible. The earth conductors shall be rigidly fixed to the walls, cable trenches, cable tunnel conduits and cables by using suitable clamps.
Main earth bus shall be taken from the main medium voltage panel to the earth electrodes. The number of electrodes required shall be arrived at taking into consideration the anticipated fault on the medium voltage network.

Earthing conductors for requirement shall be run from the exposed metal surface of the equipment and connected to a suitable point on the sub main or main earthing bus. All switch boards, distribution boards and isolators disconnect switches shall be connected to the earth bus. Earthing conductors shall be terminated at the equipment using suitable lugs, bolts, washers and nuts.

All conduits, cable, armouring etc., shall be connected to the earth all along their run by earthing conductors of suitable cross-sectional area. The electrical resistance of earthing conductors shall be low enough to permit the passage of fault current necessary to operate a fuse/protective device

and circuit breaker and shall not exceed 2 ohms.

PRECAUTIONS

Earthing system shall be mechanically robust and the joints shall be capable of retaining low resistance always. Joints shall be tinned, soldered and/or double riveted. All the joints shall be mechanically and electrically continuous and effective. Joints shall be protected against corrosion.

Conductors shall be protected so that no mechanical damage could be caused.

For all cable trays 2 runs of 25x3 mm Cu strips shall be laid for body earthing and shall be connected to the nearest earth bench / grid earth. All vertical DB & SMDBs shall be earthed to the nearest bench using 2 runs of No. 8 swg bare copper. All horizontal DBs shall be doubly earthed to the nearest earth bench / grid using 2 runs of No. 10 swg bare copper. AHU units, Lift, motors and other related electrical equipment of different services shall be earthed using conductors as per manufacturer standard. All the earthing conductors shall be connected to equipotential bond and connected to the earthing stud as per kA rating. Transformer and DG neutral shall be dedicatedly earthed to stud as per specifications.

C) CABLES

1. Scope

Supply, storing, installing, jointing / termination, testing and commissioning of High Voltage XLPE insulated, PVC Sheathed, Steel tape Armored and PVC over sheathed Aluminum Cables of reputed make laid in built up trenches/ directly buried underground / on cable trays / hume pipes conforming to IS 7098 part II (L).
Supply, storing, installing, termination, testing and commissioning of Low voltage power cables of XLPE insulated, PVC sheathed, and PVC over sheathed Aluminum cables as shown in schematic diagrams and schedules.

2. General

The high-tension cable shall be Aluminum conductor, XLPE insulated, 11000 V grade power cable. The conductors shall be made from E.C. grade aluminum wires which are to be stranded and compacted. All sizes of conductors shall be of single or three core cables and shall be in circular shape. The construction of conductor and testing should comply to IS 8130-1984 as amended up to date. The XLPE insulation and the insulation shielding are all to be extruded by one process. For XLPE cables following routine tests are to be carried out on every length. Routine test certificates from factory shall be submitted along with the delivery of the cables.

(a) Conductor resistance test
(b) Partial discharge test
(c) High voltage test.
(d) Insulation resistance test

3. Rating

The L.T Power cables shall be rated for 1100 volts.

4. Storing

On receipt of cables at site, cable shall be inspected to detect any damage. If any defect/damage is found, it shall be reported to the Site Engineer or his Representative, for action. The ends of cables shall be in sealed condition after inspection and shall be stored in a proper place. The cable drum shall not be stored flat to the ground with flanges horizontal.

5. Laying

a. L.T. Power cables shall be laid in cable trays, trenches etc.as shown in drawings and schedules, The cables shall be tied by means of purpose made cable ties/clamped at 50 cm intervals as required.
b. L.T. Power cables shall be laid in cable trays, trenches etc.as shown in drawings and schedules, The cables shall be tied by means of cable ties/clamps at minimum 60 cm intervals.
c. The cable drums shall be laid unrolled in the direction of the arrow for unrolling. Wherever cables are bent, the minimum bending radius shall not be less than 12 times the diameter of the cable. Cable shall be laid in Hume pipes, covered by concrete for mechanical protection, at all road crossings. After the cable has been properly stretched the same shall be lifted and placed over the trench / tray. For trenches the cables shall be placed in trench and again, the cable shall be covered with a sand layer of 80mm thick. Over this sand layer a layer of concrete slab shall be placed. The trenches shall then be back filled with earth and consolidated to suitable grade. Direction markers indicating the run of the cables shall be installed at every 25 meters intervals and marking must be done at all bends.

6. Cable Joints

Cable jointing shall be done as per the instruction of the cable manufacturers. Cable jointing shall be carried out only by competent cable jointers. Cable shall be jointed using standard cable joint boxes. Cable shall be jointed as per colour coding or numbering of the cores and cable/cable joint manufacturer's recommendation. The cable seal shall not be removed until all preparation for jointing is completed. Jointing the gland and armoured clamp shall establish good electrical contact between cable armour, lead sheath and body of the switch gear. The cable box and gland shall be bonded to the main earth bus with suitable size conductors.

D) LIGHT FIXTURES

All light fixtures used for the project shall be LED with latest technology providing best Lumens/Watts with CRI>80 for indoor. All fixtures shall be with IP protection and impact resistance as specified in the BOQ as per latest standards. All light fixtures should come with warranty during the course of the defect's liability period. The bidder shall supply all light fixtures along with its drivers and all mounting accessories as required as per enclosed specification. Any accessories that is not included in the BOQ but is required for the successful installation and commissioning of the light fixtures shall be deemed as part of the contract and the bidder shall quote the price including

all the components. Light fixtures shall be selected from the list of approved makes provided meeting all the specifications and warranty required. No make other than the ones specified in the makes list will be entertained. (Minimum of 300 Luminous, even lighting at throughout hangar at working heights).

E) SWITCHGEARS, RELAYS METERS

1. MOULDED CASE CIRCUIT BREAKERS

1.1 Technical Parameters

MCCBs should be current limiting type with trip time of less than 10 msec under short circuit conditions. The MCCBs should be either 3 or 4 poles fixed type. The MCCBs shall comply with the requirements of IEC 60947-2/ IS60947 – Part 2

MCCBs shall be suitable for 3 Phase 415 Volts AC 50 HZ supply. Rated insulation voltage (Ui) 690/750V AC and rated Impulse voltage 8 KV.

The moulded case circuit breaker shall have a rated service short circuit breaking capacity of not less than 36 KA RMS (Ics=100% Icu) at 415 volts AC or as specified in BOQ.

1.2 Constructional Features

MCCB cover and case shall be made of high strength heat resisting and flame retardant thermosetting insulating material. Operating handle shall be quick make/break, trip - free type. Operating handle shall have suitable ON, OFF and TRIP indicators. Suitable arc extinguishing device shall be provided for each contact. Contact trips shall be made of suitable arc resistant sintered alloy.

1.3 Protective Release

All MCCBs upto 125A shall have Variable Thermal (O/L) & Fixed Magnetic (S/C) protection settings.

All MCCBs above 125A & upto 200A shall have Variable Thermal (O/L) & Variable Magnetic (S/C) protection settings.

All MCCBs of 250A and above shall be of Microprocessor Based with adjustable Overload, Short Circuit and In-Built Earth Fault Protection.

In case of 3 Phase 4 Wire Systems, if 3 Pole MCCBs are specified then Vendor should provide Neutral CT from MCCB Manufacturer.

For Motor application, motor duty type MCCBs shall be selected with reference to Type 2 coordination chart provided by the manufacturer.

MCCBs used in the main MV Panel proposed to be integrated with SCADA shall have provision for LCD display. The display shall be mounted on the panel door. Current metering and trip data should be seen on the display.

MCCBs used in Outgoing feeders of Main panel and incomers of downstream sub- panels shall be suitable for Total Selectivity. These MCCBs shall be selected as per Manufacturer's recommendation.

1.4 Accessories

All MCCBs shall have the facility of accommodating Aux Contact (For On-Off Indication), Trip Alarm Contact (For Trip Indication) or Shunt / UV Release as specified

All MCCBs shall have Phase Barriers & Extended Rotary Operating Handles. The Rotary operating mechanism shall be of robust design and should be with door interlock & padlock facility.
All MCCBs above 63A (i.e., 100A & above) shall be provided with Silver Plated Copper Spreader Links for enhancing termination capacity
All MCCBs in the panels where specified shall be equipped to be able to measure and transmit the parameters such as true rms currents, Voltages, Frequency, Power, Energy and Calculated Demand Values, Operating & maintenance indication such as Indication of fault types (Last 10 Alarms / Tripping Events with date & Time Stamping), Alarms for high/low alarm thresholds linked to I measurements, Trip, alarm and operating histories, Time-stamped tables for settings and maxi meters, Operation, trip and alarm counters, Operating hours counter, Contact wear, Load profile and thermal image with the help of add on RS485 Modbus Communication Module. SEM (Breaker status & control Module) & IFM (Interface module) modules shall also be considered along with all MCCBs for communication with PLC and SCADA.

2. CURRENT TRANSFORMERS

a. The burden of the current transformers provided shall be adequate for the meters and protective devices connected to these.
b. Facility for short-circuiting and grounding the current transformer secondary shall be provided at the terminal blocks through proper links. Links shall also be provided to carry out current and phase angle measurement tests with the current transformers in service.
c. The voltage rating of the current transformers shall be 1000V. Their short circuit withstand capacity shall be 31MVA at 415V. The secondary rating of current transformers shall be 5A unless otherwise specified.
d. Metering current transformers shall have an accuracy of class 1 and protective current transformers shall be of class 5P10 unless otherwise specified.

3. MULTIFUNCTION DIGITAL METERS

96 X 96 mm size multifunction meter as per IEC 62053-21 for Class 1. Meter shall have multiline LED display with following parameters:

a) Phase wise instantaneous and Average values – Voltage, Current, Power Factor
b) Phase wise instantaneous and Average values – Active Power, Reactive Power lead & lag, Apparent Power
c) Import & Export Cumulative values– Active Energy, Reactive Energy lead & lag, Apparent Energy.
d) PF for 3 phases and average
e) Instantaneous Frequency
f) Total Harmonics Distortion – Phase wise Voltage and Phase wise Current
g) Min and max of VLL, VLN, A, F, W, VA, VAr, PF with date and time stamp
h) Battery backed RTC with 2 years of power down time
i) Demand calculations based on W, VA, Var
j) Demand sync – Sliding window or block window site selectable
k) Demand interval: 5 to 30 min

l) Individual harmonics up to 15th order for voltage and current
m) Percentage Unbalance – Voltage and Current
n) Cumulative Run Hours
o) Sampling rate of 64 samples / cycle
p) Frequency: 50/60Hz
q) Aux supply: 80-300VAC / DC
r) Measuring circuit burden should be lesser than 0.2 VA
s) Aux burden < 5VA

Meter shall be suitable for CT secondary 1A /5A
It should be possible to program CT ratio and PT ratio on site through key pad provided at the front facia of the meter.
Programming shall be achievable only through password protected feature provided in the meter with direct access key for Basic, Power, Energy parameters and Menu driven feature on front facia.
All Meters shall have RS485 port with MODBUS RTU protocol
All meters shall have protection of IP 51 from front end preventing from dust and moisture.

4. RELAYS

a. All protective relays shall be of draw out type, rectangular in shape suitable for flush mounting with only the dust tight covers projecting beyond the cabinet door. Relays shall be equipped with externally reset; positive action operation indicators visible from the front. Voltage relays shall have sufficient thermal capacity for continuous energization, using external resistors if necessary.
b. Unless otherwise specified, auxiliary relays can be of fixed type mounted inside the cabinet, but shall be provided with individual dust tight covers. Auxiliary relays shall be rated to operate satisfactorily between 70% and 110% of the rated voltage.

5. CONTROL AND SELECTOR SWITCHES

Control and selector switches shall be of rotary type, they shall have escutcheon plates with the operating positions marked. Control switches shall have momentary contacts while selector switches shall have stay put contacts. They shall be suitable to operate at the required voltage and current ratings. The number of contacts and the switching pattern shall conform to the functional requirements.

6. PUSH BUTTONS

Each push button shall have 2 Nos.“NO” and 2 “NC” contacts. The push buttons shall be provided with legend plates indicating their functions.

7. INDICATING LAMPS

Indicating lamps shall be LED type. They shall be of suitable voltage rating. They shall be provided with legend plates to indicate their functions.

F) CABLE TRAY

General Requirement

Perforated Cable Tray are intended for the support and accommodation of cables and possibly other Electrical equipment in Electrical/Instrumentation/Communication systems.

Design and Fabrication of Cable Trays

The cable trays shall be fabricated according to the design specified by IEC 61537 and should be tested for Safe Working Load (SWL). The relevant details of SWL and the load chart with respect to SWL, supporting distance and the deflection should be according to the following chart.

Safe Working Load (SWL) with a span length up to 5 meters								
Description	Side Height (in mm)	Width (in mm)	Span length (in meters)					
			1.5m	2m	2.5m	3m	4m	5m
			Permitted Load (in kg/meter)					
Perforated tray	60	00-500	150	100	50	-	-	-
	100	50-500	185	130	75	60	-	-

Fabrication of Tray and accessories at site and welding is permitted, and any cut or holes are made in the trays/Ladder/accessories, zinc spray needs to be applied over the surface.

The metal edge has to be protected by edge protection sleeves to avoid cable damage. Edge of the supports has to be protected with plastic END caps.

Screwed connections and internal fixing Devices should not create any damage to the cable when correctly fixed. Sudden or jerky motions shall not be used to tighten reusable screw connections.

Cables shall run in cable tray/ladder mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures using mounting accessories

Cable Tray

The cable tray and all accessories shall be fabricated from sheet steel and has to be galvanized against corrosion confirming to EN10346/ISO1461-1999 for installations in indoor and outdoor applications respectively.

The cable trays shall be supplied in standard lengths of 3000 mm and the width of the tray shall be as follows.

Width: 100, 150, 200, 300, 400, 500.

All the cable tray accessories like Bend's, TEES's, Cross overs etc. should be designed in accordance with IEC 61537 and shall be factory fabricated. The accessories shall be from the same material as

of the tray and modular type, it should be connected with the trays by using fasteners. Typical details of trays, fittings and accessories are shown in the enclosed drawings.

For Cable trays designed, tested and confirming to IEC 61537, thickness of cable tray should be according to the manufacturer's catalogue. For locally fabricated and non-tested tray, thickness should be 2 mm up to span length of 1.5meter, 2.5 mm for span length between 2 to 3 meter and 3 to 4 mm for span length between 4 and 10 meters.

Mounting Accessories (supports and Brackets)

The mounting accessories shall be fabricated from steel and has to be protected against corrosion confirming to ISO 1461-1999 for installations in both indoor and outdoor applications and should be of completely modular type.

All supports and Brackets should be factory made, hot dip galvanized after completing welding, cutting, drilling, other machining operations and tested according to IEC 61537 according to the arrangements in the enclosed drawing. The system shall be designed such that it allows easy assembly at site by using Bolts and Nuts. The main support and brackets shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hard ware etc. to form various arrangements required to support the cable trays. Welding of the components at the site shall not be allowed.

Corrosion Protection

The cable tray/ladder/accessories shall be galvanized according to EN10346/ISO 1461-1999 for installations indoor and corrosive outdoor applications respectively. Sample tray/ladder/accessories/mounting accessories and supports should be salt spray tested according to ISO 9227 for > 150 hours & 500 hours. (*155 hours according to class 3 for pre-galvanized surface and 550 hours according to class 6 for Hot dip Galvanized surface as per ISO)

Testing and Certification

Cable tray / Ladder, bend, T Bend, cross, and all supports are to be tested for Safe Working Load (SWL), deflections, Impact resistance, Salt Spray & Electrical continuity test according to IEC 61537. The cable tray/ladder should not deflect more than 1/100th of the span length at SWL in Mid span and the transverse deflection of all mounting accessories at SWL shall not exceed 1/20th of the length. The cable tray / cable ladder should be tested up to 1.7 times SWL at minimum and maximum room temperature. The temperature classification of cable tray system should be - 5 to + 150°C.

Marking, Documentation, Compliance and Inspection

Each system component shall be durably and legibly marked with:

- the manufacturers or responsible vendor's name or trade mark or identification mark
- a product identification mark which may be, for example, a catalogue number, a symbol.

When system components other than cable tray lengths and cable ladder lengths are supplied in a

package, the product identification mark may be, as an alternative, marked on the smallest package unit. Marking shall be applied, by moulding, pressing, engraving, printing, adhesive labels, or water slide transfers. Compliance is checked by inspection and, for marking on the product, by rubbing by hand for 15 s with a piece of cotton cloth soaked with water and again for 15 s with a piece of cotton cloth soaked with petroleum spirit. Marking made by moulding, pressing, or engraving is not subjected to the rubbing test. After the test, the marking shall be legible.

If a system component is stored and transported at a temperature outside the declared
Minimum and maximum temperatures, the manufacturer or responsible vendor shall declare the precautions and the alternative temperature limits. Compliance is checked by inspection.

The manufacturer or responsible vendor shall provide in his literature all information necessary for the proper and safe installation and use of the cable tray system and cable ladder system.
The SWL and impact resistance is valid for the whole temperature classification declared. The information shall include

a. Instructions for the assembly and installation of system components and for the precautions required to avoid excessive transverse deflection, which could cause damage to the cables.
b. Thermal Expansion properties and precautions to be taken, if necessary.
c. Material, Surface Treatment and Salt Spray Test certificate.
d. Relative humidity if it affects the material and Surface Treatment.
e. Information on holes or devices provided for equipotential bonding or to run Earth Bonding Bar.
f. Precautions for transport and storage outside the declared temperature classification, where applicable
g. Product dimensions
h. Torque setting in Nm for screwed connections and internal fixing Devices. These devices should not create any damage to the cable when correctly fixed. Sudden or jerky motions shall not be used to tighten reusable screw connections. To test the screwed connections, it shall be tightened and removed.
i. End Span Distance
j. Position and type of coupling along the span
k. SWL in kg/m for the fittings when not directly supported
l. Fixing method for installing cable tray or cable ladder to the supports
m. SWL in kg/m for the cable tray lengths or the cable ladder lengths including joints for various Span Distances. SWL information can be given in the form of a diagram, table or similar. Compliance is checked by inspection
n. SWL in kg for cantilever brackets
o. SWL for pendants as a bending moment in kg and /or as a force in N
p. The appropriate material specification and environmental conditions, chemical environments or aggressive agents for which the product is suitable

TESTING OF ELECTRICAL INSTALLATION

1. Insulation Resistance Test

The insulation resistance shall be measured by applying between earth and whole system of conductors or any section thereof with all fuses in place and all switches closed (except in earthed concentric wiring) all lamps in position & both poles electrically connected together, or direct current pressure of not less than twice the working pressure, provided that it need not exceed 500 volts for medium voltage circuits, be applied. Where the supply is derived from 3 wire DC or Poly phase A.C. System, the neutral pole of which is connected to the earth either direct or through added resistance, the working pressure shall be deemed to be that which is maintained between the phase conductor and the neutral. The insulation resistance measured in mega ohms between all conductors connected to one pole of phase conductor of the supply and all the other conductors and switches in off position its value shall not be less than as specified below:

The insulation resistance measured in mega ohms shall not be less than 50 megohms divided by the number of outlets or when PVC insulated cables are used for wiring, 12.5 megohms divided by the outlet subject to a minimum value of 1 mega ohm. A preliminary and similar test may be made before lamps etc. are installed and in this event the insulation resistance to earth shall not be less than 100 megohms divided by the number of outlets or when PVC insulated cables are used shall not be less than 25 mega ohms divided by the number of outlets subject to a minimum of 1 megohm.

2. Polarity Test of Switches

In a 2-wire system a test shall be made to verify that all switches in every circuit are fitted in the same conductor throughout and such conductors shall be labeled or marked for c connection to the phase conductor or to the non-earthed conductor of supply. In a 3 wire or 4 wires insulation a test shall be made to verify that every non linked single pole switch is fitted in a conductor which is labeled or marked to one of the phase conductors of supply.

3. Earth Continuity Test

The Earth Continuity Conductor including metal conduits and metallic envelopes of cables in all cases shall be tested for electric continuity and electrical resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit breaker measured from connection with earth electrode to any point in the earth continuity conductor in the completed insulation shall not exceed 1 ohm.

LIST OF SPECIFICATIONS FOR ELECTRICAL INSTALLATION WORK

The following specifications will apply under all circumstances to the equipment to be supplied and installed against this contract and it is to be ensured that the Bidder shall obtain for himself at his own expense and on his own responsibility all the information which may be necessary for the purpose of submitting the tender and for entering into a contract keeping in view the specifications of installation and inspection of site etc. Further to this all-Electrical works under this contract shall be done based on the latest govt. norm, standards of practice and specification. Where relevant specifications are not available, relevant IS specification and codes of work shall be carried out.

IS 613: 2000	Copper Rods and Bars for Electrical Purposes - Specification
IS 1248: Part 1: 2003	Direct Acting Indicating Analogue Electrical Measuring

	Instruments and their Accessories - Specification - Part: 1 Definitions and General Requirements
IS 1248: Part 2: 2003	Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories - Part 2: Special Requirements for Ammeters and Voltmeters
IS 1248: Part 3: 2003	Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories - Part 3: Special Requirements for Wattmeter and Varmeter
IS 1248: Part 4: 2003	Direct Acting Indicating Analogue Electrical Measuring Instruments and Their Accessories - Part 4: Special Requirements for Frequency Meters
IS 1248: Part 5: 2003	Direct Acting Indicating Analogue Electrical Measuring Instruments and Their Accessories - Part 5: Special Requirements for Phase Meters, Power Factor Meters and Synchroscopes
IS 1248: Part 6: 2003	Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories - Part 6: Special Requirements for Ohmmeters (Impedance Meters) and Conductance Meters
IS 1248: Part 7: 2003	Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories - Part 7: Special Requirements for Multi-Function Instruments
IS 1248: Part 8: 2003	Direct Acting Indicating Analogue Electrical Measuring Instruments and Their Accessories - Part 8: Special Requirements for Accessories
IS 1248: Part 9: 2003	Direct Acting Indicating Analogue Electrical Measuring Instruments and Their Accessories - Part 9: Test Methods
IS 1271: 1985	Thermal evaluation and classification of electrical insulation
IS 1646: 1997	Code of practice for fire safety of buildings (general): Electrical installations
IS 1885: Part 9: 1992	Electrotechnical Vocabulary: Part 9 Electrical relays
IS 1897: 1983	Copper strip for electrical purposes
IS 2419: 1979	Dimensions for panel mounted indicating and recording electrical instruments
IS 2448: Part 1: 1963	Adhesive insulating tapes for electrical purposes: Part 1 Tapes with cotton textile substrates
IS 2464: 1963	Built-up mica for electrical purposes
IS 3024: 1997	Grain oriented electrical steel sheets and strips
IS 3231: Part 1.2,3: Sec 1: 1986	Specification for Electrical Relays for Power System Protection Part 1: General Requirements Section 1: Contact Performance
IS 3480: 1966	Flexible steel conduits for electrical wiring
IS 3837: 1976	Accessories for rigid steel conduits for electrical wiring
IS 3842: Part 12: 1976	Application guide for electrical relays for ac systems: Part 12 Differential relays for transformers
IS 4483: Part 1: 1968	Preferred panel cutout dimensions for electrical relays: Part 1 Flush mounting IDMTL relays
IS 4648: 1968	Guide for Electrical Layout in Residential Buildings

IS 5216: Part I: 1982	Recommendations on Safety Procedures and Practices in Electrical Work - Part I: General
IS 9537: Part 1: 1980	Conduits for electrical installations: Part 1 General requirements
IS 9537: Part 2: 1981	Conduits for electrical installations: Part 2 Rigid steel conduits (superseding IS:1653)
IS 9537: Part 3: 1983	Conduits for electrical installations: Part 3 Rigid plain conduits of insulating materials (superseding IS:2509)
IS 9537: Part 4: 1983	Specification for Conduits for Electrical Installations - Part 4: Pliable Self-recovering Conduits of Insulating Materials
IS 9537: Part 5: 2000	Conduits for Electrical Installations - Part 5: Pliable Conduits of Insulating Material
IS 9537: Part 6: 2000	Conduits for Electrical Installations - Specification - Part 6: Pliable Conduits of Metal or Composite Materials
IS 9537: Part 8: 2003	Conduits for Electrical Installations - Specification - Part 8 : Rigid Non-Thread able Conduits of Aluminium Alloy
IS 10381: 1982	Terms (and their Hindi equivalents) commonly used for name plates and similar data of electrical power equipment
IS 11005: 1984	Dust tight ignition proof enclosures of electrical equipment
IS 14927: Part 1: 2001	Cable Trunking and Ducting Systems for Electrical Installations: Part 1 General Requirements
IS 14927: Part 2: 2001	Cable Trunking and Ducting Systems for Electrical Installations: Part 2 Cable Trunking and Ducting Systems Intended for Mounting on Walls or Ceiling
IS 14930: Part 1: 2001	Conduit Systems for Electrical Installations - Part 1: General Requirements
IS 14930: Part 2: 2001	Conduit Systems for Electrical Installations - Part 2: Particular Requirements - Conduit Systems Burried Underground
SP 30: 1985	Special Publication - National Electrical Code
IS 2516 - (L) PART I & II Section - I	LT air circuit breakers
IS 4064 (L)	Fuse switch units and switch fuse units
IS 2208 (L)	H R C fuse links
IS 2675 (L)	Distribution Boards
IS 2147	Enclosures for low voltage switch gears
IS 2418 (L)	Tabular Fluorescent lamps
IS 415 (L)	Tungsten filament lamps
IS 374 (L)	Ceiling fan
IS 1947 (L)	Flood light
IS 1771 (L)	Industrial light fittings
IS 3553 (L)	Water proof electrical fittings
IS 5133 (L)	Steel boxes for enclosure of electrical accessories
IS 2667 (L)	Fittings for rigid steel conduit:
IS 653 (L)	Mild steel conduit for Electrical wiring
IS 3837 (L)	Accessories for rigid steel conduit for electrical wiring
IS 4615 (L)	Switch socket outlets
IS 1293 (L)	Three pin plug & socket outlet

IS 3854 (L)	Switches for domestic and similar purposes
IS 2268 (L)	Call bell and buzzers
IS 3043 (L)/ / IS 62305 Part (3 & 4)	Earthing
IS 3072 (L)	Switch gear
IS 2309 (L)/ IS 62305 Part (3 & 4)	Lightning protection
IS 7098 (L)	HT cable
IS 1886 (L)	Power transformer
IS 2705 (L)	Current Transformer
IS 2516 Part I & II / Sector I (L)	MCCB
IS 2959 (L)	Auxiliary contacts
IS 2834 (L)	Power factor correction capacitors
IS 9357 (L) Part 1,2,3 & 4	PVC/ Metal conduiting
IS 2544 (L)	Bus bar support insulators
IS 375: 1963	Marking and arrangement for switchgears bus-bars, main connections and auxiliary wiring (revised) (superseded by IS: 5578 and IS: 11353)
IS 694: 1986	PVC insulated cables for working voltages upto and including 1100 V (third revision) (Amendment 1)
IS 722 (Part 1): 1986	AC electrical meters: Part 1 general requirements and tests (third revision)
IS 732: 1989	Code of practice for electrical wiring installations (third revision)
IS 1336: 1959	Recommendations for the colour of push buttons [superseded by IS: 6875 (Part 2)]
IS 1554 (Part 1): 1988	PVC insulated (heavy duty) electric cables: Part 1 for working voltages up to and including 1 100 V (third revision) (Amendment 1)
IS 10118 (Part 1): 1982	Code of practice for selection installation and maintenance of switchgear and control gear: Part 1 General
IS 10118 (Part 2): 1982	Code of practice for selection installation and maintenance of switchgear and control gear: Part 2 Selection
IS 10118 (Part 3): 1982	Code of practice for selection installation and maintenance of switchgear and control gear: Part 3 Installation
IS 10118 (Part 4): 1982	Code of practice for selection installation and maintenance of switchgear and control gear: Part 4 Maintenance
IS 12021: 1987	Control transformers for switchgear and control gear for voltage not exceeding 1000 V ac (Amendment 1)
IS 12063: 1987	Classification of degrees of protection provided by enclosures of electrical equipment
IS 13234: 1992	Guide for short-circuit current calculations in three-phase as systems (superseding IS 5728)
IS 13947 (Part 1):1993	Low voltage switchgear and control gear: Part 1 General rules (superseding IS 4237)
IS 13947 (Part 2):1993	Low voltage switchgear and control gear: Part 2 Circuit breakers [superseding IS 2516(Part 1 & 2/Sec 1): 1985] (Amendment 1)

IS 13947 (Part 3):1993	Low voltage switchgear and control gear: Part 3 Switches, disconnectors, switch disconnectors and fuse combination units [superseding IS 4064(Part 1 and 2)]
IS 13947 (Part 4/Sec1): 1993	Low voltage switchgear and control gear: Part 4 Bidders and motor starters, Sec 1 Electromechanical contactors and motor starters [superseding IS 2959 & IS 8544(All parts)] (Amendment 1)
IS 13947 (Part 5/Sec1): 1993	Low voltage switchgear and control gear: Part 5 Control circuit devices and switching elements, Sec 1 Electromechanical control circuit devices [superseding IS 6875(All Parts)] (Amendment 1)
IS 14415: 1997	Volt-ampere hour meters for restricted power factor range [superseding IS 722(Part 5) 1980]

G) LIST OF APPROVED MAKES

Sl. No.	Description	Make
2	MCCBs	Legrand/Schneider/ABB/L&T/Hager
3	Isolators	Legrand/Schneider/ABB/L&T/Hager
4	MCBs & RCCBs	Legrand/Schneider/ABB/L&T/Hager
5	Indicating Meters	Schneider/ABB/L&T/Socomec/Elmeasure
6	Current transformer	PGR Power/Indus/Kapco Elec.Pvt.Ltd/Kappa
7	Contactors	L&T/ABB/Schneider/Legrand/Siemens
8	Multifunction Meters	L&T/Conserv/Enercon/Schneider/El measure
9	Distribution Boards	Legrand/Schneider/ABB/L&T/Hager
10	Relay & Controls	Areva/L&T/Siemens/GE/ABB
11	LT Cables 1100V grade armoured XLPE insulated and PVC sheathed Aluminium conductor cable	Polycab/Havells/RR
12	FR-LSH PVC insulated stranded/multi stranded copper conductor 1100V grade wires	Polycab/Havells/RR
14	Battery	Quanta/Exide/Amaron

15	Cable gland	Dowells/Jaison/Comet
16	Crimping Sockets	Dowells/Jaison/Comet
17	Metal Clad Sockets/IP 67 Sockets	Hensel-Walther/Cape/L&T
18	Ceiling Roses/angle Batten Holder	Precision/Anchor/GM
19	GI Conduit	Jindal/AKG/Tata
20	Wiring Devices	Legrand-Myrius/Schneider/Wipro-Northwest/Honeywell
21	GI Cable Tray	Hi-Tech/Fixotech/Profab
22	Light fixtures	Wipro/Havells/Philips
23	Exhaust Fan	Crompton/Havells/Usha
24	Fire Extinguisher ISI Marked	Safeguard/Minimax/Newage/Lifeguard/Omex

AIR HANDILING UNITS

A. GENERAL DESCRIPTION & DESIGN BASE

1. SCOPE (General)

This specification, together with schedule of quantities and tender drawing enclosed, covers the design, manufacture, assembly & testing at manufacturer's works, delivery at site, installation, testing & commissioning into service, carrying out all acceptance tests, for VRV/VRF air-conditioning and ventilation systems along with AHU as IDU and Heat Recovery Wheel for ensuring effective precooling of inlet air and thereby enhancing the efficiency of the system

2. Base in Design & System proposes:

Based on air conditioning requirements, the following areas were considered to provide air conditioning system with VRV/VRF AHU considering refrigerant R410 A for the following floor areas
Internal Loads considered:

i. Lighting Load: 10W per sq.m
ii. Equipment load: 20W per sq.m
iii. People: Approx.

