

**FACT**

प्रगति के पथप्रदर्शक
PIONEERS IN PROGRESS

दि फ़र्टिलाइज़र्स एण्ड केमिकल्स ट्रावन्कोर लिमिटेड THE FERTILISERS AND CHEMICALS TRAVANCORE LTD.

(भारत सरकार का उद्यम) (A Government of India Enterprise)

पंजीकृत कार्यालय: एलूर, उद्योगमंडल, कोच्ची - 683 501, केरल राज्य, भारत
Regd. Office: Eloor, Udyogamandal, Kochi-683501, Kerala State, India. Website: www.fact.co.in CIN: L24129KL1943G01000371

NOTICE INVITING e-TENDER

Encrypted Competitive rate, **Single stage Two Bid Tenders** containing the NAME OF WORK and TENDER REFERENCE NUMBER are invited from reliable and experienced contractors of sound financial standing by the Senior Manager (Materials)-Contracts, Materials dept., FACT. Tenders received will be opened online on the due date and time. Tender details are given below.

- | | |
|--|--|
| 1. Tender No | : 08004/2026-2027/E33803 |
| 2. Name of Work | : Engaging Engineering Design Consultant for Construction of Distributed Control System (DCS) Building for Ammonia Handling at FACT UC |
| 3. Nature of Contract | : Item rate |
| 4. Earnest Money Deposit | : Rs. 25,000 /- |
| 5. Validity of Tender | : 6 months |
| 6. Period of Contract | : Kindly refer clause no. 5 of SCC. |
| 7. Document Fee | : Nil. |
| 8. Last Date & time to upload of e-Tender | : 23.07.2026, 15:00:00 Hrs |
| 9. Date, Time and Opening of Technical Bid | : 24.07.2026, 15:00:00 Hrs. |

Notes:-

1. Details of Tender are available at e-procurement platform <https://eprocure.gov.in>. Offers submitted other than on-line mode shall not be accepted. Time extensions, Corrigendums, Addendums etc if any, will be hosted in the CPP e-procure website and FACT website only and will not be published in newspapers. The bidders are requested to visit the website regularly for corrigendums, addendums, time extensions etc, if any.
2. All bidders shall be registered under GST and shall furnish their Registration documents along with their Part-I Technical bids. Bids of parties not registered are likely to be rejected without assigning reasons.
3. The bidders shall comply with the prevailing statutory ESI/PF regulations for the employees engaged by them.
4. Tenders not accompanied by EMD/Exemption certificate shall be rejected.
5. The right to accept the lowest or any other tender rests with FACT.
6. For any disparity with the conditions, SCH Q1 shall prevail.
7. Contact details :

Tender details

Phone: 0484-2568123, 0484-2568674
email: soumya@factltd.com,
anand.s@factltd.com

e-Tender Helpline

Name: Mr. Ajino Anandh
Phone: 0484-2568374/9497334230
Email: ajinoanandh@gmail.com

Date: 03.07.2026

Signature:

Designation: SM(Mat)-C
Material Dept, FACT

PRE-QUALIFICATION CRITERIA

Name of work: Engaging Engineering Design Consultant for Construction of Distributed Control System (DCS) Building for Ammonia Handling at FACT UC

Tender No : 08004/2026-2027/E33803

1.0 Purpose

The Prequalification Criteria (PQC) are intended to assess the technical competence, financial capability, and relevant experience of Engineering Design Consultants for providing design, detailed engineering, drawings, and cost estimates for the proposed New DCS Control Room Building at FACT-UC.

2.0 Eligible Bidders

Only competent agencies with proven technical capability meeting the prequalification requirements stipulated herein shall be considered.

The Bidder shall be:

- An Indian firm / company / LLP registered under applicable Indian laws, or
- A proprietary or partnership firm, duly registered and in operation in India.

The Structural consultant of the firm shall have minimum 10years of experience in structural design of Residential /Industrial buildings and infrastructure.

Documents in support of above Primary Eligibility Criteria should be enclosed.

The Bidder shall take single-point responsibility for carrying out design, detailed engineering, preparation of drawings, and estimates for Civil, Electrical, Mechanical (HVAC), Fire Protection, and Plumbing works for the New DCS Control Room Building.

Consortium / Joint Venture bidding is not permitted.

3.0 Pre-Qualification Criteria**3.1 Technical Experience Criteria**

The Bidder should have successfully completed similar engineering consultancy works during the last seven (7) years ending on the last day of the month prior to the tender submission date for:

- One similar consultancy work of value $\geq$ ₹11.0 lakh, OR
- Two similar consultancy works each of value $\geq$ ₹7.0 lakh each, OR
- Three similar consultancy works each of value $\geq$ ₹5.0 lakh each

Similar Work shall mean providing engineering consultancy services for structural design of buildings with RCC framed structures and associated services including MEP services.

*The commencement and completion date shall be during the last 7 years ending on enquiry date.

If the bidder is providing any subcontract document for prequalification, the completion certificate should be endorsed by the primary customer/client.

If the supporting documents for Pre- Qualification criteria are of work completed in any of the division of FACT, only the Work Order number and final completed date and value need to be mentioned.

3.2 Key Personnel

The Bidder shall have, on its payroll or on long-term retainer basis, at least:

- 1 No. Senior Civil / Structural Engineer with minimum 10 years experience

Brief CVs of the above key personnel shall be submitted.

4.0 Evaluation & Documentary Evidence

Only bidders meeting all PQC requirements shall be considered for further evaluation. FEDO reserves the right to accept or reject any quotation in whole or in part without assigning any reason. Incomplete and late quotations are liable to be rejected.

The cut-off date for reckoning experience and financial criteria shall be the e-publishing date of the tender.

The Bidder shall submit the following documents as proof:

1. Copy of work order(s) clearly indicating scope of engineering services and consultancy value
2. Completion certificate(s) from the Client confirming satisfactory completion of consultancy services
3. Client certificate confirming satisfactory operation of the facility (where applicable) All documents shall be submitted in English language only.

Documents pertaining to works executed outside India shall be submitted in English, duly certified by the Indian Embassy / High Commission in the respective country.

Financial Criteria:

The bidder shall have an Average Annual Turnover of minimum **Rs 4 Lakh** during the last three years ending 31/03/2025. Copies of Balance Sheet and Profit & Loss Accounts audited by a practicing Chartered Accountant/ Certificate of Turnover issued by a Practicing Chartered Accountant/ Copy of Income tax returns filed by the bidder, shall be submitted as proof. If the audited financial statements for financial year 2024-2025 is not available, then average turnover of last three years ending on 31/03/2024 shall be considered for evaluation.

Note:

- a) All Pre-qualification documents shall be submitted online in COVER-1 and shall be complete in all respects, failing which the offer is liable to be rejected. The originals of the documents should be produced at the time of evaluation, if asked for.
- b) FACT reserves the right to have the financial and other data/credentials claimed by the bidder verified independently, if necessary by a third party. FACT also reserves the right to ask for any other documents in case considered essential in support of any of the PQ criteria or on the document submitted. If the data/credentials furnished are found to be incorrect, FACT further reserve the right to reject the particular tender.

- c) FACT also reserves the right to reject any tender submitted by a party if it comes to know suo moto of any adverse reports on the certified claim submitted by the tenderer.
- d) The technical bids of the bidders not meeting the pre-qualification criteria will not be processed further and will stand rejected.

Note for micro & small enterprises and startups: Pre-qualification criteria specified above shall also be applicable for micro & small enterprises and startups without any relaxation.

INSTRUCTIONS TO BIDDERS

- 1.0 The bidder shall study carefully the Pre-Qualification criteria, Scope of work and Special requirements of the contract, Technical specifications, Instructions to Bidders, Proforma contract with schedules along with all other tender documents. All conditions set out there in shall be binding on the bidders unless conflicting with any conditions expressly stated by FACT while accepting any bid in the event of such acceptance. Copy of the Tender document shall be digitally signed by the bidders and shall accompany their Part-A bids, signifying their acceptance of the same. Bidder shall also submit along with his bid Pro forma on Information about Bidder and Bank transaction details duly filled and signed with all details required therein and with all relevant documents.
- 1.1 Before submitting the bid, the bidder shall familiarise himself, about the details of the work, operating conditions etc., collect all necessary data regarding the facilities available at FACT Cochin Division, and satisfy himself on all aspects relating to this work which he has to execute. Claiming lack of knowledge shall not be a reason for exoneration of the bidder of his contractual obligations or demand for increase in rate, in case a contract is awarded to him.
- 1.2 Offers against this NIT shall be submitted online **on e-Tendering portal <https://eprocure.gov.in>**, with valid digital signature certificate. Offers submitted on any other platform or in any other mode or including e-mails, physical offers etc., SHALL NOT be accepted.
- 1.3 All bidders are requested to register themselves on the above website with their valid digital signature certificate. It is mandatory for bidder to have valid digital signature certificate issued by any of the Certifying Authority approved by Govt. of India for participating in the tender. The cost of digital signature certificate shall be borne by the bidder. Bidders may refer "Bidders Manual Kit" available on the above website for detailed information and instructions for registration, bid submission etc.
- 1.4 The bidder shall be prepared to commence the work from date of issue of LOI /Work Order.
- 1.5 In case of award of work, the Contractor shall obtain required license from the Labour Department for employing his labourers, before commencement of the work. The Contractor shall also ensure coverage of his labourers under the PF and ESI Acts as applicable.
- 1.6 The offers of such bidders who meet PQ Criteria shall only be considered for techno-commercial evaluation and opening of price bids.
- 2.0 **Scope of Work:** Scope of work as detailed separately.
- 3.0 **Rates:**
- 3.1 Bidder shall quote his rates for the work only as per the Price Bid Format (BOQ) attached. Bidder shall quote for all items of work as per the Price Bid format. Bids not complying with the above are liable to be rejected.

3.2 The rate quoted for each item of work shall be inclusive of all costs towards statutory levies and payments, all establishment costs, labour registration, wages paid to the labourers, PF, ESI or other remittances on behalf of the labourers, accommodation and transportation of their officers etc., but excluding GST. In case the applicability of GST is not quoted explicitly in the offer by the Bidder, the offer will be considered as inclusive of all liabilities of GST. FACT will not entertain any future claim in respect of GST against such offers.

4.0 **Submission of bids:** The bid shall be submitted in two parts – Part- A Bid (Prequalification cum Techno-commercial bid) and Part- B Price Bid (Price Bid in BOQ).

Part- A Bid (Pre-qualification cum Techno-Commercial bid): This bid shall contain the following:

- i. All documents of this tender including Special requirements of the contract, Instructions to Bidders, General conditions, Unpriced Bid (Put tick mark on Quoted / Not quoted), Compliance statement, ANNEXURES, FACT safety rules etc.
- ii. Copy of GST registration certificate & PAN card
- iii. Copy of Earnest Money Deposit (EMD) payment mentioned in NIT.
- iv. Bidder should have experience in similar job as detailed in the Pre-Qualification criteria and the copies scanned from originals to prove the qualification as detailed in the pre-qualification criteria, shall be uploaded. **THE BIDDER SHALL PRODUCE THE ORIGINALS OF THE DOCUMENTS FURNISHED ALONG WITH THE PART A OF THE TENDER, AT ANY TIME, IF ASKED FOR, DURING THE EVALUATION OF PART A.**

5. **Part B:** The BOQ in the part B of the tender document shall be filled with quoted rate, GST Provisional Number and the SAC Code, which will be opened only after the Technical evaluation, is completed.

6. FACT reserves the right to extend without giving any reason the last date for submission and opening of bid. HOWEVER, ANY CHANGE IN THIS TENDER LIKE EXTENTION, CANCELATION, ETC WILL BE EFFECTED ONLY IN THE CPP PORTAL

7.0 FACT reserves the right to reject any or all bids without assigning any reason whatsoever. FACT's decision in this regard shall be final and binding on the bidders.

7.1 FACT reserves the right to call tenders from other parties in addition to parties found suitable by way of press advertisement under certain situation such as cartelisation or number of such parties are less, price bids received are less, or quoted rates are high or under any such circumstances which are detrimental to the interest of FACT, at its sole discretion. Further, FACT reserves the right to add any number of parties and at any time, to the suitable parties so considered by the company. The opinion of FACT in this behalf will be final and binding on the bidders/contractors.

8.0 **Evaluation of bids:** Bidders shall quote for all items of work in the Price Bid in excel Format. Bids not complying with the above will not be considered. Evaluation of bids and determination of the L1 bidder shall be based on the combined total value of all items of work quoted by the bidder in the Price Bid Format including plates, tubes, structural, pipes and fitting etc. The combined total value as above shall be computed based on the

- rates quoted by the Bidder against each item and the corresponding quantities indicated.
- 8.1 The following conditions shall be considered in the evaluation of quotations:
- Agreement with terms and conditions and schedules of Tender document;
 - Pre-qualification criteria
 - Price.
- 8.2 For bid evaluation, FACT shall make appropriate loadings to the quoted prices of Tenderer towards deviations in Commercial conditions.
- 8.3 In case more than one bidder becomes L1, the contract will be finalised based on revised lowest tendered amount which will be obtained from the L1 bidders. However, bidders will not be allowed to increase any of the original rates quoted by them in the revised bid submitted by them as above.
- 8.4 FACT reserves the right to reject any or all tenders without assigning any reason whatsoever. FACT also reserves the right to negotiate with the lowest bidder.
- 8.5 **This tender is non-divisible / non-splitable.**
- 9.0 **GST:** The basic rate quoted by the Bidder for all the works as per this tender shall be exclusive of applicable GST. GST rates applicable for each item shall be quoted separate in the BOQ. GST, if applicable for the work as per any statutory notification, shall be extra. If the GST is to be paid by the Contractor as per the relevant notification, he shall arrange to remit the same to the concerned authority and FACT shall reimburse the same to the Contractor based on documentary evidence. If the same is to be paid by FACT, the above shall be done by FACT directly.
- 9.1 Please also arrange to submit the following
- 9.2 The GST registration Number and details. In the case of Provisional ID, GST Registration Number shall be provided on receipt of the same.
- 9.3 Place of supply/Service
- 9.4 GST rates applicable for each item
- 9.5 HSN / SAC codes of each of the goods / services quoted in case of unregistered supplier, a declaration to that effect with reason should be furnished.
- 9.6 FACT's GST registration number in the state of Kerala is 32AAACT6204C1Z2.
- 9.7 The supplier/contractor shall confirm the following:
- Submit GST compliant tax invoice to FACT with FACT's GSTIN as 32AAACT6204C1Z2.
 - Shall ensure uploading the above invoice as per statute & File monthly returns in time enabling FACT to claim the input tax credit.
- 9.8 GST charged by the supplier/contractor shall be released separately to the supplier/contractor only after filing of the outward supply details & the monthly return on GSTN portal by the supplier/contractor and on matching the input tax credit to such invoice with the corresponding details of outward supply of the supplier/contractor.
- 9.9 In case FACT incurs any liability (like interest, penalty etc.,) due to denial/reversal of such input tax credit in respect of the invoice submitted by the supplier/contractor, for the reasons attributable to the supplier/ contractor, the same shall be recovered from the supplier/contractor
- 9.10 Further in case FACT is deprived of the input tax credit due to any reason attributable to the supplier/contractor, the same shall not be paid or recovered if already paid to the supplier/contractor.