Indoor Conditions for AC areas:

Temperature: 24 ± 2 DegC
RH: Not exceeding to 65 % RH
Fresh air intake: 1 air changes per hour or 15 CFM per person whichever is higher.
Supply air quantity with conventional filters
Inside conditions: Shall be as per ISHRAE standards

3. DESIGN DATA

STANARDS REFERED

Following standard & guidelines shall be adopted while designing the AHU system;

- National Building Code of India (NBC) 2005
- Energy conservation Building Code (ECBC)
- ASHRAE Hand Books
- ISHRAE Standards
- Duct construction standards as per relevant BIS Codes & SMACNA standards.
- Indoor Air Quality as per ASHRAE.
- National Fire Codes 2000
- National Electric Codes (NEC)
- ASHRAE Standard 90.1 200

4. AIR COOLED VRV/VRF SYSTEM

a) Unit shall be air-cooled, multi split type heat pump air-conditioner consisting of one outdoor and multiple indoor units, each having capability of working independently with remote controller.
b) Units shall operate on CFC free R-410A refrigerant.
c) The outdoor shall have different capacities ranging from 4 to 48 HP, and 0.5HP to 10HP capacity range for indoor units.
d) The capacity of the outdoor unit ranging from 4HP to 16HP shall be of 1 module, the capacity of the outdoor unit ranging from 18HP to 32HP shall be of 2 modules and the capacity of the outdoor unit ranging from 34HP to 48HP shall be of 3 modules.
e) Compressor shall be all DC inverter scroll for 8 ~ 48HP and DC Inverter Rotary for 4 ~ 6HP. Constant speed Scroll and rotary compressors shall not be accepted. The system shall be able to change between cooling and heating from the selection at the thermostat or central controller when required.
f) The air conditioner shall operate continuously at the ambient temperature of –5 deg C ~ 54 deg C in cooling mode without tripping or overheating. This should be authenticated with the help of reputed third-party test certificate in accordance to ANSI / AHRI 1230 test standards "Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air Conditioning and Heat Pump Equipment "at 35 deg C & ISO 15042:2011 "Multiple split-system air-conditioners and airto-air heat pumps" at 46 deg C. Additionally the local authority compliance should be attached to validate the COP above 3.8 for all the model line-up. The COP less than 3.8 shall not be acceptable.
g) Outdoor unit shall be suitable for mix-match connection of different capacity with the following indoor models.
    - Wall mounted unit Series (Deluxe, Standard & Wide)
    - Ceiling concealed Duct unit (Low, Hi static & Built In type)
    - Ceiling Cassette type (1, 2 & 4 way)
    - Floor Standing (Case/without case)
    - Ceiling & Floor type.
    - Fresh Air Handling Units (Customized)
h) The units shall be factory assembled and charged with eco-friendly R-410a refrigerant. Both Indoor and Outdoor units to be manufactured in the same factory and tested under stringent

quality control to ensure compatibility of indoor with outdoor unit, reliability of operation and performance as stated in the manufacturer's catalogue.

i) The compressor shall be from same origin of Outdoor and Indoor units.
j) The technician shall attend and successfully complete the training course at the VRF Manufacturer and obtain a certificate of passing the course. The technician shall have the detailed knowledge of the VRF installation, piping installation and commissioning procedures.
k) The supplier shall demonstrate the successful operation of similar VRF models for last 5 years.
l) The electric power supply to the outdoor unit shall be 380-415 V / 3 ph / 50 Hz.
m) The duration in the condensing unit's capacity from 35 deg C to 42 deg C shall not exceed 20%

4.1. OUTDOOR UNIT

Modular type outdoor units equipped with highly efficient DC scroll compressors with all inverter type compressor(s) only, Blue fin precoated heat exchanger, twin accumulator, low noise condenser fan, auto check function for connection error, R410a Refrigerant, auto address setting and the equipment should deliver 100% capacity at 43 degree Celsius ambient without any deration. The equipment shall be flexible for operation at a voltage range of 320V-460V. Working Temperature up to 56-degree Celsius.

4.2. REFRIGERATION PIPING WORKS

REFNETS

All the refrigerant joints shall be proprietary in nature from the main VRF/VRV supplier. It should have one inlet and two outlet connections, both for suction and liquid line of respective size of the refrigerant piping along with its insulation. The refrigerant joint should be designed and supplied by the supplier of VRF/VRV indoor and outdoor unit manufacturer.

Recommended copper pipes Material:

Seamless phosphorous deoxidized copper pipe Wall Thickness: Comply with the relevant local and national regulations for the designed pressure 3.8MPa (551psi). We recommend the following table as the minimum wall thickness.

Outer Dia (mm)	6.35	9.52	12.70	19.05	22.20	25.40	28.58	31.80	34.90	38.10	41.30	44.40
Min Thickness (mm)	0.80	0.80	0.80	0.99	0.99	0.99	0.99	1.10	1.21	1.35	1.43	1.43

Recommended minimum Wall thickness interconnecting refrigeration pipe work between the indoor and outdoor +Slave 1& 2 recommended to layout on galvanized GI tray. Pipe work sizing, layout, fittings, etc shall be in strict accordance with the manufacturers design and installation requirements. (Refer Product data book) The pipe work shall be of refrigerant quality copper to

half hard temper. Soft tempered pipe work may be used where the pipe diameter is ¼" or 3/8". Long radius bends shall be formed using pipe bender. The use of short radius preformed bends and elbows should be avoided to minimize pressure drop and possibility of leaks. Pipe work shall be carried out manufacturer's design and installation instructions and in accordance with longest possible of copper wire shall be utilized to minimize joints on site. Appropriate refrigeration installation tools must be utilized to avoid the use of elbows, dry Nitrogen must be in the system brazing (no cold brazing will be allowed).

Pressure Testing, Evacuation and Commissioning:

After installation of pipe work, and prior to sealing of insulation joints, pipe work shall be pressure tested for R-410A to 28 ~ 38kg/cm2(398~540 psi approx.), held for 24 hrs and checked for leaks, vacuumed/dehydrated to 0.5~0.8 Torr or (-752mm Hg) and held at that setting for 1 to 4 hours depending on the pipe length.
Note: If you suddenly press the nitrogen gas to 28 or 38 kg/cm2 the heat exchangers of indoor unit will be damaged.

Brazing work:

Dry nitrogen must be passed through the pipe work during all brazing of joints to prevent the formation of oxidization scale on the inside surface of the pipes. All pipe work shall be clean, de-hydrated and sealed. Pipe work shall be stored under dry conditions. Any pipe work found to be stored without the end caps should be rejected. Where sections are cut from a new coil any remaining lengths must be resealed. During the installation if the system has to be left unattended for any purpose whatsoever, the openings in the systems must be securely sealed. Y Branch or headers joints shall be used for branching to indoor units. No other fittings are acceptable. The positioning of these joints shall be strictly in accordance to the manufacturer's specification. However, the brackets must not be positioned directly on the joints or headers. On horizontal pipe work the bracketing should be over the insulation to allow pipe movement due to contraction and expansions. The vertical pipe work shall be bracketed at no more than 1000mm. The horizontal pipe work shall be bracketed at no more than 1500mm.

4.3. REFRIGERANT PIPE INSULATION

The whole of the suction and liquid line including all fitting, valves and strainers bodies etc. shall be insulated with 19 MM respectively thick class 'o' Elastomeric anti-microbial Nitrile Rubber sleeve as per BOQ. Thermal conductivity of insulation material shall not exceed 0.035 W/ (mK) at mean temperature of 0degC as per EN ISO 8497. Moisture Diffusion Resistance Factor or 'μ' value of insulation material shall be minimum 7,000 without any external barrier as per EN 13469. Water Absorption by Volume of insulation material shall be < 0.2% as per ASTM C 1763 / ASTM C 209.
Density of insulation material shall be between 40 to 55 K g/m3. The insulation material shall be dust and fibre free. The insulation material shall be formaldehyde free. The insulation material shall be CFC & HCFC free. The insulation material shall withstand maximum surface temperature of +105 Deg.C and minimum surface temperature of -50 Deg.C as per EN 14707.

The insulation material shall have Microban an anti-microbial product, which is EPA (Environmental Protection Agency), as an integral part of insulation that cannot be washed off or worn off. The

insulation material shall give enhanced level of protection against harmful Microbes such as bacteria, mold, mildew and fungi and should confirm to following standards: EN ISO 846 Method A - Fungi / Mould Resistance and EN ISO 846 Method C – Bacterial Resistance. The base insulation material shall have ODP (Ozone Depletion Potential) and GWP (Global Warming Potential) of Zero. Thickness of the insulation shall be as specified for the individual application. The insulation material shall be installed as per manufacturer's recommendation.

The joint shall be properly sealed with R242 adhesive of polychloroprene to ensure proper bonding at the ends. Insulation must be protected glass cloth covering with foster painting. The FRP/poly shield coating shall be applied over the insulation for exposed application. Glue all insulation (after pressure and leak testing) to provide a complete seal to prevent any condensation. Flexible braided pipe (for external/terrace runs of pipe). Insulation shall be nitrile rubber covered with glass-cloth having density of 200GSM. All exposed piping insulation shall be with UV Protection/UV Coating with glass cloth fabric.

4.4. DRAINPIPE INSULATION

Drain pipe carrying condensate water shall be insulated with 13 MM thick nitrile rubber sleeves. The joint shall be properly sealed with R242 adhesive of polychloroprene to ensure proper bonding at the ends. For proper drainage of condensate U-trap shall be provided in the drain piping (wherever required). All pipe supports shall be of pre-fabricated and pre-painted slotted angle supports properly installed with clamps.

4.5. VIBRATION ISOLATORS

The indoor and outdoor units shall be provided with ribbed rubber pad vibration isolators.

4.6. PAINTING

Cassette unit/Ductable CSU for VRF system shall be factory finished with durable alkyd spray enamel. Shop coats of paint that have become marred during shipment or erection shall be cleaned off with mineral spirits, then coated with enamel paint to match the finish over the adjoining shop painted surface.

5. HEAT RECOVERY WHEEL

The Thermal Heat Recovery Wheel shall be cabinet type construction, comprising of various sections such as supply air, exhaust air and fresh air connections as shown on drawings and included in schedule of quantities.

Wheel - The wheel shall be made of alternate layer of corrugated and intervening flat composite material of aluminium foil of uniform width to ensure smooth surface. The wheel medium should be bonded together to form rigid transfer medium forming a multitude of narrow channels ensuring laminar flow. The wheels shall be of proven design. The wheel can be fully wound or on larger units, sectorized, i.e. assembled in segments. In latter case the segments are assembled between rigid spokes thus ensuring structural longevity and allowing replacement of one or specific segments only. The wheel shall be cleanable by spraying its face surface with compressed air, low

temperature steam or hot water or by vacuum cleaning without affecting its latent properties. The face velocity across the wheel should not exceed 700 fpm (3.5 m/s). The wheels shall be tested in accordance with ASHRAE S4-78 method of testing air to air heat exchangers. Development a manufacturer shall meet all quality assurance criteria specified in BSEN ISO 9001. The minimum sensible and latent efficiencies should be 75%. A computerized selection should be enclosed along with offer.

Casing- The casing shall be constructed as a single skin, self-supporting, galvanized sheet steel structure and include rotary wheel support beams and purging sector. The casing shall be supplied with access panels to facilitate inspection and service. Size 2150 mm and larger shall be in two sections to facilitate shipping and handling.

Seals: The casing shall be equipped with adjustable brush seals, which minimize the carryover to max 0.05 – 0.2%.

Hub and Spokes: Hub and Spokes on one piece rotor shall be Aluminium and on sectorized rotor Hub shall be made of steel, painted with anti-corrosion paint and galvanized sheet steel spokes.

Drive: The wheel shall be belt driven along its perimeter. A constant speed fractional horsepower motor shall be used. The motor shall be mounted on a self-adjusting base to provide correct belt tension.

6. AIR HANDLING UNIT

Supply, installation, testing & commissioning of variable volume type, double skin construction fabricated out of extruded aluminum section with 1 mm pre-coated GSS outside and 0.8mm plain GSS inside, Thermal Break with 40mm thick PUF of density 48 kg/m3 sandwiched between the GSS sheets, comprising copper cooling coil section with aluminum fins, pre-filter and filter section, double sloping stainless steel drain pan (for zero water retention) made out of 18G SS sheet of 304 grade, mixing air chamber . . Fans shall be plugging fan with aluminium impeller with efficiency levels of class IE4/IE3 or equivalent and suitable for operation on 415V +/- 5%, 50 Hz AC supply. Damper at inlet and outlet of AHU. Fire retardant flexible connection between fan outlet and duct, Metallic plate sandwiched between Neoprene rubber pad shall be used between CSU and foundation. Fire retardant flexible connection between fan outlet and duct, Metallic plate sandwiched between Neoprene rubber pad shall be used between CSU and foundation. Speed of fans shall be modulated on the basis of occupancy, variation in ambient temperature and indoor conditions. Sound levels shall not exceed 65dB at a distance of 1.5m from the CSU when operated individually In addition, since fresh air quantity for space shall be very large, carbon-di-oxide level monitoring shall be carried out for all occupied spaces and fresh air damper shall be modulated to ensure that difference between indoor and outdoor CO2 levels is maintained less than 530 ppm. The AHU s requiring mixing boxes shall be complete with modulating fresh & return air dampers as per the specifications. DX type cooling coils shall have 12.5mm to 15mm diameter tubes minimum 0.4mm thick aluminum fins bonded to copper tubes. Each coil shall be factory tested at 21kg/cm2 air pressure under water. Fin spacing shall be 4-5fins/cm. The DX type coil shall be minimum 6 row cooling coil with SS drain pan and a vent. The coil shall have copper header with

DX type supply and return connections protruding out of CSU. The filters shall be MERV 9 & MERV 13 as specified in ER. AHU body shall consist of fan section, coil section, filter section, fresh air section with mixing boxes wherever required. CSU/AHU shall be included of communication kit and interfacing kit suitable to integrate with VRF ODU. The plug fan and motor shall be AMCA certified and AHU shall be EUROVENT certified.

7. DIFFUSERS AND REGISTERS

Diffusers, registers and grilles shall be arranged for flush mounting in laying type ceilings and overlap mounting in plaster, mineral tile and similar ceilings, with concealed fixings unless otherwise directed. Grilles, register and diffuser locations shall be adjusted to suit reflected ceiling drawings, or Consultant's site instructions. All grilles, registers, diffusers, louvers shall be from one manufacturer. Provide plaster frame for grilles, and diffusers installed in plaster ceilings.

All diffusers, grilles and registers shall be supplied completely factory powder coated. Finish colour shall be to the approval of the Architect. The interior of all grilles and diffusers is to be factory painted matt black. All supply grilles and diffusers will have opposed blade balancing dampers. All will have foam rubber sealing band around the edge to seal to the structure. All pivots will be round section, not of formed sheet, and not relying on a spring steel locking wire.
Unless otherwise specified, basic grilles and diffuser materials shall be Aluminium extruded sections. Sections in the airstream shall be carefully selected to minimize turbulence. Linear bar grilles shall be fabricated from aluminium, with 6.4mm wide bars on 12.5mm centers pressed into a notched steel retaining bar. The core can be either welded into the cuter frame, or, where the grille is used in a sill application, held in the outer frame by spring clips fixed to the core retaining bar.

The outer frame shall be 35mm deep and shall have a visible flange 25.4 mm wide. Mitered end caps shall be welded to give a near invisible joint. The grill shall be complete with an opposed blade damper painted matt black, and shall be fixed with universal mounting brackets. Both the damper and the fixing brackets shall be accessible through the face of the grille.

Continuous grilles shall be provided with positive alignment strips, which fit into special keyways extruded into the frame of the grille to ensure clean unbroken lines. Ceiling Diffusers shall be multimode giving 4-way horizontal discharge.

The three centre cones of the diffuser shall be manufactured from pressed aluminium, with the remaining cones and the outer frame fabricated from extruded aluminium welded at the corners to give near invisible joints.

One, two, and three-way pattern cores shall be used as indicated on schedules. All cores shall be interchangeable. The core shall be removable without the use of special tools, but for safety, shall be fixed to the outer frame by a small length of chain.
The diffuser shall be complete with an opposed blade damper painted matt black. Wall registers shall be double deflection fabricated from aluminium, the front vanes being horizontal, the rear vanes vertical. This grille shall be complete with an opposed blade damper painted matt black and adjustable from the face of the diffuser.

Both sets of vanes shall be fully adjustable without the use of special tools. Eggcrate return or extract grille shall be provided with a steel lattice core of 12.7mm x 12.7mm openings, giving a free area of 90%. The core shall be fixed into an extruded aluminium frame, with welded corners and a 25mm face flange.

The grille is complete with an opposed blade damper painted matt black and adjustable through the face of the diffuser. Vision proof door transfer grilles shall consist of a steel core with inverted V type blades, and an extruded aluminium frame with matching rear flange. The frame shall be adjustable from 28mm to 60mm to suit the door width.
The diffusers shall be complete with pattern control blades, fully adjustable from face of diffuser through 180 degrees and shall be fitted with end caps at each end. The diffuser members shall be constructed from high quality aluminium extrusions to BS 1474 while the pattern control blades shall be of black rigid PVC. Exhaust valves shall be manufactured from highly quality sheet steel spinning protected by a stove enamelled or powder coated paint finish. Flanges shall be fitted with sealing gaskets.

B. SHEET METAL WORKS

i. Scope

Supply and erect all sheet metal work as per the specifications described below:

Material for Ducting: All duct work shall be constructed out of best quality cold annealed, flat galvanized sheet steel (galvanized to specifications of IS: 277 (latest edition)).

The joints shall be finished straight and neat. The duct work shall be supported /secured from roof slab or any other building member using angles, rods as may be required.

Thickness of sheets shall be as shown in the tables given below:

Maximum size of		Thickness of GS Sheet in mm
Rectangular Duct in mm	Round Duct dia in mm	
Up to 750	Up to 600	0.63 (24G)
751 to 1500	601 to 750	0.80 (22G)
1501 to 2250	751 to 900	1.00 (20G)
2251 & above	901 & above	1.25 (18G)

The fabrication of duct shall be done as per IS: 655 (latest edition). Transverse joints, connections, bracing, seam etc. shall be generally as per IS: 655.

All the ducts over 300mm in either dimension shall be cross broken except those on which rigid board insulation is applied. Stiffening angles shall be black structural steel and riveted to the cutwork.

The longitudinal seam on all ducts may be Pittsburgh seam hooked and hammered. Ducts of size

600 mm and above shall be reinforced between the joints. Where drive-slips are used, angles shall be riveted to the ducts 50mm from slips.

- All sheet metal ductwork shall be constructed and installed in accordance with the Heating and Ventilating Bidder's Association (HVCA) Specification for Sheet Metal Ductwork DW/144 - Low, Medium and High Pressure/Velocity Air Systems 1998, and all subsequent addenda and associated additional documents. The installations shall be fabricated and erected by a ductwork specialist. The ductwork shall be installed in accordance with the following classifications.

Duct Pressure Class	Static Pressure Limit (Pa)		Maximum Air Velocity (m/s)
	Positive	Negative	
Low Pressure – Class A	500	500	10
Medium Pressure – Class B	1000	750	20
High Pressure – Class C	2000	750	40

- The Specification DW/144 shall be used as a guide to the minimum standard of construction that will be accepted. The ductwork specialist shall use thicker gauge material or employ alternative approved methods of strengthening the ductwork as considered necessary and shall ensure that the ductwork is free from vibration and drumming. The minimum nominal sheet thickness for any ductwork shall be 0.8 mm, mounted internal to a building and 1.6 mm externally.
  Button punch, snap lock seams shall not be used.
- Ductwork shall be true in section and not twisted or distorted. Seams should be arranged, where possible, so they are not visible when ductwork is erected in an exposed position. All joints and seams shall be made with an approved sealer during manufacture and in erection. The sealer shall be applied to lock formed joints and seams during manufacture. Sealers must be similarly durable and applied strictly in accordance with manufacturer's recommendations with particular reference to cleanliness and "setting" times. Care must be taken to ensure that the sealant has not deteriorated or hardened before use. Sealers must not be applied in temperatures below the manufacturer's recommendations or applied to wet or damp sheet metalwork.
- Ductwork shall meet the specified air leakage rate without the application of tape or other external sealant application.
- On bends and offsets, the centre line radius shall be equal to 1.5 times duct width unless space considerations preclude this, in which case they shall be as large as possible. Where indicated on the drawings, or where long radius bends are not possible, approved turning vanes or splitters shall be fitted. Branches shall generally be taken as Fig 106 of DW144. They shall be designed to avoid exposure to the air stream of any cut edges.
- Setting out of ductwork shall be carried out to minimize the number of changes of direction or shape and every effort shall be made to avoid increasing resistance to air flow or creating localized high velocity or excessive turbulence.
- Connections to grilles or diffusers shall be in accordance with the grille or diffuser manufacturer's recommendations regarding air approach, neck length, equalizing control and volume control.

- Where ducts are lined internally for acoustic attenuation or thermal insulation, the sizes shown on the drawings shall be maintained as internal clear dimensions and overall sheet metal sizes increased accordingly.
- All materials associated with ductwork construction or erection, such as plastics, synthetic materials, etc., used for gasketing or sealing shall be unaffected by other solvents or sealants and shall not deteriorate under the effects of time, temperature, light or humidity.
- Ductwork passing through walls, floors or ceilings shall be sleeved and packed with material, in order to eliminate noise transmission to and from the structure and from room to room, and to provide a fire stop where it passes through a fire rated structure. Where a continuous vapour barrier is specified, the sleeve shall be oversized accordingly using the dimensions of the metal finished face of the insulation instead of the enclosed ductwork. The internal angle of the sleeve shall not be in direct contact with the ductwork or finished face of the vapour barrier insulation section. Cover retaining plates shall be fitted where packing is exposed in plant rooms and occupied spaces and where necessary to maintain packing within sleeve.
- Where joining the equipment flange sizes shall correspond with equipment flanges and all corners shall be neatly rounded.
- Metallic ductwork systems shall be bonded in accordance with BS 7671: Requirements for Electrical Installations (The IEE Wiring Regulations 16th Edition).
- Where ductwork penetrates external walls and floors, a flange shall be fixed and sealed to the ductwork and wall suitable for flashing by others. Where penetrations are made through pitched roofs, a purpose-made roof sheet shall be provided, complete with flashing plate. For flat and pitched roofs, an upstand and a cravat shall be provided with a skirt extended over the roof flashing and upstand. Where welding is carried out to form a weather proof fitting, the entire section shall be galvanised after manufacture. The sheet shall be of sufficient thickness to ensure the galvanising process does not disturb the duct section.
- Brass screwed pockets and/or bosses for ductwork mounted thermostats, sensors etc. shall be provided in all necessary positions as required, as indicated on scheme drawings or described elsewhere in the Specifications.

ii. Flexible Connections

- Flexible connections shall be fitted to fan inlet and discharge connections, all connections to air plant containing vibration generating equipment and at all points where ducts cross structural expansion joints. Ductwork passing across building expansion joints shall be provided with flexible connections that shall allow an axial displacement in the horizontal plane to match the building movement tolerance and an associated displacement within the vertical plane.
- Flexible connections shall be fitted in such a manner to maintain acceptable alignment. Flexible connections shall have a minimum effective length of 100 mm and a maximum effective length of 200 mm. Flexible connections shall be considered as part of the ductwork system when considering leakage rates, or fire protection integrity and stability.
- They shall be fabricated from a material that is non-combustible, rot proof and of a quality and grade to suit the temperature, velocities and pressures involved, they shall not permit

perceptible air leakage or noise breakout. Flexible connections shall not pass between fire zones. All flexible connection joints shall have fire resistance properties of at least 15 minutes integrity to BS 476: part 8 and comply with BS 476 part 7, Class 1 surface of very low flame spread.

- Canvas or asbestos material joints shall not be used.
- Flexible connections shall be fitted free from stress and shall not be required to support any weight. The material shall be securely fixed to a frame and not secured by straps. Where connections are identified as requiring an acoustic performance in respect of sound breakout the connection material and form of fixing shall be selected by the attenuator manufacturer.
- Flexible connections shall not impair the electrical bonding of any part of the ductwork system.

iii. Hang all ductwork securely and in a rigid manner. Provide hangers as follows:

LARGER SIDE OF DUCT (mm)	VERTICAL ROD DIAMETER (mm)	MAXIMUM SPACING BETWEEN SUPPORTS (mm)
Upto 900	10	2400
901 to 1500	10	2400
1501 to 2400	10	2400
2401 and above	10	2400

- In addition to the above, additional supports shall be provided near bends, elbows, tees or Other special fittings. Additional supports are also to be provided in locations where dampers are provided in the ducting.