10.0 EARNEST MONEY DEPOSIT:

10.1 EMD shall be remitted online through 'State Bank Collect' portal using the link given below:

[https://www.onlinesbi.sbi/sbicollect/icollecthome.htm?corpID=9303&categoryName=Earnest%20Money%20Deposit%20\(EMD\)/SD%20Remittance](https://www.onlinesbi.sbi/sbicollect/icollecthome.htm?corpID=9303&categoryName=Earnest%20Money%20Deposit%20(EMD)/SD%20Remittance)

The link is also available on of our website www.fact.co.in (Tenders ➔ 'Click Here to Pay EMD/ Security Deposit')

The bidder shall precisely indicate the Name of the bidder, Tender number and other relevant details while making the online payment through 'State Bank Collect' and the payment receipt generated shall be uploaded along with the tender document.

10.2 If the above link becomes inactive, EMD remittance may be facilitated via RTGS/NEFT. In such cases UTR No./ scanned copy of the payment receipt may be submitted along with the Part-A of the bid. Details of Bank A/c for remittance of EMD are given below:

Account Type	: Cash Credit
Account No	: 57017844467
IFS CODE	: SBIN0070158
Name of Bank	: State Bank of India
Branch	: Udyogamandal
District	: Ernakulam
State	: Kerala.

10.3 Bids without EMD shall be rejected except in the following cases: EMD will be exempted for Govt. Depts. / firms, public sector units, Micro and Small Enterprise units registered under MSME Act (subject to Declaration of Udyam Registration Numbers by the vendors on CPP Portal and uploading the copy of latest valid Udyam Registration Certificate along with their bid). Also EMD is exempted for government departments/PSUs /Khadi board/ registered labour contract cooperative societies, etc. as per applicable govt. directions, on submission of valid documents in proof of the same.

10.4 No interest shall be paid on EMD.

10.5 If any bidder retracts from or revises his bid during its validity period or fails to submit Security Deposit and execute the required Agreement if the contract is awarded or fails to commence execution of the work on the stipulated date, the EMD/SD furnished shall be liable to be forfeited without prejudice to FACT's right to claim damages.

10.6 In case the bidder whose bid is accepted, fails to deposit the prescribed Security Deposit or fails to execute the agreement or fails to commence the execution of the work within the specified time, the contract issued to him is liable to be cancelled and the Earnest money already deposited by the contractor shall be forfeited without any further reference to the contractor and alternative arrangements made at the risk and cost of the Contractor.

- 10.7 On the successful tenderer entering into an agreement and providing the Performance Bond, the EMD will be released. EMD of unsuccessful bidders will be returned after acceptance of a tender is finally settled.
- 10.8 Declaration of Udyam no on CPPP is mandatory; failing which bidders will not be able to enjoy the benefits as per PP policy. Bidders will get the benefit of PP policy only if they are MSE bidders at the time of submission of their offers.
- 10.9 Government of India has implemented Trade Receivable Discounting System (TReDS) to address challenges faced by MSMEs in delayed payments from Government buyers. TReDS is an online electronic institutional mechanism for facilitating the financing of trade receivables of MSMEs through multiple financiers. FACT is registered on the TReDS platform by Receivable Exchange of India Limited (RXIL), Mumbai. The MSME vendors can avail the TReDS facility, if they want to.

11. PURCHASE PREFERENCE:

This tender shall be based on MSME order dtd. 23rd March 2012, and as amended from time to time, pertaining to public procurement policy in respect of procurement of goods & services, produced and provided by micro and small enterprises, including special benefit of MSE firms owned by SC/ST and women entrepreneurs, on furnishing relevant documents as proof. Bidders will get the benefit of PP policy only if they are MSE bidders at the time of submission of their offers.

In divisible tenders, participating MSEs (Micro and Small Enterprises) quoting price within price band of L1+15% shall also be allowed to supply a portion of requirement by bringing down their price to L1 price in a situation where L1 price is from someone other than an MSE. Such MSEs shall be allowed to supply at least 25 % (or as applicable) of the total tendered value. In case of more than one such MSE, the supply will be shared proportionately (to tendered quantity). Special provisions extended to certain categories of MSEs as per the order shall also be applicable.

In case of non-divisible tenders, an MSE quoting in the price band of L1+15% may be awarded full/complete work of tendered value, considering the spirit of policy for enhancing the government procurement from MSEs subject to bringing down of price to L1 by the MSE concerned.

This tender is non-divisible.

12. The bids shall be valid for a period of number of days mentioned in the NIT from the date of opening of Part-1(Prequalification cum Techno-commercial) Bids, unless otherwise mentioned in the NIT.
13. The bid shall be digitally signed by the bidder. Incomplete bids are liable to be rejected.
14. Enquiry documents are not transferable. Bidders shall meet all expenses in connection with submission of his bid, attending the bid opening, meetings if required.
15. Bidder shall clearly indicate the time (number of days) required for mobilisation

PRPD. BY :AS

CHKD. BY :SNK

APPRD. BY :SKG

Pg. No: 5

COROPRATE MATERIALS -
CONTRACTSFERTILISERS AND CHEMICALS
TRAVANCORE LIMITED

/commencement of work from the date of Letter of Intent (LOI) / Work Order.

16. Work order shall be issued by SM, Materials department, FACT LTD, Udyogamandal. The work shall be administered and executed by the FEDO Projects.
17. Any further information on site familiarization/ nature of work, if required by the bidders, can be had from Project Manager| SM(P&C)

For any clarification on this enquiry, the DM(Mat)F, Phone No: 0484 2568674, Contracts department, Corporate Materials, FACT-PD Administration Building, Udyogamandal, Cochin, may be contacted.

18. The bidders are advised to get themselves informed of all the details they require before submitting their bids.
19. FACT has introduced a new ERP system, wherein, the activities related to evaluation of bids, certification of bills, payments etc. are being simplified.
20. For any disparity with the conditions, the Special Conditions and TPS shall prevail.
21. **FRAUD PREVENTION POLICY:** Bidders shall comply with Fraud Prevention Policy of FACT 2012 (FPPF 2012). The said Policy is available in FACT Website www.fact.co.in
22. Bids from bidders against whom any criminal case, enquiry or investigation/report by authorities like Vigilance, CBI etc., are pending in relation with FACT or bidders who are defaulting contractors of FACT shall be disqualified and rejected.
23. FACT reserves the right to reject any or all bids without assigning any reasons whatsoever, and / or based on the past unsatisfactory performance by bidders at FACT / other PSEs / Govt. Departments. The opinion of FACT regarding the same shall be final and conclusive.
24. All tender documents should be signed digitally while uploading in CPP portal. All other documents (PQ documents, financial documents, Compliance statement, Un-priced bid, Deviation statement if any, ANNEXURE, Attachments if any etc.) shall be filled wherever applicable, signed and seal affix and shall be uploaded in CPP portal. Scanned copy of Solvency and EMD are also shall be uploaded in the portal.
25. **ACCEPTANCE OF TENDER AND ISSUE OF LOI/WORK ORDER:** The acceptance of the bid will be intimated to the successful bidder, who will be called CONTRACTOR thereafter, through a Letter Of Intent (LOI) or a Work Order. If an LOI is issued first, this will be followed by a Work Order. The duplicate Copy of the Work Order will have to be returned to FACT duly signed on all pages as token of acceptance of the Work Order. Within 15 Days from the receipt of LOI/Work Order whichever is issued first, the CONTRACTOR will have to remit the required Security Deposit for the Work. Also as prescribed in the LOI/Work Order/tender documents, the contractor will have to execute an agreement in stamp paper of the required value as per the proforma prescribed by FACT for the satisfactory performance of the contract. In case the CONTRACTOR fails to accept the Work Order or fails to deposit the prescribed Security Deposit or fails to execute the Agreement or fails to commence the execution of the work within the time specified in

PRPD. BY :AS

CHKD. BY :SNK

APPRD. BY :SKG

Pg. No: 6

COROPRATE MATERIALS -
CONTRACTSFERTILISERS AND CHEMICALS
TRAVANCORE LIMITED

the LOI/Work Order/Work to Proceed Notice, the LOI/Work Order issued will be cancelled and the party will be disqualified from bidding for any contract with FACT for a period of Three years from the date of notification.

26. MAKE IN INDIA**26.1 MAKE IN INDIA**

26.1.1 Purchase preference shall be applicable only to Class 1 local suppliers (suppliers or service providers whose goods, services or works offered for procurement has local content equal to or more than 50%) in the manner specified in the latest Revision of Public Procurement (Preference to Make in India) Order 2017, and amendments thereto, subject to orders issued by Deptt. of Fertilisers, Govt. of India.

26.1.2 For the purpose of extending purchase preference as in Cl. 26.1.1 above, margin of purchase preference shall be 20% or as defined in the above Orders, unless specified otherwise in the Enquiry.

26.1.3 When supply / service as per the tender is divisible in nature, Class 1 Local Suppliers quoting within the price band prescribed in Cl.26.1.2 above shall be allowed to supply / execute a portion of the requirement as prescribed in the Make in India Order, subject to conditions as mentioned therein.

26.1.4 When supply / service as per the tender is non-divisible or non-splitable in nature, Class 1 Local Suppliers quoting within the price band prescribed in Cl.26.1.2 above (in ascending order) may be awarded full as prescribed in the Make in India Order, subject to conditions as mentioned therein.

26.1.5 To claim benefits under Make in India Order, the bidder shall provide self certification or such other certificate(s) as prescribed in the Order, as applicable, that the item offered meets the minimum local content and shall give details of the location(s) at which the local value addition is made.

27. DISPUTES:

If the Contractor is not a Central Public Sector Enterprise/Central Government Department: If any dispute arises out of or relating to or in connection with this CONTRACT, between the CONTRACTOR and the OWNER/FACT, the same shall be amicably settled through mutual discussions, failing which, the unresolved dispute(s) shall be referred to arbitration in accordance with the provisions of the Arbitration and Conciliation Act, 1996, as amended from time to time. The number of Arbitrator shall be one. The venue of the Arbitration shall be at Ernakulam and the proceedings shall be in ENGLISH.

If the CONTRACTOR is a Central Public Sector Enterprise or Central Government Department: In the event of any dispute or difference relating to the interpretation and application of the provisions of this contract(s) between Central Public Enterprises (CPSEs)/Port Trusts inter se and also between CPSEs and government departments / Organizations (excluding disputes concerning Railways, Income Tax, Customs & Excise Departments), such dispute/ difference shall be taken up by either Party for resolution through AMRCD as mentioned in DPE OM No. 4(1)2013-DPE(GM)/FTS-1835 dated 22.05.2018."

PRPD. BY :AS	CHKD. BY :SNK	APPRD. BY :SKG	Pg. No: 7
COROPRATE MATERIALS - CONTRACTS		FERTILISERS AND CHEMICALS TRAVANCORE LIMITED	

Any legal proceedings relating to or in connection with this CONTRACT shall be limited to the exclusive jurisdiction of the High Court of Kerala.

Whenever any portion of the “Special Conditions of the contract” or “Notice Inviting Tender” (NIT) is repugnant to or at variance with any provision of this document “Instructions to Bidders”, the respective provisions of “Special Conditions of the contract” or “Notice Inviting Tender” (NIT) shall prevail. Similarly, whenever any portion of the “GCC” is repugnant to or at variance with any provision of this document “Instructions to Bidders”, the respective provisions of “Instructions to Bidders” shall prevail.



TENDER

For

**Engaging Engineering Design Consultant for Construction of
DCS Building for Ammonia Handling at FACT UC**

PART I: COMMERCIAL

SPECIAL CONDITIONS OF CONTRACT (SCC)

**CONTENT**

<u>Clauses</u>	<u>Description</u>
1.0	Definitions
2.0	Scope of Contract
3.0	Consultant's Responsibilities
4.0	Deliverables
5.0	Schedule & Milestones
6.0	Payment Terms
7.0	Manpower & Subcontracting
8.0	Variations
9.0	Liquidated Damages
10.0	Liability & Indemnity
11.0	Termination
12.0	Confidentiality
13.0	Governing Law & Arbitration
14.0	Site Particulars
15.0	Change in Constitution
16.0	Order of Precedence



1.0 Definitions

The following expressions shall have the meanings specified against the respective item, wherever used in this document, unless repugnant to the context and meaning thereof.

1.1 CONTRACT means this Agreement including the Articles, Schedules, Annexes and Appendices as listed in the List of Titles forming part hereof and any written amendments thereto executed by authorized signatories on behalf of the parties hereto.

1.2 'DATE OF CONTRACT' means the Date on which CONTRACT is signed by either party after signature by the other.

1.3 'WORK' means all duties, responsibilities and obligations to be discharged by the Consultant pursuant to CONTRACT.

1.4 'OWNER' means FACT-UC

1.5 'PMC' means FACT Engineering and Design Organisation (FEDO).

1.6 'Consultant' means the Consultant to whom the CONTRACT is awarded

2.0 Scope of Contract

2.1 The scope of this contract is strictly limited to engineering consultancy services only, comprising design, detailed engineering, preparation of drawings, technical specifications, estimates, BOQs, and related documentation for the New DCS Control Room Building for Ammonia Handling Facility at FACT Petro-UC.

2.2 For detailed scope of the work, please refer the document **32775-12-PS-001** titled *TECHNICAL PROCUREMENT SPECIFICATION FOR ENGAGING ENGINEERING DESIGN CONSULTANT FOR CONSTRUCTION OF DISTRIBUTED CONTROL SYSTEM (DCS) BUILDING FOR AMMONIA HANDLING AT FACT UC*.

2.3 This contract does not include supply, procurement, fabrication, construction, erection, installation, testing, commissioning, supervision, or site execution of any works. All construction activities shall be carried out by agencies appointed separately by the Owner/PMC under independent contracts.

3.0 Consultant's Responsibilities

3.1 The Consultant shall be fully responsible for:

- Accuracy, adequacy, safety, and completeness of all designs, drawings, calculations, estimates, and documents



- Compliance with applicable Indian Standards, statutory codes, safety regulations, and good engineering practices
- Coordination among all engineering disciplines

3.2 Review, comments, or approval of documents by Owner/ PMC shall not relieve the Consultant of their responsibility or liability for correctness and adequacy of engineering.

4.0 Deliverables

The Consultant shall submit, but not be limited to, the following deliverables:

- Design calculations (Civil, Structural, Electrical, Mechanical, HVAC, Fire Protection)
- General Arrangement (GA) drawings
- Detailed construction drawings (Issued for Tender)
- Detailed BOQ and cost estimates
- Responses to technical queries during tendering and construction

All deliverables shall be submitted in hard copy and editable soft copy formats as specified by Owner/PMC.

5.0 Schedule & Milestones

5.1 The Consultant shall complete the services as per the mutually agreed project schedule, counted from the **date of issue of Letter of Intent (LOI)**, unless otherwise approved in writing by Owner/PMC.

5.2 The Consultant shall complete all the documentation activities within specified period in the tender from the date of award of work.

MILESTONE	TIME PERIOD
Tender purpose drawings, Technical specifications and Cost Estimate	45 days from date of issue of LOI
Design calculations and Good for construction drawings as hardcopies and soft copy (including native files)	60 days from the date of final approval of Tender documents
As built drawings	15 days from the date of completion of the project

5.3 Submission of Tender documents including the Tender purpose drawings, Technical specifications, schedule of items of work and Detailed estimate shall be submitted within 45 days (including holidays) from the date of issue LOI. Comments/Clarification on the tender documents, if any, will be informed to the Consultant. Revised tender documents shall be submitted within 7 days of receipt of comments from Owner/PMC.

5.4 The Consultant shall start submitting such first set of design calculations and Drawings within sixty days (2 MONTHS) from the date of approval of the final tender documents. The Consultant shall forward to OWNER soft copy of design calculations and drawings preferably for the



building/pipe rack at a time along with all the concerned scope drawings and load data sheets. After reviewing the above design calculations and Drawings, Owner will send comments to the Consultant within 15days time from the date of receiving the above. The Consultant will send their designer, if required, to Owner's office for clarifications /modifications/ incorporations and to finalize designs/Drawings across the table. The Consultant to resubmit the design calculations and drawings within 15days of receipt of comments from Owner/PMC.

5.5 As built drawings shall be marked in hard/Pdf copy and send to Consultant by Owner/PMC after the completion of the construction work by other agencies. The same shall be updated in the AutoCAD drawings and submitted to PMC within 15days of receiving of the drawings in Hard and Soft format as mentioned in the Tender document.

5.6 Delays attributable to the Consultant shall attract Liquidated Damages as per Clause 9.0 of this SCC.

5.7 If at any point of time, work is hindered for reasons attributable to Owner/PMC, the Consultant shall be issued a Stop-Memo Notice by Owner/PMC and schedule extended accordingly without Liquidated Damages.

6.0 Payment Terms

6.1 All documents, drawings, estimate etc. prepared by the Consultant has to be approved by Owner/PMC. Payments shall be linked to submission and acceptance of deliverables and released stage-wise as follows:

Sl.No:	Milestone	% of Contract Value
1.	Tender Drawings and Detailed bill of Quantities of Civil, Plumbing Mechanical and Electrical works for Tender.	20%
2.	Design and submission of Good for Construction Drawings (Architectural / Structural) for all structures in hard and soft format (including native files)	40%
3.	Design and submission of Good for Construction Drawings for Electrical, Mechanical, Plumbing and other allied internal and external Building services in hard and soft format (including native files).	20%
4.	Clarification, discussion, reviews etc. in connection with the Design and drawings during execution of the Project by other agencies	10%
5.	Preparation of As-built drawings and obtaining final statutory clearance certificates	10%
	TOTAL	100%

7.0 Manpower & Subcontracting



7.1 The Consultant shall deploy qualified personnel as per the Prequalification Criteria.

7.2 Subcontracting of core engineering activities is permitted with prior written intimation to Owner/PMC.

7.3 The Consultant shall retain single-point responsibility for the entire scope of work

8.0 Variations

Any change in scope shall be carried out only upon written instruction from Owner/PMC. Fees for additional scope, if any, shall be mutually agreed in writing before execution.

9.0 Liquidated Damages

9.1 Delay attributable to the Consultant shall attract Liquidated Damages (LD) at 0.5% of the contract value per week, subject to a maximum of 10% of the total contract value.

9.2 LD shall apply only to delays in submission of agreed deliverables.

10.0 Liability & Indemnity

10.1 The Consultant shall be liable for errors, omissions, or deficiencies in design and documentation.

10.2 The Consultant shall indemnify Owner/PMC against losses arising due to professional negligence, limited to the total contract value.

11.0 Termination

11.1 Owner/PMC reserves the right to terminate the contract for default or convenience with written notice.

11.2 In case of termination, payment shall be made only for services satisfactorily completed up to the termination date.

12.0 Confidentiality

All drawings, documents, and data related to the project shall remain confidential and shall not be disclosed without written permission of Owner/PMC.

13.0 Governing Law & Arbitration

13.1 The contract shall be governed by the laws of India.

13.2 Arbitration shall be as per the General Conditions of Contract (GCC).

14.0 Site Particulars



The site is at Udyogamandal Complex of FACT, at Eloor. The Consultant shall visit the site and familiarize themselves thoroughly with the state/local rules, regulations, living / working conditions, and site conditions relevant to the scope of consultancy services. Non-familiarity or ignorance of these conditions will not be considered a reason for extra claims or for not carrying out the work at a later stage

15.0 Change in Constitution

Any Change in constitution of Consultant's firm must be done only with prior information to Owner/PMC.

16.0 Order of Precedence

In case of conflict, the order of precedence shall be:

1. Letter of Award
2. Specific Requirements of Work
3. Special Conditions of Contract (SCC)
4. General Conditions of Contract (GCC)
5. Tender Documents & Drawings

TECHNICAL PROCUREMENT SPECIFICATION FOR ENGAGING ENGINEERING DESIGN CONSULTANT FOR CONSTRUCTION OF DISTRIBUTED CONTROL SYSTEM(DCS) BUILDING FOR AMMONIA HANDLING AT FACT UC				32775-12-PS-001	
				PAGE 1 OF 1	R2
TPS NO.		32775-12-PS-001			
STATUS		☒ ENQUIRY ☐ COMMITMENT			
ORIGINATING DEPT.		CIVIL			
P.O / W.O NO.					
PROJECT		NEW DCS CONTROL ROOM FOR AMMONIA HANDLING FACILITY IN PETRO UC			
LOCATION		UDYOGAMANDAL, ERNAKULAM			
CLIENT		M/S. FACT- UDYOGAMANDAL DIVISION			
PURCHASER		M/S. FACT- FEDO			
VENDOR					
ITEM: ENGAGING ENGINEERING DESIGN CONSULTANT FOR CONSTRUCTION OF DISTRIBUTED CONTROL SYSTEM(DCS) BUILDING FOR AMMONIA HANDLING AT FACT UC					
2	20.04.2026	Re-Issued for Tender	NKV	NJ	NJ
1	26.02.2026	Issued for Tender	NKV	NJ	NJ
0	22.01.2026	Issued for Comments	NKV	NJ	NJ
REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED
FACT ENGINEERING AND DESIGN ORGANISATION				 FEDO	

CIVIL DEPARTMENT		CONTENTS <u>TECHNICAL PROCUREMENT SPECIFICATION</u> FOR ENGAGING ENGINEERING DESIGN CONSULTANT FOR CONSTRUCTION OF DISTRIBUTED CONTROL SYSTEM(DCS) BUILDING FOR AMMONIA HANDLING AT FACT UC			32775-12-PS-001			
					Page 1 of 1			
S.No.	Doc. No.	Description	No. of Pages	Rev. No. with Issue				
				0	1	2	3	
1.0	TECHNICAL DOCUMENTS							
1.1	32775-12-PS-001 SW	Scope and Specific requirements of work- Civil	19	0	1	2		
1.2	32775-12-PS-001 DB	Design Basis-Civil & Structural works	29	0	0	0		
	Annexure A	Soil Investigation report	59	0	0	0		
1.3	32775 -01-PS-001 SW-DC	Scope of work, specific requirements & Deliverables -Mechanical items	4	0	1	1		
1.4	32775-01-PS-001 AC	Mechanical specification (HVAC system including pressurisation and chemical filtration for DCS control room)	24	0	1	2		
1.5	32775-01-PS-001 CA	Mechanical specification (Clean Agent System)	13	0	1	2		
1.6	32775-13-PS-01 DP	Design Philosophy- Electrical	7	0	1	2		
1.7	32775-12-SW-001A	Schedule of items of work	1	0	0	0		
2.0	DRAWINGS							
2.1	32775-12-DG-00001	Location of New DCS Control Room	1	0	0	0		
2.2	32775-12-DG-00002	New DCS Control Room-Plan and Section	1	0	0	0		
2.3	FPTS-KP-27-1752	Layout of duct for proposed DCS building - Ammonia Handling	1	0	0	0		
2	20.04.2026	Re-Issued for Tender	NKV	NJ	NJ			
1	26.02.2026	Issued for Tender	NKV	NJ	NJ			
0	22.01.2026	Issued for comments	NKV	NJ	NJ			
REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED			
FACT ENGINEERING AND DESIGN ORGANISATION				 FEDO				

TECHNICAL PROCUREMENT SPECIFICATION	SCOPE AND SPECIFIC REQUIREMENTS OF WORK	32775-12-PS-001 SW R2
		PAGE 1 OF 19

**SCOPE AND SPECIFIC REQUIREMENTS OF WORK FOR ENGAGING
ENGINEERING DESIGN CONSULTANT FOR CONSTRUCTION OF
DISTRIBUTED CONTROL SYSTEM(DCS) BUILDING FOR AMMONIA
HANDLING AT FACT UC**

2	17.03.2026	Revised as per Comments	NKV	NJ	NJ
1	17.02.2026	Revised as per Comments from UC	NKV	NJ	NJ
0	21.01.2026	Original Issue	NKV	NJ	NJ
REV	DATE	REVISION DESCRIPTION	PRPD	CHKD	APPRD
FACT ENGINEERING AND DESIGN ORGANISATION					

TECHNICAL PROCUREMENT SPECIFICATION	SCOPE AND SPECIFIC REQUIREMENTS OF WORK	32775-12-PS-001 SW R2
		PAGE 2 OF 19

**ENGAGING ARCHITECTURAL AND ENGINEERING DESIGN
CONSULTANT FOR CONSTRUCTION OF DCS BUILDING FOR FACT UC
AT UDYOGAMANDAL, ELOOR.**

1.0 INTRODUCTION

M/s Fertilisers and Chemicals Travancore (FACT) Limited proposes to construct a Distributed Control system (DCS) building in Ammonia Handling at Udyogamandal complex, Eloor, Ernakulam. The FACT Engineering and Design organisation (FEDO) is appointed as the Project Management Consultant (PMC) by the Owner for the Construction of the DCS building.

In furtherance thereof, on behalf of FACT, FEDO hereby invites bid from all eligible Consultants/Architectural firms for the work. The scope of work involves Providing comprehensive Consultancy services for preparation of Architectural drawings(including finishing schedule and MEP drawings), structural design and drawings including preparation of Detailed Estimate for the Construction of DCS building at FACT Udyogamandal complex, Eloor, Ernakulam, Kochi

The work shall be executed as defined below and as per the schedule of items of works attached.

2.0 LOCATION AND SITE DETAILS

The proposed DCS building will be located within the Udyogamandal Complex of FACT, at Eloor. The allocated area for the building measures 28.2 m × 19.2 m. The Owner has already conducted a soil investigation for this site. The soil investigation report including foundation recommendations are included in the tender documents as information to bidders as Annexure A.

3.0 DEFINITIONS

For the purpose of these documents, the following definitions shall hold:

Owner : FACT-Udyogamandal Complex

PMC : FEDO

Bidder : Architectural/Structural design Consultant

TECHNICAL PROCUREMENT SPECIFICATION	SCOPE AND SPECIFIC REQUIREMENTS OF WORK	32775-12-PS-001 SW R2
		PAGE 3 OF 19

4.0 SCOPE OF WORK OF DESIGN CONSULTANT

The DCS building plan has been finalized by the PMC/Owner, and the approved drawing is included in the tender documents. Bidder may improve the preliminary architectural drawings in terms of aesthetics, functionality, orientation, space utilization etc, but in consultation with the PMC/Owner.

The daily manpower in the DCS building is estimated to be **10 persons**. The plumbing and sanitary design shall be prepared accordingly.

The Bidders scope of work mainly comprises of the following activities:

Initial documents to be submitted for Tendering, for Construction of DCS building and allied facilities:

1. Architectural elevations and sections of the DCS building to be developed from the approved plan.
2. 3D model and walkthrough of the project
3. Based on the approved Preliminary architectural drawings and designs, bidder shall prepare detailed Tender(structural) drawings and technical specifications including schedule of items of work as per CPWD specifications for all components of works.
4. Total cost estimate for the work. Rate analysis of all items shall be furnished by the bidder.
5. Scope of work and Technical specifications of the construction of DCS building and allied facilities.

Documents to be submitted for construction of DCS Building:

6. Structural design of the DCS building including submission of the design calculations and the supporting analysis files. The basic requirement for design is mentioned in the "Design basis" attached with the tender.
7. Good for construction drawings including foundations of the DCS building. BOQ of PCC, RCC and reinforcement steel shall be shown in each drawing.
8. False flooring layout.
9. Reflected suspended ceiling layout.
10. Door window schedule and details.
11. Tile layout for the building.
12. Electrical, Sanitary and plumbing drawings including water tanks, soak pit and septic tank(RCC) details for the DCS building.
13. Schematic line diagram for Potable water supply and service water supply.
14. Fire layout (detection, clean agent system as required).

TECHNICAL PROCUREMENT SPECIFICATION	SCOPE AND SPECIFIC REQUIREMENTS OF WORK	32775-12-PS-001 SW R2
		PAGE 4 OF 19

15. Wall opening schedule for HVAC, Electrical and firefighting to be provided.
16. Structural design and drawings of the Road crossing cable bridge with an overhead clearance of 8m.
17. Site supervision is not included in the scope of bidder, but the successful bidder has to address and give timely clarifications for the queries related to site during construction stage.
18. Preparation of As built drawings
19. Bidder shall issue Stability certificate for the building after completion of project.

The above referred work is not conclusive. The materials considered for the building shall be as per the project requirements mentioned in the tender document. Any other drawings or technical specification, not defined in the scope of work ,but required for the satisfactory completion of the Project shall be under the scope of the Bidder.

Time is of the essence in respect of the said work/ project. The successful bidder shall adhere to all the deadline, dates and time periods set forth in this document.

EXCLUSION FROM THE SCOPE OF WORK:

1. Soil Investigation of the proposed plot
2. Sub surface utility survey
3. Tendering for Construction work
4. Supervision for construction work.

5.0 PROJECT REQUIREMENTS

DISTRIBUTED CONTROL SYSTEM(DCS) BUILDING

BUILDING STRUCTURAL REQUIREMENTS:

The DCS building is proposed as a G+1 storey structure with an approximate plinth area of 370 m². The minimum floor-to-floor height shall be 5.0 m, inclusive of false ceiling and false flooring provisions.

The building shall be designed as an RCC framed structure with solid block infill walls.

For design purposes, future loading shall be considered on the first-floor terrace of the building.

TECHNICAL PROCUREMENT SPECIFICATION	SCOPE AND SPECIFIC REQUIREMENTS OF WORK	32775-12-PS-001 SW R2
		PAGE 5 OF 19

SLAB AT GROUND LEVEL

As per the soil report, the soil in the location is found to be filled up (Blackish silty clay) with N value 0, upto a depth of 7.5m. Bidder to suggest suitable method for supporting the grade slab or the slab at ground level shall be designed as structural slab. In any case, no floor shall rest on the existing soil directly. The type of slab shall be finalised after consultation with PMC/Owner. Antitermite treatment shall be provided under the building as per IS 6313 and IS 8944.

12mm tile drop shall be provided to all external platform at door locations on outside door.

Ground floor toilet shall have 500mm sunken slab from FFL.

INTERIOR AND EXTERIOR WALL:

All masonry shall be 230thick solid block wall except for partitions for toilets and dining area. 40 thick DPC shall be provided at plinth level in Masonry walls.

All walls around Rack room, Console room and UPS room shall be up to RC ceiling.

Parapet wall shall be of 1200mm height RCC with 125mm thickness.

All internal wall openings for pipe/conduit shall be provided with rigid sleeves.

JOINTS IN BUILDING

All joints in buildings shall be made gas tight and watertight at locations as under:

(a) joints between doors'/windows' frames and block work or concrete structure.

(b) joints between masonry wall and concrete structure.

(c) joints around utility opening after installation of pipes/ cable, ducts etc. Same shall be sealed with smoke stop and fire-resistant sealant.

Gaps in floor cutout shall be sealed with fire retardant material (with fire rating of 2 hrs).

LINTELS & SUNSHADES:

Lintel beams shall be provided throughout the building. Sunshade shall be minimum 600mm for windows and 1500mm for doors.

SANITARY/PLUMBING:

Water logging area such as toilet, dining area shall be sunk with 12mm tile drop.