- Rectangular Ducts shall rest on supporting GI Slotted channel (16G for ducts upto 750mmwidth and 12G for ducts between 751 and 2400mm, for higher sizes suitable MS painted angles shall be used with prior approval) and this supporting slotted channel shall be suspended from two full threaded GI rods fixed to concrete ceiling by suitable sized anchor fastener.

iv. Duct Construction

The intent of the above specification is to obtain duct pieces that are robust and rigid enough to preclude flutter & to achieve minimum amount of air leakage.
The bidder may fabricate ducts conforming to any other approved standard to achieve the desired result. However, detailed specifications shall be submitted for approval before adopting the same.
Suitable rubber gaskets shall be provided between the duct flanges.
Ducting shall be supported from independent hangers fixed to the building structure. In any case the duct shall not be supported from false ceiling, ceiling hangers, light fixtures, support for light fixtures or piping work etc.
In case the structure is under construction, inserts and anchors required for duct support shall be set in the building structure at the time of pouring concrete. The Bidder shall prepare detailed drawings of hangers and supports and submit for the approval of consultants.
Dimensions of duct sections shown are inside the dimensions of bare ducts. Where ducts are required to be lined or insulated on the inner surface, their dimensions have to be enlarged so that the cross-section area is not reduced as compared to those shown on the drawings.

a) Elbows, Vanes etc

Simple elbows, transformation sections, shall be formed with pits burg corner seams. Complicated fittings shall be constructed with double corners.
Elbows, bends and offset pieces shall have a center line radius of not less than 1.5 times the radial of width of the duct.
Turning vanes should be provided at required spacing such that the aspect ratio of each individual elbow formed by the vanes shall not be more.

b) Transformation

Duct transformation shall be made with a side slope of 10mm to 70mm. However, if the duct cross section area needs to be reduced, a maximum reduction of 20% of the original area shall be allowable.

c) Take offs

Branch take-offs and collars shall be provided with turning vanes. Straightening vanes shall be provided in the collars wherever practicable.

d) Apparatus & Equipment connections

Duct sleeves made of 20gauge thick galvanized sheet steel shall be used for ducts passing through load bearing walls or partitions.
Sleeves shall provide 25mm clearance all around as per duct or insulated duct. The space between sleeve and duct shall be packed with twisted asbestos.
All the sheet metal plenums required to confine the flow of air through filters and fans, shall be fabricated out of 18gauge galvanized sheet steel, and suitably braced as required. Suitable access doors shall be provided for plenums.

e) Access Doors

Hinged or bolted access doors shall be provided in ducting for fire dampers, coils, plenums and any apparatus requiring frequent servicing for inspection.
Access doors shall be rigid and shall be provided with air tight rubber gaskets. Insulated ducts shall be provided with insulated doors.

f) Installation

- The installation of ducting shall conform to standard practice of the trade. The bidder shall provide and neatly erect all the sheet metal work as shown on the approved drawings.
- The Bidder shall upon the award of work prepare detailed shop drawings of ducting for approval by Engineer-in-charge.
- The drawings shall indicate the exact route of ducting, ducting dimensions, details of splitters, vanes, dampers, fire dampers, heaters, filters etc.
- As specified and required. The drawings shall also incorporate cross section indicating beams, obstruction, piping, cables etc.

- The ducting shall be suitably designed to avoid all obstructions and at the same time utilizing a minimum number of bends/transformations/divisions etc.
- Every duct layout drawing shall clearly indicate the location & spacing of supports & hangers. Ducting over the false ceiling area shall be supported from the ceiling slab or from beams.
- In no event, the ducting shall be supported from false ceiling hangers, cable trays/racks, pipe supports or be permitted to rest on the false ceiling.
- All the ducts shall be rigid and shall be adequately supported and braced wherever required with tees, angles or adequate size to prevent buckling, Vibration or breathing.
- The bidder should mention the total quantity of various sizes of ducting sheet along with each floor drawing of duct layout.

g) Acoustic and Thermal Insulation

THERMAL INSULATION

Insulate all rectangular supply, return and extract ductwork with class O type nitrile rubber having following specification. Insulation material shall be Closed Cell Elastomeric Nitrile Rubber with antimicrobial properties. Density of Material shall be between 40 to 55 Kg/m3. Thermal conductivity of insulation material shall not exceed 0.035 W/(m.K) at mean temperature of 0deg.C as per EN 12667. Moisture Diffusion Resistance Factor or 'μ' value of insulation material shall be minimum 7,000 without any external barrier as per EN 12086. Water Absorption by Volume of insulation material shall be < 0.2% as per ASTM C 1763 / ASTM C 209.

The insulation material shall be dust and fibre free. The insulation material shall be formaldehyde free. The insulation material shall be CFC & HCFC free. The insulation material shall withstand maximum surface temperature of +85 Deg.C and minimum surface temperature of -50 Deg.C as per EN 14706.

The insulation material shall have Microban an anti-microbial product, which is EPA (Environmental Protection Agency), as an integral part of insulation that cannot be washed off or worn off. The insulation material shall give enhanced level of protection against harmful Microbes such as bacteria, mold, mildew and fungi and should confirm to following standards: EN ISO 846 Method A - Fungi / Mould Resistance and EN ISO 846 Method C – Bacterial Resistance. The base insulation material shall be ROHS (Resistance of Hazardous Substance) complaint. The base insulation material shall have ODP (Ozone Depletion Potential) and GWP (Global Warming Potential) of Zero.

Thickness of the insulation shall be as specified for the individual application. The insulation material shall be installed as per manufacturer's recommendation.

The sample of insulation material shall be submitted for approval to the Engineer in Charge and the sample shall be tested for thermal conductivity values by the bidder at his own expense. Adhesive used for setting the insulation shall be non-flammable, vapour proof, CPRX compound. All joints on the insulation should be sealed with good quality sticking compound. All joints should be covered with 2" wide insulation tape of same material.

ACOUSTIC INSULATION

All low-pressure ductwork shall be lined with acoustic insulation up to the first take off point, or minimum 3meters from the fan / unit outlet. Acoustic insulation material shall be Open Cell Engineered Nitrile Rubber foam.
The acoustic insulation material shall be dust and fibre free. The acoustic insulation material shall have good sound absorption, damping and barrier properties. The density of acoustic insulation material shall be within 140-180 Kg/m3.

The acoustic insulation material shall have Microban antimicrobial product protection, and shall pass Fungi / Mould Resistance as per EN ISO 846 method A and Bacterial Resistance as per EN ISO 846 method C, from an independent testing agency.

The acoustic insulation material shall have a thermal conductivity not exceeding 0.047 W/(mK) @ 20 Deg. C as per EN 12667. The acoustic insulation material shall withstand temperature of +85 Deg.C and minimum surface temperature of -20 Deg.C as per EN 14706.
Thickness of the insulation shall be as specified for the individual application. The insulation material shall be installed as per manufacturer's recommendation.

The Random Incidence Sound Absorption Coefficient (RISAC) of the material - Tested as per EN ISO 354:2003, EN ISO 11654:1997 & ASTM C 423. Liner will be attached by a fire-resistant adhesive such as Foster 81-99, or equivalent. In addition, a galvanized steel mesh (size 10) or 0.5mm perforated Aluminum sheet having 3mm perforations held in place with self-adhesive fasteners to prevent erosion of the liner. All abutting edges must be caulked and at the extremities of lining shall have a sheet metal nosing of at least 40 mm length.

h) Testing

After completion of ducting, the entire system shall be tested for air leakages.
The maximum allowable air leakage shall be 10% on commissioning of the plant, the entire air distribution system shall be balanced to supply the required air quantities to various regions and rooms to maintain the specified inside conditions. The readings of air quantities, after final balancing of the system, through each register, diffuser or grille shall be recorded and submitted to the Engineer-in-Charge.

PLUMBING

1. SANITARY & PLUMBING WORK

1.1. BASIS OF DESIGN

The Plumbing, Sanitary& Drainage System for the project is designed keeping in view the following:
Requirement of adequate and equal pressure availability of water lines in toilets and sinks.
Two toilets one for male and one for females should be planned.

Adequate storage of water in underground domestic water tanks in necessary areas. Levels of roads / pavements and other services in the area of project.

The execution of works and materials used shall be as per the latest relevant I.S. specifications. Wherever reference has been made to Indian Standard or any other specifications, the same shall mean to refer to the latest specification irrespective of any particular edition of such specification being mentioned in the specifications below or Schedule of Quantities.

1.1.1 Water and Waste Management: A water management system should be in place to handle runoff from aircraft cleaning, painting, and chemical spills. The system should include separation and filtration of hazardous materials.

1.1.2 Waste Disposal: Proper disposal mechanisms should be in place for used paints, solvents, and other hazardous waste in compliance with local environmental regulations.

1.2. CONCEPT OF THE SYSTEM

The following services are envisaged for the project:

Gravity distribution of water from Terrace tanks towards user points is also provided. Sewage and Sullage collection system is based on IS: 1742 and applicable standards for domestic drainage. The sanitary system inside buildings shall be two pipe systems as per National Building Code, in which the soil and waste pipes shall be distinct with common vent. The rain water from building roof shall be directed down at appropriate slope and suitable size down pipe provided at the edge of the roof. No rainwater harvesting has been considered in the current scope of work.

2. SCOPE

The scope of this section comprises the supply, installation, testing and commissioning of piping network for water supply for internal & external services as follows:

a) Potable Water Supply- This section covers the Drinking water distribution from the OH tank for each building.
b) The Bidder shall make all necessary application and arrangements for his work to be inspected by the Local Authorities.
c) The Bidder shall be solely responsible for obtaining the Authorities approval of his works prior to the handing over of the complete water supply / distribution installation to the Department.

2.1. GENERAL

a) All sanitary fixtures, CP Fittings and CP/SS accessories shall be supplied at site of work as per manufacturers' standard supply.
b) All fixtures and fittings shall be provided with all such accessories and fixing devices as are required to complete the item in working condition, even if the same is not specifically mentioned the Bill of Quantities, Specifications or shown on the drawings. The rate quoted will include all devices for proper fixing arrangement, nuts, bolts, screws and required connection pieces etc.
c) Fixing screws shall be half round head stainless steel wood screws or bolts with Stainless Steel washers. Iron screws rust and will not be permitted.
d) All fittings and fixtures shall be fixed in a neat workmanlike manner true to level and heights shown on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken

to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at Bidder's cost.

e) Cut outs and cores shall be packed with non-shrink grout followed by pasting with polyurethane compound thus making water tight. Water shall be filled in slab and checked.
f) Location of medical equipment that require plumbing shall be confirmed with the client before execution.
g) The bidder shall check the toilets floor slabs during shuttering period. They shall make sure that no beams protrude into the sunken floor space. The top of secondary beams within the toilet shall be flush with the top of sunken floor slab.
h) If the floor slab is raised to conceal the drainage pipes, then the height of rise shall be checked and coordinated with the civil bidder.

3. PLUMBING FIXTURES

3.1. SANITARY FIXTURES AND FITTINGS

Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the CP/sanitary fixtures as required by the drawings, specified hereinafter and given in the Schedule of Quantities.

Fittings shall conform to the GRIHA norms and must be of matching IS Specification. Interchange of fittings of one standard with fittings on the other standard will not be permitted.

3.1.1. CP FITTINGS

a) Pillar Tap for Wash Basins shall be 15mm. CP Pillar Tap (Strictly Quarter turn Type with Min 50mm Length Spatula Lever), Aerator for Cold & Hot Water Supply (overall dimensions: 115 x 120mm. or equal) including all other necessary accessories.
b) C.P. long body tap with aerator type, both cold &hot water supply shall be of 15mm. nominal bore, 177mm. long for toilets, with wall flanges and all other necessary accessories, all as per manufacturer's instructions and to the approval of the engineer-in-charge.
c) Health Faucet shall be of durable and long lasting with 15mm. cp braided hose, hook and all other necessary accessories, all as per manufacturer's instructions and to the approval of the engineer-in-charge.
d) C.P. shower set, for cold and hot water bath shall be of commercial range, complete with concealed bath mixer exposed control, unit head shower, shower arm etc, complete set, including all necessary accessories.
e) C.P. brass angle valve shall be durable and long lasting, approved quality conforming to is: 8931 (a) 15 mm nominal bore.
f) Single Lever Surgical Purpose Elbow Action Sink Mixer with aerator Extended Operating Lever, connecting legs & wall flanges, 15mm. nominal bore including all necessary accessories.
g) C.P. Brass concealed valve with exposed part for Cold Bath only shall be of Commercial Range from reputed manufacturers, complete with Concealed Valve & Exposed Control Unit complete set including all necessary accessories.

3.1.2. WATER CLOSET (EUROPEAN) & URINAL

Wall mounting type water closet and urinal shall be white glazed vitreous china extended wall

mounted type, as per IS: standards, Prefer Rimless wall hung WC with soft close seat cover, hinges, accessories set confirming to green building norms through selection of low flow fix by 50%.

Each W.C. set shall be provided with an approved type of plastic seat of approved finish compatible and fitting appropriately with the WC set with rubber buffers and hinges. The WC seat shall be those approved and accepted for fixing on a particular type of WC.

3.1.3. HEALTH FAUCET SPRAY

A chromium plated spray with integral hand control valve and connected to a flexible pipe and angle valve with wall flange and hook shall be provided as shown on the drawings or directed by the Engineer-in-charge.

3.1.4. WASH BASIN

Wash basins shall be of white vitreous china flat back conforming to IS 2556 (Part-I) and IS 2556 (Part-4).Wash basins of flat back as specified shall be of one-piece construction, including a combined overflow. All internal angles shall be designed so as to facilitate cleaning.

Each basin shall have a rim on all sides, except sides in contact with the walls and shall have a skirting at the back. Basins shall be provided with single or double tap holes as specified. The tap holes shall be 28 mm square or 30 mm round or 25 mm round for pop up hole. A suitable tap hole button shall be supplied if one tap hole is not required in installation.

Each basin shall have circular waste hole to which the interior of basin shall drain. The waste hole shall be either rebated or beveled internally with dia meter of 65 mm at top. Each basin shall be provided with a non-ferrous 32 mm waste fitting.

Stud slots to receive the brackets on the underside of the wash basin shall be suitable for a bracket with stud not exceeding 13 mm diameter, 5 mm high and 305 mm from the back of basin to the centre of the stud. The stud slots shall be of depth sufficient to take 5 mm stud. Every basin shall have an integral soap holder recess or recesses, which shall fully drain into the bowl. A slot type of overflow having an area of not less than 5 sq. cm, shall be provided and shall be so designed as to facilitate cleaning of the overflow.

Flat back wash basin of size 550x400mm with single 15 mm C.P. brass pillar taps will be used.

3.1.5. TOILET ACCESSORIES

Accessories shall be of any of the following types for both toilets:

a) Towel rails
b) Towel rings
c) Coat hooks
d) Soap dishes
e) Paper holder
f) Mirrors

Accessories shall be fixed with stainless steel half round head screws and cup washers in wall with

rawl plugs or nylon sleeves and shall include cutting and making good.

Porcelain accessories shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand) and fixed in relation to the tiling work. The flange of the recessed fixture shall cover the recess in the wall fully.

Rates for all items mentioned above shall be inclusive of cutting holes and chases and making good the same, stainless-steel screws, nuts, bolts, fastener and any fixing arrangements required and recommended by manufacturers, testing and commissioning.

4. WATER SUPPLY

Water supply pipes shall be CPVC for concealed work, UPVC SCH 40 for the exposed work or in trenches/shaft designated by their nominal diameters. Pipes up to 50mm diameter shall be SDR11. Pipes above 50mm shall be SCH 40.

Pipe and fittings shall be joined with screwed joints, after cutting a pipe with a hacksaw or a cutting machine care shall be taken to remove burr from the end of the pipe after reaming with a proper file.

Pipe threaded joints will be made by applying suitable grade of TEFLON tape used for drinking water supply. (Use of red and white lead sutli will not be permitted for screwed joints)

All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. CPVC pipes inside shall be fixed in wall chases well above the floor. No pipes shall be run inside a sunken floor as far as possible. Pipes may be run under the ceiling or floors and other areas as shown on drawings.

All pipes and fittings shall have the approved manufacturer name and class embossed on them.

Pipe line for eye wash stations to be provided in the scope.

4.1.CPVC PIPES

All CPVC pipes and fittings for water supply shall be according to requirements of ASTM D 2846 or ASTM F441/442 (SDR11) and rated at a continuous working pressure of 7kg/cm2 at 180O F (82OC). The solvent cement used for CPVC pipes and fittings shall conform to ASTM F 493.

CPVC fittings shall conform to ASTM F 438 for SCH 40 pipes and ASTM F 439 for SCH 80 pipes. The terminal fittings for jointing fixtures shall be brass threaded Male/Female type as per ASTM 437.

4.1.1. LAYING & JOINTING

The pipes may be cut to the required lengths using circular tubing cutters, Ratchet type cutters or chop saws. The cuts shall be square. Burrs and filings shall be removed from outside and inside of the pipes using a chamfering tool.

For jointing CPVC pipes special solvent cement is required. The cement may be applied by a paint brush to the end surfaces to be jointed. The surfaces are to be dry before solvent cement is applied.

A heavy even coat of solvent cement may be applied. Excess solvent cement shall not be allowed to puddle in the fitting and pipe assembly. The pipe may then be rotated to one quarter to half turn while inserting into the fitting socket. When the pipe end is seated it may be held in place for ten seconds to allow the joint to set. Teflon tape may be used as thread sealant.

4.1.2. CLAMPS

CPVC pipes in the shaft and other locations shall be supported by clamps of design approved by Engineer-In-Charge. Pipes in wall chases shall be anchored by hooks. Pipes at ceiling level shall be supported on structural clamps.

Spacing of clamps, hooks etc. Shall be as per good engineering practice approved by the Engineer-in-charge.

4.1.3. UNIONS

Bidder shall provide adequate number of unions on pipes 50mm and below to enable easy dismantling later when required. Unions shall be provided near each gunmetal valve, stop clock, or check valve and go on straight runs as necessary at appropriate locations as required and/or direct by Engineer-In-Charge.

4.1.4. FLANGES

Flanged connections shall be provided on pipes 65 mm and above as required or where, shown on the drawings generally as follows:

a) At connections to main branch lines.
b) On all valves ends
c) On equipment/pump connections as necessary and required or as directed by Engineer – in - charge.
d) Flanged connections shall be made by the correct number and size of the bolts and made with 3 mm thick insertion neoprene gaskets Bolt hole dia. for flanges shall conform to match the specification for valve.

4.1.5. LINES IN 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
15 mm to 50 mm	30 cm	75 cm
65 mm to 100 mm	45 cm	100 cm

*The minimum cover for pipes is 100cm in road crossings.

4.1.6. TESTING

Water testing to a pressure of 10 kg/ cm2 may be carried out for CPVC SDR 11 piping system. Air testing shall not be done. Other gases shall also not be used for testing.

Hydrostatic pressure testing should commence only after all set and cure times for solvent cemented joints have been satisfied.

The system should be pressure tested in accordance with local code requirements following industry accepted practices for thermoplastic systems.

Under slab installations that contain joints must be pressure tested before pouring the slab. CPVC Solvent Cemented Hot and Cold-Water Distribution Systems," requires a test at 150 psi (10 kg/ cm2) for 2 hours.

In freezing temperatures, the system should be adequately purged of water after testing to avoid damage from freezing.

In addition to the sectional testing carried out during the construction, Bidder 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 Bidder during the defect's liability period without any cost.

4.2.UPVC PIPES

All Internal Cold Water Supply Pipe Work shall be with High Pressure uPVC Pipes, Sch. 40 (ASTM D 1785) and Sch. 40 (ASTM D 2466) Fittings. The Solvent Cement shall be one step for pressure pipes and fittings from the same manufacturer.

All the out let points, for concealed pipe work in Toilets, Kitchen and Pantries, for fixing angle valves, taps etc, shall be with 15mm. brass female threaded end fittings, from the same manufacturer.

Cold Water Supply Pipe Work for Treated Water Transfer / Pumping Line and Pipe Work at Terrace / Roof ring shall be with High Pressure uPVC Pipes, Sch. 80 (ASTM D 1785) and Sch. 80 (ASTM D 2467) Fittings.

4.2.1. PIPE JOINTING

Consists essentially of a solution of vinyl chloride polymer or copolymer dissolved in a suitable volatile mixture of organic solvents. The solvent constituents soften the mating surfaces, which diffuse into one another to form a 'cold weld'.

Solvent cement is available in three grades of viscosity as given below to cover a range of pipe sizes from 20 mm to 630 mm. Sufficient solvent cement shall be applied so that a wet film thickness adequate enough to fill a gap in a pipe joint is formed. Selection is also dependent on the climatic conditions prevalent at the site.

4.2.2. TESTING

The recommended selection of test pressure is either the nominal pressure PN of the piping system (lowest PN of any component), or 1.5 times the actual operating pressure, whichever is greater.

The volume of water added is an allowance made to compensate for the natural expansion/movement of the pipe and flexible joints under pressure and for the inevitable entrapment of small amounts of air within the test length. In bubble form, this air compresses and may pass in and out of solution at test pressures.

4.3.VALVES

All valves shall be of the particular duty and design as specified. Valves shall either be of screwed type or flanged type, as specified, with suitable flanges and non-corrosive bolts and gaskets. Tail pieces as required shall be supplied along with valves.

4.3.1. BALL VALVES

The Ball Valve of size below 50 mm dia shall be made from forged brass and tested to 20 Kg/ cm^2 pressure. The valve shall be internally threaded to receive pipe connections. The Ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body bonnet gasket and gland packing shall be of Teflon.

The handle shall be of chrome plated steel with PVC jacket. The handle shall also indicate the direction of 'open' and 'closed' situations. The gap between the ball and the Teflon packing shall be sealed to prevent water seeping upto 14 Kg / cm^2 pressure. The handle shall also be provided with a lug to keep the movement of the ball valve within 90 degrees.

Strainers shall be of the approved type with SS body with SS304 Strainer Basket designed to the test pressure of 10 Kg/ cm^2. Strainers shall be fabricated with minimum 1.2mm thick stainless-steel sheet with 3 mm dia. perforation holes. Strainers shall be provided with flanges or threaded sockets as required. They shall be designed so as to enable blowing out accumulated dirt and facilitate removal and replacement of screen without disconnection of the main pipe.

4.4.BASIC PIPING SYSTEM

Soil, waste and vent pipes in shafts, and in concealed areas i.e. false ceilings etc. shall consist of PVC Pipes 6 kg/cm2 /PVC Pipes 4 kg/cm2 & fittings as called for. The sizes are specified in the Schedule of Quantities.

The rain water down taking system shall also consist PVC 6 kg/cm2 pipes as per IS 4985 and required Specifications for all diameters. The sizes are specified in the Schedule of Quantities.

The soil pipes shall be circular with a minimum diameter of 100mm. Pipes shall be fixed by means of stout GI clamps in two sections, bolted together, built into the walls, wedged and neatly jointed as directed and approved by the Engineer In-Charge.

All bends, branches, swan necks and other parts shall conform to the requirement and standards as described for the pipes. Pipes shall be rested against the walls on suitable wooden cradles.

Local authority regulations applicable to the installations shall be strictly followed.

Where indicated, the soil pipes shall be continued upwards without any diminution in its diameter, without any bend or angle to the height shown in the drawings. Joints throughout shall be made with molten lead as described under jointing of cast iron pipes.

Soil pipes shall be painted as provided under `painting'. The soil pipes shall be covered on top with cast iron terminal outlets as directed and approved by Engineer in charge. All vertical soil pipes shall be firmly fixed to the walls with properly fixed clamps, and shall as far as possible be kept 50mm clear of wall. Waste pipes and fittings shall be of pvc pipes. Pipes shall be fixed, jointed and painted as described in installation of soil, waste & vent pipes.

Every waste pipe shall discharge above the grating of properly trapped gully. The bidder will ensure that this requirement is adequately met with. Wherever floor traps are provided, it shall be ensured that at least one wash is connected to such floor traps to avoid drying of water seal in the trap.

Ventilating pipes shall be of cast iron or galvanize iron pipes, conforming to the requirements laid down earlier. Anti-syphon vent pipes/relief vent pipes where called for on the drawings shall be of cast iron or galvanized iron pipes a specified. The pipes shall be of the diameter shown on the drawings.

All traps on branch soil and waste pipes shall also be ventilated at a point not less than 75mm or more than 300mm from their highest part and on the side nearest to the soil pipe or waste pipes
.
Access doors for fittings and clean outs shall be so located that they are easily accessible for repair and maintenance. Any access panel required in the civil structure, false ceiling or marble cladding etc. shall be clearly reported to the Department in the form of shop drawings so that other agencies are instructed to provide the same.

All the fittings used for connections between soil, waste and ventilation pipes and branch pipes shall be made by using pipe fittings with inspection doors for cleaning. The doors shall be provided with 3mm thick rubber insertion packing and when closed and bolted shall be air and water tight.

Where soil, waste and ventilating pipes are accommodated in shafts, adequate access to cleaning eyes shall be provided.

Head (starting point) of drains and sewage / waste water sumps (as and where applicable) having a length of greater than 4 m up to its connection to the main drain or manhole shall be provided with a 80 / 100 mm vent pipe.

Application

a) PVC 6 kg/cm2 pipes are for concealed sewage works inside building

b) PVC 4 kg/cm2 pipes are for vent piping works.
c) PVC 4 kg/cm2 pipes (100mm dia to 200mm dia) for rain water pipes located within the core of the building

4.4.1. SOIL WASTE PIPE

a) The Soil & Waste pipe system above ground has been planned as a “two pipe system" as defined in BIS: The system of plumbing in which soil and waste pipes are distinct and separate. The soil pipes being connected to drain direct and waste pipes through trapped gully. The AHU condensate drain, in central air conditioning, shall be led to underground recharge pits via dedicated gully trap. The waste water coming from urinal enter manhole via dedicated gully trap.
b) Waste water from AHU's plant and pump rooms, floor channels in basements will be provided with a deep seal trap before connecting to the main drain or vertical stack.
c) Vertical soil & waste stacks descending inside the building shall connect to horizontal transition pipes leading to the exterior of the building before dropping to the yard.
d) Materials as specified in the BOQ.

4.4.2. JOINTING

a) Pipes shall be jointed using manufacturer approved solvent cement as per manufacturer specifications and relevant IS codes.
b) Soil, Waste and Rain water pipes shall be jointed with utmost care. The plumber shall double check each joint before progressing to next. Pipe leak identified during testing shall be rectified.

4.4.3. FITTINGS

a) Fittings shall conform to the same Indian Standard as for pipes. Pipes and fittings must be of matching IS Specification. Interchange of pipes of one standard with fittings on the other standard will not be permitted.
b) Fittings shall be of the required degree of curvature with or without access door.
c) Access door shall be easily accessible. The threads of the door and pipe fitting shall be thoroughly cleaned and fastened well before testing.

4.4.4. FIXING

a) All vertical pipes shall be fixed by structural support clamps truly vertical. 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).
b) Horizontal pipes running along ceiling shall be fixed on structural adjustable clamps (Clevis clamps) of special design shown on the drawings or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them.
c) Bidder shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the Engineer-In-Charge/ Building Bidder for making such provisions in the structure as necessary. All damages shall be made good to restore the surfaces.

4.5.TRAPS

4.5.1. GRATINGS FOR TRAPS

Muli floor trap shall be provided with 100-150mm square or round C.P./ Stainless steel grating/ PTMT, with rim of approved design and shape as per BOQ.

4.5.2. WASTE PIPE FROM APPLIANCES

Waste pipe from appliances e.g. washbasins, sinks and urinals shall be of uPVC /SWR as given in the Schedule of Quantities or shown on the drawings.

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 good engineering practice approved by the Engineer-In-Charge.

4.5.3. CUTTING AND MAKING GOOD THE DAMAGE

Pipes shall be fixed and tested as building proceeds. Bidder shall provide all necessary holes 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 sands: 4 stone aggregate 20 mm nominal size) or brick work in cement mortar 1:2 (1 cement: 2 coarse sand) and the surface restored as in original condition.

Cores in slabs shall be packed as per standard procedure mentioned and shall not be paid separately.

4.5.4. TESTING

1. Testing procedure specified below apply to all soil, waste and vent pipes above ground including pipes laid in basement ceiling.
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. Bidder 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 shall be certified for its calibration by an approved laboratory.
3. All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site. All testing equipment must be calibrated and shall carry certificate from an approved laboratory.
4. Testing soil, waste and rainwater pipes
5. The entire installation shall be tested by smoke testing machine. The test can be conducted after the plumbing fixtures are installed and all traps have water seal or by plugging all inlets by bellow plugs. Apply dense smoke keeping the top of stack open an observe for leakages. Rectify or replace defective sections.
6. 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.
7. Bidder shall maintain a test register identifying date and time of each area. All tests shall be conducted in presence of Engineer-in-charge and signed by both.

4.5.5. MEASUREMENT

1. Rates for all items quoted shall be inclusive of all work and items given in the specifications and Schedule of Quantities.
2. Rates are applicable for the work under floors, in shafts at ceiling level area for all heights and depths.
3. Rates are inclusive of cutting holes and chase in RCC and masonry work and making good the same.
4. Rates are inclusive of pre testing, on site testing, of the installations, materials and commissioning of the works.
5. Pipes (Unit of measurement, linear meter to the nearest Centimeter) or as specified in specifications.
6. All SWR/ RCC Soil, waste, vent, anti-syphonage and rain water pipes shall be measured net when fixed correct to a centimeter including all fittings along its length.
7. Pipes shall be measured per running metre correct to a centimeter for the finished work which shall include fittings e.g., bends, tees, elbows, reducers, crosses, sockets, nipples and nuts. The length shall be taken along center 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 as specified in the schedule of quantities. The pipes shall be described as including all cutting and waste. In case of fittings of unequal bore, the largest bore shall be measured.
8. Cement concrete pipes shall be measured along the center of the pipe line measured per linear metre and include any masonry supports, shuttering and centering cutting complete as described in the relevant specifications.
9. Slotted angles/channels shall include threaded rods, bolts, nuts and clamps embedded in masonry walls with cement concrete blocks or fixed to concrete slabare included in the rate of pipes and nothing will be paid extra for the same.
10. Fittings
11. Nothing extra will be paid for fittings. Pipe fittings are included in the rate of pipes.
12. Excavation for soil pipes
13. 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.
14. Engineer-in-charge's decision with respect to the correct interpretation regarding mode of measurement shall be final and binding on the bidder.

4.5.6 Effluent Treatment Plant (ETP) & Water Curtain System

The primary purpose of an Effluent Treatment Plant in hangar is to treat the wastewater generated from activities such as:

- Aircraft washing
- Aircraft painting
- Chemical cleaning

The ETP should ensures that all effluents are treated to meet environmental and safety standards before being discharged into the environment or reused in the hangar operations.

Components of an ETP in a Hangar

1. Pre-Treatment Stage:
   - Screening: The first stage of the treatment process involves screening out large particles and solid waste (e.g., oils, greases, paint chips, and debris) from the wastewater.
   - Oil and Grease Separation: Since aircraft maintenance and cleaning may generate oily wastewater, an oil-water separator is used to remove oil and grease from the effluent. This can include a coalescing plate separator or API separator.
2. Primary Treatment:
   - Sedimentation: This process involves settling out suspended solids and larger particulates. It may use primary clarifiers or settling tanks to allow particles to settle at the bottom, thus separating them from the water.
3. Secondary Treatment:
   - Biological Treatment: For organic contaminants in the effluent, a biological treatment process is used. This can include activated sludge or bioreactors that utilize microorganisms to break down organic material.
   - Aeration: In some cases, aeration tanks are used to introduce oxygen into the wastewater, promoting the growth of bacteria that digest organic contaminants.
4. Tertiary Treatment (if needed):
   - Filtration: To further purify the effluent, filtration systems such as sand filters, activated carbon filters, or membrane filtration may be used.
   - Disinfection: Disinfection processes like UV light treatment or chlorination can be employed to kill harmful microorganisms in the treated effluent.
5. Sludge Management:
   - The treatment process produces sludge (solid waste), which must be properly managed. This could involve dewatering (using centrifuges or filter presses) to remove excess water from the sludge before disposal or further treatment.
6. Recycling and Reuse:

   The treated effluent may be recycled and reused within the hangar for non-potable purposes such as cleaning and washing aircraft, reducing the overall water consumption and wastewater generation.

Water Curtain System for Paint Booths

Water Curtain System is an essential air purification and safety feature in aircraft painting booths. It helps maintain a clean and hazard-free working environment by capturing overspray and paint fumes.

It should be capable of

- Efficient Air Filtration: The system uses a continuous sheet of water to trap airborne paint particles and fumes, which are then carried away with the water stream.
- Improved Safety and Cleanliness: By capturing overspray at the source, it significantly reduces airborne contaminants and flammable vapors, enhancing worker safety and booth cleanliness.
- Sustainable Operation: Unlike dry filter booths that use disposable paper or mesh filters, water curtain systems are designed for continuous operation with the potential for water recirculation.
- Design and Water Management Considerations-should be according to EIC.

FIRE ALARM SYSTEM as per the specified standard.

1. SCOPE

This specification is intended to cover engineering, manufacture, procurement, test and inspection at works, packing for transportation, delivery to site, erection, testing, commissioning, performance, demonstration at site and handing over to purchaser of Fire Protection and Fire Alarm System as indicated in the Schedule of Requirement and scope of work and as required for reliable and effective fire protection for Owner/ Engineer in charge.
Unless specifically mentioned otherwise, all the applicable Codes and Standards published by the Bureau of Indian Standards and their subsequent revision / BS Standards shall govern in respect of design, workmanship, quality and properties of materials and method of testing; standards listed below shall be applicable, in particular:

PART 1 GENERAL

1.1 DESCRIPTION

A. The fire alarm system shall comply with requirements of NFPA 410 & NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.

B. The facility shall have an emergency voice alarm communication system. Digitally stored message sequences shall notify the building occupants that a fire or life safety condition has been reported. Message generator(s) shall be capable of automatically distributing up to eight (8) simultaneous, unique messages to appropriate audio zones within the facility based on the type and location of the initiating event. The Fire Command Center (FCC) shall also support Emergency manual voice announcement capability for both system wide or selected audio zones, and shall include provisions for the system operator to override automatic messages system wide or in selected zones.

C. The system shall support additional, alternate Fire Command Centers, which shall be capable of simultaneous monitoring of all system events. Alternate Fire Command Centers shall also support an approved method of transferring the control functions to an alternate Fire Command Center when necessary. All Fire Command Centers shall be individually capable of assuming Audio Command functions such as Emergency Paging, audio zone control functions, and Firefighter's Telephone communication functions.

D. Each designated zone shall transmit separate and different alarm, supervisory and trouble signals to the Fire Command Center (FCC) and designated personnel in other buildings at the site via a multiplex communication network.

1.2 SCOPE

A. A new intelligent reporting, microprocessor-controlled fire detection system shall be installed in accordance to the project specifications and drawings.

B. Basic Performance:

1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Class A Signaling Line Circuits (SLC).
2. Device Circuits (IDC) shall be wired NFPA Class A as part of an addressable device connected by the SLC Circuit.
3. Notification Appliance Circuits (NAC) shall be wired NFPA Class A as part of an addressable device connected by the SLC Circuit.
4. On Class A configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
5. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.
6. Speaker circuits may be controlled by NAC outputs built into the amplifiers, which shall function as addressable points on the Digital Audio Loop.
7. NAC speaker circuits shall be arranged such that there is a minimum of one speaker circuit per floor of the building or smoke zone whichever is greater.
8. Audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions.
9. NAC speaker circuits and control equipment shall be arranged such that loss of any one (1) speaker circuit will not cause the loss of any other speaker circuit in the system.

   Two-way emergency telephone communication circuits shall be supervised for open and short circuit conditions.

   Speaker circuits shall be arranged such that there is a minimum of one speaker circuit per smoke zone.

   Speaker circuits shall be electrically supervised for open and short circuit conditions. If a short circuit exists on a speaker circuit, it shall not be possible to activate that circuit.
10. Audio amplifiers and tone generating equipment shall be electrically supervised for abnormal conditions. Digital amplifiers shall provide built-in speaker circuits, field configurable as four Class B, or two Class A circuits.
11. Digital amplifiers shall be capable of storing up to two minutes of digitally recorded audio messages and tones. The digital amplifiers shall also be capable of supervising the connection to the associated digital message generator, and upon loss of that connection shall be capable of one of the following system responses:

    a. The digital amplifier shall automatically broadcast the stored audio message.
    b. The digital amplifier shall switch to a mode where a local bus input on the digital amplifier will accept an input to initiate a broadcast of the stored message. This bus input shall be connected to a NAC on a local FACP for the purpose of providing an alternate means of initiating an emergency message during a communication fault condition.
    c. Speaker circuits shall be either 25 VRMS or 70VRMS. Speaker circuits shall have 20% space capacity for future expansion or increased power output requirements.
    d. Two-way emergency telephone (Fire Fighter Telephone) communication shall be supported between the Audio Command Center and up to thirty (30) remote Fire Fighter's Telephone locations simultaneously on a conference in multiple FFT Risers.
    e. Means shall be provided to connect FFT voice communications to the speaker circuits

in order to allow voice paging over the speaker circuit from a telephone handset.

f. The digital audio message generator shall be of reliable, non-moving parts, and support the digital storage of up to 32 minutes of tones and emergency messages, shall support programming options to string audio segments together to create up to 1000 messages, or to loop messages and parts of messages to repeat for pre-determined cycles or indefinitely.

1.3 GENERAL INSTRUCTIONS

a) Protect from moisture by using appropriate coverings. Store at dry interior locations.

b) Sequence work to avoid interferences with building finishes and installation of other products.

c) Supply as maintenance stock, consumable devices, components as recommended by Supplier, but shall not be less than two units of each type/ rating of installed consumable material/ component/ device.

d) For ease of service all panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity for #18 to #12 AWG wire. Terminal blocks that are permanently fixed are not acceptable.

1.6 APPLICABLE STANDARDS AND PRODUCT APPROVALS

A. The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.

B. National Fire Protection Association (NFPA) - USA:

NFPA 410	Standard on Aircraft maintenance.
NESHAP	National Emission Standards for Hazardous Air Pollutants.
OSHA	Occupational Safety and Health Administration
NFPA 70	National Electric Code
NFPA 90A	Air Conditioning Systems
NFPA 92A	Smoke Control Systems
NFPA 92B	Smoke Management Systems in Malls, Atria, Large Areas
NFPA 72	National Fire Alarm Code
NFPA 101	Life Safety Code

C. Underwriters Laboratories Inc. (UL) - USA:

UL 268, 7th Edition	Smoke Detectors for Fire Protective Signaling Systems
UL 864, 10th Edition	Control Units for Fire Protective Signaling Systems
UL 2572	Mass Notification Systems
UL 217	Smoke Detectors, Single and Multiple Station
UL 228	Door Closers - Holders for Fire Protective Signaling Systems

UL 268A	Smoke Detectors for Duct Applications
UL 521	Heat Detectors for Fire Protective Signaling Systems
UL 464	Audible Signaling Appliances
UL 38	Manually Actuated Signaling Boxes
UL 1481	Power Supplies for Fire Protective Signaling Systems
UL 346	Waterflow Indicators for Fire Protective Signaling Systems
UL 1076	Control Units for Burglar Alarm Proprietary Protective Signaling Systems
UL 1971	Visual Notification Appliances
UL 2017	Standard for General-Purpose Signaling Devices and Systems
UL60950	Safety of Information Technology Equipment

D. Factory Mutual – USA
E. Local and State Building Codes.
F. All requirements of the Authority Having Jurisdiction (AHJ).
G. The system shall be certified for seismic applications in accordance with the International Building Code (IBC). The basis for qualification of seismic approval shall be via shake table testing.
H. The System shall be FM 6320 (Factory Mutual) approved as a Gas Detection system when employed with the 4-20 monitor module and industry standard 4-20 mA gas detectors.

1.7 PART 2.0 PRODUCTS

MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE:

A. Main FACP or network node shall contain a microprocessor based Central Processing Unit (CPU) and power supply. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, and other system-controlled devices.

B. In conjunction with intelligent Loop Control Modules and Loop Expander Modules, the main FACP shall perform the following functions:

1. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
2. Supervise all initiating signaling and notification circuits throughout the facility by way of connection to addressable monitor and control modules.
3. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed.

System Capacity and General Operation

A. The FACP shall can communicate on a peer-to-peer, inherently regenerative communication format and protocol. The network shall support communication speed up to 100 Mbps and support up to 200 panels / nodes per network.
B. The control panel shall be capable of expansion via up to 10 SLC loops. Each loop shall

support minimum 300 analog/addressable devices for a system capacity of 3000 points. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit 600-character liquid crystal display, individual, color coded system status LEDs, and a QWERTY keypad for the control of the fire alarm system. Said LCD shall also support graphic bit maps capable of displaying the company name and logo of either company.

C. All programming or editing of the existing program in the system shall be achieved without interrupting the alarm monitoring functions of the fire alarm control panel.

D. The FACP shall be able to provide the following software and hardware features:

1. Pre-signal and Positive Alarm Sequence: The system shall provide means to cause alarm signals to only sound in specific areas with a delay of the alarm from 60 to up to 180 seconds after start of alarm processing. In addition, a Positive Alarm Sequence selection shall be available that allows a 15-second time period for acknowledging an alarm signal from a fire detection/initiating device. If the alarm is not acknowledged within 15 seconds, all local and remote outputs shall automatically activate immediately.
2. Smoke Detector Pre-alarm Indication at Control Panel: To obtain early warning of incipient or potential fire conditions, the system shall support a programmable option to determine system response to real-time detector sensing values above the programmed setting. Two levels of Pre-alarm indication shall be available at the control panel: alert and action.
3. Alert: It shall be possible to set individual smoke detectors for pre-programmed pre-alarm thresholds. If the individual threshold is reached, the pre-alarm condition shall be activated.
4. Action: If programmed for Action and the detector reaches a level exceeding the pre-programmed level, the control panel shall indicate an action condition. Sounder bases installed with either heat or smoke detectors shall automatically activate on action Pre-Alarm level, with general evacuation on Alarm level.
5. The system shall support a detector response time to meet world annunciation requirements of less than 3 seconds.
6. Device Blink Control: Means shall be provided to turn off detector/module LED strobes for special areas.
7. NFPA 72/NFPA 409/NFPA 410 Smoke Detector Sensitivity Test: The system shall provide an automatic smoke detector test function that meets the sensitivity testing requirements of NFPA.
8. Programmable Trouble Reminder: The system shall provide means to automatically initiate a reminder that troubles exist in the system. The reminder will appear on the system display and (if enabled) will sound a piezo alarm.
9. On-line or Off-line programming: The system shall provide means to allow panel programming either through an off-line software utility program away from the panel or while connected and on-line. The system shall also support upload and download of programmed database and panel executive system program to a Personal Computer/laptop. A single change to one CPU database shall not require a database download to other CPUs.
10. History Events: The panel shall maintain a history file of at least last 5000 events, each with a time and date stamp. History events shall include all alarms, troubles, operator actions, and programming entries. The control panels shall also maintain a 1000 event Alarm History buffer, which consists of the 1000 most recent alarm events from the 5000-event history file.
11. Smoke Control Modes: The system shall provide means to perform Fire Smoke Control Station mode. This mode controls all dampers, smoke extraction fan, fresh air supply fans,

etc during Fire condition. Smoke Control to meet NFPA-92A and 90B and AHU mode to meet NFPA 90A.

12. The system shall provide means for all SLC devices on any SLC loop to be auto programmed into the system by specific address**.** The system shall recognize specific device type ID's and associate that ID with the corresponding address of the device.
13. Passwords and Users: The system shall support two password levels, master and user. Up to 9 user passwords shall be available, each of which may be assigned access to the programming change menus, the alter status menus, or both. Only the master password shall allow access to password change screens.
14. Block Acknowledge: The system shall support a block Acknowledge for Trouble Conditions
15. Sensitivity Adjust: The system shall provide Automatic Detector Sensitivity Adjust based on Occupancy schedules including a Holiday list of up to 15 days.
16. Environmental Drift Control: The system shall provide means for setting Environmental Drift Compensation by device. When a detector accumulates dust in the chamber and reaches an unacceptable level but yet still below the allowed limit, the control panel shall indicate a maintenance alert warning. When the detector accumulates dust in the chamber above the allowed limit, the control panel shall indicate a maintenance urgent warning.
17. Custom Action Messages: The system shall provide means to enter up to 100 custom action messages of up to 160 characters each. It shall be possible to assign any of the 100 messages to any point.
18. Local Mode: If communication is lost to the central processor the system shall provide added survivability through the intelligent loop control modules. Inputs from devices connected to the SLC and loop control modules shall activate outputs on the same loop when the inputs and outputs have been set with point programming to participate in local mode or when the type codes are of the same type: that is, an input with a fire alarm type code shall activate an output with a fire alarm type code.
19. Read status preview - enabled and disabled points: Prior to re-enabling points, the system shall inform the user that a disabled device is in the alarm state. This shall provide notice that the device must be reset before the device is enabled thereby avoiding activation of the notification circuits.
20. Custom Graphics: When fitted with an LCD display, the panel shall permit uploading of a custom bit-mapped graphic to the display screen.
21. ACTIVE EVENT: The system shall provide a Type ID called FIRE CONTROL for purposes of air-handling shutdown, which shall be intended to override normal operating automatic functions. Activation of a FIRE CONTROL point shall cause the control panel to (1) initiate the monitor module Control-by-Event, (2) send a message to the panel display, history buffer, installed printer and annunciators, (3) shall not light an indicator at the control panel, (4) Shall display ACTIVE on the LCD as well a display a FIRE CONTROL Type Code and other information specific to the device.
22. NON-FIRE Alarm Module Reporting: A point with a type ID of NON-FIRE shall be available for use for energy management or other non-fire situations. NON-FIRE point operation shall not affect control panel operation nor shall it display a message at the panel LDC. Activation of a NON-FIRE point shall activate control by event logic but shall not cause any indication on the control panel.
23. Mass Notification Override: The system shall be UL 2572 listed for Mass Notification and shall be capable, based on the Risk Analysis, of being programmed so that Mass Notification/Emergency Communications events take precedence over fire alarm events.

24. Security Monitor Points: The system shall provide means to monitor any point as a type security.
25. One-Man Walk Test: The system shall provide both a basic and advanced walk test for testing the entire fire alarm system. The basic walk test shall allow a single operator to run audible tests on the panel. All logic equation automation shall be suspended during the test and while annunciators can be enabled for the test, all shall default to the disabled state. During an advanced walk test, field-supplied output point programming will react to input stimuli such as Control by Event and logic equations. When points are activated in advanced test mode, each initiating event shall latch the input. The advanced test shall be audible and shall be used for pull station verification, magnet activated tests on input devices, input and output device and wiring operation/verification.
26. Control By Event Functions: CBE software functions shall provide means to program a variety of output responses based on various initiating events. The control panel shall operate CBE through lists of zones. A zone shall become listed when it is added to a point's zone map through point programming. Each input point such as detector, monitor module or panel circuit module shall support listing of up to 10 zones into its programmed zone map.
27. Permitted zone types shall be general zone, releasing zone and special zone. Each output point (control module, panel circuit module) can support a list of up to 10 zones including general zone, logic zone, releasing zone and trouble zone. It shall be possible for output points to be assigned to list general alarm. Non-Alarm or Supervisory points shall not activate the general alarm zone.
28. 1000 General Zones: The system shall support up to 1000 general purpose software zones for linking inputs to outputs. When an input device activates, any general zone programmed into that device's zone map will be active and any output device that has an active general zone in its map will be active. It shall also be possible to use general zone as arguments in logic equations.
29. 1000 Logic Equations: The system shall support up to 1000 logic equations for AND, OR, NOT, ONLY1, ANYX, XZONE or RANGE operators that allow conditional I/O linking. When any logic equation becomes true, all output points mapped to the logic zone shall activate.
30. 100 trouble equations per device: The system shall provide support for up to 100 trouble equations for each device, which shall permit programming parameters to be altered, based on specific fault conditions. If the trouble equation becomes true, all output points mapped to the trouble zone shall activate.
31. Control-By-Time: A time-based logic function shall be available to delay an action for a specific period of time based upon a logic input with tracking feature. A latched version shall also be available. Another version of this shall permit activation on specific days of the week or year with ability to set and restore based on a 24-hour time schedule on any day of the week or year.
32. Multiple agents releasing zones: The system shall support up to 10 releasing zones to protect against 10 independent hazards. Releasing zones shall provide up to three cross-zone and four abort options to satisfy any local jurisdiction requirements.
33. Alarm Verification, by device, with timer and tally: The system shall provide a user-defined global software timer function that can be set for a specific detector. The timer function shall delay an alarm signal for a user-specified time period and the control panel shall ignore the alarm verification timer if another alarm is detected during the verification period.

C. Central Processing Unit

1. The Central Processing Unit shall contain and execute all control-by-event (including Boolean functions including but not limited to AND, OR, NOT, ANYx, and CROSSZONE) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure.
2. The Central Processing Unit shall also provide a real-time clock for time annotation, to the second, of all system events. The time-of-day and date shall not be lost if system primary and secondary power supplies fail.
3. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.
4. The CPU shall provide an RS-232 interface between the fire alarm control panel and the UL Listed Electronic Data Processing (EDP) peripherals.
5. The CPU shall provide two RS-485 ports for the serial connection to annunciation and control subsystem components.
6. The RS-232 serial output circuit shall be optically isolated to assure protection from earth ground.
7. In the event of CPU failure, all SLC loop modules shall fallback to degrade mode. Systems not offering degrade mode shall offer Redundant CPU. Such degrade mode shall treat the corresponding SLC loop control modules and associated detection devices as conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.

D. Display

1. The system display shall provide a 600-character backlit alphanumeric Liquid Crystal Display (LCD). It shall also provide eleven Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM, SECURITY, SUPERVISORY, SYSTEM TROUBLE, OTHER EVENT, SIGNALS SILENCED, POINT DISABLED, CONTROLS ACTIVE, and CPU FAILURE.
2. These characters shall be only for fire alarm / trouble information and not for Logo or other purpose. It shall be UL Listed. Repeater panel displays in FACP is not allowed unless until approved by UL
3. The system display shall provide a QWERTY keypad for ease of operation.
4. The keypad shall have control capability to command all system functions, entry of any alphabetic or numeric information, and field programming without the use of any external equipment or laptop. Two different password levels with up to ten (one Master and nine User) passwords shall be accessible through the display interface assembly to prevent unauthorized system control or programming.

E. Loop (Signaling Line Circuit) Control Module:

1. The control panel shall be capable of expansion via up to 10 SLC loops. Each loop shall support minimum 300 analog/addressable devices for a system capacity of 3000 points.
2. The Loop Control Module shall contain its own microprocessor and shall be capable of operating in a local/degrade mode (any addressable device input shall be capable of

activating any or all addressable device outputs) in the unlikely event of a failure in the main CPU.

3. Each loop shall maintain 20% spare capacity for future expansion.
4. Each Loop shall be capable of operating as a NFPA Class B circuit in case of single open circuit fault in existing SLC Circuit
5. The SLC interface board shall receive analog or digital information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that particular device. Each SLC Loop shall be isolated and equipped to annunciate an Earth Fault condition. The SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and the automatic determination of detector maintenance requirements.

F. Digital Voice Command Center

1. The Digital Voice Command Center located with the FACP, shall contain all equipment required for all audio control, emergency telephone system control, signaling and supervisory functions. This shall include speaker zone indication and control, telephone circuit indication and control, digital voice units, microphone and main telephone handset.
2. Function: The Voice Command Center equipment shall perform the following functions:

a. Operate as a supervised multi-channel emergency voice communication system.
Operate as a two-way emergency telephone system control center.
b. Audibly and visually annunciate the active or trouble condition of every speaker circuit and emergency telephone circuit.
c. Audibly and visually annunciate any trouble condition for digital tone and voice units required for normal operation of the system.
d. Provide all-call Emergency Paging activities through activation of a single control switch.
e. As required, provide vectored paging control to specific audio zones via dedicated control switches.
f. Provide a factory recorded "library" of voice messages and tones in standard WAV. File format, which may be edited and saved on a PC running a current Windows® operating system.
g. Provide a software utility capable of off-line programming for the DVC operation and the audio message files. This utility shall support the creation of new programs as well as editing and saving existing program files. Uploading or downloading the DVC shall not inhibit the emergency operation of other nodes on the fire alarm network.
h. Support an optional mode of operation with four analog audio outputs capable of being used with UL 864 fire-listed analog audio amplifiers and SLC controlled switching.
i. The Digital Voice Command shall be modular in construction, and shall be capable of being field programmable without requiring the return of any components to the manufacturer and without requiring use of any external computers or other programming equipment.
j. The Digital Voice Command and associated equipment shall be protected against unusually high voltage surges or line transients.
j. Fire, Voice & Telephone data shall flow through single network cable.
k. The Voice Evacuation System shall be capable of establishing communication between the

master voice controller and amplifier over fiber optic cable network without using any third-party media converter.

l. Failure of Fire Panel CPU shall not affect the operation of DVC. Incase DVC / Amplifiers are controlled by Fire Panel CPU, a separate panel with dedicated CPU shall be considered for each DVC & Amplifier.

G. Power Supply

1. The Main Power Supply shall operate on 120/240 VAC, 50/60 Hz, and shall provide all necessary power for the FACP.
2. The Main Power Supply shall provide the required power to the CPU using a switching 24 VDC regulator and shall incorporate a battery charger for 24 hours of standby power using dual-rate charging techniques for fast battery recharge.
3. The Main Power Supply shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge. The supply shall be capable of charging batteries ranging in capacity from 7-200 amp-hours within a 48-hour period.
4. The Main Power Supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.
5. The Main Power Supply shall be power-limited per UL864 requirements.
6. The Main Power Supply shall communicate power supply, line voltage, battery status and charger status to the local LCD display. Any abnormal condition shall be annunciated and logged to the system alarm history log.
7. The interface to the power supply from the Fire Alarm Control Panel (FACP) shall be via the Signaling Line Circuit (SLC) or other multiplexed means Power supplies that do not use an intelligent interface are not suitable substitutes. The required wiring from the FACP to the addressable power supply shall be a single unshielded twisted pair wire.
13. The addressable power supply shall supervise for battery charging failure, AC power loss, power brownout, battery failure, NAC loss, and optional ground fault detection. In the event of a trouble condition, the addressable power supply shall report the incident and the applicable address to the FACP via the SLC.
14. The addressable power supply shall have an AC Power Loss Delay option. If this option is utilized and the addressable power supply experiences an AC power loss, reporting of the incident to the FACP will be delayed. A delay time of zero, two, eight or sixteen hours shall be programmable.
15. The addressable power supply shall have an option for Canadian Trouble Reporting and this option shall be programmable.
16. The addressable power supply mounts in either the FACP backbox or its own dedicated surface mounted backbox with cover.
17. Each of the power supply's four output circuits shall be programmed- for Notification Appliance Circuit or General Purpose 24 VDC power. Any output circuit shall be able to provide up to 2.5 amps of 24 VDC power.
18. The addressable power supply's output circuits shall be individually supervised when they are selected to be either a Notification Appliance Circuit when wired Class "A" or by the use of and end-of-line resistor. When the power supply's output circuit is selected as General 24 VDC power, the circuit shall be individually supervised when an end-of-line relay is used.
19. When selected for Notification Appliance Circuits, the output circuits shall be individually programmable for Steady, March Time, Dual Stage or Temporal.

20. When selected as a Notification Appliance Circuit, the output circuits of the addressable power supply shall have the option to be coded by the use of a universal zone coder.
21. The addressable power supply shall interface and synchronize with other power supplies of the same type. The required wiring to interface multiple addressable power supplies shall be a single unshielded, twisted pair wire.
22. An individual or multiple interfaced addressable power supplies shall have the option to use an external charger for battery charging. Interfaced power supplies shall have the option to share backup battery power.

I.Controls with associated LED Indicators

1. Speaker Switches/Indicators

a. The speaker circuit control switches/indicators shall include visual indication of active and trouble status for each speaker circuit in the system.
b. The speaker circuit control panel shall include switches to manually activate or deactivate each speaker circuit in the system.\

2. Emergency Two-Way Telephone Control Switches/Indicators

a. The emergency telephone circuit control panel shall include visual indication of active and trouble status for each telephone circuit in the system.
b. The telephone circuit control panel shall include switches to manually activate or deactivate each telephone circuit in the system.

J. Specific System Operations

1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.
2. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 0 to 60 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.

K. System Point Operations

1. Any addressable device in the system shall have the capability to be enabled or disabled through the system keypad or Graphics User Interface.
2. System output points shall be capable of being turned on or off from the system keypad or the video terminal.
3. Point Read: The system shall be able to display the following point status diagnostic functions without the need for peripheral equipment. Each point shall be annunciated for the parameters listed:

   a. Device Status.
   b. Device Type.
   c. Custom Device Label.

d. Software Zone Label.
e. Devise Zone Assignements.
f. Analog Detector Sensitivity.
g. All Program Parameters.

4. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 5000 system events. Each of these events will be stored, with time and date stamp, until an operator requests that the contents be either displayed or printed. The contents of the history buffer may be manually reviewed; one event at a time, and the actual number of activations may also be displayed and or printed. History events shall include all alarms, troubles, operator actions, and programming entries.
5. The history buffer shall use non-volatile memory. Systems which use volatile memory for history storage are not acceptable.
6. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent system detector and shall analyze the detector responses over a period of time.
7. If any intelligent detector in the system responds with a reading that is below or above normal limits, then the system will enter the trouble mode, and the particular Intelligent Detector will be annunciated on the system display, and printed on the optional system printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
8. The system shall include the ability (programmable) to indicate a "pre-alarm" condition. This will be used to alert maintenance personal when a detector is at 80% of its alarm threshold in a 60 second period.

2.2 SYSTEM COMPONENTS - ADDRESSABLE DEVICES

A. Addressable Devices – General

1. Addressable devices shall provide an address-setting means using rotary decimal switches. Addressable devices that require the address be programmed using a programming utility are not an allowable substitute.
2. Addressable devices shall use simple to install and maintain decade, decimal address switches.
3. Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute. Addressable devices that require the address be programmed using a special tool or programming utility are not an allowable substitute.
4. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits.
6. Addressable smoke and thermal detectors shall provide dual alarm and power/polling bi-colour LEDs. Both LEDs shall flash green under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady red illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
7. The fire alarm control panel shall permit detector sensitivity adjustment through field

programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity.

8. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72.
9. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base options shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications. The system shall also support an intelligent programmable sounder base, the programmable sounder base shall be capable of providing multiple tones based on programming and at a minimum be capable of providing a Temp-4 tone for CO (Carbon Monoxide) activation and a Temp-3 tone for fire activations and be capable of being synchronized with other programmable sounder bases and common area notification appliances; 85 DBA minimum.
10. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (PHOTO, THERMAL).
11. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
12. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.
13. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.
14. Addressable modules shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box. An optional surface mount Lexan enclosure shall be available.
15. Detectors / Bases with connection terminals exposed to Ceiling / False Ceiling shall be provided with Protective Insulation of the same make as of Detectors.

B. Addressable Manual Call Point (Break Glass / Pull Down Type)

1. Addressable manual call point shall send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
3. Manual fire alarm boxes shall be constructed of Lexan / ABS Plastic with clearly visible operating instructions provided on the cover. The word FIRE / Fire Sign shall appear on the front of the stations.

C. Intelligent Photoelectric Smoke Detector:

The intelligent photoelectric smoke detector shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

1. Designed to meet UL268 7th Edition.
2. Modern profile with White color for improved aesthetics.
3. Sensitvity Range of 0.5% to 4.0% obs/ft
4. Stable communication technique with noise immunity.
5. Low standby current. 200 micro-Amps @ 24 VDC
6. Two-wire SLC connection.
7. Rotary, decimal addressing
8. Dual bi-color LED design providing 360° viewing angle. LEDs blink green in normal condition and illuminate steady red on alarm
9. Remote test feature from the panel.
10. Walk test with address display
11. Built-in functional test switch activated by external magnet.
12. Built-in tamper-resistant feature.
13. Sealed against back pressure.
14. Expanded color options.
15. Optional relay, isolator, and sounder bases.

D. Addressable Dry Contact Monitor Module,

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panels SLCs.
2. The IDC zone shall be suitable for Class A or Class B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

E. Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of one conventional circuit of compatible Notification Appliances, 24 VDC powered, polarized audio/visual notification appliances
2. The control module NAC may be wired for Class A/B with a current rating of 2 Amps
3. Audio/visual power shall be provided by a separate supervised circuit from the main fire alarm control panel or from a supervised UL listed remote supply.

F. Addressable Relay Module

1. Addressable Relay Modules shall be available for AHU control and other network building functions
2. The module shall provide two form C relays rated at up to 3 Amps resistive and up to 2.0 Amps inductive.
3. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to ensure that 100% of all auxiliary devices energize at the same time on the same pair of wires;
4. For multiple relays control a module shall be available that provides 6 programmable Form-C relays.

G. Isolator Module

Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.

1. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.
2. The isolator module shall not require address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.
3. The isolator module shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.
4. If Isolator Bases are proposed, Vendor needs to consider Isolator base for all detectors

I Batteries

The battery shall have sufficient capacity to power the fire alarm system for not less than 48 hours in standby plus 2 hours of alarm upon a normal AC power failure.

The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.

If necessary to meet standby requirements, external battery and charger systems may be used.

PART 3.0 - EXECUTION

3.1INSTALLATION

A. Installation shall be in accordance with the NEC, NFPA 72,NFPA 410,NFPA 409, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

D. Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

3.2CAUSE & EFFECT LOGIC

System shall be programmed as per the attached cause & effect logic.

3.3 TESTING

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72,NFPA 410,NFPA 409.

A. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
B. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
C. Verify activation of all waterflow switches.
D. Open initiating device circuits and verify that the trouble signal actuates.
E. Open and short signaling line circuits and verify that the trouble signal actuates.
F. Open and short notification appliance circuits and verify that trouble signal actuates.
G. Ground all circuits and verify response of trouble signals.
H. Check presence and audibility of tone at all alarm notification devices.
I. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.
J. Each of the alarm conditions that the system is required to detect shall be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
K. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.4 FINAL INSPECTION

A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

3.5 INSTRUCTION & TRAINING

A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

B. The bidder and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

1. PASSIVE SAFETY EQUIPMENTS

1.1 Fire Extinguishers

1.1.1 Fire extinguishers shall be halon free and worked out in such a way that the Occupants shall not travel more than 15m to reach a Fire extinguisher. Also there shall be a Fire extinguisher for every 300 sq.m of floor plate / rooms of suitable type / size. In addition to above mention areas Extinguishers to be provided at Surface car parks, outdoor Transformers / electrical instillations and on the landing of each Staircase of all floors.

1.1.2 All Fire extinguishers shall be portable and hand held, an operating instruction should be pasted on the extinguisher body. Portable Fire extinguishers should be BIS approved and valid ISI certificates to be furnished at the time of delivery to site.

1.1.3 Portable fire extinguishers are provided at locations mentioned below:

a. Dry chemical powder type fire extinguisher conforming to IS 2171 near car parking lots, main switch board room, transformer, generator room, pump room, Offices and lift machine room.
b. Water expelled carbon-dioxide type fire extinguisher conforming to IS 940 located near each staircase landing on every floor and office areas.
c. Carbon dioxide type fire extinguishers conforming to IS 2878, located in office areas, electrical panel room, pump room, lift machine room and also inside the Kitchen of every Flat, and for electrical rooms, D.G. rooms and Transformers.
d. Mechanical foam type fire extinguishers at HSD Yard, D.G. Rooms, and near oil filled Transformers.

1.2 Fire Exit Signs

1.2.1 Required, as per Local fire force like exit signs & Floor indication (eg. Ground floor, 1st floor.), size shall 200mm x 500mm & action chart (size shall be 600mm x 1000mm) in case of fire / emergency, Staircase location indication etc. The location / quantity shall be on each landing of every staircase on each floor.

1.2.2 Signs shall be made out of 3mm thick PVC foam board with PVC non – reflective self-adhesive vinyl foam board OR equivalent material with Mirror fasteners for fixing complete.

FIRE FIGHTING SYSTEM

2. Intent of Specification

2.1.1 This specification is intended to cover engineering, manufacture, procurement, test and inspection at works, packing for transportation, delivery to site, erection, testing, commissioning, performance, demonstration at site and handing over to purchaser of Fire Protection and Fire Alarm System as indicated in the Schedule of Requirement and scope of work and as required for reliable and effective fire protection for Owner/ Engineer in charge.

2.1.2 This specification also includes complete earthwork, i.e. excavation and back filling for the buried piping for hydrant system and any other underground work related to the system

including buried cabling work.

2.1.3 It is not the intent to completely specify all the details of design and construction herein. Nevertheless the equipment and installation shall conform to high standard of engineering, design and workmanship in all respect and shall be capable of performing continuous satisfactory operation and acceptable to The, Owner/ Engineer in charge as well as to the various authorities. In case of any violation of the above The Owner/ Engineer in charge /consultant reserves the right change/reject/modify the equipment/system during execution stage of the contract.

2.1.4 Wherever material or article is specified or described by the name of particular brand, manufacturer or vendor, the specific item mentioned shall be understood as established type, function and quality desired. Other manufacturers / product shall not be accepted unless the Owner / Engineer have approved them in charge /consultant prior to award of the contract.

3. ERECTION AND LAYING OF PIPES

3.1 Intent of Specification

This specification is intended to cover the technical requirements for the execution of piping pre-fabrication assembly and erection of the entire pipe work define here under. Welded pipe fittings are used for firefighting both external and internal.

3.2 Applicable Standards

3.2.1 The job shall be executed in line with the following standards:

a. Code for Petroleum refinery piping
b. Code of Practice for laying of welding pipes Code for procedure for manual metal arc welding of mild steel for structural work Welder Qualification
c. ANSI B 31.3 : IS: 5822
d. IS: 823
e. ASME-SEC A IC

i. All codes referred shall be the latest editions.
ii. The bidder shall bear the cost of repair, changes replacement etc. due to non-compliance with the standards, codes and this tender or due to disregard of the instructions given by the Engineer-in-charge
iii. Pipes up to 40mm dia will be threaded joints. Above 40mm dia will be welding.

3.3 Scope of Work

a. The scope of work of the bidder is generally described below:

i. Fabrication and erection of all piping systems from piping materials supplied in accordance with this I specification and applicable drawings & standards.
ii. Fabrication and erection of supporting elements i.e. shoes, clips, cradles etc. including applying one coat of red oxide zinc chromate primer.

iii. Fabrication and erection of supporting fixtures.
iv. Fabrication and erection of all drain piping and vent piping assembly, instrument tapping piping up to isolation valve.
v. Erection of rotating equipment.
vi. Testing, flushing, and drying.
vii. All piping systems shall be fabricated, installed, flushed and tested in accordance with specification and applicable codes/drawings. Any deviation from the specification and drawing shall be permitted only after obtaining the written approval of the Engineer-in-charge.
viii. Pipes upto 40mm dia will be threaded joints. Above 40mm dia will be welded fittings.

3.4 Notes on Supports

3.4.1 Supports, guide and anchors for piping shall be fabricated and provided as shown in the drawings. No Anchors on piping shall be used except at locations shown in the drawings. The pipe shall be secured firmly at anchor supports.

3.4.2 Fabrication and erection of supporting elements and structural fixtures wherever required and pointed out by the Engineer-in-charge, whether in drawing or not to prevent vibration excess sag etc. shall be carried out by the bidder. No separate payment will be made for erection of these additional support and it will be deemed as part of piping erection work.

3.5 Fabrication Piping

3.5.1 Pre-Fabrication:

a. The bidder shall fabricate all piping work in conformity with the requirements of pertinent general arrangement drawings and specifications. Where specific details of fabrication are not indicated on the drawings or not specified herein fabrication and erection shall be done in accordance with the code for Petroleum Refinery piping ANSI B 31.3 and ASME B 31.4 latest edition.
b. The bidder shall be responsible for working to the exact dimensions as shown on the drawings irrespective of individual tolerance permissible. Where errors found it is bidder's responsibility to notify the Engineer-in-charge prior to fabrication or erection.

3.5.2 Layout and Cutting of Pipes:

a. For laying out headers, tees, laterals and other irregular details, cutting templates shall be used to ensure accurate cutting and proper fit up.
b. All cutting shall follow the outline of the templates.
c. Machine cut levels to form the grove are preferred in carbon steel pipe. However, smooth, clean, slag free, flame cut bevels are acceptable.
d. All flanges facing shall be true and perpendicular to the axis of the pipe to which they are attached. Flanges bolt holes shall straddle the normal center lines unless different orientation is shown in drawings to match the equipment connections etc.

3.5.3 Pipe Joints:

a. The relevant piping class attached to each line specifics the type of pipe joints to be adopted in construction in all piping systems. All pipes shall be having threaded joint up to 40 dia and above shall be welded joint.

3.5.4 Cleaning of Pipes:

a. On completion of fabrication, all pipes and fittings shall be cleaned inside by suitable means (mechanical cleaning tool, wire brush, etc.) before erection to ensure that assembly is free from all loose foreign materials such as scale, stand, spatter, particles, cutting chips etc.
b. All field fabricated piping shall also be cleaned at the conclusion of the fabrication.
c. Both shop and field shall be blown out with compressed air at the termination of cleaning and capped.
d. Cleaning requirements for special services, if any, shall be as specified in the piping, material specifications.
e. Where practicable and except when otherwise in the drawings, valve steams shall be installed in a vertical

3.5.5 Erection of Piping:

a. The intent of pre-fabrication at the shop is to accelerate progress of pipe work and to minimize work in the field.
b. All piping shall be grounded and located as shown in piping drawings keeping in view the piping specifications. No deviations from the arrangement shown shall be permitted without the written consent of the Engineer-in-charge. While fitting up mating flanges, care shall be exercised to properly align the pipes and to check the flanges for trueness, so that faces of the flanges can be equipment nozzles. The bolt holes of flanges in the vertical plane shall straddle the vertical center line of the pipe in the erected position and for flanges in the horizontal plane, the bolt holes shall straddle plant north-south axis unless otherwise indicated on the drawings. Flanged connections at the pump shall be made in such a way as not to induce any stressed due to misalignment, excessing gap etc. The final tightening shall be redone when the machines are aligned completely and specifically authorized by the Engineer-in-charge. Temporary protective covers shall be provided at all flanges connections of pumps, compressors, turbines and other similar equipment until the piping is finally connected.
c. After the piping is erected in final position, it shall be cleaned, tested for tightness and kept dry wherever instructed, as described in this specification.
d. The valve spindle positions shall be at accessible location. It shall however, bring it to the notice of the Engineer-in-charge, in case he encounters some difficulty them.
e. Where practicable and except when otherwise on the drawings, valve stems shall be installed in a vertical direction and shall not be installed which stems below the horizontal.
f. All underground pipe work shall be well protected, as specified below, and laid in a neat manner. Underground pipe shall be laid at a minimum depth of 100 Cm. For road crossing and other traffic areas protective encasement, as specified, for underground fire lines shall be required. Thrust blocks, as specified, shall be provided to bends, tees etc, where ever flow direction changes.

3.5.6 Painting

All Steel members used for firefighting Installation should be protected by the following detailed

protective system.

The Installation shall be cleaned by mechanical buffing or emery paper to remove rust and coatings and finally with cotton wastes and approved thinner. The cleaned member, pipe and fittings shall be immediately coated with one coat of approved Zinc Rich Metal Primer.
(Avoiding areas where cutting and welding are required).

After fabrication and erection, the affected areas of pipe work should be immediately cleaned properly to remove dust, rest, welding flex and any other foreign matters, preferably by mechanical buffing, and apply one touch up coat of Zinc rich Primer. The total MS and pipe work, after fabrication and erection, are to be painted with 2nd coat of Zinc Rich Primer.

Piping work above ground shall be protected with 2 coats of approved Fire Red Enamel Paint. (Shade No. 536 as per IS 5). Piping work underground should be protected with 2 coats of approved Bitumen Painting System over 2 coats of Zinc Rich Primer. Underground pipes are further protected with encasement of one layer of 3mm thick, approved, Self - adhesive Bitumen Based flexile wrapping, having polythene encasement or with polymer-based tape by thermo fusion process. The protective paints used shall be compatible, each other.

The protection system shall be carried out as per Consulting Engineers instructions and as per paint manufacturer's recommendations. The interval between successive paint coatings shall be 24 to 48 hours (or as per recommendation of the manufacturer). For applying the next coat after 48 hours or a long time, the pre painted surface has to be cleaned completely with suitable size emery paper to clean and roughening the surface to receive the next coating.
After removal of dust and loose particles, with cotton waste and light thinner, next paint coating can be applied.

3.5.7 General Inspection:

a. The Owner/ Engineer in charge's inspector shall have free access in all places where the work is being done or any other thing and place concerned with the work.
b. The Owner/ Engineer in charge is entitled to send his own inspector to field or shops where pre-fabricated and erection of pipe lines being done, with the following functions but not limited:

1. To check that the welding performance and welding equipment used on the job are suitable and conform to relevant standards.
2. To supervise welding procedure qualification.
3. To supervise fixing performance qualification.
4. To check whether welding is conforming to relevant specification and the practice followed is in accordance with good pipeline construction practice.
5. To check any other performance to ensure quality of work.

c. Bidder shall notify sufficiently in advance the commencement of qualification tests, welding work and acceptance tests, to enable The Owner/ Engineer in charge's inspector to supervise the same.
d. Bidder shall provide the, Owner/ Engineer in charge's Inspector with all facilities necessary for carrying out his work at no extra cost to the Owner/ Engineer in charge.

e. Approval from the Owner/ Engineer in charge's Inspector shall not relieve the bidder partially or fully of his responsibilities and guarantees under this contract.

4. PASSIVE SAFETY EQUIPMENTS

4.1 Fire Extinguishers

4.1.1 Fire extinguishers shall be halon free and worked out in such a way that the Occupants shall not travel more than 15m to reach a Fire extinguisher. Also, there shall be a Fire extinguisher for every 300 sq.m of floor plate / rooms of suitable type / size. In addition to above mention areas Extinguishers to be provided at Surface car parks, outdoor Transformers / electrical instillations and on the landing of each Staircase of all floors.

4.1.2 All Fire extinguishers shall be portable and hand held, an operating instruction should be pasted on the extinguisher body. Portable Fire extinguishers should be BIS approved and valid ISI certificates to be furnished at the time of delivery to site.

4.1.3 Portable fire extinguishers are provided at locations mentioned below:

e. Dry chemical powder type fire extinguisher conforming to IS 2171 near car parking lots, main switch board room, transformer, generator room, pump room, Offices and lift machine room.
f. Water expelled carbon-dioxide type fire extinguisher conforming to IS 940 located near each staircase landing on every floor and office areas.
g. Carbon dioxide type fire extinguishers conforming to IS 2878, located in office areas, electrical panel room, pump room, lift machine room and also inside the
h. Kitchen of every Flat, and for electrical rooms, D.G. rooms and Transformers.
Mechanical foam type fire extinguishers at HSD Yard, D.G. Rooms, and near oil filled Transformers.

SL NO:	ITEM DESCRIPTION	UNIT	QUANTITY
A	ELECTRICAL.		
1	LT PANELS AND SWITCHGEARS		
	The rates for the LT Panels boards (IP 54) shall also include the following: a) Supporting rigid steel framework. b) Cubicle type, 14 gauge CRCA sheet steel enclosed with powder coated with approved shade for ACB panels & 16 gauge for other panels. c) Complete with interconnections and distribution bus bars. d) Proper bonding to earth. e) Painting / lettering on Breakers and distribution boards, the location and purpose, SLD of each panel and DB details. f) Providing cable clamps / supports within distribution boards cable alley. g) Door interlocking for all outgoing feeders shall be provided. h) ACBs shall have LCD based display showing current, power factor, voltage etc. i) All ACB shall be Microprocessor based with ON/OFF/Trip lamps, 3 NO + 3NC Auxiliary contacts other than used in control circuit.		

	j) TPN MCCBs/ACBs shall be provided with solid neutral link. k) ACBs shall be suitable for ICS = ICU = ICW for 1 Second. l) All MCCBs shall be ICS = ICU. m) All MCCB shall have rotary handle with pad locking arrangement. n) Minimum breaking capacity for MCBs shall be 10 KA. o) All indicating lamps shall be provided with 2 amps control MCBs. p) All outgoing terminals shall be provided in cable alley on proper insulated supports q) Degree of protection of distribution panel enclosure shall be IP54. r) Bus bar rating shall be considered as maximum 0.8 amps and 1.2 amps per Sq mm for aluminium and copper bus bars respectively. s) All hinged door shall be earthed through 2.5 sq mm tinned braided copper wire. t) The tripping characteristics of MCBs shall be as under: * Type "B" - For resistive, lighting and convenience power. * Type "C" - For motor protection. * Type "D" - For UPS and discharge lamps. u) Potential free contacts and power contactor shall be provided in all panels for BMS integration. v) MCCBs above 160 Amps shall have microprocessor-based releases and upto 160 Amps shall have thermal magnetic trip unit. Only thermal shall not be acceptable. w) Removable lifting hook shall be provided in all transportation section. x) CT class for LT Panels shall be 5VA, Class - I y) The panel shall be "Linear" or "L" or "U" shape to suit proposed electrical room. z) Fault level calculation, Relay coordination etc. shall be submitted along with shop drawing. aa) DG Synchronizing panel should be PLC Based auto start, auto changeover, auto load balancing, auto synchronizing panel. ab) Active Harmonic Filters to be included for suppression of harmonics. ac) Voltmeters/ammeters with selector switches should be included. ad) Digital dual type KWH meter with suitable ratio		

	CTs and RS-485 port. ae) Bus bars with colour coded heat shrinkable insulation sleeve. af) All Main Panels fed from DG / Transformers shall be of Type 4A construction and the remaining panels shall be of Type 3A constructions. ag) All ACB's to have minimum LSIG protection and all MCCB's to have minimum LSI protection. ah) The kA rating should be atleast 20% more than the Short circuit rating at the point of use. ai) Neutral bus should be minimum of 50% of phase bus. aj) Earth bus shall be minimum of 25x6mm GI with a current carrying capacity of 120% of the fault current. ak) 8) All sub LT panels to have ELR in the incomer part and in the outgoing feeding to kitchen equipment's. Fixed RCCB's of 30m can also be considered for the Kitchen equipment feeders. al) SPD Type 01 for all the HT incomer/outgoing to be consider. SPD Type 02 for rest of all the loads to be considered.		
1.1	LT PANELS		
1.1.1	SSB#Utility Panel	Nos	As per BOQ /dwg.
	Bus Bar: Phase & Neutral: AL,25kA,1Rx32mmx10mm		
	Incomer:		
	250A,4P,MCCB 25 kA -1 Nos		
	Multifuntion meter (V, A, F) with CT-1 Set, Phase Indicators-1 Set		
	Out goings:		
	125A,TPN,MCCB,Ics/Icw=25kA, TM- 5 Nos		
1.1.2	SDB#PHE Panel	Nos	As per BOQ /dwg.
	Bus Bar: Phase: AL,25kA,1Rx25mmx10mm		
	Bus Bar: Neutral: AL,25kA,1Rx25mmx6mm		
	Incomer:		
	125A,4P, MCCB -1 Nos		

	Indicating lamps- 1Set, Multifunction meter- 1Set		
	Out goings		
	80A,TPN,MCCB,Ics/Icw=25KA,TM -4Nos		
	63A,TPN,MCCB,Ics/Icw=25KA, with DOL Starter with lockable push button and 2 Nos Aux ContactTM - 4Nos		
	63A,TPN,MCCB,Ics/Icw=25KA,TM - 4Nos		
1.1.3	SSB#AHU Panel	Nos	As per BOQ /dwg.
	Bus Bar: Phase: AL,25kA,1Rx25mmx10mm		
	Bus Bar: Neutral: AL,25kA,1Rx25mmx6mm		
	Incomer:		
	125A,4P, MCCB -1 Nos		
	Indicating lamps- 1Set, Multifunction meter- 1Set		
	Out goings		
	63A,TPN,MCCB,Ics/Icw=25KA,TM - 5Nos		
1.1.4	SDB#GF Common Area Panel	Nos	As per BOQ /dwg.
	Bus Bar: Phase: AL,25kA,1Rx25mmx10mm		
	Bus Bar: Neutral: AL,25kA,1Rx25mmx6mm		
	Incomer:		
	125A,4P, MCCB -1 Nos		
	Indicating lamps- 1Set, Multifunction meter- 1Set		
	Out goings		
	63A,TPN,MCCB,Ics/Icw=25KA,TM - 5Nos		
2	MCB DISTRIBUTION BOARD		
	Unless otherwise specifically mentioned all MCB (standard) DBs shall be considered with double door arrangement only. The type of DB shall be vertical or horizontal based on design and site conditions. MS enclosure of minimum 1.6 mm thickness for PPI DB's and minimum 1.2mm thickness for all other DB's (IP 42) with all accessories as required including earth links, neutral links, end termination etc.. The MCBs for lighting and raw power distribution shall be considered with Curve 'C" and Curve 'D' for UPS distribution respectively. The MCB's shall be rated for a minimum short circuit level of 10 kA. All Distribution Boards to be of PPI type unless specified.		

	7 Segment TPN MCB DBs including all the C/D Curve MCB as required. (Power) Incomer : 01 No: -40/50A 4P MCB Sub Incomer : 03 Nos - 40/63,30mA DP RCCB, Outgoing : 36 Nos - 10/16/20A SP MCBs.		
2.1.1	12 Way	Set	As per BOQ /dwg.
2.1.2	8 Way	Set	As per BOQ /dwg.
	VTPN DB		
	VTPN MCB DBs including all the C Curve MCB as required. Incomer : 01 No: -50A 4P MCB,63A,100mA 4P RCCB, Outgoing : 9 Nos - 16/20/25/32A SP MCBs,5 Nos. 25A TP		
2.1.3	8 Way	Set	As per BOQ /dwg.
	4P Isolator with Metal Enclosures - Outdoor (6A-25A MCB shall be considered.Above 25A-100A MCB type Isolator shall be considered unless specified.)		
2.1.4	6A to 25A	Set	As per BOQ /dwg.
2.1.5	32A	Set	As per BOQ /dwg.
2.1.6	40A	Set	As per BOQ /dwg.
2.1.7	63A	Set	As per BOQ /dwg.
3	CABLES AND END TERMINATION		
	Supply, laying, testing and commissioning of 1100V grade, steel armored XLPE insulated, PVC inner sheathed, armored, PVC outer sheathed LT cable. Cables laid in readymade trenches/ cable tray/ Hume pipes complete as per technical specification & drawing details.		
	Vendor shall consider Double compression glands - for cables of all the sizes. Terminating Lugs - Aluminium lugs for aluminium conductor cables and copper lugs for copper conductor cables. Tagging of cables & Glanding Earthing with necessary copper clips and wires should also be included.		
3.10	CABLES		
3.1.1	4C x 16 Sqmm Al. Ar. XLPE Cable	Mtrs	As per BOQ /dwg.
3.1.2	4C x 25 Sqmm Al. Ar. XLPE Cable	Mtrs	As per BOQ /dwg.