FIXTURES:

- ✖ Water Closet - Water efficient (dual flush) wall hung water closet European type, (white colour).
- ✖ Health Faucet- 15dia bib tap with health faucet

TECHNICAL PROCUREMENT SPECIFICATION	SCOPE AND SPECIFIC REQUIREMENTS OF WORK	32775-12-PS-001 SW R2
		PAGE 6 OF 19

- ✖ Wash basin- Rounded/ oval, coloured wash basin 550x400 over granite counter (with electronic sensor) (white colour)
- ✖ Pillar cock- 15dia two in one pillar cock (hot and cold) shall be provided for all wash basin /Sink.
- ✖ Mirror- full length bevelled edged mirror of 5.5mm thick float glass
- ✖ Towel rail- 20 dia x 600 long towel rail (1200 above FFL.) 1.25 thk. (chromium plated brass)
- ✖ Geyser - capacity 15 ltr.
- ✖ Floor drain – 110dia uPVC floor trap with C.P. grating cover.
- ✖ Urinal- Standard wall hung type urinal with electronic sensor (premium luxury model) (white colour) with ceiling vitreous cistern 10 Liters capacity
- ✖ Urinal partitions- engineered marbles 12mm thick screwed with SS fixture.
- ✖ Toilet paper holder
- ✖ Coat/Hat hook
- ✖ Chromium plated liquid soap container
- ✖ Drinking water dispenser
- ✖ Shower

PIPES

- ✖ Waste pipes -CI/GI for pipes laid inside building upto Inspection chamber(IC).
-uPVC pipe from IC to septic tank.
- ✖ Supply lines -CPVC pipes of required dia.
- ✖ Rain water pipe - 150mm dia uPVC pipes encased in concrete

All sanitary drain / plumbing pipe lines in toilet / Domestic water lines(below False ceiling) shall be concealed in block wall only, no chipping allowed in RC column, beams.

All internal drainage pipes shall be laid in 1:80 slope.

All plumbing fixtures shall be brass chromium plated (UNO). The chromium plating shall confirm to is: 4827 (Thickness 10 micron).

All G.I. visible pipes and clamps within and outside building shall be painted with two coats of aluminium paint.

Inspection Chamber and gully traps to be provided.

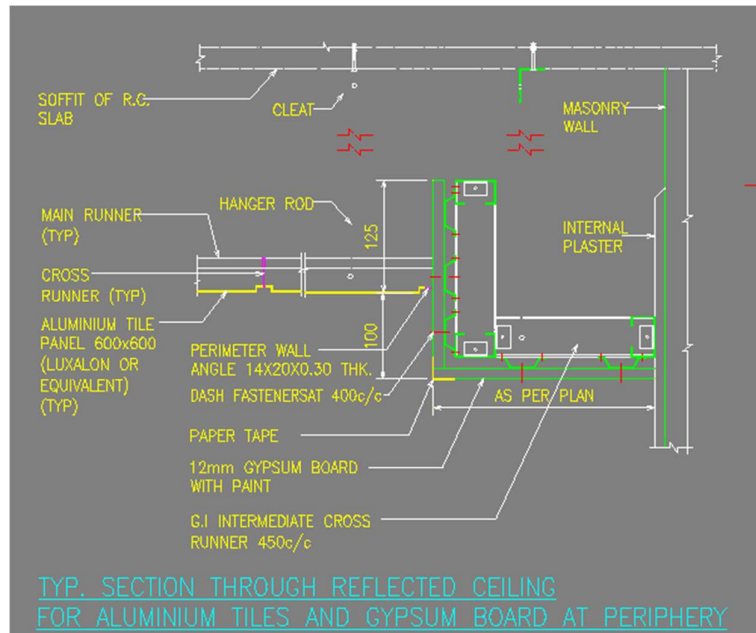
Under cut shall be provided on WC door for fresh air.

Flush water overhead tank and Domestic water overhead tank to be provided at terrace.

INTERNAL FINISHING SCHEDULE:

FALSE CEILING:

Console room/Rack room/UPS room/battery room/passageway: 600x600 powder coated aluminium tile with Gypsum boards drop ceiling of 400mm width along the periphery finished with acrylic emulsion paint.



Toilet: Gypsum board Moisture resistant tile 600x600x12mm thick (removable type).

AHU room/Clean agent room/Dining area/Rest room: No false ceiling required, acrylic emulsion paint over 6mm thick plain cement plaster (1:3).

Above false ceiling sleeves to be used for lighting, Fire alarm, telephone and paging cable.

Suspended ceiling tiles/panel/boards shall be resistant to fire, termites, fungi, wood boring insects, and delamination due to moisture and cyclic changes in weather.

Walls and ceilings in void above suspended ceilings shall be whitewashed.

Opening in false ceiling shall be adequately secured and properly sealed after installation of fixtures.

Exposed roof of air-conditioned area shall be provided with under-deck insulation.

FALSE FLOORING:

Console room/Rack room/UPS room: Non combustible 35mm thick, 600x600 Premoulded (USF 1000 grade) cementitious tile with 3mm thick antistatic high-pressure laminate.

TECHNICAL PROCUREMENT SPECIFICATION	SCOPE AND SPECIFIC REQUIREMENTS OF WORK	32775-12-PS-001 SW R2
		PAGE 8 OF 19

Below false floor sleeves/cutout to be use for power and control cable entry.
Center to center distance between studs is 600mm UNO.
Height of false flooring shall be minimum 800mm from Top of concrete.

FLOORING OVER GRADE/RC SLAB:

Clean Agent room/AHU room: 50mm thick granolithic flooring(cement flooring in 1:1:2) with non-metallic floor hardner topping 12mm thick.

Toilet: 8mm thick anti skid vitrified tiles(Matt finish) over cement mortar bedding with overall thickness of 40mm with epoxy pointing.

Airlock/Passage/Rest room/Dining area: 8mm thick anti skid vitrified tiles over cement mortar bedding with overall thickness of 40mm with epoxy pointing. 

Battery room: Heavy duty acid/alkali resistant tiles over cement mortar bedding with overall thickness 40mm.

INTERNAL WALL/PARTITION:

All rooms except battery room: Acrylic Emulsion paint over 12mm thick cement plaster(1:4) with POP punning and cement primer.

SKIRTING:



Airlock and passage : skirting with 125mm high 8mm thick vitrified tiles over cement mortar.

Clean agent room: 125mm high ,18 thick cement mortar.

Console room/Rack room/UPS room : 125mm high PVC skirting to match false floor tile.

DADOING:

Battery room: Acid/Alkali resistant epoxy coating 2200mm high and acrylic emulsion paint above 2200mm height over 12mm thick cement plaster.

Toilet : Glazed vitrified tiles dado upto False ceiling. 

HVAC:

Passage/Battery room/Console room/Rack room/UPS room: Underdeck insulation & Air conditioning.

Airlock/Clean agent room/Toilet/AHU room/dining area: Mechanical ventilation.

EXTERNAL FINISHING SCHEDULE:

FLOORING:

Entrance platform and steps: Flame finished Granite stone flooring over cement mortar 1:4 . 

Ramp: 50mm thick granolithic flooring (cement flooring in 1:1:2) with non-metallic floor hardener topping 12mm thick.

External Wall/RC columns/Beams: Weather sheild, anti-algal waterproof acrylic emulsion paint with cement primer over 15mm thick cement plaster.

RC roof slab: Fiber reinforced elastomeric water proofing membrane as per CPWD specifications. 25mm thick PCC layer (1:2:4) in slope 1:100 above water proofing treatment.

FURNISHING OF ROOMS:

Dining Room/Rest room:



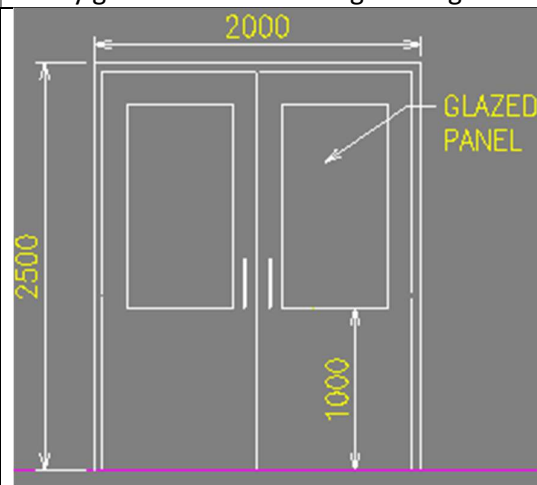
Furniture layout and specifications for Dining room and Rest room are in the scope of bidder.

DOOR / WINDOW DETAILS

DOOR SCHEDULE

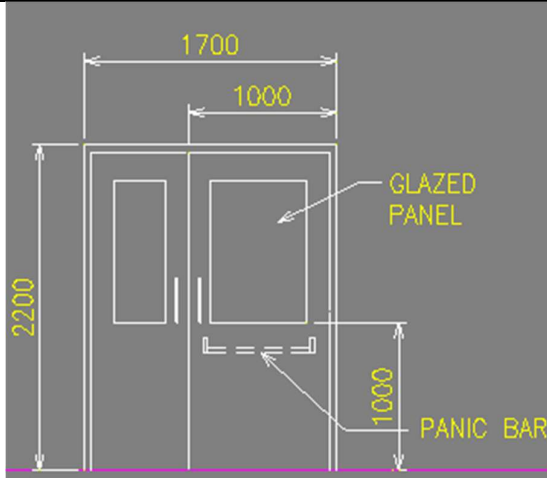
1. ENTRY TO RACK ROOM AND CONSOLE ROOM

Door size	2000x2500
Type of door	Equal Double Leaf
Fire rating	2 hrs
Frame Material	Hollow metal pressed steel with paint
Shutter material	Hollow metal pressed steel with paint
Hardware	Hinges, Door closer, Door handle(Both sides), Latch with lockset and lever handle
Glazing	Partly glazed with 8mm toughened glass



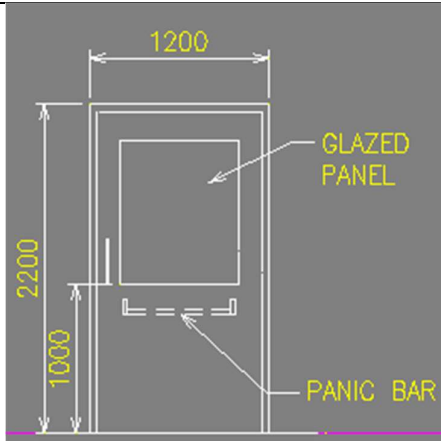
2.UPS ROOM

Door size	1700x2200
Type of door	Unequal Double Leaf
Fire rating	2 hrs
Frame Material	Hollow metal pressed steel with paint
Shutter material	Hollow metal pressed steel with paint
Hardware	Hinges, Door closer, Door handle(Both sides),Latch with lockset and lever handle, Panic bolt from inside
Glazing	Partly glazed with 8mm toughened glass

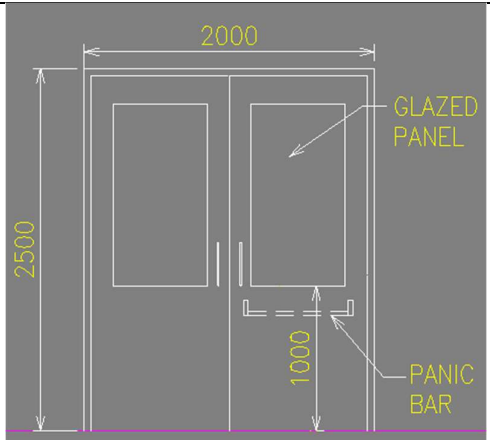


3.RACK ROOM TO CONSOLE ROOM, BATTERY ROOM, UPS ROOM,REAR SIDE EMERGENCY EXIT

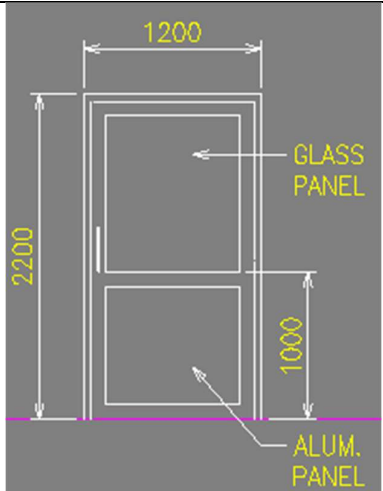
Door size	1200x2200
Type of door	Single Leaf
Fire rating	2 hrs
Frame Material	Hollow metal pressed steel with paint
Shutter material	Hollow metal pressed steel with paint
Hardware	Hinges, Door closer, Door handle(Both sides),Latch with lockset and lever handle, Panic bolt from inside
Glazing	Partly glazed with 8mm toughened glass



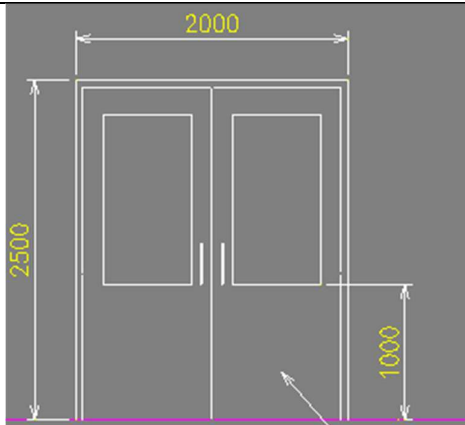
4.AIR LOCK

Door size	2000x2500
Type of door	Equal double Leaf
Fire rating	2 hrs
Frame Material	Hollow metal pressed steel with paint
Shutter material	Hollow metal pressed steel with paint
Hardware	Hinges, Door closer, Door handle(Both sides),Latch with lockset and lever handle, Panic bolt from inside
Glazing	Partly glazed with 8mm toughened glass
	

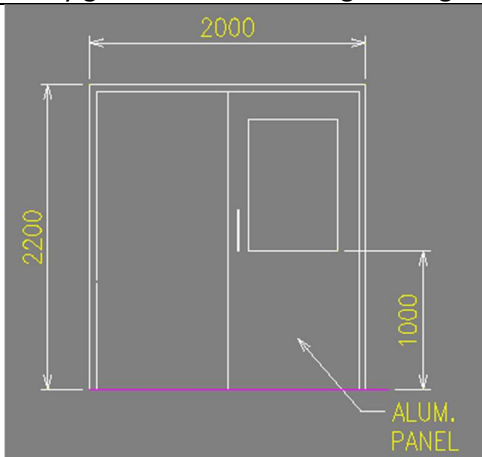
5.AIR LOCK(REAR SIDE), CLEAN AGENT ROOM, DINING AREA

Door size	1200x2200
Type of door	Single Leaf
Fire rating	NA
Frame Material	Aluminium(Powder coated,50 microns)
Shutter material	Aluminium(Powder coated,50 microns)
Hardware	Hinges, Door closer, Door handle(Both sides),Latch with lockset and lever handle
Glazing	Partly glazed with 6mm toughened glass
	

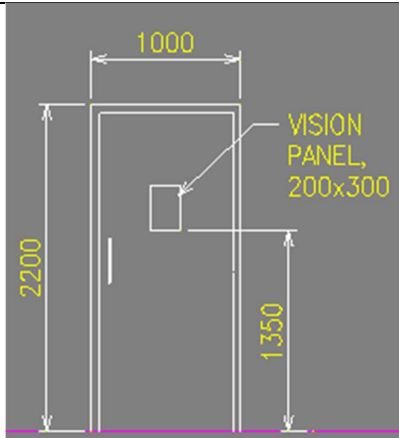
6.AIR LOCK(ENTRANCE DOOR)

Door size	2000x2500
Type of door	Equal double Leaf
Fire rating	NA
Frame Material	To be finalised by Architect
Shutter material	To be finalised by Architect
Hardware	Hinges, Door closer, Door handle(Both sides),Latch with lockset and lever handle
Glazing	Partly glazed with 6mm toughened glass
	

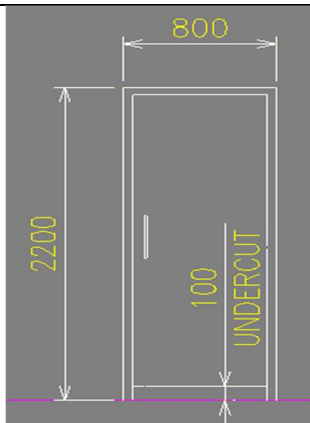
7.BATTERY ROOM(SLIDING DOOR)

Door size	1000x2500
Type of door	Sliding door
Fire rating	NA
Frame Material	Aluminium (Powder coated,50 microns)
Shutter material	Aluminium(Powder coated,50 microns)
Hardware	Hinges, Door handle(Both sides),Latch with lockset and lever handle
Glazing	Partly glazed with 6mm toughened glass
	

8.TOILET

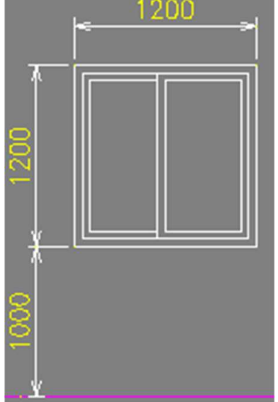
Door size	1000x2200
Type of door	Single Leaf
Fire rating	NA
Frame Material	uPVC(Moulded)
Shutter material	uPVC(Moulded)
Hardware	Hinges, Door closer, Door handle(Both sides),Latch with lockset and lever handle
Glazing	Vision Panel with 6mm toughened glass(Frosted film)
	 The diagram shows a vertical door with a width of 1000mm and a height of 2200mm. A vision panel is located in the upper right portion of the door, with dimensions of 200mm by 300mm. The distance from the bottom of the door to the bottom of the vision panel is 1350mm.