3.1.3	3.5C x 95 Sqmm Al. Ar. XLPE Cable	Mtrs	As per BOQ /dwg.
3.1.4	3.5C x 300 Sqmm Al. Ar. XLPE Cable	Mtrs	As per BOQ /dwg.
3.2	CABLE ENDTERMINATION		
3.2.1	4C x 16 Sqmm Al. Ar. XLPE Cable	Ea	As per BOQ /dwg.
3.2.2	4C x 25 Sqmm Al. Ar. XLPE Cable End Termination.	Ea	As per BOQ /dwg.
3.2.3	3.5C x 95 Sqmm Al. Ar. XLPE Cable End Termination.	Ea	As per BOQ /dwg.
3.2.4	3.5C x 300 Sqmm Al. Ar. XLPE Cable End Termination.	Ea	As per BOQ /dwg.
4	POINT WIRING AND RECPTABLES		
4.10	PRIMARY POINT		
4.1.1	Supply & wiring for primary light point with 1.5 sq. mm, 1.1 kV grade, ISI marked, FRLS PVC insulated single-core, stranded Copper conductor cable conforming to IS 694 (with latest amendments) in 20 mm dia. 16 SWG GI conduit concealed/surface/with raceways in ceiling/wall/ floor/column including supply & fixing of 1 No. 6A, single pole modular weather proof switch for control suitable for 230V, 50Hz AC supply, fixed in suitable size back boxes suitable for modular W/P switches, and earthing with 1 run of FRLS 1.5 sq. mm, 1.1kV grade, ISI marked, PVC insulated single-core Copper, multi-strand conductor cable (green colour) run inside the conduit including supply of all fixing materials, accessories and interconnections complete as required.	Ea	As per BOQ /dwg.
	Notes: 1. Rates for all point wiring items are inclusive of necessary circuit mains from DB to the first switchboard and also sub-circuits from one switchboard to the subsequent switchboards in the same circuit. 2. Secondary point shall include necessary wiring looped from primary light point as indicated in electrical scheme. 3. Rate for power point wiring items is inclusive of necessary power circuit from DB to power socket. 4. All the Chases made in the wall, ceiling, etc., at the time of laying of conduits, fixing switch boards shall be filled up neatly after installation of conduit.		
4.20	SECONDARY POINT		

4.2.1	Supply & wiring generally same as Primary wiring, but without control switch. The wiring shall include necessary wiring looped from the primary light point.	ea	As per BOQ /dwg.
4.3	Supply, installation, testing & commissioning of power points using 1100V, FRLS multi-strand copper conductor wire in GI Conduit, ISI marked. The point wiring shall be terminated in a terminal block, switches, DBs etc as per the instructions of Engineer In Charge as required as complete..		
4.3.1	2R 2.5Sqmm + 1R 2.5 Sqmm Cu Wire	Mtrs	As per BOQ /dwg.
4.3.2	2R 4Sqmm + 1R 2.5 Sqmm Cu Wire	Mtrs	As per BOQ /dwg.
4.3.3	2R 6Sqmm + 1R 4 Sqmm Cu Wire	Mtrs	As per BOQ /dwg.
4.40	POWER SOCKETS		
4.4.1	6/16A W/P Single Switched Sockets	Nos	As per BOQ /dwg.
5	LIGHT FIXTURES		
	Receiving, unloading, Storing, reconciliation, installation, testing & commissioning of LED light fixtures [All the LED Light Fixtures should have CRI > 80, power factor > 95% and THDi <10%] : Rates should be inclusive of leader cables, jumper cables, connectors, junction boxes, brackets, anchor fasteners, J Nut & Bolts, civil foundation for outdoor fixtures, loopin-loopout connectors, gel connectors, suspending GI chains, GI down rods, MS/GI Conduits, flexibles etc all accessories as required as complete. Vendor shall assume suspensions length meeting the actual levels and site conditions.		
5.1	40W W/P LED Light Fixture -IP65,4000K - L2	Nos	As per BOQ /dwg.
5.20	Fixture Type: 13 210 Watt LED UFO High Bays	Nos	As per BOQ /dwg.
6.00	EARTH PITS		
6.10	Copper Plate Earthing using Class B GI Pipe and Copper Plate of thickness 3mm / 6mm with salt, charcoal, Brick / RCC masonry chamber with heavy duty SFRC / DI /CI heavy duty cover with locking arrangement with frame painted with bitumastic paint (suitable to take fire tender load - tender truck movement) of 450mm x 450mm x 3000mm chamber.CI funnel with 20 gauge GI wire mesh		

	etc..(Earth strip to be left upto the Earth pit for Connection)		
6.1.1	600 x 600 x 3mm	Nos	As per BOQ /dwg.
6.2	EARTH STRIPS		
	GI/Cu earth strips on cable tray or below ground as per site condition. All Cu. All the accessories, supports, clamps, welding, painting etc should be included. Strips shall be run in pvc heat shrinkable sleeve & mounted on insulation mounts. Cost of civil works shall be included for strips laid below ground.		
	CU FLAT / STRIP		
6.2.1	8SWG Cu Wire	Mtrs	As per BOQ /dwg.
6.2.2	25 x 6 mm Copper strip	Mtrs	As per BOQ /dwg.
6.2.3	Earth benches (using 25X3mm cu strip)	Nos	As per BOQ /dwg.
7	CABLE TRAYS AND GI RACEWAYS		
	Cable Trays : Cable trays should be hot dipped galvanised having 1.8mm thickness including all the necessary supports such as M8 / M12 Threaded GI Rods, nuts and bolts with GI/MS C Channel/angles upto 450mm wide, and MS angle/channel supports for 600mm wide and above. Rate should be inclusive of cutting, grouting, welding, painting etc.		
7.10	150 mm x 60 mm	Mtrs	As per BOQ /dwg.
7.20	200 mm x 60 mm	Mtrs	As per BOQ /dwg.
	GI Raceways with Cover: Supply, installation, testing and commissioning of Unperforated Cable tray with cover /Ceiling Raceway closed with snap fit lid confirming to IEC-61537. The Tray shall be galvanized for corrosion protection confirming to DIN EN 10346 / ISO 1461. The Ceiling Raceway shall be supplied with cover with the standard length of 3 Mtr, thickness of the GI raceway should be 1.8mm.		
7.30	150 mm x 50 mm compartment	Mtrs	As per BOQ /dwg.
8.0	MISCELLANIOUS ITEMS		

8.1	Professional charges for coordinating with statutory body like CEIG, local Electricity authority's, KSEB, other statutory governing authorities for obtaining necessary approvals & sanctions for complete electrical system including DG sets installed by some other agency including preparation of necessary shop drawing. Receipt for the fee paid/ deposited with local authorities in original to be obtained in name of owner.(Including Statutory charges)	LS	As per BOQ /dwg.
	TOTAL FOR ELECTRICAL		
B	AHU		
1	Factory Fabricated duct		
	Supply, Installation, Testing of factory fabricated galvanized steel ductwork complete with TDC/ TDF flanges and Butyl rubber or EPDM polymer gasket as per specifications, threaded rod suspension arrangement, GI perforated 'C' channel supports etc. in accordance with the approved shop drawings and specifications. Ducts shall be factory boxed and in addition, all longitudinal and transverse joints should be fully applied with sealants. The joints shall be with least leak and shall be tested.		
1.1	24 gauge GSS	Sqm	As per BOQ /dwg.
1.2	22 gauge GSS	Sqm	As per BOQ /dwg.
1.3	20 gauge GSS	Sqm	As per BOQ /dwg.
1.4	18 gauge GSS	Sqm	As per BOQ /dwg.
2	Duct Insulation		
	supply & fixing of 9 mm thick Class O nitrile rubber HT insulation / EPDM Insulation of duct using with antimicrobial property with adhesive as per the recommendation of the manufacture with density 45-55kg/m3.R-value for the insulating material shall be minimum 0.6(m2. K/W)		
2.1	13 mm thick	Sqm	As per BOQ /dwg.
3	Duct Liner		
	Supply installation and testing of open cell elastomeric foam with a density of 160-240Kg/m3.The joints shall be provided with proper 24G GI frame at all four joints. Elastomeric		

	insulation should be passed on these standard tests, ASTM C411,ASTM C518, BS476 part7, ASTM G21, ISO 22196, ASTM D3575, ISO 354, ASTM C423		
3.1	10 mm Thickness	Sqm	As per BOQ /dwg.
4	Flexible Duct Connections		
4.1	Supply, Installation and Testing of 150mm deep Antivibration Flexible Joints made out of imported fire retardant fabric with extruded aluminum frame/ flange on both sides of approved make.	Rmt	As per BOQ /dwg.
5	Aluminum Grill		
	Supply, Installation and Testing of extruded aluminum powder coated air transfer grilles for supply and return air as per specification and drawing.		
5.1	Supply and return air grill	Sqm	As per BOQ /dwg.
6	Air diffuser		
	Supply, Installation and Testing of extruded aluminum powder coated Supply/Return diffusers as per specification. Supply should be with Collar Damper.		
6.1	Supply Air diffuser	Sqm	As per BOQ /dwg.
6.2	Return Air diffuser	Sqm	As per BOQ /dwg.
7	Collar damper		
	Supply, installation, testing, balancing and commissioning of Collar Dampers made of GI with black powder coating for Grilles / Diffusers as per specification with necessary supports and accessories	Sqm	As per BOQ /dwg.
8	CONDENSATE DRAIN PIPING		
	Supply, installation, testing and commissioning of Rigid heavy class uPVC piping with minimum 9 mm nitrile rubber insulation over the pipes ,complete with fittings, supports,U trap arrangement ,clean plug and accessories for units as per specifications and technical specification.Nitrlie insulation with 40mm width self adhesive foam tape to be used at joints		
8.1	25 mm Dia	Rmt	As per BOQ /dwg.
9.0	CSU (DX type)		

	Supply, installation, testing & commissioning of variable volume type, double skin construction fabricated out of extruded aluminum section with 1 mm pre-coated GSS outside and 0.8mm plain GSS inside, Thermal Break with 40mm thick PUF of density 48 kg/m3 sandwiched between the GSS sheets, comprising copper cooling coil section with aluminum fins, pre-filter and filter section, double sloping stainless steel drain pan (for zero water retention) made out of 18G SS sheet of 304 grade, mixing air chamber . . Fans shall be plug fan with aluminium impeller with efficiency levels of class IE4/IE3 or equivalent and suitable for operation on 415V +/- 5%, 50 Hz AC supply. Damper at inlet and outlet of AHU.Fire retardant flexible connection between fan outlet and duct ,Metallic plate sandwiched between Neoprene rubber pad shall be used between CSU and foundation.Fire retardant flexible connection between fan outlet and duct ,Metallic plate sandwiched between Neoprene rubber pad shall be used between CSU and foundation.. Speed of fans shall be modulated on the basis of occupancy, variation in ambient temperature and indoor conditions. Sound levels shall not exceed 65dB at a distance of 1.5m from the CSU when operated individually In addition, since fresh air quantity for space shall be very large, carbon-di-oxide level monitoring shall be carried out for all occupied spaces and fresh air damper shall be modulated to ensure that difference between indoor and outdoor CO2 levels is maintained less than 530 ppm. The AHU s requiring mixing boxes shall be complete with modulating fresh & return air dampers as per the specifications. DX type cooling coils shall have 12.5mm to 15mm diameter tubes minimum 0.4mm thick aluminum fins bonded to copper tubes. Each coil shall be factory tested at 21kg/cm2 air pressure under water. Fin spacing shall be 4-5fins/cm. The DX type coil shall be minimum 6 row cooling coil with SS drain pan and a vent. The coil shall have copper header with DX type supply and return connections protruding out of CSU . The filters shall be MERV 9 & MERV 13 as specified in ER. AHU body shall consist of fan section, coil section, filter section, fresh air section with mixing boxes wherever required .CSU/AHU shall be included of communication kit		

	and interfacing kit suitable to integrate with VRF ODU.The plug fan and motor shall be AMCA certified and AHU shall be EUROVENT certified.		
9.1	35 TR,14000 CFM	Nos	As per BOQ /dwg.
10	VARIABLE REFRIGERANT FLOW/VOLUME SYSTEM		
	Supply, installation, testing and commissioning of VRF outdoor units for providing cooling with multi scroll/ Twin Rotary inverter compressors , special pre-coated fins, panel, corrosion resistant coated condenser, inverter based condenser fan, hot dip galvanized stands / supports, electrical & microprocessor panel, with fire tripping provision, isolating valves and all the necessary accessories for proper functioning of the units, having following approximate capacities. The units shall be suitable for BMS integration at the outdoor unit with BACnet/IP and shall provide all controls, power and interlocks internally. 415v 3 Phase power shall be provided at the Outdoor units and power and control cabling up to indoor units shall be in the bidders scope of work. Outdoor units should be coated with anti rust coating. It should be possible to start and stop the unit from remote locations. The ODU shall be selected at 37 Deg. C ambient condition. VRV receiving at site, equipment unloading, storing, handling, hoisting, installing in position, effecting connections, anchoring, grouting testing and commissioning equipment including supplying and installing all necessary indigenous accessories as required to complete the installation. Fins and copper tubes of Air-cooled Condenser along with copper tubing / piping with all joints and U-Bends exposed to atmosphere / aggressive ambient, shall be painted with special corrosion prevention coating either in factory or at site. Minimum COP shall be provided as per Ashrae 90.1 2019 at AHRI conditions Power cabling & earthing as per specifications between outdoor unit & indoor units to be installed. Bidder has to provide the Hot dip GI stand for ODU placement. The ODU		

	shall be provided with IP 66 Integrated isolator or IP 66 local isolator by Bidder.		
	Outdoor Unit		
10.1	ODU (22 HP Each)	Nos	As per BOQ /dwg.
11.0	COPPER PIPING		
	Supply, Installation testing & commissioning of refrigerant copper(seamless) piping including,refnut joints, tees, elbows,reducer,u-trap, ahu kits and all other required fittings along with insulation and supports, between indoor & outdoor units duly installed as per specifications. All piping inside the building shall be supported with hangers & threaded rods &outside the building shall be properly supported in cable tray. Exposed cable tray shall be provided with proper GI covering also. The piping shall be of high grade copper pipe. The Dia of the pipe shall be finalized based on the approved manufacture recommendation. The scope includes pressure testing,flushing,vaccumization & charging of refrigernat.Including the control cable and power cable as recommended by the manufacturer. Refrigerant pipe quantities, sizes of refrigerant copper pipe and condensate drain to be verified from the approved shop drawing by the bidder.		

11.1	Insulation, thick sleeve made out of closed cell elastomeric nitrile rubber foam insulation of fire retardant 'O' class. Nitrile rubber insulation exposed to outdoor conditions shall be provided with cladding of "Armachek Silver 350" by Armacell or equivalent 3-layer composite film with shining aluminum like metallic appearance, with UV protection and polymer backing for mechanical protection. However AHU sub-bidder can suggest the thickness of insulation as per manufacturer standards.	MTR	As per BOQ /dwg.
12	VENTILATION FAHU WITH HEAT RECOVERY SYSTEMS		
	HEAT RECOVERY WHEEL TYPE The Thermal Heat Recovery Wheel shall be cabinet type construction, comprising of various sections such as supply air, exhaust air and fresh air connections as shown on drawings and included in schedule of quantities.		
	Wheel The wheel shall be made of alternate layer of corrugated and intervening flat composite material of aluminium foil of uniform width to ensure smooth surface. The wheel medium should be bonded together to form rigid transfer medium forming a multitude of narrow channels ensuring laminar flow. The wheels shall be of proven design. The wheel can be fully wound or on larger units, sectorised, i.e. assembled in segments. In latter case the segments are assembled between rigid spokes thus ensuring structural longevity and allowing replacement of one or specific segments only. The wheel shall be cleanable by spraying its face surface with compressed air, low temperature steam or hot water or by vacuum cleaning without affecting its latent properties. The face velocity across the wheel should not exceed 700 fpm (3.5 m/s). The wheels shall be tested in accordance with ASHRAE S4-78 method of testing air to air heat exchangers. Development an manufacturers shall meet all quality assurance criteria specified in BSEN ISO 9001. The minimum sensible and latent efficiencies should be 75%. A computerized		

	selection should be enclosed along with offer.		
	Casing The casing shall be constructed as a single skin, self-supporting, galvanized sheet steel structure and include rotary wheel support beams and purging sector. The casing shall be supplied with access panels to facilitate inspection and service. Size 2150 mm and larger shall be in two sections to facilitate shipping and handling. c. Seals: The casing shall be equipped with adjustable brush seals, which minimize the carryover to max 0.05 – 0.2%. d. Hub and Spokes: Hub and Spokes on one piece rotor shall be Aluminium and on sectorrized rotor Hub shall be made of steel, painted with anti-corrosion paint and galvanized sheet steel spokes. e. Drive: The wheel shall be belt driven along its perimeter. A constant speed fractional horsepower motor shall be used. The motor shall be mounted on a self-adjusting base to provide correct belt tension.		
12.1	14000 CFM	NOS	As per BOQ /dwg.
13	Control Panel		

13.1	SITC of local control panel for HRW along with starter & Controller start stop push button switch, Main Isolator switch, auxiliary contactor., indication lamps, voltmeter ,Ammeter, transformers for 230V/24V DC supply, contact relays for fire mode activation, along with required toggle switches. Power & Control cabling, Cable Tray, Double Earthing, Cable termination from panel to Fan motors, sensors shall be included in the quoted rate. All the panels are BMS compaitable, with Auxiliary contracts, Hard wire & Software integration compatibility. The panel shall have suitable rating kW VFD with IP-54 rating. VFD shall be provided with AHF at local level above & including 15kW but without AHF below 15kW rating. The VFD shall be inclusive of passive filter for below 15kW rating. THD shall be less than 5% as per IEEE 519. VFD filters shall be provided with EMI/EMC compliant for the respective Cable length as per site conditions. Interconnecting XLPE power AL.	Nos	As per BOQ /dwg.
14	Volume Control Damper		
14.1	Supply, Installation and Testing of Manual Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade with gasket beading design as indicated, low-leakage rating, with linkage outside air stream, and suitable for horizontal or vertical applications. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 1.6 mm thick for proper balancing of the air distribution system as per the approved shop drawings and specifications.	Sqm	As per BOQ /dwg.
15	Motorized Fire and Smoke Damper		
15.1	Supply, Installation, Testing & Commissioning of smoke cum fire dampers as per UL 555 with at least 90 minutes fire rating as per the approved shop drawings & specifications. Frame and Blades: 1.62 mm-thick, galvanized, sheet steel. The fire damper should be complete with control panel, Temperature Release Device, Damper actuator Motor: 220 V, single phase, 50 Hz and shall be BMS compatible as per the specifications.	Sqm	As per BOQ /dwg.
16	Fire alarm control panel and actuators		

16.1	Panels should provide 24V DC with Necessary potential free contact for fire trip to be provided & transformer to be inbuilt. Control Panel should trip upon the input from Temperature Sensor @ 72 deg C (to be provided with the panel), Smoke Detector, External Fire panel / BMS with Auto Reset option, AHU door opening. Interlocking of AHU's with timer for Reset and 2 additional equipment's (Hooters, Electrical Panels). Control panel should show the status (Open / close) of individual fire damper. RS 485 port for BMS to be mentioned. Panel material of construction to be specified. Conduiting for control cables to be part of spec with civil works if any.	NOS	As per BOQ /dwg.
	Supply, installation, testing and commissioning of Fire damper control panel with maximum 6 outgoing feeders for Actuators and incomer from AHU starter panel, Control panel should have necessary provisions to take BMS contacts for each actuator status and also show local display with reset option. Necessary Terminal block to be provided for fire interlocking complete as per technical specification & drawing details.		
	Supply, installation, testing and commissioning of Spring return type Actuators for AHU room dampers complete as per technical specification & drawing details.		
17	GI FACTORY FABRICATED SUPPLY AIR PLENUMS		
17.1	All Sheet metal double skin air plenum section of following sizes for AHU. The plenum shall be constructed using double-skinned acoustic panels with minimum 0.8 mm thick pre-coated GSS sheet for outer skin and & minimum 0.8 mm plain GSS sheet for inner skin of the unit. All the panels shall incorporate 50 mm thick PUF insulation sandwiched in between inner & outer skin. Plenum shall be powder coated and all necessary cut outs to connect with AHU and branch duct to be considered.	Sqm	As per BOQ /dwg.
18	Supplying, fabricating, structural steel supports fabricated from MS channels, angles, flats including as per Standard details or similar type of supports including painting with one coats primer and two coats of enamel paint of an approved shade rate quoted shall include for supply and providing	Kg	As per BOQ /dwg.

	necessary, welding cutting, 'U' clamps bolts nuts, washers etc.as per specification of pipe supports for horizontal / vertical pipes running along wall / column, slabs trenches etc. to suit different dia pipes/Equipment.		
	TOTAL FOR AHU		
C	FIRE PROTECTION SYSTEM- as per the specification mentioned		
	FIRE ALARM SYSTEM		
1.0	Supply, installation, testing and commissioning of 1 Loop wall recess mounting microprocessor based networkable analogue addressable Fire Control Panel having a Fire Alarm Capability of 100/125/150 detectors/devices per loop with each loops length being restricted to 80% of manufacturer specified maximum loop length). The Fire control panel shall have 100% hot redundancy for CPU, load etc. It shall be expandable by minimum 1 additional loops. The operating panel shall have minimum 80 character LCD display, 4 access levels, 1000 events historical logging, flash E-PROM, 240 volts ac power supply, automatic battery charger, 24V sealed lead-acid battery suitable operating the system for 24 hours in emergency condition. The Panel shall be Integrated with the PA System and with suitable power amplifiers for the hooter/strobes. The Panel shall be Integrated with the BMS System and shall include cost of supply of any additional modules, software and interfaces as required for the same and as required by the Client. The Panel shall provide either or all BACNET/RS485/ LON/MODBUS protocols as required. The panel shall be complete as per specifications and as required. One Loop Panel.	Nos	As per BOQ /dwg.
2.0	Supply, installation, testing and commissioning of plug-in type intelligent analogue addressable multi criteria photo electric cum Smoke detectors including the cost of base plate, 75 mm dia M.S. outlet box for fixing of the detector base, mounting accessories etc. complete as per specifications and as required.	Nos	As per BOQ /dwg.
3.0	Supply, wiring, Installation, Testing and Commissioning Intelligent Analog Addressable heat detector and detectors shall be UL listed.	Nos	As per BOQ /dwg.

4.0	Supply, installation, testing and commissioning of Addressable type fault for isolating shorted, dewired and loose circuits between two successive fault isolators with automatic resetting arrangement (base Model)	Nos	As per BOQ /dwg.
5.0	Supply, installation, testing and commissioning of Addressable type Response indicator.	Nos	As per BOQ /dwg.
6.0	Supply, installation, testing and commissioning of intelligent analogue addressable Control Modules including the cost of 75 mm dia MS outlet box for fixing of the module, mounting accessories complete as per specifications and as required.	Nos	As per BOQ /dwg.
7.0	Supply, installation, testing and commissioning of recess/surface mounting dust and vermin proof intelligent addressable analogue Manual Pull stations including cost of all required modules, mounting accessories etc including the cost of M.S. outlet box for fixing of the station, mounting accessories etc. complete as per specifications and as required.	Nos	As per BOQ /dwg.
8.0	Supply, Installation, Testing and commissioning of high intensity hooters cum Strobe Lights with 110 cd. The strobes shall be synchronized for better evacuation.	Nos	As per BOQ /dwg.
9.0	Supply, laying, testing and commissioning of 2 core 1.5 sqmm copper conductor FRLS Armoured pvc insulated cable FP200 cable 1100volt wires in FRLSPVC Conduit for all concealed and above false ceiling application, IS embossed black enameled 25mm dia 16 SWG MS surface conduiting system including cost of providing saddles etc for surface conduiting and/or cost of cutting and filling chases for recessed conduiting as required and including the cost of crimped termination's complete as required.	Meters	As per BOQ /dwg.
10.0	Supplying fixing testing and commissioning heavy gauge ISI embossed black enameled GI Conduit recessed and/or surface conduits including cost of providing saddles etc for surface conduiting and/or cost of cutting and filling chases for recessed conduiting complete as per specifications, as required and as below. 25 mm 16 SWG	Meters	As per BOQ /dwg.
	TOTAL FOR FIRE ALARAM		

C	PHE		
1	SANITARY FIXTURES & FITTINGS		
	Note:		
	i) Detail of Sanitary fixture are for the information of the Bidder, however model / makes of all sanitary fixture shall be selected by Architect / Interior designer / client and the same shall be binding for execution		
	ii. No additional all fixing cost shall be paid for change in type of sanitary fixture or fitting.		
	iii. Provision of extension piece for final connection of CP fitting shall be supplied and installed by the bidder accordingly (as required)		
1.0	Supply, fixing, testing and commissioning of vitreous china below / above counter wash basins with PVC connection pipe for water supply, CP brass waste assembly, CP bottle trap with extension piece, wall flanges and rubber adapters for waste connection complete including CI / MS brackets duly painted, cutting and making good the walls floors wherever required.	Nos.	As per BOQ /dwg.
2.0	Supply, Fixing, testing and commissioning of single liver faucet (pillar tap) for Wash Basin with all required accessories to make it operational.	Nos.	As per BOQ /dwg.
3.0	Providing, fixing, testing and commissioning of flexible pipe connection of 600 mm long including nuts and washers and making connection to fixtures and fittings complete as required. (used for wash basin, sinks, etc)	Nos.	As per BOQ /dwg.
4.0	Providing, fixing, testing and commissioning of C.P. brass angle valve with C.P. wall flange, Nut and Washer etc. complete as required.	Nos.	As per BOQ /dwg.
5.0	Providing and fixing white European type wall-hung Water Closet, Size 360mm x 360mm x 575 mm with flush valve having flow rate up to 6.0 Litr/Minute of Jaquar/Cera/Hindware /Perryware or equivalent make including PVC soil pipe, vent pipe up to outside face of wall, 100mm dia PVC plug bend inlet	Nos	As per BOQ /dwg.

	pipe all fittings, cutting & making good walls, floors etc as directed by Engineer in charge.(Make shall conform to manufacturer's Green product and shall got approved from the Engineer In Charge.)		
6.0	Providing and fixing health Faucet with regulator of approved quality with plastic flexible pipe 1.5 m long, wall hook complete as required.	Nos	As per BOQ /dwg.
7.0	Providing and fixing Two Way Bib Cock for EWC complete as required.	Nos	As per BOQ /dwg.
2.0	INTERNAL WATER SUPPLY		
1.0	Providing and fixing CPVC (Chlorinated Poly Vinyl Chloride) water supply pipes with pipe as per CTS SDR - 11 as per IS 15778, at a working pressure of 27.6 Kg/Sqcm. at 27 deg C & 6.8 Kg/Sqcm. at 82 deg C and 65mm above consider CPVC SCH 40 pipes with pipe as per ASTM F 441, using solvent welded CPVC fittings i.e Tees, Elbows, Couplers, Unions, Reducers, brushings etc. including transition fittings connection between CPVC & metal pipe / GI) i.e Brass Adaptors (both Male & Female threaded) conforming to ASTM D-2846 (upto 50mm dia.) /ASTM F-438 (65mm & above dia. pipe) with only CPVC solvent cement conforming to ASTM F-493 with fabricated & subsequently hot dip galvanized clamps / structural steel supports as required / directed at site including cutting chasing and fixing the same with cement concrete / cement mortar as required, including painting the exposed pipes with one coat of desired shade of enamel paint. All termination points for installation of faucets shall have brass termination fittings. Installation shall be to the satisfaction of PMC / Consultant / manufacturer of pipes & fittings. (For Cold and Hot Water Supply Inside toilets)		
a	15 mm	RM	As per BOQ /dwg.
b	20 mm	RM	As per BOQ /dwg.
c	25 mm	RM	As per BOQ /dwg.
d	32 mm	RM	As per BOQ /dwg.
e	40 mm	RM	As per BOQ /dwg.
f	50 mm	RM	As per BOQ /dwg.

3.0	Providing & fixing full way lever operated forged brass ball valve (PN16) of brass body with forged brass hard chrome plated steel ball with threaded / flanged joints complete with nuts, bolts, gaskets, washers etc.		
a	15 mm dia	Nos.	As per BOQ /dwg.
b	20 mm dia	Nos.	As per BOQ /dwg.
c	25 mm dia	Nos.	As per BOQ /dwg.
d	32 mm dia	Nos.	As per BOQ /dwg.
e	40 mm dia	Nos.	As per BOQ /dwg.
f	50 mm dia	Nos.	As per BOQ /dwg.
4.0	Supply, installation, testing & commissioning of Submersible Water Pump - 1HP along with its control panels and related consumables	Nos.	As per BOQ /dwg.
3.0	INTERNAL DRAINAGE		
1.0	Providing and fixing at all floors Upvc SWR Type-B pipes including all fittings such as plain and door bends, tees, cowls, elbows, equal and unequal junctions, heel rest sanitary bends, collars etc. confirming to IS13592, including jointing with solvent and providing necessary supports, clamps/MS brackets at specified intervals. The joints of pipe and fittings shall be of drip seal jointing in exposed areas like in shafts etc. and pasted type (solvent) for all other locations all complete and as per directions of Engineer - in - charge. (Soil and Waste inside the Toilet)		
a	75 mm dia	Nos.	As per BOQ /dwg.
b	110 mm dia	Nos.	As per BOQ /dwg.
2.0	Providing and fixing at all floors Upvc Agri 6 kg/cm2 pipes including all fittings such as tees & elbows etc. confirming to IS4985, including jointing with solvent and providing necessary supports, clamps/MS brackets at specified intervals. The joints of pipe and fittings shall be of drip seal jointing in exposed areas like in shafts etc. and pasted type (solvent) for all other locations all complete and as per directions of Engineer - in - charge.(West pipe fitting to FT)		
a	32 mm dia	Nos.	As per BOQ /dwg.
b	40 mm dia	Nos.	As per BOQ /dwg.

c	50 mm dia	Nos.	As per BOQ /dwg.
3.0	Providing and fixing floor trap of self-cleansing design with water seal not less than 50mm with or without vent, including setting the trap in Ceiling, closing the sleeve and making waterproof etc. complete.		
a	110 mm inlet and 75 mm outlet. (FT)	Nos.	As per BOQ /dwg.
4.0	Providing and fixing of PVC catch basin with Perforated GRP bucket with 250mm height and 110mm outlet	Nos.	As per BOQ /dwg.
5.0	GI Trech grating	Mtr.	As per BOQ /dwg.
	TOTAL FOR PHE		
D	FIRE FIGHTING-In accordance with **NFPA 410.**		
1.0	ISI marked (IS:2878) Fire Extinguisher, Carbon-di-oxide type (gas based) capacity 4.5 Kg. Flat base including valve, discharge hose of not less than 10 mm dia, 1M long and complete in all respects including initial fill with CO2 gas conforming to IS:307-1966 filled to a filling rate of not more than 0.667 and wall suspension bracket. It should be halon free.	No.	As per BOQ /dwg.
2.0	ABC (Dry Powder Type) Fire Extinguisher (6 kg). In HP Mild Steel Cylinders ISI marked TAC approved fitted with pressure indicating gauge, internal tube, squeeze lever type valve fully charged with ABC powder (Mono Ammonium Phosphate) pressured by Nitrogen complete in all respects including wall suspension bracket and conforming to IS:1349-1993.	Nos.	As per BOQ /dwg.
3.0	Providing and Fixing BFV valve (suitable for working pressure of 16kg/sq. cm.) of following dia complete with flanges, nuts, bolts etc.		
a.	80 mm	Nos.	As per BOQ /dwg.
4.0	Providing and fixing GI C Class suction & delivery headers of required length conforming to IS : 1239 / IS : 3589 with DI Fittings (for pipes up to 50mm dia threaded forged steel fittings and for pipes above 50 mm dia GI fitting with welded joint shall be used) and with end flange connections having inlet & outlet flanged connections including GI supports		

	from wall, floors & ceiling complete as required. Cost should be inclusive of all supports / clamps / brackets, anchor fastener etc. as required. (In pump room)		
	Providing two coats of synthetic enamel paint of approved shade over one coat of red oxide primer. Prior to application of primer the surface should be cleaned for any dirt, rusts, rough substance etc. Including painting of legends both direction arrow as per the approval of the Project Manager.		
a.	80 mm	RM	As per BOQ /dwg.
5.0	Providing, laying, jointing, testing and commissioning of following sizes of MS pipes conforming to IS-1239 with all accessories like including tees, elbows, reducers, union, flanges, rubber gaskets, GI nuts bolts, washer including supporting/fixing the pipe on floor / wall /ceiling with clamps, hangers (using anchor fasteners) as per specification. G.I. pipe sleeve of suitable higher size shall be provided wherever the pipes are crossing the walls/floors as per Project Manager's / Consultants requirements including cutting holes and chases in brick, R.C.C work and making good the same to original conditions complete in all respects. All hangers, clamps, brackets etc. shall be of galvanized mild steel unless specified otherwise and then supply of the same shall also be included for rates under this head.		
	Welding of any kind on the galvanized support / hanger shall not be permitted. Including two coat of synthetic enamel paint on each pipe dia of approved shade over a coat of red oxide primer.		
	For wet riser System - MS `C' Heavy class pipe		
a.	80 mm dia	RM	As per BOQ /dwg.
b	Providing & fixing Stainless Steel single headed landing valve with 80 mm N.B. flanged inlet, SS spindle controlled 63 mm dia female instantaneous outlet type. SS. coupling, blank cap, chain, twist release type lug & all accessories Conforming to relevant IS : 5290. Including fixing with anchor fastener and flanged tapping from wet riser and providing pressure gauge with gun metal ball valve	Nos	As per BOQ /dwg.

	complete as required. (Internal Landing Valve)		

OTHER REQUIREMENTS

- Chemical Storage Area

A provision for the storage of the paint materials to be provided.