9.SHOWER AND WC

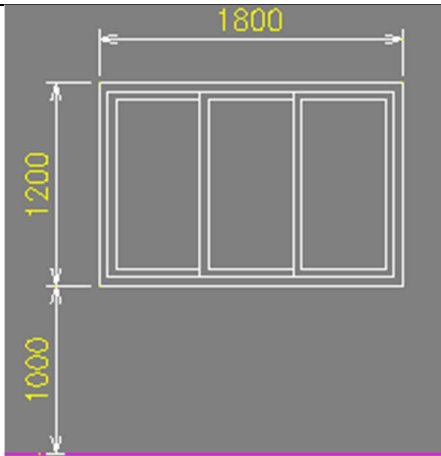
Door size	800x2200
Type of door	Single Leaf
Fire rating	NA
Frame Material	uPVC(Moulded)
Shutter material	uPVC(Moulded)
Hardware	Hinges, Door handle(Both sides),Baby Latch
Additional	Indicator lock
	 The diagram shows a vertical door with a width of 800mm and a height of 2200mm. There is a 100mm undercut at the bottom of the door.

WINDOW/VENTILATOR SCHEDULE

1.BATTERY ROOM

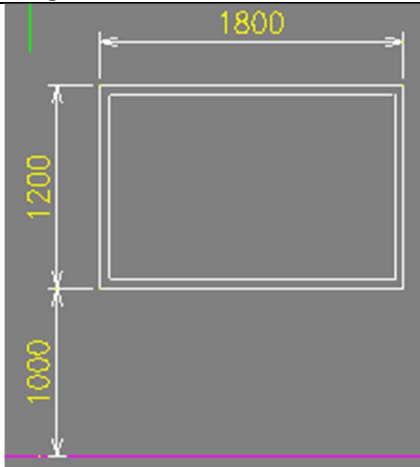
Window size	1200x1200
Type of window	Sliding window
Fire rating	NA
Window Frame	Aluminium sections(Anodized)
Shutter Frame	Aluminium sections(Anodized)
Shutter	6mm thick clear toughened glass
Hardware	Handle with lock
	

2.CLEAN AGENT ROOM,UPS ROOM,CONSOLE ROOM,RACK ROOM,DINING

Window size	1800x1200
Type of window	Sliding window
Fire rating	NA
Window Frame	Aluminium sections(Anodized)
Shutter Frame	Aluminium sections(Anodized)
Shutter	6mm thick clear toughened glass
Hardware	Handle with lock
	

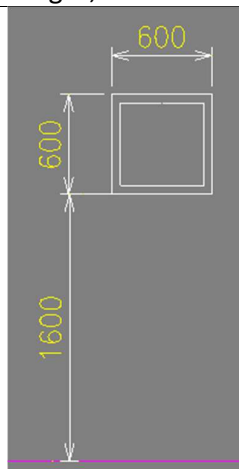
3.CONSOLE ROOM TO RACK ROOM

Window size	1800x1200
Type of window	Fixed window
Fire rating	NA
Window Frame	Aluminium sections(Anodized)
Shutter Frame	Aluminium sections(Anodized)
Shutter	6mm thick clear toughened glass
Hardware	Hinges,Handle with lock



4.TOILET

Ventilator size	600x600
Type of Ventilator	Top hung
Fire rating	NA
Window Frame	Aluminium sections(Anodized)
Shutter Frame	Aluminium sections(Anodized)
Shutter	6mm thick clear toughened glass with frosted film
Hardware	Hinges,Handle with lock



SPECIFICATIONS FOR CABLE RACK

Cable rack shall be designed for a length of 16m. Width of the cable rack support shall be minimum 1000mm. The clear height from the road top shall be 8m from top of road.

Instrumentation cable load (including tray supports, tray load) shall be taken as 144kg/m.

Structural steel support for instrumentation: One vertical member with 3 tier cable tray arrangement is envisaged, with 2 meter span support.

Electrical cable load (including tray supports, tray load) shall be taken as 30kg/m.



6.0 MILESTONE ACHIEVEMENT TARGET

The Bidder shall complete all the documentation activities within specified period in the tender from the date of award of work.

MILESTONE	TIME PERIOD
Tender purpose drawings, Technical specifications and Cost Estimate	45 days from date of issue of LOI
Design calculations and Good for construction drawings as hardcopies and soft copy (including native files)	60 days from the date of final approval of Tender documents
As built drawings	15 days from the date of completion of the project.

Submission of Tender documents including the Tender purpose drawings, Technical specifications, schedule of items of work and Detailed estimate shall be submitted within **45 days** (including holidays) from the date of issue LOI. Comments/Clarification on the tender documents, if any, will be informed to the bidder. Revised tender documents shall be submitted within **7 days** of receipt of comments from PMC/Owner.

The Bidder shall start submitting such first set of design calculations and Drawings within **sixty days (2 MONTHS)** from the date of approval of the final tender documents. The Bidder shall forward to OWNER soft copy of design calculations and drawings preferably for the building/pipe rack at a time along with all the concerned scope drawings and load data sheets. After reviewing the above design calculations and Drawings, Owner will send comments to the Bidder within 15 days time from the date of receiving the above. The Bidder will send their designer, if required, to Owner's office for clarifications /modifications/ incorporations and to finalize designs/Drawings across the table. The bidder to resubmit the design calculations and drawings within 15 days of receipt of comments from Owner/PMC.

As built drawings shall be marked in hard/Pdf copy and send to Bidder by the site-in-charge at the completion of the project. The same shall be updated in the AutoCAD drawings and submitted to Owner/PMC within 15days of receiving of the drawings in Hard and Soft format as mentioned in the Tender document.

7.0 DISCUSSIONS

Bidder/Architects shall attend all discussions at FEDO, Head Office at Kochi. Charges for Presentation of preliminary designs to Owner at FEDO, Head Office and any further discussion as required shall also be included in the offer.

In case of an eventuality of discontinuing the project due to non-receipt of approval for construction of facilities from statutory authorities or change in the policy decisions of FACT or for any other reasons whatsoever, the payment to the Bidder will be restricted up to which the services has been performed by the Bidder, on mutually agreed basis.

8.0 DOCUMENT REVIEW/APPROVAL & PAYMENT FOR REVISIONS AND CORRECTIONS

The Bidder shall carry out the work and incorporate all corrections, revisions, additions, alterations, deletions, and substitutions as instructed by FEDO from time to time, and no extra payment shall be admissible for such changes up to a maximum of four (4) revisions. Any major change in building concept from PMC/Owner after initial approval of architectural and structural drawings, will be treated as change order on mutually agreed basis.

Document shall be reviewed and approved in five codes.

CODE 1	REJECTED	Document discarded being void/superseded
CODE 2	COMMENTS AS NOTED	Revise and Resubmit documents for review incorporating comments
CODE 3	MINOR COMMENTS	Work to proceed as per comments. Incorporate comments in Final/As built documents
CODE 4	NO COMMENTS	Document approved. Work to proceed.
CODE 5	INFORMATION ONLY	Document accepted for Information/Records only. Work may proceed.

All Architectural drawings and plumbing/Sanitary drawings shall be reviewed and accepted as FOR INFORMATION (CODE 5).

All structural drawings shall be reviewed by PMC/Owner and approved with NO COMMENTS (CODE 4) if found satisfactory, else shall be given as COMMENTS AS NOTED (CODE 2) or MINOR COMMENTS (CODE 3).

TECHNICAL PROCUREMENT SPECIFICATION	SCOPE AND SPECIFIC REQUIREMENTS OF WORK	32775-12-PS-001 SW R2
		PAGE 18 OF 19

All soft copies of approved drawings and analysis files (native files of CAD and analysis file in Staad/Etabs), will be given by the Bidder to FEDO after final approval is received from Owner/PMC. The approved design / drawings prepared by the Bidder for this job will become the property of FEDO and FEDO will be free to use the same at their own discretion.

10.0 GENERAL CONDITIONS

- 10.1 Bidders are advised to visit the site and get a clear idea of the work before quoting. The offers shall be, deemed to have been made with full knowledge of all features of the area as well as the procedures to be followed for executing the work.
- 10.2 Bidder should consider that the entire job has to be carried out in the operating plant and the required measures shall be considered in the schedule of items of work, so that the work is completed without disturbing the routine operations.

11.0 PAYMENT FOR SITE VISITS BY CONSULTANT



A "Visit / Personnel" shall mean a single and independent mobilization of the Consultant from its registered base location to the project site for a specific project phase or milestone, followed by demobilization. Any subsequent deployment shall be treated as a separate mobilization requiring independent travel.

A continuous stay at the project site for multiple consecutive days, up to a maximum of three (3) days, during a single mobilization shall be considered as one (1) Visit only, irrespective of the number of days within this period.

Any extension of stay beyond three (3) days during the same mobilization shall not automatically qualify as a separate Visit. Such extension shall be treated as an additional Visit only if expressly approved in advance in writing by the Owner.

The duration of stay for each Visit / Personnel, up to a maximum of three (3) days, shall be as determined by the Owner/Engineer-in-Charge based on project requirements. The Consultant shall plan and deploy its resources accordingly. No additional payment, compensation, or claims of any nature shall be admissible for any stay within this three (3) day period.

Each Visit / Personnel shall be undertaken strictly upon written instruction from the Owner/Engineer-in-Charge specifying the relevant phase or milestone. Any Visit undertaken without such written instruction shall not be eligible for payment.

TECHNICAL PROCUREMENT SPECIFICATION	SCOPE AND SPECIFIC REQUIREMENTS OF WORK	32775-12-PS-001 SW R2
		PAGE 19 OF 19

12.0 ELECTRICAL WORKS

Technical specifications of electrical works to be followed are given as a separate document as an “Design Philosophy-Electrical.”

13.0 MECHANICAL WORKS

Technical specifications of mechanical works to be followed are given as a separate document as an “Scope of work, specific requirements & deliverables-Mechanical items” and “Design Philosophy”.

13.0 TIME OF COMPLETION

The Bidder has to complete all the work as per the scope of work as mentioned in this document and instruction from FEDO.

The time of completion for the work shall be 10 months from the date of “work to proceed notice”.

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 1 OF 29

**DESIGN BASIS OF CIVIL & STRUCTURAL WORKS FOR CONSTRUCTION OF
DISTRIBUTED CONTROL SYSTEM(DCS) BUILDING FOR AMMONIA
HANDLING AT FACT UC**

0	21.01.2026	Original Issue	NKV	NJ	NJ
REV	DATE	REVISION DESCRIPTION	PRPD	CHKD	APPRD
FACT ENGINEERING AND DESIGN ORGANISATION					

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 2 OF 29

1.0 GENERAL

1.1 SCOPE

This document is intended to provide the minimum design criteria that shall form the basis for carrying out detailed structural design and engineering of all plant and non-plant structures, selection of materials, preparation of engineering specifications and drawings for all structures and foundations essential for the construction of new Distributed Control system (DCS) building and associated facilities in Ammonia Handling in FACT UC, Kochi.

1.2 DEFINITIONS

For the purpose of these documents, the following definitions shall hold:

Client : FACT – UC

PMC : FEDO

1.3 UNITS OF MEASUREMENTS

Units of measurement in design shall be MKS/SI system and shall be as follows:

Elevation : Meter (m)

Dimension : Millimeter (mm)

Force : Kilo Newton (KN)

Mass : Kilogram (Kg)

Moment : Kilo Newton meter (KN-m)

Stress : Newton/mm² or Mega Pascal (M Pa)

Pressure : Kilo Newton/m² (KN/m²) or Kilo Pascal (K Pa)

Loadings : Kilo Newton/m² (KN/m²)

1.4 REGULATORY REQUIREMENTS

The work covered in this document shall comply with all government and local laws, regulations and standards. For subjects not covered by regulations, codes and standards or specifications, the design shall be based on sound and economical engineering practice and shall be subject to by the client.

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 3 OF 29

1.5 CODES AND STANDARDS

The design shall be in accordance with the latest editions and revisions of established codes, sound and economical engineering practices and shall conform to the statutory regulations applicable in India.

The main codes, standards and statutory regulations considered as minimum requirements are as follows. **Latest revision of these shall be followed.**

National Building Code of India : 2005

IS: 875 (Part 1) – Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures (Part 1 – Dead Loads).

IS: 875 (Part 2) - Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures (Part 2 – Imposed Loads).

IS: 875 (Part 3) - Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures (Part 3 – Wind Loads).

IS: 1893 (Part 1):2016 –Criteria for Earthquake Resistant Design of Structures (Part 1– General Provisions and Building).

IS: 1893 (Part 4):2015 –Criteria for Earthquake Resistant Design of Structures (Part 4 – Industrial Structures including Stack-Like Structures).

1.5.1 STRUCTURAL STEEL

IS: 800 – Code of Practice for General Construction in Steel

IS: 802 – Code of Practice for use of structural steel in overhead transmission line towers.

IS: 1161 – Code of Practice for Circular hollow sections/pipes.

IS: 4923 – RHS & SHS sections.

IS: 2629 – Recommended practice for hot dipped galvanizing on iron and steel.

IS: 2633 – Methods for testing uniformity of coating of zinc coated articles.

IS: 6533 – Code of Practice for design and construction of steel chimney.

IS: 6745 – Method for Determination of mass of zinc coating.

IS: 814 – Covered Electrodes for manual metal arc welding of Carbon and carbon manganese steel.

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 4 OF 29

IS: 816 – Code of Practice for use of Metal arc welding for General Construction in mild steel.

SP-06 – (Part 1 to Part 7)- Handbook for Structural Engineers.

1.5.2 REINFORCED CONCRETE AND MASONRY WORK

IS: 456 – Plain and Reinforced Concrete – Code of Practice

SP:16 - Design Aids for Reinforced Concrete to IS: 456

SP:34 – Handbook of Concrete Reinforcement and Detailing.

SP:24 – Explanatory Handbook on Indian Standard Code of Practice for Plain and Reinforced

SP:20(S & T) – Explanatory Handbook on Masonry Design and Construction.