1. Material Storage Cabinets:

I) All chemicals and hazardous materials, particularly those used in the painting process (e.g., paints, solvents, thinners, and adhesives), must be stored in flammable material storage cabinets.
II) Purpose of Cabinets: These cabinets are designed to safely store flammable liquids and materials, providing protection from heat sources or open flames.
III) Fire Resistance: The cabinets must be constructed from fire-resistant materials to contain any potential fire or spill and minimize risks.
IV) Cabinet Features: Must include self-closing doors and proper ventilation to reduce the risk of fire.

Ventilation:

I) The storage area must be well-ventilated to prevent the accumulation of harmful fumes or vapors that may arise from chemicals like solvents and paints.
II) The ventilation system must be designed to ensure continuous airflow, ideally using explosion-proof fans or systems to handle potentially volatile chemical fumes.

Temperature Control:

I) The ambient temperature of the storage area must be maintained within the range of 25°C to 35°C. This temperature range helps prevent materials from becoming unstable or degrading due to extreme cold or heat.
II) Ensure climate control systems (heating, cooling, or both) are in place to keep the storage area within the required temperature range, particularly in areas with extreme weather conditions.

Fire Partition and Fire Doors:

I) If the chemical storage area is within the same building as the hangar, it should be segregated by a fire-resistant partition that prevents the spread of fire.
II) Fire Doors: Openings in the fire partition must be protected by an approved and listed fire door. These doors must conform to the NFPA 30 standards, ensuring they provide adequate fire protection.

III) The fire doors should be self-closing, ensuring that the compartment remains secure in the event of a fire. These doors must be tested and certified to meet fire resistance standards.

All the above said requirements should be fulfilled.

- Hangar doors/Shutter and emergency door: -automated mechanised hangar door having provision with electro-hydraulic operation and manual operation in case of no availability of power from the hangar floor. The operational panel located at the suitable corner of the hangar as per the instruction of EIC.

1. Number of Doors:

- Hangar Door Horizontal sliding (full open) with suitable number of halves to slide towards both ends with the guide rail provision at bottom and top(The bottom rail gap is small enough to allow the Aircraft tyres/ other equipment tyres pass through smoothly). Front Side: Facing the airport runway and the main approach to the hangar.
- Rolling Shutter at other end of the hangar Size 6.2 X 5 Meter. Electric & manually operated.
- Emergency door –Fire Rating doors. At middle of hangar as per the reference sketch. The door must be made from durable materials such as steel or aluminum to withstand the demands of a hangar environment and ensure fire protection.

2. Type of Doors:

o Horizontal Folding Shutters for Main entrance: The doors should be horizontal folding shutters, a preferred solution for this type of application. This type of door provides several advantages:

- Airtightness: Horizontal folding shutters are highly effective in preventing air leakage, ensuring that contaminants, dust, and pollutants do not enter the hangar.
- Space Efficiency: These doors do not require as much lateral space as traditional swing doors, making them ideal for areas where space is limited.
- Security and Durability: The design ensures robust security and protection against external environmental factors such as wind, dust, and weather.

3. Design Considerations:

o The L-1 bidder will be responsible for preparing and submitting a detailed design of the electrical cum manual sliding horizontal folding shutters for approval. The design must take into account:

- Airtightness: Ensuring that the doors seal tightly to prevent air leakage.
- Material Selection: The materials should be durable, weather-resistant, and corrosion-proof, considering the airport's harsh environmental conditions.
- Operation Mechanism: Both electrical and manual operation mechanisms should be included in the design, allowing for automatic opening/closing as well as manual override in case of power failure.
- Safety and Security: The design should include safety features such as emergency stops, locks, and manual override options.

4. Performance and Functionality:

I) The doors should ensure optimal air control, essential for the paint booth environment, where air quality is critical.

II) The airtightness of the door is particularly important to prevent contaminants from entering the hangar and to maintain the desired airflow for the paint booth.

III) Noise Reduction: The shutters should also help reduce noise levels, contributing to a better working environment.

5. Compliance and Approval:

I) The design should comply with local regulations, airport standards, and engineering best practices.

II) The AIESL Engineer will review and approve the submitted design before proceeding with the construction and installation of the doors.

Important Notes:

1. Site visit is mandatory for participating in tender.
2. The specifications for this project must comply with all the specification mentioned in the tender and all relevant IS codes, standards, and regulations, as referenced or applicable.
3. The rate includes the cost of all consumables and hire charge of all tools and plants, and labour required for the work including all incidental charges (such as electricity, labour insurance) etc. The rate should also include the Scaffolding required for the purpose of the required width and height. No extra payment towards scaffolding will be paid in any case.
4. The Minimum Warranty for quality of Civil Construction repairs/ Works / Workmanship will be ten years from the date of commissioning and hand over to AIESL. In case any defects / damages are noticed or if repairs are necessitated during the warranty period, then the same should be undertaken by the Bidder / Contractor at no extra cost to AIESL. The warranty should be as whole.
5. Work should be completed as per the said standard quality and the contractor shall commence the services within one week from the date of placement of Purchase order and completed within 150 days, however suitable effort to complete the project at the earliest well before 75 days. Any delay / intended delay/ effortless work. in completion of the work beyond the duration indicated above, will attract penalty as per the penalty clause of the tender.
6. The contractor shall solely be responsible for conduct and behavior of their personnel and any loss or damage to the company property due to the conduct of their personnel shall be made good by the contractor at the earliest.
7. It will be the primary responsibility of the Contractor / Bidder, to ensure all safety measures are undertaken before commencing the job / work, by usage of all necessary safety devices such as scaffolding, nets, ladders, ropes, gloves, helmet etc., and cost of the same to be borne by the bidder. It shall be the responsibility of the bidder / contractor to ensure that all protective and safety gear is worn / used by their personnel during their course of work in MRO.
8. The contractor shall solely be responsible for Contractor obtain clearance from other statuary/ regulatory/agency/ authority, Example KSEB/ Pollution control board etc, for external related matters for commencing of work, if required.
9. Restoring of the disturbed area/location/items at time of completion, caused due course of the above said work.
10. Contractor shall clear the site after completion of job in all respect without which the invoice will not be certified/cleared by AIESL for payment.
11. For the electricity and water for the construction purposes the bidder has to avail necessary connections from the suitable points available within AIESL on chargeable basis. No additional extensions will be given by AIESL, the additional extensions will be under bidder's scope only. The water for construction purpose has to be taken from any nearest point. Additional pipelines and storage tanks will be under bidder's scope. Nothing extra shall be payable on this account.

12. The water (Chargeable) for construction work shall be got tested monthly from the laboratory approved by the Engineer in charge (KWA water testing laboratory/Equivalent run by GVT or autonomous bodies) to ensure its suitability for construction. The charges for these tests and related arrangements shall be borne by the Bidder. In the event of water found unsuitable for construction, the Bidder shall make alternative arrangement for suitable water from any other source to the satisfaction of the Engineer in charge.
13. The structure should not have any gaps or openings that allow access to animals or reptiles.
14. The bidder must arrange and bear all costs associated with obtaining the electric connection from the existing substation to the newly constructed building, including all trenching, underground piping, and duct work. No additional costs will be accepted for this.
15. The Bidder shall provide, at his own cost instruments for surveying, weighing and measuring purpose at the site of work as may be necessary for execution of the work as per the instructions from Engineer in charge time to time. All those equipment /machines have to be calibrated by a certified organization approved/run by GVT of India/Kerala and the certificates has to be valid during the time of contract. All copies of the relevant certificates and necessary documents has to be submitted immediate to the award of the contract along with equipment /machines model, serial number/registration number in complete etc.
16. The Bidder shall take care of all safety Precautions pertaining to construction of work, such as excavation, trenching, provision of scaffolding, ladder, working platforms, gangways, mixing asphaltic materials, electric arc/ gas welding, use of hoist and construction machinery. All the above stipulated activities have to be followed by the IS standards mentioned as part of detailed specification and BOQ as part of tender document. He shall be governed by relevant provisions of safety code and as directed by the Engineer in charge and nothing extra shall be payable on this account.
17. On account of security consideration, some restrictions may be imposed by the security staff on the working and/ movement of men and materials etc. The Bidder shall be bound to follow all such restrictions/ instructions and he shall organize his work accordingly. Especially since the site is adjacent to runway special safety measures has to be taken and all the precautionary measures instructed by the authority must be implemented. No claim on this account, whatsoever, shall be payable.
18. The Bidder shall take all Precautions to avoid accidents by exhibiting necessary caution boards day and night, speed limit boards, red flags, red lights and providing barriers. He shall be responsible for all damages and accidents caused to existing/ new work due to negligence on his part. No hindrance shall be caused to routine movements and functions of MRO during the execution of the work.
19. The Bidder shall be responsible for the watch and ward of the building safety of all fittings and fixtures including Electrical, AHU system, firefighting system, sanitary and water supply fittings and fixtures against pilferage and breakage during the period of installation and thereafter till the building is physically handed over to the department.
20. The work will be carried out in the manner complying, in all respects, with the requirements of relevant bye-laws of the local body under the jurisdiction of which the work is to be executed or as directed by the Engineer in charge and nothing extra shall be paid on this account.
21. The work of water supply, internal sanitary installations and drainage work etc. shall be carried out as per local Municipal Corporation or such local body bye-laws and the Bidder shall produce

necessary completion certificates, wherever required, from such authorities after completion of work.

22. Water tanks, taps, pipes, fittings and accessories shall conform to bye-laws and specifications of the Municipal body/ corporation. The Bidder should engage licensed plumbers (Valid license issued by KWA/ any state or central bodies) for the work and get the materials, (fixtures and fittings) tested by the Municipal Authorities or by the licensed plumber, wherever required, at his own cost and nothing extra shall be payable. A copy of the valid license has to be attached along with the tender technical documents.
23. The Bidder shall comply with proper and legal orders and directions of the local or public authority or municipality and abide by their rules and regulations and pay all fees and charges which may be liable and nothing extra shall be paid on this account.
24. All the pre-construction approvals are to be obtained by the Bidder in association with AIESL. If any approvals are pending at the time of award of work Bidder will assist in getting clearance done from appropriate authorities. All approvals during construction stage and commissioning phase are to be obtained by the Bidder. The fee for such clearances shall be borne by the Bidder.
25. The Bidder shall give due notices to Corporation, Police and/ or other authorities that may be required under the law/ rules under force in the area and obtain all requisite licenses for temporary obstructions / enclosures and pay all charges which may be liveable on account of the execution of work under the agreement. And cost of same has to be borne by the bidder solely.
26. All materials to be incorporated in the work shall be arranged by the Bidder and shall be in accordance with the specifications laid down.
27. The tenderer shall use materials as per BOQ and specifications mentioned in PART- A, B, C, D bearing ISI Certification Mark/provided in BOQ/specifications unless otherwise specified or allowed in writing by the Engineer in charge. Any material banned by AIESL/AIESL approved forum shall not be used in the work.
28. The Bidder shall submit to the Engineer in charge samples of all materials for approval. Such samples of materials which affect aesthetics of the work shall also be got approved from the Engineer in charge of the project before procuring bulk supplies. These approved samples shall be Preserved and retained in the custody of the Engineer-in charge as standards of materials till the completion of the work. The cost of such samples shall be borne by the Bidder and nothing shall be payable on this account over the Agreement rates.
29. Even ISI marked materials may be subjected to quality test at the discretion of the Engineer in charge. Whenever ISI marked, materials are brought to the site of work the Bidder shall, if required by the Engineer in charge, furnish manufacturer's test certificate or test certificate from approved testing laboratory to establish that the materials procured by the Bidder, satisfy the provisions of relevant ISI codes. The testing charges shall be borne by the Bidder. However, cement/ steel (reinforcement as well as pre-fab steel) will be necessarily tested before start of work and also during the execution of work as per the requirements of specifications, and will not be used till test certificates are obtained and approved by Engineer in charge.
30. Cement bags shall be stored in separate godowns to be constructed by Bidder at his own cost as per sketch approved by Engineer in charge with weatherproof roofs and walls. Each godown shall be provided with a single door with double lock arrangement. The keys of one lock shall always remain with authorized representative of Engineer in charge of work and that of the other lock with the authorized agent of the Bidder at site of work so that the cement from the godown is

removed according to daily requirement with the knowledge of both the parties and proper account of issue of cement is maintained in the Prescribed proforma.

31. The steel reinforcement shall be stored by the Bidder at site of work in such a way as to prevent distortion and corrosion and nothing extra shall be paid on this account. Bars of different sizes and lengths shall be stored separately to facilitate easy counting and checking at any time as and when desired by the Engineer in charge.
32. The actual issue and consumption of steel on work site shall be calculated and proper accounts maintained. The theoretical consumption of steel shall be worked out as per procedure.
33. The work shall be executed and measured in metric system. The metric dimensions given in the schedule of quantities and drawing etc. shall be followed. (The dimension in FPS units wherever indicated, is for guidance only). The measurements as per the approved drawings submitted by the Bidder shall be followed.
34. The Bidder shall be responsible for completing the work and for satisfying all terms and conditions of the Contract without any extra payment over his quoted rates unless otherwise specified. The Bidder shall quote his rates for various items of work accordingly and no claim whatsoever shall be entertained for any incidental or extra work involved in the execution of the work as per nomenclature of the item and the specifications indicated in the tender documents.
35. Subject to the nomenclature of the item as per schedule of quantities, the specification indicated in the tender documents, the rates shall include cost of all materials including royalty and taxes if any, labour, sundry inputs, execution of work at all heights, levels, pattern and design for all leads, lifts and depths including overhead charges and Bidder's profit. Nothing extra shall be paid on this account. The cost of unloading cement and steel from the trucks & its carriage to store/site of work shall be borne by the Bidder.
36. Loading and unloading of the materials, related all materials related to execution of the project shall be executed as per the loading and unloading policies of labour laws of the state/ local governing bodies. No disputes related to such incidents will be entertained during the course of execution of the project. Any delay if any happens due to the loading and unloading issues, AIESL will not be responsible and no excuse/extension will be given for the timely completion of the project. The bidder can refer the details as per the document G-2/3715/2020 issued by state government.
37. The rate shall be inclusive of making design, pattern and execution of work as per Architectural and structural drawings, at all levels and heights as per the details stipulated in BOQ – Part – A to D and detailed specifications mentioned in the document.
38. The rate of items of flooring shall be inclusive of work for sunken or depressed floors (Existing taxi bay). Upon request site detailing can done with representative of bidder and Engineer in Charge. Site preparations and constructions as per Part-C of tender document and the BOQ cum Specification.
39. The rate shall be inclusive of working under water and adverse or foul conditions and including pumping out or bailing out water, unless otherwise specified in the nomenclature. This will include water encountered from any sources such as rains, floods and any other cause whatsoever and including sub-soil water.
40. Other agencies doing works related with this project will also simultaneously execute the works and the Bidder shall afford necessary co-ordination for un-hindered completion of these sub-works.

41. The Bidder shall leave necessary holes, openings or core cutting as required etc as may be directed by the Engineer in charge for laying, burying or fixing, conduits, pipes, boxes, hooks, fans, plumbing pipes, firefighting pipes etc. Without any extra cost implication.
42. Conduits for electrical wiring/ cables will be laid in a way that they leave enough space for concreting and do not adversely affect structural members.
43. The Bidder shall give a satisfactory performance test of installations individually and as a whole to ensure their proper functioning before the work is finally declared completed and accepted.
44. The Bidder shall continue to maintain watch and ward to safeguard the Owner's property in his possession until the same is formally handed over as per directions of the Engineer in charge. Nothing extra over agreement rates shall be paid on this account.
45. All tools, plants and measuring or weighing equipment shall be arranged by the Bidder himself and nothing extra shall be paid to the Bidder on this account. Measuring and weighing equipment shall possess valid calibration certificate availed from State or central organization.
46. The Bidder shall protect the adjoining buildings or works and the work under execution from fire and shall make adequate arrangements for fire protection and firefighting and if any property is damaged, by fire due to the negligence of the Bidder, the same shall be made good by the Bidder at his own cost, to the entire satisfaction of Engineer-in charge.
47. The Bidder shall provide adequate lighting arrangements as approved by the Engineer in-charge for carrying out the work during night time, if so required and also provide all other facilities for the labour employed to carry out the work as per direction of Engineer in-Charge. Construction safety codes will be followed in such cases including cabling and connectivity.
48. In order to achieve the targeted date of completion the Bidder may have to work in multiple shifts, round the clock and nothing extra shall be paid on this account.
49. The Bidder shall get the samples of all the materials to be used, in the work approved from Engineer in charge before going for bulk procurement. Bulk procurement shall be taken up only after obtaining approval from the Engineer in charge. Any delay in getting the samples approved shall be Bidder's responsibility and no excuse shall be given on such situations.
50. All materials, articles and workmanship shall be of respective best quality and kind for the class described in the schedule of quantities and specifications. All materials, so used in different items of work shall be subject to the approval of the Engineer in charge.
51. The Bidder shall be responsible for all statutory provisions and deductions towards ESI, PF or any other, as the case may be or any other levies and taxes shall be borne by the Bidder. The TDS and Contract Tax or any other statutory levies/ taxes incorporated from time to time shall be deducted from the bills, as applicable at the time of payment. No claim in this regard shall be entertained.
52. The Bidder is supposed to abide the minimum wages act, and shall produce all records to the Engineer in charge or any other statutory authority as and when called for. The Engineer in charge does not hold any responsibility, on account of any lapses in this regard.
53. In respect of the work of other agencies, where the commencement or progress of such work of any other agency is dependent upon the completion of particular portions of the Bidder's work or generally upon the Bidder maintaining progress in accordance with the approved coordinated construction programme, it shall be the responsibility of the Bidder to complete such portions and maintain such progress.

54. Should any difference arise between the Bidder and the other agencies, these shall immediately be brought to the attention of the Engineer in charge who after reviewing the matters causing the differences will give their decision which shall be final and binding on the Bidder.
55. The Bidder shall have to do all drilling of holes and cutting of walls, chases or other elements of the building for the complete and proper installation of the pipe lines/ ducts and other equipments by using electrically operated tools such as drills/ chase cutting machine/core cutter etc. Manual drilling or chiseling or cutting shall be permitted on special request only.
56. No chiseling or cutting or drilling of RCC columns, beams, girders and other principal structural members shall be done unless prior permission has been granted by the Engineer in charge in writing.
57. The Bidder shall Prepare and produce instruction, operation and maintenance manuals in English for the use, operation and the maintenance of the supplied equipment and installations, and submit to the Engineer in charge in (5) copies at the time of handing over. The manual shall generally consist of the following: a) Description of the project b) Operating instructions c) Maintenance instructions including procedures for Preventive maintenance d) Manufacturers catalogues e) Spare parts list f) Trouble shooting charts g) Drawings of civil construction, Prefab drawings, Electrical scheme, Plumbing scheme, Fire system scheme, Scheme of AHU system h) Type and routine test certificates of major items.
58. The Bidder will arrange to erect, at his own cost, barricading as per norms of buyer around the infrastructure site, with entry/ exit gates at suitable points. The Bidder shall, at his own cost, provide and erect suitable fencing around the spaces allotted to him at the infrastructure sites to ensure the security of his men, materials and equipment within the sites and in relation to other Bidders who will also be allotted spaces at above sites. The security of workmen, materials, equipment stores etc, within the area allotted to the Bidder shall be the responsibility of the Bidder.
59. The Bidder has to get executed the works from specialized agencies for the specialized nature of works such as flooring works, electrical works, Firefighting works, Structural steel work and any other specified work as decided by Engineer In charge. The Bidder can engage such agencies from the approved list only and has to avail MAF from such agencies and shall produce along with the tender documents. The Bidder has to obtain the approval from Engineer In charge for execution of specified nature of work.
60. Nothing extra shall be paid for the additional thickness of cement mortar bed wherever required over and above thickness mentioned in the nomenclature of various items of flooring for providing the slope and / or matching the floor levels of various type of floor finishes like ceramic/ vitrified tiles and cement concrete flooring etc.
61. The Bidder, at his own cost, shall obtain initial corporation approvals for starting the work in Kerala as per norms, and Corporation of Thiruvananthapuram & completion certificate of the building from the local body for occupation of the building. The buyer will render all assistance. Similarly, the Bidder, at his own cost, shall be responsible for getting the water and sewer connection if any sanctioned from the concerned Local Authority. For obtaining the above completions/ clearances/ connections, the Bidder shall prepare necessary drawings/ documents/ load calculations and submit the same to the concerned authorities along with Prescribed receipted fee (which shall be paid by the Bidder) and do all running about/ persuasion for issue of the completion certificate / clearances/ connections at the earliest.

62. SITE DOCUMENTS The following site documents shall mainly be maintained by the Bidder at site: Copy of contract documents and drawings, Computerized bill format, Site Order Book, Material testing registers/ Quality Inspection Reports/ Calibration reports, Measurement books on computerized format, Progress bar chart, Sample approval register, Visitors register, Any other detail and specific requirement as deemed necessary, Hindrance Register, Work Diary, Stage passing Register, Labour register with details of Adhar no address etc.
63. In case the above are not provided at site within 10 days of placement of LOI, buyer shall provide the same and necessary expenditure shall be deducted from the bills for documents.
64. AIESL reserves the right to add/delete any point not exclusively mentioned in the bid document but found necessary for incorporation at any time during the period of technical discussion before placement of order. The same shall be considered a part of tender and shall be mandatory and binding on the Vendor.
65. Insurance Coverage for Labor/Workers- All laborers/workers engaged for the project shall be mandatorily covered under appropriate insurance policies, such as Workmen's Compensation (WC) Policy and/or All Risk Policy, as applicable. The responsibility for obtaining and maintaining these insurance policies lies entirely with the contractor. Proof of valid coverage must be submitted before the commencement of work and kept updated throughout the contract period.
66. AIESL premises is strictly a No-Smoking Zone - Smoking is strictly prohibited in all areas within the AIESL premises. All personnel, including visitors and contractors, are expected to adhere to this policy without exception. Violation may lead to disciplinary or legal action as per applicable rules.
67. Hot working/ height working/working on fragile roofs- permission to be obtained before starting the work, which ever applicable.
68. Manufacturer's Warranties: The Bidder shall:

    A.Ensure that all the manufacturer's warranties are made available to the AIESL and the legal documentation between the Bidder and the Supplier must have a transparent pass through of the warranty benefits to the AIESL as the user/maintenance Body of the Asset for the entire duration of warranty time.

    B. Warranty that the material is new and free from all defects and faults in workmanship and manufacture and shall be of the highest grade and consistent with the established and generally accepted standards for materials of the type ordered and shall perform in full conformity with the specifications and drawings.

    C. The Bidder shall be responsible for any defects that may develop under proper use but arising from faulty materials, design or workmanship and shall remedy such defects at its own cost, or get them remedied from the supplier, when called upon to do so by AIESL, who shall state in writing in what respect the material is faulty.

2. Inspection of materials & Equipment's: - The Bidder before supplying of any materials/ equipment shall give a inspection notice well in advance for inspection & testing of the same at the manufacturing units/ shop. The expenditure on account of TA/ DA of inspecting officials of AIESL for the inspection of the said items shall be borne by the Bidder. However, inspection report issued by the inspecting officials of AIESL does not waiver of quality /performance of equipment & due quality/performance & successful commissioning of equipment/item is the responsibility of Bidder.
3. Pneumatic provisions should be provided as per the instruction of EIC.

4. MINOR DETAILS OF CONSTRUCTION: The rates quoted by the Bidder shall be deemed to cover for all the minor details / requirement of construction which may not have been specifically shown on the drawings from the bidder or given in particular specifications, BOQ, but are required as per established engineering practice.
5. DISCREPANCY IN DRAWINGS: The Bidder shall be responsible to ensure correlation in Structural drawings, Architectural Drawings and Bill of Quantities, before quoting for the work and also before commencement and execution of work. In case of discrepancy, the Bidder shall bring it to the notice of the Engineer in charge for clarifications within 28 days of the issue of Letter of Acceptance. In the event of such discrepancy arising during the course of the work for which drawings are given after the date of issue of Letter of Acceptance, the Bidder shall seek clarifications within 14 days of receipt of such drawings. The Bidder shall take into consideration such contingencies in the completion schedule the programme of work is finalized and the Bidder shall not be eligible for any extension of time for such occurrences. The decision of the Engineer-in Charge shall be final and binding in this case. The bidder is also advised to visit the site and seek clarifications before submitting his bid.
6. Authorization: The bidder should provide Manufacturer Authorization Forms (MAFs) or OEM authorization for Air Handling Units (AHUs), plumbing, electrical, fire, and steel items.
7. Pre-Bid Meeting: Attending the pre-bid meeting is mandatory to understand the land position and requirements. Bidders who do not attend the pre-bid meeting will be disqualified from participating in the tender.
8. Experience and References: The bidder should provide a detailed list of past projects, including references to showcase their experience and reliability.
9. Environmental Compliance: The bidder should ensure that the project complies with all applicable environmental regulations and standards.
10. Subcontractors: The bidder is not allowed for subcontracting this project.
11. Penalties for Delays: The bidder should agree to penalties for any delays not caused by force majeure.
12. Warranty: The bidder should provide a warranty for the materials and workmanship for the specified period and a service engineer to be available within call not more than 2 hours away.
13. Technological Expertise: The bidder should demonstrate expertise in using the latest technology relevant to the project.
14. DOCUMENTS FOR SUPPLY ITEMS: For supply items in BOQ the Supplier shall submit the following documents to Engineer in-Charge

a) Warranty Cards
b) Manufacturer's test certificate.
c) Any other test certificate from an external laboratory to determine the Pre-Specification.
d) Catalogues
e) List of recommended spares with specification and costs thereof.
f) Operation & Maintenance manuals.

78. Some of the common safety rules to be followed during working are as follows:

a) Nobody is allowed to enter at construction site without Safety Shoe.
b) Never enter work area without Safety helmet & chin strap in place.
c) No climbing/working allowed without proper safety belt above 2 m. height.

d) Do not exceed the speed limit 25 Kmph within Premises.
e) No debris obstacles allowed on the roads & passages.
f) Do not walk on pipelines or false ceiling if like any.
g) Maintain good Housekeeping at work site.
h) No photography/ Videography allowed without permission
i) All Site supervisors & engineers (including sub-Bidders) must be imparted structured training on construction safety before start of the job & record to be submitted along with tender submission.
j) Availability of qualified & trained Site Engineer at site during all working hours. An engineer with M.Tech in structural engineering with valid license number and proof of his/her engagement in the project has to be submitted during the time of participation.
k) Site Safety training to be imparted to all workers & plan to be made to cover every worker.
l) All accident / incidents (Near Miss) to be reported & investigated. (formats & procedure should be finalized)
m) Daily Safety Checking by Each Site Engineer along with Safety engineer.
n) All Safety equipment must be ISI marked & checked by Safety officer/Engineer in Charge before use.
o) Tag system for erection & use of scaffoldings.
p) Bamboo/wooden Scaffolding material not allowed.
q) LPG cylinders not allowed for gas cutting.
r) Good Housekeeping. Separate waste bins to be used for flammable & nonflammable material.
s) Safety awareness programs for workers by display of boards, posters, competitions, talks etc.
t) Display of List of First Aid trained persons.
u) Testing certificates for lifting tools & tackle. The operators should have minimum 5 + years in the relevant field. Valid documents has to be attached along with tender documents.
v) Provision & maintenance of fire extinguishers at construction site & material stores.
w) Display of emergency telephone numbers at various locations. - For work in confined space use 24 V lamp fitting & use tools with air motors or electric tools with max. 24 V.
x) For confined space entry Gas test must be done before & at regular intervals. ¬ Checking & tag of equipment like grinding machine, welding machine, gas cutting set etc. by supervisors before use.

ADDITIONAL CONDITONS OF CONTRACT AND SPECIFICATIONS

I) RELATING TO CIVIL, STEEL FABRICATION, ELECTRICAL, PLUMBING & FIRE FIGHTING WORKS, AHU WORKS.

General

1.1. The following Additional Conditions and specification shall be read in conjunction with General Conditions of Contract and Specific Conditions of Contract. If there are any provisions in these Additional Conditions of Contract & specifications which are at variance with the provisions in the above-mentioned documents, the provisions in these Additional Conditions of Contract & specifications shall take precedence.

1.2. Rates: - The quoted rates shall be for complete items of work i.e. inclusive of material, labour, plant and machinery, tools and tackles, batching plant etc. including water & electricity, overheads charges, all taxes, statutory charges / levies applicable from time to time and others as specified etc, incidental works and all other charges for items contingent to the work, such as, packing,

forwarding, insurance, freight and delivery at Site, watch and ward of all materials & successful installation, testing & commissioning at site etc.

Scope of Contract

The scope of work covers the supply, erection, testing and commissioning of the Civil, Plumbing, Fire Fighting & Electrical Systems and AHU works which also includes design & preparation of structural and all other detailed shop drawings, testing and commissioning of components and accessories. All bidders have to submit shop drawings related to CIVIL, Structural, Electrical, Fire Fighting and fire Alarm systems, Plumbing, Hanger door and AHU during the time of Bid participation. Any bids found without afore said drawings will be considered as invalid and will be disqualified.

- Civil works, Steel Fabrication, plumbing & Fire Fighting works, Fire Alarm System.
- Electrical works – AHU System and Lightings

The work shall be carried out in conformity with the relevant drawings and the requirement of architectural, electrical, structural, and other specialized service drawings approved by Engineer in charge.

The Bidder shall make provision of hangers, sleeves, structural openings and other requirements during construction to avoid holding up progress of the construction schedule. The Bidder should ensure that the structure is designed for additional loads or cut outs. Subsequent Cutting holes in the RCC structural members /slab shall not be allowed.

The contract items comprise of furnishing of all materials, equipment, labour & transportation etc. necessary to render the installation/ item fully operational as per the intent of specification and drawings, including any necessary adjustment or corrections. Further the installation /item shall be in conformity with local laws and manufacturer instructions applicable.

II) ELECTRICAL CONTRACTOR LICENCE

The Bidder or its nominated person as the case may be, shall have a valid electrical contractor's license for working in the State in which the job site is located. The Bidder shall furnish a copy of the same during the tender submission and to Engineer in charge before commencement of any electrical work or work pertaining to Electrical System. No Electrical work or work pertaining to electrical system (s) shall be permitted to be executed without a valid Electrical Bidders License being produced by the Bidder or Sub Bidder, as the case may be, intending to execute the work. The bids without such valid license shall be considered as disqualified. All tests clearances and certificates required by the State Government Authorities for energizing/ commissioning the electrical system laid by the bidder shall be obtained at his costs and initiative, for which the bidder shall perform such tests and undertake such rectification and/or changes as may be required.

III) VENDOR LIST FOR CEMENT, REINFORCEMENT AND STRUCTURAL STEEL

Following is the vendor list for supply of materials:

Cement: All Cement supplied by the BIDDER shall be as per the Technical Specifications enclosed with the Bid Document. The following manufacturers of Cement are approved for this scope of work, ACC cement

1. Ultra Tech Cement

2. Gujarat Ambuja
3. J. K. Cement
4. Zuari Cement

In the event of non-availability of cement from the approved vendors, the BIDDER shall propose additional vendor(s) to AIESL for their prior approval, on case-to-case basis, before procurement of Cement. Reinforcement, Structural Steel, Steel Plates:
All TMT Reinforcement Bars / structural steel including plates, supplied by the BIDDER shall be as per the Technical Specifications enclosed with the Bid Document. The following manufacturers of TMT Reinforcement Bars /steel plates / structural steel are approved for this scope of work
a) TMT Reinforcement Bars Manufacturers
1. SAIL
2. Tata Steel
3. Jindal
4. RINL
5. JSW Steel Ltd.
6. Kalliyath Steel
b) Steel Plates / Structural Steel Manufacturers
1. Jindal
2. TATA Steel
3. Appolo Steel

BIDDER shall procure bulk TMT Reinforcement Bars / steel /plates / structural steel only from above mentioned manufacturers unless the above manufacturers do not manufacture such TMT Reinforcement Bars / structural steel.The Bidder has to collect an authorization form from the manufacturer agreeing to supply the necessary quantities as per BOQ and specification in manufacturers letter head mentioning the tender details and has to be submitted during the time bid participation. Bids without such authorization letter will not be considered and will be disqualified (Applicable for Cement. Reinforcement, Structural Steel, Steel Plates).

IV) TIME OF COMPLETION

Time is the essence of contract. The work shall be executed strictly as per Time Schedule given as part of this Contract Document. The entire job covered under this tender shall be completed by the Bidder. This Contractual completion period of 150 days includes submission of final documents. The bidder shall furnish his proposed time schedule along with his Bid and which will be a criteria for choosing the final bidder by AIESL.

V) COMPLETION DRAWINGS (AS BUILT DRAWINGS)

On completion of the work and before issue of certificate of virtual completion, the Bidder shall submit to the Client/Engineer in charge/Consultant, completion plan drawn to a scale in the manner decided by him including the under mentioned details along with one set of computer CD containing the data.
a. Run and size of conduits, inspection boxes, junction boxes and pulls boxes
b. Number of circuits in each conduit
c. Location and rating of sockets and switches controlling the light and power outlets
d. Location and details of main & sub distribution boards, distribution boards indicating the circuit

number controlled by them
e. Type of fitting viz. fluorescent, pendants, brackets, bulkhead etc., including their rating & type of lamp, fans and exhaust fans if any.
f. A complete wiring diagram as installed and schematic drawings showing all connections for the complete electrical system
g. Location of telephone outlets, junction boxes and sizes of various conduits and number & sizes of wire drawn
h. Location of all earthling stations, route and size of all earthling conductors, manholes etc.
i. Layout and particulars of cables & sub mains.
j. Layout and details of lightning protection system.
k. Insulation tests and earth test results o
l. Cable route layout of HT, LT & other cables s. External lighting drawing with road layout.

NOTE

- Please note that the decision of AIESL will be the final, in case of any alteration/modification in the scope.
- The structure should be designed in such a way that, in the future, it could be dismantled and reassembled at a different location within the compound, without much significant cost if any.

SECTION- C

TECHNICAL BID FORMAT

1. *Technical Bid Format to be submitted with Check list provided below in the tender document.*

Sl.	Qualifying Criteria	Yes	No
1.	Whether registered with the Registrar of Companies/Registrar of Firms in India. If so, mention number and date and enclose Registration Certificate copy		
2.	**Turnover:** Have an average annual turnover of **at least 2.6 Crores relating** to the same Service during the **last 3 year i.e 2021-22, 2022-23, 2023-24 financial years.** **Turnover for 2021-22: _____ Turnover for 2022-23: _____ Turnover for 2023-24: _____** **Average Turnover of above said FY: _____** Copy of the audited Balance Sheet and Profit & Loss account certified by a Chartered Accountant to be submitted. ****FY:2024-25 :-** **Unaudited P&L statement to be submitted -If Audit not over/else submit audited statement of P&L and Balance sheet.		
3.	**Experience:** As on date of submission of the tender, the bidder must have previous experience in the relevant field. The tenderer will be qualified if they have complete similar nature of works during last FIVE years with any of the following conditions. • One single work of similar nature of at least 80% of estimated value of contract or • two works of similar nature each of at least 50% of estimated value or • three works of similar nature each of at least 40% estimated value of contract. **Details** Copy of document to be submitted (completion certificate with final value)		
4.	**Not Blacklisted / Debarred** As on date of submission of the tender**, is your company blacklisted / debarred** from participating in new tenders by any Govt. /Govt. Agency / AIESL or their sister / subsidiary companies.		
5	**# Enclosed EMD Details Transaction No: Date:**		
6.	**# If EMD is NOT enclosed, have you attached Supporting documents for Exemption?**		
7.	**Have valid Labour License (under Contract Labour Regulation & Abolition Act 1970) as on the date of submission of Bids**		
8	**PAN NO: ISSUE DT: VALID TILL:**		

9	**GST Registration No. with details:**		
10	**Agreeing for the payment Term of 60 Days**		

11	Exemption for MSE shall be applicable on submission of MSE certificate (mandatory)		
12	IT Returns for 3 FY **2021-22, 2022-23, 2023-24**		
13	Site Visit conducted		
14	Indemnity Bond		
15	Capability and Agreement to comply with Section B (scope of Work) of this document given as attachment to tender document		
16	**Preference will be given to the bidders who done Civil / structural projects in Kerala. Provide work completion certificate. Government works will be an advantage.		

**Preference will be given if two or more parties appears as L1

Date:

Place:

Signature

Name

Designation

Co. Name & Seal

I/We have read and examined the Notice Inviting Tender, Annexure, Specifications Applicable, General Rules and Instructions, General Conditions of Contract, and all other documents referred to in the conditions of contract and all other contents in the tender document for the work and accept the terms and conditions of the tender in full conformity.

Date:

Place:

SEAL & SIGNATURE OF THE VENDOR/CONTRACTOR

NOTE: Filled up Excel File of the table of Section C above to be provided with Technical Bid.

Validate Print Help

Item Wise BoQ

Tender Inviting Authority: SR AGM ,Trivandrum

Name of Work: Tender for Design, Supply, Fabrication, Erection and Commissioning of Aircraft paint booth at AIESL MRO, Trivandrum, Kerala-695007

Contract No: AIESL/TRV-MRO/MMD/04-169

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 relevent columns, else the bidder is liable to be rejected for this tender. Bidders are allowed to enter the Bidder Name and Values only)

NUMBER #	TEXT #	NUMBER #	TEXT #	NUMBER #	NUMBER	NUMBER	NUMBER #	NUMBER #	TEXT #
Sl. No.	Item Description	Quantity	Units	BASIC RATE In Figures To be entered by the Bidder in Rs. P	GST (If applicable in Percentage)	GST Amount in Rs. P	TOTAL AMOUNT excluding taxes in Rs. P	TOTAL AMOUNT including taxes Rs. P	TOTAL AMOUNT In Words
1	2	4	5	7	8	9	11	12	13
1	Carrying out the paint booth work as per the scope of work/ requirement shown in Section 'B' by deploying appropriate manpower and equipment including consumables etc at TRV-MRO	1.000	Nos			0.00	0.00	0.00	INR Zero Only
Total in Figures							0.00	0.00	INR Zero Only
Quoted Rate in Words								**INR Zero Only**	

Note
1. Grand Total including taxes shall be considered as L1 value. Rate and amounts to be quoted in figures & words
2. Filled up Excel File of the table of Section D, to be provided with Financial Bid only (Do not attach this sheet with Technical Bid) Otherwise Bid shall be rejected)
3. Grand Total should be the Total value inclusive of all the charges (GST inclusive)
4. Changes in GST rates will be considered for settling the payment.
5. The complete breakup of pricing shall be provided immediately upon request to the technically qualified bidders during financial evaluation.

CERTIFICATION

Certified that:

a) There are no hidden costs to AIESL Over and above that indicated above.

b) Any changes (increase/decrease) in statutory taxes/levies, arising during the term of the contract, shall apply to this contract also.

c) We have read, understood and accept all the terms and conditions of the Tender.

d) Prices quoted above by us for material and services as quoted are compiled by us in our Price Bid.

AUTHORISED SIGNATORY *COMPANY SEAL*

UNDERTAKING FROM BIDDERS

I / We.....confirm that I / we do not have any relative, who is an Employee of AIESL or its subsidiaries and is likely to benefit us during the Award / implementation of the contract/PO.

I / We also indemnify that any subsequent detection of direct or indirect beneficiary of any application / award of any contract to any employee of the organization may result in disqualification / termination as the case may be. AIESL or its subsidiary will have the sole discretion to do so and such cases cannot be referred for arbitration.

SIGNATURE:

SEAL OF THE COMPANY:

INDEMNITY BOND

THIS INDEMNITY BOND is executed on the_____th Day of_____2025,
By _____
_____having, it Registered Office
at_____here in after referred to as Service Provider (which expression shall unless it be repugnant to the context to the meaning there of shall be deemed to mean and include it successor and assigns).
Whereas_____(name of the Service Provider) shall enter into an agreement with M/s. AI Engineering Services Limited, a Company hereinafter referred to as"AIESL" incorporated in New Delhi under Companies Act, 1956 having, its Regd. Office at II nd Floor, CRA Building, Safdarjung Airport, New Delhi- 110003 (which expression shall unless it be repugnant to the context to the meaning there of shall be deemed to mean and include its successors and assigns).

And whereas the Service Provider by means of an agreement shall execute **Design, Supply, Fabrication, Erection and Commissioning of Aircraft paint booth at AIESL MRO, Trivandrum, Kerala-695007**

1. Under this contract, the Service Provider agrees to undertake to keep AIESL indemnified against any claims/cost / damages and penalties in respect of breach of any Labor Laws both central and State.
2. the Service Provider agrees to be responsible for ensuring the compliance of Labor Laws both Central and State especially, but not limited to Employees State Insurance Act, 1948 and Workmen's Compensation Act, 1923, Employees Provident Funds & Miscellaneous Provisions Act 1952, Payment of Wages Act1936, Minimum Wages Act, 1938, Contract Labor (Regulations and Abolition) Act, 1970, time to time and further shall be solely responsible for any cost and consequences on account of any breach and / or non-compliance of any other provisions of Labor Laws and shall indemnify AIESL against any claim / cost / remedies and penalties in respect of breach of any of the provisions of Laws in force.
5. The Bidder shall strictly ensure that Minimum Wages as stipulated by the appropriate Government is paid each month to the workmen deployed by them.
6. The Service Provider hereby indemnifies AIESL with regard to the service rendered on all the applicable laws, rules, regulations etc., as mandated by the Adani Airport Limited, Trivandrum / AAI (Airports Authority of India) and other applicable State / Central Government agencies during the contract period.
7. The Service Provider hereby indemnifies and agrees to keep the AIESL indemnified, during the period of the contract on account of non-compliance of whatsoever nature on the part of the Service Provider in the matter of all applicable legislations with regard to his employees deployed on contract awarded to them by the AIESL and even thereafter, to make good any losses, payments, penalties incurred by the AIESL.
8. The Service Provider shall indemnity AIESL against payment of penalty, their Party claims, damages, loss of property of AIESL, Adani airport limited and/ or other party, due to mishandling, theft, damages due to rash driving, accidents, negligence, violation of any statutory laws and etc., by them and/ or the personnel deployed by the them. In case, any such claim amount is not deposited/ paid to AIESL or to the concerned personnel or agency then the same shall be deducted from their performance guarantee/ invoice payments. This shall also

include legal cost involved.

7. The Service provider shall indemnify AIESL for any damage caused to AIESL employees, its property or loss to any third party resulting from failure of equipment within the mentioned warranty period. This shall cover all the compensation payable including legal charges due to any personnel injuries or fatalities.
8. The Service provider shall indemnify AI Engineering Services Limited and its subsidiaries, assigns and successors, against any claim from ESI Authorities / PF Authorities and / or any other statutory bodies under various labour laws relating to claim with regard to the workmen deployed by us. WE further indemnify AIESL and its subsidiaries against any losses that may accrue/occur on account of Vigilance Case/s filed/to be filed by ESI authorities/PF Authorities and/or any other statutory body under various labour laws.

The Service Provider hereby indemnifies and agrees to keep the AIESL indemnified, against any clause elsewhere as referred to in this tender document no **AIESL/TRV-MRO/MMD/04-169 Design, Supply, Fabrication, Erection and Commissioning of Aircraft paint booth at AIESL MRO, Trivandrum, Kerala-695007** which specifies so.

Signed, Sealed & Delivered

Within the named_____

Through their Director / Proprietor / Representative. Witness:

1.

2.

ACCEPTANCE LETTER TO OUR TERMS AND CONDITIONS ON BIDDER'S LETTER HEAD

To,

The General Manager
AI Engineering Services Ltd MRO – TRV Chackai,
Trivandrum Sir,

It is certified that we have studied, understood and abide by the terms and conditions of this tender document no. **AIESL/TRV-MRO/MMD/04-169 "Design, Supply, Fabrication, Erection and Commissioning of Aircraft paint booth at AIESL MRO, Trivandrum, Kerala-695007"** along with warranty period (minimum 10 Year). The Security Deposit will be refunded after any adjustments at the end of warranty period. We agree to abide by the same unconditionally.

AUTHORISED SIGNATORY

NAME:
DESIGNATION: COMPANY
SEAL
E-mail:
Tel. No.:
Mobile:

CHARTERED ACCOUNTANT'S CERTIFICATION

I, CA (Name) ---------- Membership Number have verified the above details as per the financial documents/records submitted for verification and hereby certify that the above statement is correct for this tender document no. **AIESL/TRV-MRO/MMD/04-169 Design, Supply, Fabrication, Erection and Commissioning of Aircraft paint booth at AIESL MRO, Trivandrum, Kerala-695007**

Signature of CA ----------& Seal

CHECK LIST: Please check if Following Documents have been attached with Technical Bid

Sl No	Description	Documents Required	Documents Attached (Tick)
1	Company Profile	Yes	
2	GST Registration Certificate	Yes	
3	Audited balance sheet and P/L accounts for the last financial year	Yes	
4	ITR of last three year	YES	
5	Income Tax PAN	Yes	
6	Rs. 2,00,000/- towards EMD	Yes	
7	Acceptance letter to our terms and conditions	Yes	
8	The Bidder should be ISO 9001 certified. Valid Certificate for this year to be enclosed.	Yes	
9	The Bidder should have previous Experience of similar nature works. Proof in this respect should be enclosed	Yes	
10	Purchase order of customers where similar projects has been implemented during the previous year. Need to be enclosed along with full address, telephone numbers and fax nos. of customers	Yes	
11	All columns in Annexures should be filled in the tender document, all pages are to be Signed by the bidder and attached	Yes	
12	All Products shall be manufactured in accordance with IS STANDARD	Yes	
13	Confirmation of product support on spares/services for minimum of 10 years after warranty period.	Yes	
14	MSE certificate submitted to claim MSE (mandatory)	Yes	
15	Certificate of Incorporation/Partnership Deed		

16	Submitted shop drawings related to CIVIL, Structural, Electrical, Fire Fighting and fire Alarm systems, Plumbing, Hanger door and AHU. The design and drawing should be approved by related government agencies/ IIT.	Yes	

17	Manufactures authorization form for Cement, Reinforcement steel and Structural steel. (Should be obtained in OEMs letter head mentioning the tender details and nature of association)	Yes	
18	Submitted Engagement details of structural engineer mentioning the registration number and acceptance of the engagement confirmation from engineer. (M.Tech in structural engineering with Chartered Engineer)	Yes	
19	Engagement of plumber with valid plumbing license and engagement and acceptance details submitted.	Yes	
20	Engagement of electrical contractor with valid license and engagement and acceptance details submitted.	Yes	
21	minimum Average turnover for the last Three year of Rs 2.6 crores	Yes	
22	Detailed project report along with work completion schedule	Yes	

Authorized Signatory:

Name of Signatory _____

Designation of Signatory _____

Seal of Company

Place: _____

Date: _____

Performance Bank Guarantee /Security Deposit Form

To
The General Manager
AI Engineering Services Ltd
MRO – TRV
Chackai, Trivandrum

Reference this tender document no. **AIESL/TRV-MRO/MMD/04-169, Design, Supply, Fabrication, Erection and Commissioning of Aircraft paint booth at AIESL MRO, Trivandrum, Kerala-695007**
WHEREAS (Name and address of the bidder) (Hereinafter called "the service provider") has undertaken, in pursuance ofcontract no…… dated.....to supply (description of services) (herein after called "the contract").

AND WHEREAS it has been stipulated by you in the said contract that the service provider shall furnish you with a bank guarantee by a scheduled commercial recognized by you for the sum specified therein as security for compliance with its obligations in accordance with the contract.

AND WHEREAS we have agreed to give the service provider such a bank guarantee.

NOW THEREFORE, we..... Bank, hereby affirm that we are guarantors and responsible to you, on behalf of the service provider, up to a total of (Amount of the guarantee in words and figures), and we undertake to pay you, upon your first written demand declaring the service provider to be in default under the contract and without cavil or argument, any sum, or sums within the limits of (amount of guarantee) as aforesaid, without your needing to prove or to show grounds or reasons for your demand or the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the service provider before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the contract to be performed there under or of any of the contract documents which may be made between you and the service provider shall in any way release us from any liability under this guarantee and we hereby waive notice of any such change, addition, or modification.

This guarantee shall be valid until the ……. day of..... 2035

(Signature of the authorized officer of the Bank)

……

Name and designation of the office
…….

…….
Name & address of the Bank Branch

SECURITY DEPOSIT DECLARATION FORM

(To be printed on bidder's company letter head. Signed & duly stamped scanned copy to be submitted along with Technical Bid)

To

The General Manager
AI Engineering Services Ltd MRO –
TRV
Chackai, Trivandrum

I/We, the undersigned declare that:

After qualifying for award of Contract for Tender No. **AIESL/TRV-MRO/MMD/04-169 for "Design, Supply, Fabrication, Erection and Commissioning of Aircraft paint booth at AIESL MRO, Trivandrum, Kerala-695007"**. We will deposit 5**% (Five percent) of the total value of the Contract towards interest free Security deposit**, within 2 weeks of receipt of the Contract.

The Security Deposit will be paid by way of through the **payment gateway** available on our AIESL website portal/Bank Guarantee (BG) issued from any commercial bank, Fixed Deposit under LIEN with AIESL from any Commercial bank, in favor of AI Engineering services Limited **(**AIESL), payable at Trivandrum.

Authorized Signatory

Name of Signatory _____

Designation of Signatory _____

Seal of Company

Place: _____

Date: _____

FORMAT OF BID SECURITY DECLARATION FROM BIDDERS IN LIEU OF EMD

(to be submitted on Bidder's Company Letter Head duly signed and stamped)

To
The General Manager
AI Engineering Services Ltd MRO – TRV Chackai,
Trivandrum

I / We, the authorized signatory of M/s ....., participating in the subject tender No . ..... for the item / job of ..... , do hereby declare the following:

1. That I / we have availed the benefit of waiver of EMD while submitting our offer against the subject Tender and no EMD being deposited for the said tender.

2. That in the event we withdraw / modify our bid during the period of validity Or I/we fail to execute formal contract agreement within the given timeline OR I/we fail to submit a Performance Security within the given timeline Or I/we commit any breach of Tender Conditions / Contract which attracts penal action of forfeiture of EMD and I/we will be suspended from being eligible for bidding / award of all future contract(s) of AI Engineering Services Limited for minimum period of One year or up to 3 years from the date of committing such breach.

Authorized Signatory

Signature of Signatory _____

Name of Signatory _____

Seal of company

Place: _____

Date: _____

SPECIAL INSTRUCTIONS TO THE CONTRACTORS/BIDDERS FOR THE E-SUBMISSION OF THE BIDS ONLINE THROUGH CPPP

The bidders are required to submit soft copies of their bids electronically on the CPP Portal, using valid Digital Signature Certificates. The instructions given below are meant to assist the bidders in registering on the CPP Portal, prepare their bids in accordance with the requirements and submitting their bids online on the CPP Portal.
More information useful for submitting online bids on the CPP Portal may be obtained at:
https://eprocure.gov.in/eprocure/app .

Registration

1. Bidders are required to enrol on the e-Procurement module of the Central Public Procurement Portal (URL:https://eprocure.gov.in/eprocure/app) by clicking on the link "Online bidder Enrolment" on the CPP Portal which is free of charge.
1. As part of the enrolment process, the bidders will be required to choose a unique username and assign as password for their accounts.
2. Bidders are advised to register their valid email address and mobile numbers as part of the registration process. These would be used for any communication from the CPP Portal.
3. Upon enrolment, the bidders will be required to register their valid Digital Signature Certificate (Class III Certificates with signing key usage) issued by any Certifying Authority recognized by CCA India (e.g. Sify /nCode / eMudhra etc.), with their profile
4. Only one valid DSC should be registered by a bidder. Please note that the bidders are responsible to ensure that they do not lend their DSC's to others which may lead to misuse.
5. Bidder then logs in to the site through the secured log-in by entering their user ID / password and the password of the DSC / e-Token.

Searching for Tender Documents

1. There are various search options built in the CPP Portal, to facilitate bidders to search active tenders by several parameters. These parameters could include Tender ID, Organization Name, Location, Date, Value, etc. There is also an option of advanced search for tenders, wherein the bidders may combine a number of search parameters such as Organization Name, Form of Contract, Location, Date, Other keywords etc. to search for tender published on the CPP Portal.
1. Once the bidders have selected the tenders they are interested in, they may download the required documents /tender schedules. These tenders can be moved to the respective 'My Tenders' folder. This would enable the CPP Portal to intimate the bidders through SMS / e- mail in case there is any corrigendum issued to the tender document.
2. The bidder should make a note of the unique Tender ID assigned to each tender, in case they want to obtain any clarification / help from the Helpdesk.

Preparation of Bids

1. Bidder should take into account any corrigendum published on the tender document before submitting their bids.

1. Please go through the tender advertisement and the tender document carefully to understand

the documents required to be submitted as part of the bid. Please note the number of covers in which the bid documents have to be submitted, the number of documents - including the names and content of each of the document that need to be submitted. Any deviations from these may lead to rejection of the bid.

2. Bidder, in advance, should get ready the bid documents to be submitted as indicated in the tender document /schedule and generally, they can be in PDF / XLS / RAR / DWF/JPG formats. Bid documents may be scanned with 100 dpi with black and white option which helps in reducing size of the scanned document.

3. To avoid the time and effort required in uploading the same set of standard documents which are required to be submitted as a part of every bid, a provision of uploading such standard documents (e.g. PAN card copy, annual reports, auditor certificates etc.) has been provided to the bidders. Bidders can use "My Space" or ''Other Important Documents'' area available to them to upload such documents. These documents may be directly submitted from the "My Space" area while submitting a bid, and need not be uploaded again and again. This will lead to a reduction in the time required for bid submission process.

Note: My Documents space is only a repository given to the Bidders to ease the uploading process. If Bidder has uploaded his Documents in My Documents space, this does not automatically ensure these Documents being part of Technical Bid.

Submission of Bids

1. Bidder should log into the site well in advance for bid submission so that they can upload the bid in time i.e.on or before the bid submission time. Bidder will be responsible for any delay due to other issues.

1. The bidder has to digitally sign and upload the required bid documents one by one as indicated in the tender document.

2. Bidder has to select the payment option as "offline" to pay the tender fee / EMD as applicable and enter details of the instrument.

3. Bidder should prepare the EMD as per the instructions specified in the tender document.

4. Bidders are requested to note that they should necessarily submit their financial bids in the format provided and no other format is acceptable. If the price bid has been given as a standard BOQ format with the tender document, then the same is to be downloaded and to be filled by all the bidders. Bidders are required to download the BOQ file, open it and complete the white coloured (unprotected) cells with their respective financial quotes and other details (such as name of the bidder). No other cells should be changed. Once the details have been completed, the bidder should save it and submit it online, without changing the filename. If the BOQ file is found to be modified by the bidder, the bid will be rejected.

5. The server time (which is displayed on the bidders' dashboard) will be considered as the standard time for referencing the deadlines for submission of the bids by the bidders, opening of bids etc. The bidders should follow this time during bid submission.

6.All the documents being submitted by the bidders would be encrypted using PKI encryption techniques to ensure the secrecy of the data. The data entered cannot be viewed by unauthorized persons until the time of bid opening. The confidentiality of the bids is maintained using the secured Socket Layer 128 bit encryption technology. Data storage encryption of sensitive fields is done. Any bid document that is uploaded to the server is subjected to symmetric encryption using a system generated symmetric key. Further this key is subjected to asymmetric encryption using buyers/bid opener's public keys. Overall, the uploaded tender documents become readable only after the tender opening by the authorized bid openers.

7. The uploaded tender documents become readable only after the tender opening by the

authorized bid openers.

8. Upon the successful and timely submission of bids (i.e. after Clicking “Freeze Bid Submission” in the portal),the portal will give a successful bid submission message & a bid summary will be displayed with the bid no. and the date & time of submission of the bid with all other relevant details.

9. The bid summary has to be printed and kept as an acknowledgement of the submission of the bid. This acknowledgement may be used as an entry pass for any bid opening meetings.

Assistance to Bidders

1. Any queries relating to the tender document and the terms and conditions contained therein should be addressed to the Tender Inviting Authority for a tender or the relevant contact person indicated in the tender.

1. Any queries relating to the process of online bid submission or queries relating to CPP Portal in general maybe directed to the 24x7 CPP Portal Helpdesk