IS:2911 (Part 1 to Part 4) – Code of Practice for Design and Construction of Pile Foundation.

IS:2950 (Part 1) – Code of Practice for design and construction of Raft foundation

IS:2974 (Part 1 to Part 5) – Code of Practice for design and construction of Pile Foundations.

IS:3370 - Code of Practice for Concrete Structures for storage of liquids.

IS:4326 – Code of Practice for earthquake resistant design & construction of buildings

IS:13920 – Code of Practice for ductile detailing of reinforced concrete structures subjected to seismic forces.

IS:1172 - Code of basic requirements for water supply, drainage & sanitation IS:1742 - Code of practice for building drainage

IS:1905 - Code of practice for structural use of unreinforced masonry

IS:2212 - Code of practice for brick work

1.5.3 ROADS AND SANITARY WORKS

IS:2065 - Code of practice for water supply in buildings

IS: 8835 - Guidelines for design of surface drains.

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 5 OF 29

IRC:6 - Code of practice for road bridges, Section-II Loads and stresses

IRC:19 - Standard Specifications And Code of Practice for Water Bound Macadam

IRC:37 - Design of flexible pavements

IRC:58 - Design of rigid pavements

Note: The above list is suggestive and not exhaustive. Apart from these basic Codes any other related codes shall be followed wherever required.

1.6 SOIL DATA & UNDER GROUND WATER TABLE

The Soil Investigation report which shall be considered for the design of foundations for the building and piperack is enclosed as Annexure A.

2.0 MATERIALS OF CONSTRUCTION

2.1 CONCRETE

2.1.1. STRUCTURAL CONCRETE

All cast-in-situ structural concrete shall be Reinforced Concrete conforming to IS:456 and shall be of minimum grade M35 for all Sub-structures and M30 for all Super-structures. Characteristic strength of Concrete shall be 35 N/mm² and 30 N/mm² respectively at 28 days. Pre-cast concrete shall be of minimum grade M30. Minimum cement content shall be as per severe exposure conditions. Minimum grade for general RCC works like cable trenches & drains shall be M30 or higher

2.1.2. FOUNDATIONS LEAN CONCRETE

80 mm thickness of Lean concrete mix 1:4:8 (by weight, using 40mm and down size grade crushed stone aggregate) shall be provided under all RCC foundations. Levelling course below liquid retaining structures shall be of CC 1:3:6 mix

Lean concrete of grade 1:5:10 shall be used as filler material wherever loose sub-grade exists by removing the loose soil/fill. Any specific requirement regarding grade and thickness of PCC to be provided shall be incorporated in the drawing.

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 6 OF 29

2.1.3. GROUTING AND MINIMUM GROUT THICKNESS

Grout shall be used under all base plates of equipment and structures, where a uniform bearing surface is required for the transfer of loads into the foundation. Grout thickness if not provided in vendor or equipment drawing shall be taken as per following table:

SI No.	Used Below	Thickness	Grout
1	Structural bases	a. 25mm normally	Non Shrink cement Grout (CONBEXTRA GP2 or Eqvt.)
		b. 50mm for pedestal least side 800mm	
2	Static Equipments	25 mm least side < 600mm or as per vendor's requirements	Non Shrink cement Grout (CONBEXTRA GP3 or Eqvt.)
3	Heavy Vibratory Equipment (Compressors)	50 mm or Vendor's Requirements	Non-Shrink cement Grout (CONBEXTRA GP3 or Eqvt.) or Epoxy Grout or as specified by manufacturer.
4	Reactor, Process Columns	50 mm or Vendor Requirement	Non-Shrink cement Grout (CONBEXTRA GP3 or Eqvt.) / Epoxy Grout. (Epoxy grout shall be used for cases where pulsating/ vibratory loads are predominant.)

2.1.4. CONCRETE COVER

Minimum clear cover to main reinforcement for different members shall be as under unless otherwise stated.

SL.NO	MEMBER/STRUCTURE	CLEAR COVER
a.	Slab (roof slab, floor slab etc.), canopy and staircase waist slab	25 mm or Dia whichever is greater
b.	Grade Slab Singly Reinforced / Doubly Reinforced	25mm (Top Cover) 50mm (Bottom cover)
c.	Beams (roof & floor beam etc.) and lintels	40mm or Dia whichever is greater of bar
d.	Columns and pedestals	50mm

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 7 OF 29

e.	Basement walls, retaining walls & pit walls Outside face in contact with earth Inside face	50 mm or Dia of bar whichever is greater
f.	Water /liquid retaining structure Wall face in contact with water/liquid Wall face away from water/liquid Wall face in contact with earth	50mm or Dia of bar whichever is Greater
g.	Foundation slab/plinth beams base slabs	75 mm
h.	Pile	75mm (Sides) 100mm (Bottom)
i.	Pile cap	75 mm (Bottom), 75 mm (Sides)

2.1.5. MINIMUM HEIGHT OF PLINTH /PEDESTAL

The minimum height of plinth/pedestal above finished grade or floor level shall be as follows.

- | | | |
|----|--|-------------------------------------|
| 1. | Building plinth | As per final architectural drawings |
| 2. | Pedestal / encasements of structural columns | |
| | Open area | 300mm |
| | Covered area | 150mm |
| 3. | Pedestal for all equipments | |
| | Open area | as required but not less than 300mm |
| | Covered area | as required but not less than 150mm |
| 4. | Stair pedestal | 150mm |
| 5. | Ladder pedestal | 150mm |

2.1.6 EXPANSION JOINTS

Joints in the super-structure shall be provided by means of gap between two consecutive structural members. The gap shall be based on the design requirements.

Expansion joints shall be provided as necessary and shall be made as shown on the construction drawings. Expansion joints in concrete structures shall be provided as per IS 456/ IS 3414 Code provisions.

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 8 OF 29

Bitumen impregnated fibre boards of approved manufacture as per IS 1838 Part 1 shall be used as fillers for expansion joints. The gap between the expansion joints shall be thoroughly cleaned and the bitumen fibre boards placed in position as per manufacturer's specification and the surface shall be sealed with elastomeric silicone rubber sealants.

All expansion/ separation joints in ground floor slabs shall be filled with sand for the full depth of the slab except top 25 mm, which shall be filled with approved mastic sealing compound.

Joints around equipment shall be confined to items likely to transmit vibration, e.g. Compressors, fans, large pumps. Water stops in joints shall be shown on the construction drawings.

2.2 REINFORCEMENT RODS

The reinforcement rods for concrete in piles, Main bars in foundations, pile cap, columns, walls, footings, slabs, all Lateral ties, stirrups, Reinforcement for floors/yard paving etc shall be as High strength deformed TMT bars conforming to IS1786 and of grade Fe 500/Fe 550 having elongation more than 14.5%.

2.2.1. SPACING OF BARS

The free distance between individual bars shall not be less than:

- 1.3 times the maximum size of the coarse aggregate.
- Diameter of the larger bar or the diameter of the immersion vibrator.
- 50 mm for bars in walls.

The center-to-center distance of individual bars shall not be more than:

150 mm	For main bars in beams where bending moments are maximum.
250 mm	For main bars in slabs where bending moments are maximum.
	For bars perpendicular to main bars in slab.
	For bars perpendicular to main bars in slab.
	For distribution in bars in slabs.

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 9 OF 29

	For bars in walls.
	For mild steel stirrups in beams.
300 mm	For longitudinal bars in columns.
	For horizontal side bars in beams.
	For high yield stirrups in beams.
400 mm	For any other bars not mentioned above, provided the cross bars are spaced not more than 250 mm.

2.2.2 MINIMUM THICKNESS OF STRUCTURAL CONCRETE ELEMENTS

The following minimum thickness shall be followed:

i)	Footings (All types, with or without beams) (Note : Tapered footings shall not have thickness less than 150mm at the edges, minimum average thickness shall not be less than 300 mm)	300mm
ii)	Pile Cap	500mm
iii)	Basement/cellar area	
a)	walls	150mm
b)	Base Slab with beams	200mm
c)	Base Slab without beams	300mm
iv)	Slab thickness in raft foundations with beam & slab construction	150mm
v)	Floor/Roof Slab, Walkway and Canopy Slab	120mm
vi)	Cable/ Pipe Trench / Launder Walls & base Slab	125mm
vii)	Parapet	100mm
viii)	Louvre / Fin.	100mm
ix)	Precast Trench cover slab	80mm
x)	Precast Trench Cover /Floor Slab in contact with liquid	125mm
xi)	Louvre (in contact with liquid)	125mm
xii)	Liquid Retaining / Leak proof Structure	

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 10 OF 29

a)	Walls	150mm
b)	Base Slab with beams	200mm
c)	Base Slab without beams	300mm
xiii)	Underground Pit	
a)	Walls	150mm
b)	Base Slab with beams	200mm
c)	Base Slab without beams	300mm
xiv)	Minimum dimension of beam	200mm
xv)	Minimum dimension of column	300mm
xvi)	Minimum dimension of grade slab	150mm

2.3 STRUCTURAL STEEL

All steel bars, sections, plates and other miscellaneous steel materials, etc. shall be free from loose mill scales, rust as well as oil, mud, paint or other coatings. The materials, construction specifications such as dimensions, shape, weight, tolerances, testing etc., for all materials covered under this section, shall conform to respective codes.

The design of all structural steel work such as Roof trusses, Steel sheds, pipe racks, pipe bridges, tank supporting platforms, stairs, ladders, walkways, crane girders steel enclosures etc. will be carried out in accordance with Limit State method of IS:800-2007.

Design, fabrication and erection of all above work shall be carried out in accordance with the following IS Codes as applicable to the specific structures, viz. IS:800, IS:814, IS:875, IS:1893 etc., Basic consideration of structural framework shall primarily be stability, ease of fabrication / erection and overall economy satisfying relevant Indian Standard codes of Practice. Simple and fully rigid design as per IS:800 shall be used. Where fully rigid joints are adopted they shall generally be confined to the major axis of the column member.

2.3.1 STEEL GRADE

Structural steel shall be of yield stress of 250 MPa conforming to Grade A of IS: 2062. Tubular steel shall conform to YST 240 of IS: 1161.

Miscellaneous steel materials shall conform to the following Codes:

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 11 OF 29

Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement (grade i)) For mild steel bars of anchor bolts, Rungs, metal inserts, grating etc.)	IS:432
Hexagonal head bolts, screws and nuts of product Grade C.	IS:1363
Plain washers	IS:2016
Steel Chequered plates.	IS:3502
Hexagonal Bolts and nuts(M42 to M150)	IS:3138

2.3.2 MINIMUM THICKNESS OF STEEL

Trusses, Purlins, side girts & bracings	6mm
Columns & beams(Rolled section)	6mm
For gussets, stiffeners, plate guides, etc.	8mm
For base plates	10mm
Chequered plates	6mm (on Plain)
Grating	5mm

However the minimum thickness of structural components (except gratings & chequered plates) which are directly exposed to weather and inaccessible for repainting shall be 8mm.

The minimum thickness of tubes shall be as specified in IS 1161 for medium class tubes.

The min. thickness for rolled beams and channels shall be mean flange thickness regardless of web thickness.

2.3.3 SLENDERNESS

Maximum Values of Effective Slenderness Ratios

Sl.no	Member	Maximum Effective Slenderness Ratio (KL/r)
-------	--------	--

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 12 OF 29

i)	A member carrying compressive loads resulting from dead loads and imposed loads	180
ii)	A tension member in which a reversal of direct stress occurs due to loads other than wind or seismic forces	180
iii)	A member subjected to compression forces resulting only from combination with wind/ earthquake actions, provided the deformation of such member does not adversely affect the stress in any part of the structure	250
iv)	Compression flange of a beam against lateral torsional buckling	300
v)	A member normally acting in a tie in a roof truss or a bracing system not considered effective when subject to possible reversal of stress into compression resulting from the action of wind or earthquake forces	350
vi)	Members always under tension ¹⁾ (other than pre-tensioned members)	400

¹⁾Tension members, such as bracing's, pre-tensioned to avoid sag, need not satisfy the maximum slenderness ratio limits.

Where 'KL' is the effective length of the member and 'r' is appropriate radius of gyration based on the effective section

2.3.4 PERMISSIBLE DEFLECTION

The permissible vertical and lateral deflection for structural steel members shall be as specified in IS 800:2007.

2.3.5 CONNECTIONS

As far as possible, the connections shall be welded. Field connections shall be made with black bolts for ladders, hand rails posts, stair stringers, removable members and floor plates, platform forming members 200mm and under in size, purlins, girts and minor cable support members that require not more than three bolts per connection. The minimum size of bolts shall be 16mm unless limited by the size of the connected parts. Any connection shall have at least two bolts.

2.3.6 PAINTING OF STRUCTURAL STEEL

Painting coats shall be applied as follows:

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 13 OF 29

Primer	Epoxy Zinc Phosphate Whitish Grey color, Matt finish	40 – 60µm
1 st Intermediate coat	Micaceous Iron Oxide epoxy paint, Brown color, Matt finish	70 – 110 µm
2 nd Intermediate coat	Two pack poly amide cured high build epoxy finish paint, white color, Matt/semi glossy finish	40 – 50µm
Topcoat	Aliphatic acrylic polyurethane finish paint, Light blue / green / whitish color, Glossy finish	30-40 µm
Total dry film thickness (DFT)		180 –260µm

a) Painting Material

Only the paints/primers approved by Engineer in-charge are to be used. Thinner used for the painting work shall conform to the brand specified by the manufacturer in the product literature. Primer and paint for a particular system must be purchased from same manufacturer for compatibility accompanied by manufacturers test certificate. Recommendation of the paint manufacturer regarding mixing, maturing, application (except as indicated specially in this specification) must be followed meticulously. Technical representative of the paint manufacturer at site must be made available as and when requested by owner / PMC for their expert advice as well as to ensure that painting work is executed as per instruction of manufacturer. All paint material must be accompanied by manufacturer certificate. However, if Owner / PMC has any doubt regarding quality of material, then contactor shall be required to get doubtful material tested by approved testing agencies at their own cost. All paints and primers must be supplied to site in original containers with factory seal and should be consumed before expiry date.

b) Surface Preparation

Surface preparation for all items to be painted shall be done by shot blasting to Sa 2.5 as per IS 9954. (Mill scale, rust & foreign matter shall be removed to the extent that only traces remaining are slight stains in the form of spots or strip) and identified as per Swedish Specification SIS 05-59-00. Air used for shot blasting must be dry and oil free. Pressure at blasting gun should be maintained at around 7 kg/cm² and maximum

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 14 OF 29

height of profile should be kept around 50 microns. Shot blasted surfaces must be coated with primer within 2 hours in dry climate. Moreover, it is not advisable to carry out shot blasting when humidity exceeds 50% RH.

c) Primer application

All the surfaces must be shot blasted, and one coat of primer and first intermediate coat are to be applied in the fabrication shop/at project site, before erection at heights.

d) Washing

After erection is over all the surfaces must be washed as indicated below:

- i) Wash with clean water (pressure approximately 7 kg/cm²) using suitable nozzles. During washing, broom corn brushes to be used to remove foreign matter, if any.
- ii) Solvent washing if felt necessary to remove traces of oil, grease etc.
- iii) After washing surfaces as indicated above, shall be suitably touched up to the extent required, so that all the damages to the primed surfaces caused during erection are taken care off.

e) Miscellaneous

Surfaces affected by welding and/or gas cutting or handling during erection shall also be suitably touched up after preparing damaged surfaces by mechanical means such as grinding, power brushing etc. to achieve surface finish to ST-3.

Number of coat and DFT per coat must be strictly followed as indicated in the specification above and if the desired DFT is not achieved in the specified number of coats, Bidder shall be required to apply extra coat(s) to achieve desired DFT without any additional cost to owner. DFT for painting shall be measured at least 20 points and mean DFT shall not vary by more than 10% of the specified DFT. Reliable and calibrated instrument for measurement of DFT shall be arranged and provided by Bidder at his cost at site.

2.3.7 HOLDING DOWN BOLT

All holding down bolts or threaded rods for non-post tensioned applications shall be out of Mild Carbon steel conforming to IS: 2062 with Fy = 250 MPa Unless Noted Otherwise. For scrubbing and acid storage section, holding down bolts should conform to SS 316.

BOLT PROJECTIONS

The threaded bolt projection above the top of structural concrete shall be calculated as follows:

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 15 OF 29

Projection P = Thickness of grout + Thickness of base plate + Threads (n) – 15 mm Or for projection length refer design drawing.

MINIMUM EDGE DISTANCE

Clear distance between a Standard Mild Steel Holding down Bolt or Anchor Sleeve and the face of Foundation shall be as per IS 800.

2.3.8 OTHER INSERTED AND EMBEDDED ITEMS

Unless otherwise specified, all structural steel shall be weldable structural steel “Standard Quality” (Fe 410 WA), in accordance with code IS: 2062.

All embedded steel items (exposed to atmosphere) shall be hot-dip galvanized in accordance with IS: 2629, except if noted otherwise on the design drawings.

All inserted and embedded items shall be accurately placed or template in and be securely anchored prior to placing concrete.

At sliding ends of vessels and horizontal exchangers, sets of plain steel plates shall be provided. In order to reduce the horizontal force due to friction at sliding ends sets to PTFE bonded steel plates may be provided.

2.3.9 STEEL LADDER

Minimum width of steel ladder shall be 60 cm. Maximum spacing of rungs for steel ladder shall be 200 mm. Where the height of the steel ladder exceeds 2.4m, cages shall be provided. All rails on which a travelling crane moves shall be of proper size and adequate strength. The rail shall have an even running surface. Each such rail or track shall be properly laid and adequately supported.

3.0 DESIGN LOADS

3.1 DEAD LOAD (DL)

Dead load is the vertical load due to actual weight of all permanent structural and non-structural components of building such as floors, roofs, walls, staircases, fixtures etc.

Dead loads shall be estimated for purposes of design using the actual weights of material of construction and finishes on the basis of unit weights given in IS 875- Part 1

The following densities shall be considered for computation of dead loads

Density of reinforced cement concrete	2500 kg/cum
---------------------------------------	-------------

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 16 OF 29

Density of plain concrete	2400kg/cum
Density of structural steel	7850kg/cum
Density of soil	1800 kg/cum

3.1.1 BUILDINGS

The following dead loads shall be included in the design of buildings:-

- Self-weight of structural elements.
- Framing, walls, floors, roofs, suspended ceilings, finishes, permanent partitions and stairs.
- Equipment, fixed services, machinery, lifts, runway beams, electrical feeders, heating/ventilating/air conditioning, etc. wherever their loads are transmitted to structural elements. Equipment loads shall be taken from Manufacturer's Data.
- Fireproofing on structural steelwork.
- Any other permanent load if applicable.
- Self-weight of structural elements.
- Equipment, machinery, lifts and runway beams.

3.1.2 PIPE/CABLE RACKS

- Self weight of structural elements.

The following dead loads shall be included for the design of Pipe/cable racks:-

- A uniformly distributed dead load of 1.0 KN/m² for a single level of cable trays and 1.9 KN/m² for a double layer of cable trays.
- Any other permanent load if applicable.

3.1.3 EQUIPMENT FOUNDATIONS

- Self weight of Equipment.
- Self weight of other structural elements.
- Equipment valves and piping.
- Fireproofing on vessel skirts and equipment.
- Vessels including all internals, refractory linings, platforming and ladders.
- Insulation installed on piping and equipment.
- Any other permanent load if applicable.

3.2 IMPOSED LOADS (IL)

3.2.1 BUILDINGS

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 17 OF 29

Live Loads

For the design of each structural element the imposed loads shall be applied in the least favorable pattern.

Imposed loads on floors shall be the actual loads when these are known, but shall not be less than the distributed loads given below:-

• Console room/Rack room	5.00 kN/m ²
• Clean agent room/fire fighting room	3.00 kN/m ²
• AHU room	Load as per actuals
• Battery rooms/UPS room	10.00 kN/m ²
• Offices, residential and domestic buildings	Refer to IS 875
• Pedestrian areas, balconies, fire escape, etc. and areas accessible to normal vehicular traffic	Refer to IS 875
• Sheeted roofs with access for maintenance only	0.75 kN/m ²
• Concrete roofs with access for maintenance only	1.50 kN/m ²
• Roofs used for access to equipment	2.50 kN/m ²

Roofs carrying equipment shall, in addition to the above, be designed for the load imposed by the equipment supported.

All roof members shall be checked for a single concentrated load of 2 kN in the least favorable location and in addition to the distributed loads specified above.

The loads due to rain on roof should be considered as per Clause 4.3 and Table 2 of IS 875: Part 2.

Equipment Loads (Contents)

The Contents of equipment shall be considered as live load and shall be applied in the least favourable pattern. Ensure the correct specific gravity is applied when calculating the load.

Handling Loads

Consideration should be given to loadings occurring during installation, operation and possible removal and replacement of any equipment contained within the buildings. The

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 18 OF 29

actual loads shall be checked against the above loading, with due account being taken of material handling methods such as for fork lift trucks, which impose high concentrated loads.

Live Load Reduction on Columns

For Building, the reductions given in the following Table 1 (based on the number of floors qualifying for load reduction carried by the member under consideration) may be applied to the uniformly distributed imposed floor load in the design of columns, their supports and foundations.

Number of floors with loads qualifying for reduction carried by member under consideration	Reduction in total distributed Imposed Load on all Floors to be Carried by the member under consideration (Percent)
1	0
2	10
3	20
4	30
5 to 10	40
Over 10	50 Max

Table 1: Live Load Reduction on Columns.

Reduction of live load on beams shall be taken as per Clause 3.2.2 of IS 875: Part 2.

The moments on a column should be determined from the load used to design the beams at the appropriate level and not reduced on the same basis as the axial load.

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 19 OF 29

Stairs and landings	5.0 kN/m ² or 4.5 kN single point load
Hand railing systems	0.36 kN/m run
<u>Equipment Loads (Contents)</u>	
The Contents of equipment shall be considered as live load and shall be applied in the least favorable pattern. Ensure the correct specific gravity is applied when calculating the load.	
<u>Handling Facilities</u>	
Permanent handling facilities shall be designed for the following loads:-	
- Trolley beams and their supports shall be designed to IS 800/ IS 807/ IS 3177 with an allowance of 25 % of the total load for vertical impact. Where the hoist is to be operated with a grade mounted winch, a line pull of not less than 25 % of the lifted load shall be included. i.e. Design Load = 1.25 (W + 0.25 W + weight of trolley). This line pull allowance assumes the pulley system has a mechanical advantage of 4. - Crane beams and supports for travelling cranes shall be designed in accordance with IS 800/ IS 807/ IS 3177.	
<u>Miscellaneous Loads</u>	
Consideration shall be given to loads of a special nature such as thrusts from expansion joints, expansion loads from horizontal vessels and exchangers, purpose made handling equipment such as counterbalanced crane hooks, and thermal expansion of the structure.	
3.2.2 PIPE/CABLE RACKS	
<u>Live Loads</u>	
To be applied if permanent access (walkways) is provided.	
Access for maintenance only	1.0 kN/m ²
Access to Equipment	2.5 kN/m ²

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 20 OF 29

3.2.3 EQUIPMENT FOUNDATIONS

Live Loads

The contents of equipment shall be considered as live load and shall be applied in the least favorable pattern.

In the absence of any suitable provision for live loads in this specification or relevant IS codes for any particular type of floor or structure, the assumed loading shall be got approved . Apart from the specified live loads, any other equipment load or possible overloading during maintenance/ erection shall also be considered in the design.

3.3 WIND LOADS (WL)

Where the references listed above do not cater for the wind loading on a structure due to dynamic effects such as gusting, vortex shedding, flutter and galloping then the load shall be determined in accordance with the latest technical literature and practice. If a specialist supplier or consultant is employed for the design of such a wind sensitive structure, then the wind loading design criteria shall be reviewed by Owner and approved prior to the commencement of design.

Design Wind loadings for buildings

Design wind loading shall be in accordance with IS 875:Part 3-“Code of practice for design loads for buildings and structures-Wind loads” and as per clause given below.

Design Wind loadings for Pipe/cable racks and Equipments

Design wind loading for pipe/cable racks and equipment shall be established from IS 875: Part 3 with the following minimum requirements:

Basic wind speed shall be 39 m/sec for a 50 year return period for structural and equipment design.

Wind load design should be done as per IS: 875 (Part 3) -2015

Design wind pressure,

$P_d = K_d \times K_a \times K_c \times p_z$ N/m² Ref Clause 7.2 of IS: 875 Part-3

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 21 OF 29

Where wind pressure $p_z = 0.6V_z^2$

Design wind speed, $V_z = V_b \times k_1 \times k_2 \times k_3 \times k_4$ Ref IS: 875 Clause 6.3

Basic wind speed, $V_b = 39$ m/s

Probability factor, $k_1 = 1.0$ Risk coefficient

Terrain height and k_2 Ref. Table 2 of IS: 875 Part-3, based structure size factor on terrain category 3

Topography factor $k_3 = 1.0$

Cyclonic factor $k_4 = 1.0$

The values of P_d , however shall not be taken as less than $0.70 P_z$

Wind pressure and forces shall be calculated as per latest IS 1875(Part 3)

The effective exposed area of open framed structures which support cables and equipment shall be estimated as a percentage of the gross projected area.

Vessels or other large equipment supported on a structure shall be calculated separately and be additive in computing the total wind load .

The design wind loading shall be assumed to act in any direction. Reduction shall not be made for the shielding effect of adjacent structures or equipment except:

In case of open structures with two or more parallel frames where the windward frame has a shielding effect on the frames to leeward , a shielding factor shall be applied in accordance with Clause 7.4.3.4 and Table 32 of IS 875: Part 3.

The shielding effect shall also be considered when assessing wind load on series of cables in one plane.

In case of vessels and stacks where leeward items are shielded for some wind directions.

Dynamic Effects

Structures such as tall towers, may be sensitive to wind gust effects and/or vibrations due to vortex shedding. In general, the following guidelines may be used for examining the problems of wind induced oscillations:

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 22 OF 29

Building and closed structures with a height to minimum lateral dimension ratio of more than about 5.0, or

Buildings and structures whose natural frequency in the first mode is less than 1.0 Hz.

Any building or structure which satisfies either of the above two criteria shall be examined for dynamic effects of wind.

If vortex shedding analysis results indicate that unacceptable levels of vibrations can occur, then helical strakes, dynamic vibration absorbers or other means shall be adopted provided prior approval is obtained from Owner.

All calculations for gust or vibration analysis on purchased equipment shall be submitted to Owner for review prior to release for fabrication.

3.4 EARTH QUAKE LOADS (EL)

The plant structures must be designed for design basis earthquake (DBE) as per clause no. 7.0 and the design spectra given in IS: 1893 (Part-IV), Annex B for Type-2 medium soil.

The design value of horizontal seismic coefficient A_h shall be computed by the following expression:

$$A_h = \frac{Z I S_a}{2 R g}$$

Following data are to be considered:

Seismic load on the structures shall be calculated as per IS 1893 by taking Zone factor Z corresponding to Zone III.

Response reduction factor “ R ” shall be taken as per Table 4

Damping (for DBE) 5% (for concrete) 2% (for steel)

Importance factor I :

Should be considered as per Table-3, IS-1893, Part-4 based on the category of structure defined in Table-6 of IS-1893: pt-4).

Equipment support structures/ cable racks/ sub-station buildings / control building - Category-2, so Importance factor $I = 1.5$

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 23 OF 29

Sa/g is the average Response acceleration coefficient to be taken from Annex B corresponding to the natural period of the structure.

Ductile detailing of reinforcement is mandatory for moment resisting RCC frames and hence response reduction factors corresponding to special moment-resisting frame shall be considered.

3.5 LOAD COMBINATIONS

All buildings, structures and foundations shall be investigated for each of the loading combinations given in latest revisions of IS codes and the most severe shall determine the final design.

4.0 ANALYSIS OF RCC STRUCTURES

Buildings shall be of RCC framed construction. Frame analysis shall be carried out for all structures for all load combinations using structural analysis and design software as mentioned in this tender document. Rigidity at Column Beam joints shall be considered in the analysis.

Ductile detailing of RCC frames shall be done as stipulated in IS 13920 for RCC structures in Zone 3.

5.0 STRUCTURAL DESIGN OF RCC ELEMENTS

Limit state design shall be adopted for design of all structural elements.

The values of partial safety factors shall be considered as specified by IS 456 for different load combinations

DL + IL	1.5 DL	1.5 LL	
DL + WL	1.5 DL	1.5 WL	
DL + WL	0.9DL	1.5 WL	
DL + IL + WL	1.2 DL	1.2 IL	1.2 WL

Where DL = Dead Load, IL = Live load, WL = Wind load

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 24 OF 29

While considering earthquake effects, EL shall be substituted in place of WL and appropriate portion of IL shall be considered as stipulated by IS 1893.

5.1 SLABS

Two way slabs shall be designed based on the Bending moment coefficients given in annexure D of IS 456. For continuous one way slabs moment coefficients given in Table 12 of IS 456 shall be used. Deflection check of the slabs as envisaged in IS 456 shall also be done .

5.2 BEAMS

Reinforcement steel shall be provided for the required moment of resistance obtained from the analysis of frames. Shear stirrups shall be provided to withstand balance shear after deducting the shear capacity of concrete section based on the percentage steel provided to resist Bending Moment. Spacing of stirrups shall be detailed in accordance with IS 13920.

5.3 COLUMNS

Columns shall be designed for the combined effect of axial loads and biaxial moments due to frame action obtained from the analysis for the worst load combination and the detailed design output specifying the percentage steel to be provided and the interaction ratios shall be furnished.

5.4 FOUNDATIONS

The soil investigation report furnished by Owner shall be considered for design of foundations. All foundations shall be designed to suit the existing soil conditions . The sizing of foundations & design shall be done as per recommendations given in the soil investigation report. The bearing capacity / safe pile capacity shall satisfy strength as well as settlement criteria. The permissible increase in bearing capacity/ pile capacity in wind and seismic load combinations shall be as per IS 875 - part5 and IS 1893 respectively.

While designing foundations at various levels, effect of uplift/ subsoil water table shall also be considered.

All underground pits, sumps, etc. shall be designed to take care of the uplift forces due to buoyancy, if required.

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 25 OF 29

The foundations for machinery and allied equipment shall be designed as recommended by equipment suppliers. Provision for isolation pads, vibration dampeners, bearing pads, springs etc, shall be provided as per equipment manufacturers drawing. The minimum cover of 75mm shall be provided for foundations pockets to the edge of foundations.

If the sub soil is of aggressive nature, suitable precautions are to be taken as recommended in the soil investigation report in respect of type of cement, concrete cover etc. for foundations / underground structures.

5.5 REINFORCEMENT DETAILING

1. All requirements governing quantum of reinforcement and detailing of reinforcement as per clause 26 of IS 456 and as detailed in SP 34 for detailing of reinforcement shall be adhered to while preparing the construction drawings.
2. The recommendations for detailing for earthquake resistant construction given in IS 13920 shall also be followed.

6.0 LIQUID RETAINING STRUCTURES

1. M30 grade concrete shall be used.
2. The provisions regarding expansion joints, contraction joints, construction joints, bitumen sliding layer above levelling course, etc. shall be provided as recommended in the standards.
3. Hydro swelling gasket kept in place by a single component hydro swelling polyurethane sealant for sealing or other approved treatment shall be provided at construction joints in concrete both at vertical and horizontal construction joints of water retaining structures to make it leak proof.
4. For underground storage tanks, pits, trenches etc. where protection against uplift due to buoyancy from subsoil water is to be considered, a min. factor of safety of 1.2 shall be ensured. For the purpose of calculating downward load due to overburden, only the mass located vertically over the projected area of the base shall be taken into account.
5. All liquid retaining/ storage structures shall be designed assuming liquid up to the full height of wall irrespective of provision of any overflow arrangement.
6. The walls and base slab of liquid retaining/ storage structure shall be provided with reinforcement on both faces irrespective of any thickness.
7. All embedded parts such as nozzles, pipes, bolts, etc. shall be provided at the time of concreting.

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 26 OF 29

8. Plastering with cement mortar 1:4, 10 mm thick, mixed with integral waterproofing compound like Conplast X4211C of M/s. FOSROC or equivalent shall be provided for inside surface after hydro test.

9. All leaks or wetting noticed during hydro tests shall be rectified as per approved methods, using approved materials.

7.0 BUILDING & STORMWATER DRAINAGE

The rain water collected from the roof shall be connected to the storm water drainage system. Sufficient number of down water pipes shall be provided to drain out the water from the roof depending upon the roof area and intensity of rain fall. The minimum diameter of down water pipes shall be 100mm and shall be of PVC.

Drains shall be laid under the building only in unavoidable circumstances. Where it is necessary to lay drain under a building, following conditions shall be satisfied:

- ✓ Pipe shall be of cast iron
- ✓ The drain shall be laid in a straight line at a uniform gradient.
- ✓ Means of access in the form of materials shall be provided at each and immediately outside the building.

All drain pipes shall be designed to discharge three times of the dry weather flow flowing half full with a minimum self-cleaning velocity of 0.75 m/second. Rainwater falling on such portion of paved areas shall be collected in open rectangular RCC drains provided at ground. These drains shall be covered by gratings and shall be generally connected to peripheral storm water drains. Drains shall be designed for the maximum of rainwater / firewater on same principles as storm water drains. Storm water drains shall be RCC drains of mix M30, with a minimum self-cleaning velocity of 0.6 m/second and minimum slope of 1 in 600. Effluent drains(contaminated flow) shall be suitably lined with acid proof tiles based on process requirement. The minimum slope of drains shall be 1/300.

Velocity shall be calculated by Manning's formula with $n=0.015$. RCC precast cover slabs with adequate thickness and reinforcement shall be provided at road crossing, for effluent RCC drains and at places specified to suit project requirement. Reinforced cement concrete or cast iron pipe of suitable diameter with sufficient earth cushion can also be provided depending on the conditions outside the building.

8.0 CABLE TRENCHES

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 27 OF 29

Cable trenches shall be provided inside the plant building and outside the plant buildings to suit the Electrical requirements. Minimum internal depth and width of the cable trench shall be 1000mm X 600mm respectively. The cable trenches shall be RCC of mix M30 depending on the size of cable trenches and space availability. For fixing cable racks in cable trenches minimum 150 x 150 x 8 mm thick MS insert plate shall be provided in the side wall of RCC trench. Precast RCC cover slabs of suitable size and thickness shall be provided as specified with proper lifting arrangements at top. In paved areas, the top will be flush with finished floor level. Covers shall overlap walls and joints with paving shall be sealed to prevent water entry. In unpaved areas, walls shall be raised above ground level by 150 mm. A bed slope of 1/400 provided for RCC cable trenches.

9.0 DESIGN CALCULATIONS

The Bidder shall prepare the design calculations based on the standard accepted practice and guidelines from Owner/PMC.

All design calculations shall be written or typed systematically in MS Excel, legibly and submitted for approval as per standard accepted practice.

Structural analysis shall be carried out using the latest version of STAAD.Pro and/or ETABS software. For structural design purposes, RCDC and STAAD Foundation software may be used. Any other software proposed for analysis or design shall be intimated to the Owner/PMC at the bidding stage, and prior approval for the same shall be obtained by the bidder.

For other miscellaneous works Excel and Word shall be used. Design calculations shall be done on A4 size sheet only.

10.0 DRAWINGS

The Bidder shall prepare

-Architectural drawings, Civil & structural design & construction drawings based on the standard accepted practice and guidelines from OWNER.

- Bar bending schedules.

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 28 OF 29

-Fabrication drawings.

-As-built drawings

Detailing / drafting shall be done on latest version of AUTOCAD only. Drawing size used shall be preferably of A1 size only.

All Drawings shall be in metric units showing dimensions in millimeters and elevations/ levels in metres. Drawings shall indicate quantities of concrete grade wise and or nominal mix wise, reinforcement bars diameter wise and structural steel section wise and or thickness wise as detailed therein.

The Bidder shall submit soft copy of the supporting design calculations along with explanatory notes/ sketches, computer inputs & outputs and Drawings (complete in all respects) to Owner for review and checking purposes. All the above design Calculations and Drawings submitted by the Bidder shall be completed in all respects and thoroughly checked, Approved, stamped as "Approved for Construction" and signed by the Bidder's authorised representative before submission to the Owner/ PMC. Incomplete, unchecked and unsigned Drawings and design calculations shall not be accepted for review/ checking and will be returned forthwith.

The design calculations and Drawings prepared for this works shall have to be got checked and Approved by the Owner/PMC as per mutually agreed time schedule. Correctness / soundness of the designs/ Drawings shall be the sole responsibility of the Bidder irrespective of the fact whether the same has been Approved by Owner or not.

If at a later stage, the Bidder feels the necessity for any addition or alteration, prior approval of Owner must be taken for effecting the changes. The Bidder shall also be bound to incorporate any addition and alteration which Owner may suggest at a later stage.

At any stage of work Owner may review and offer comments / suggestions on the layout, structural schemes, designs and/or Drawings prepared by the Bidder and the latter shall adhere to such comments/ suggestions and revise his designs/ Drawings accordingly without any extra cost to the Owner.

The Bidder shall furnish to Owner eight prints each of the following finally Approved Drawings which must be included but not limited to the same to carry out construction work at site. A copy of detailed estimate and native files of CAD and analysis files(Etabs/Staad) shall be handed over to Owner for his records/reference along with the hard copies.

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN BASIS-CIVIL & STRUCTURAL WORKS	32775-12-PS-001 DB R0
		PAGE 29 OF 29

ANNEXURE A **SOIL INVESTIGATION REPORT**



GEOTECHNICAL INVESTIGATION REPORT

REF NO: -GEO-49/SEP/2025-26

DATE:13.09.2025 TO 16.09.2025

NAME OF THE WORK: -

GEOTECHNICAL INVESTIGATION FOR THE PROPOSED CONSTRUCTION
OF NEW AMMONIA HANDLING CONTROL ROOM IN FACT AT
UDYOGAMANDAL COMPLEX, KOCHI, KERALA.

REPORT SUBMITTED TO: -

THE GENERAL MANAGER (PROJECTS & PLANNING) – UC,
FACT, UDYOGAMANDAL COMPLEX,
KOCHI, KERALA.



SUNSTAR FOUNDATION CONSULTANT

(Civil Engineering Consultant & Contractor)

**Topographical Surveying, Soil Investigation, Pile Load Test, Plate Load Test, Rock Core Drilling,
Earth Resistivity & Laboratory Material Testing**

(An ISO/IEC 17025:2017 Certified laboratory)

No: -15/16, First Floor, Kasthuribai 4th Street, Ganapathy, Coimbatore-641006.

Mob: -+91-8300404680,8300404681, E-mail: -sunstarfoundationconsultant@gmail.com

www.sunstarfoundationconsultant.in



S.NO	DESCRIPTION	PAGE NO
1	INTRODUCTION	3
	1.1. SCOPE OF WORK	3
2	SITE DISCRPTION	3
3	FIELD INVESTIGATION	4
	3.1. Advancing Bore Hole	4
	3.2. Standard Penetration Test	4
	3.3. Collection of Samples	5
4	FIELD INVESTIGATION PHOTOGRAPHS	5
5	FIELD BORELOG SHEET	6 -7
6	SOIL PROFILE CURVES	8
7	LABORATORY INVESTIGATION	9
	7.1. LABORATORY TEST RESULTS	10 – 11
8	GRAIN SIZE DISTRIBUTION CURVE	12
9	DISCUSSION ON FOUNDATION	12
	9.1. Subsurface Conditions	12
	9.2. Engineering Appraisal	13
	9.3. Design of Methodology	13
10	FOUNDATION RECOMMENDATIONS	14 -15
11	SAFE BEARING CAPACITY CALCULATIONS	16 -31
12	PILE CARRYING CAPACITY CALCULATIONS	32 – 43
13	ELECTRICAL RESISITIVITY TEST RESULTS	44 – 51
14	CHEMICAL ANALYSIS OF SOIL AND WATER	52 – 53
15	BOREHOLE LOCATION DRAWING	54 – 55
16	BIS CODE & REFERENCES	56
17	LABORATORY TEST RESULT GRAPHS	57 - 59



1.INTRODUCTION: -

The General Manager (Projects & Planning) – UC, FACT, Udyogamandal Complex, Kochi, Kerala has entrusted the work of conducting geotechnical investigations at structures locations pertaining to The Proposed Construction of New Ammonia Handling Control Room in FACT at Udyogamandal Complex, Kochi, Kerala was awarded to M/S.Sunstar Foundation Consultant. This report presents results of the geotechnical investigation along with foundation recommendations for the proposed structure.

1.1. SCOPE OF WORK: -

- Conducting Geotechnical Investigation along with suitable foundation recommendation for the proposed structure.
- Determine the soil profile at the site with ground water level observation.
- Conducting SPT's at regular depth intervals.
- Collecting Disturbed Soil (DS)/Undisturbed Soil (UDS) Samples.
- Conducting relevant laboratory tests on Soil samples.
- Submitting report with Field observations, laboratory test results along with recommendations and safe bearing pressure at foundations level.

In this report, preliminary details of sub-soil layers encountered, brief account of the strength of the strata based on the Field Tests, discussion on foundation options and recommendations for foundations are presented.

2. SITE DISCRPTION: -

Based on boreholes information, sub surface profile for The Proposed Construction of New Ammonia Handling Control Room in FACT at Udyogamandal Complex, Kochi, Kerala. The area where the tests were conducted for the Borehole locations-1 to 2 undulating level area with respect to surroundings.



3. FIELD INVESTIGATION: -

3.1. Drilling in Overburden: -

Rotary drilling machines were mobilized and drilling operation was taken up. 100mm to 150mm diameter boreholes were made at pre-determined locations and the boreholes were advanced up-to varying depths. The drilling was commenced by driving a casing of suitable diameter in the upper layers of the bore holes. Drilling was carried out as per IS 1892 - 1979. In this method, boring is effected by the cutting action of a rotating bit that is kept in firm contact with the bottom of the hole. The bit is attached to the lower end of a hollow drill rod that is rotated by a suitable chuck. Drilling mud (usually Bentonite) is continuously forced down the hollow drill rods. The mud returning upwards through the annular space between the drill rods and the side of the hole brings the cutting to the surface. As stated earlier, the boreholes are terminated after sufficiently advancing in hard strata.

3.2. Standard Penetration Test: -

Standard Penetration Tests (SPT) were conducted as per IS 2131-1981. In a SPT test, a standard split spoon sampler is driven at the bottom of the borehole. The penetration resistance in terms of blows for 300mm penetration of the split spoon sampler is measured as 'N' Value. The blows are imparted by a standard weight of 63.5 kg falling through a height of 750 mm. The resistance is measured for 150 mm, 300 mm, and 450 mm penetrations. The resistance of first 150 mm is ignored since those blows are considered as seating blows due to the loosening of the strata. The resistance of next 300 mm is recorded as standard penetration value 'N'. If the sampler is driven less than 450 mm (total) then the penetration resistance is given for the last 300 mm of penetration. If the penetration depth is less than 300 mm and the blow count is more than 50 then the 'N' value is considered as 'Refusal' and actual penetration is recorded with the blows. These tests were conducted at close intervals of 1.50m depth intervals at shallow depths. Disturbed Soil (DS) collected in the SPT sampler was



preserved in polythene covers and transported to the laboratory. One more polythene cover was provided to prevent the loss of moisture during the transit period.

3.3. Collection of Samples: -Collecting of Disturbed and Undisturbed Soil Samples and Rock Samples were collected through the split spoon and core barrel was done up to the borehole termination level.

4.FIELD INVESTIGATION PHOTOGRAPHS: -

BOREHOLE LOCATION: - 1

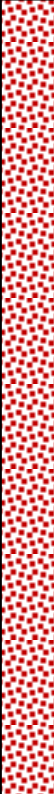


BOREHOLE LOCATION: - 2



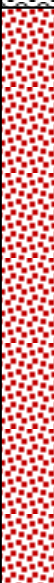


5.1. FIELD BORELOG DATA SHEET-1

NAME OF THE PROJECT: - “THE PROPOSED CONSTRUCTION OF NEW AMMONIA HANDLING CONTROL ROOM IN FACT AT UDYOGAMANDAL COMPLEX, KOCHI, KERALA”																
LOCATION: -BH-1				LOCATION: - WASTE WATER CLARIFIER					GROUND WATER TABLE: -0.80m							
CHAINAGE: -				GPS LOCATION LATITUDE:10 ⁰ 06’82.00’’N LONGITUDE:76 ⁰ 29’28.00’’ E					DATE OF STARTED: -13.09.2025							
REDUCED LEVEL: -									DATE OF COMPLETED: -15.09.2025							
Depth below , NGL’ (m)	Soil profile	Description of Strata	Thickness of stratum (m)	Depth of samples collected (m)	SPT- ‘N’ Values Details				Type of samples collected	Relative Density/ Consistency	Graphical representation of SPT- ‘N’ Values					
					N1=15cm	N2=30cm	N3=45cm	N _{VALUE} = N2+N3			20	40	60	80	100	
0.00 2.75		FILLING SOIL (Blackish silty clay with decayed coal)	2.75	0.00	-	-	-	-	-	-						
		POORLY GRADED SAND-SILT WITH CLAY MIXTURES	18.45	3.00	5	7	8	15	DS	Stiff						
				3.60	-	-	-	-	UDS	-						
				4.50	4	6	9	15	DS	Stiff						
				5.60	-	-	-	-	UDS	-						
				6.00	2	3	5	8	DS	Stiff						
				7.50	6	6	8	14	DS	Medium						
				9.00	4	7	9	16	DS	Medium						
				11.00	8	11	14	25	DS	Medium						
				13.00	12	13	18	31	DS	Dense						
				15.00	9	15	21	36	DS	Dense						
				17.00	11	18	23	41	DS	Dense						
				19.00	10	17	25	42	DS	Dense						
21.20				21.00	36	50/2	-	>50	DS	V.Dense						
		POORLY GRADED SILTY SAND	13.80	23.00	50/4	-	-	>50	DS	V.Dense						
				25.00	50/7	-	-	>50	DS	V.Dense						
				27.00	11	27	31	>50	DS	V.Dense						
				29.00	14	25	37	>50	DS	V.Dense						
				31.00	50/5	-	-	>50	DS	V.Dense						
				33.00	50/6	-	-	>50	DS	V.Dense						
35.00				End of Borehole		35.00	50/9	-	-	>50	DS	V.Dense				

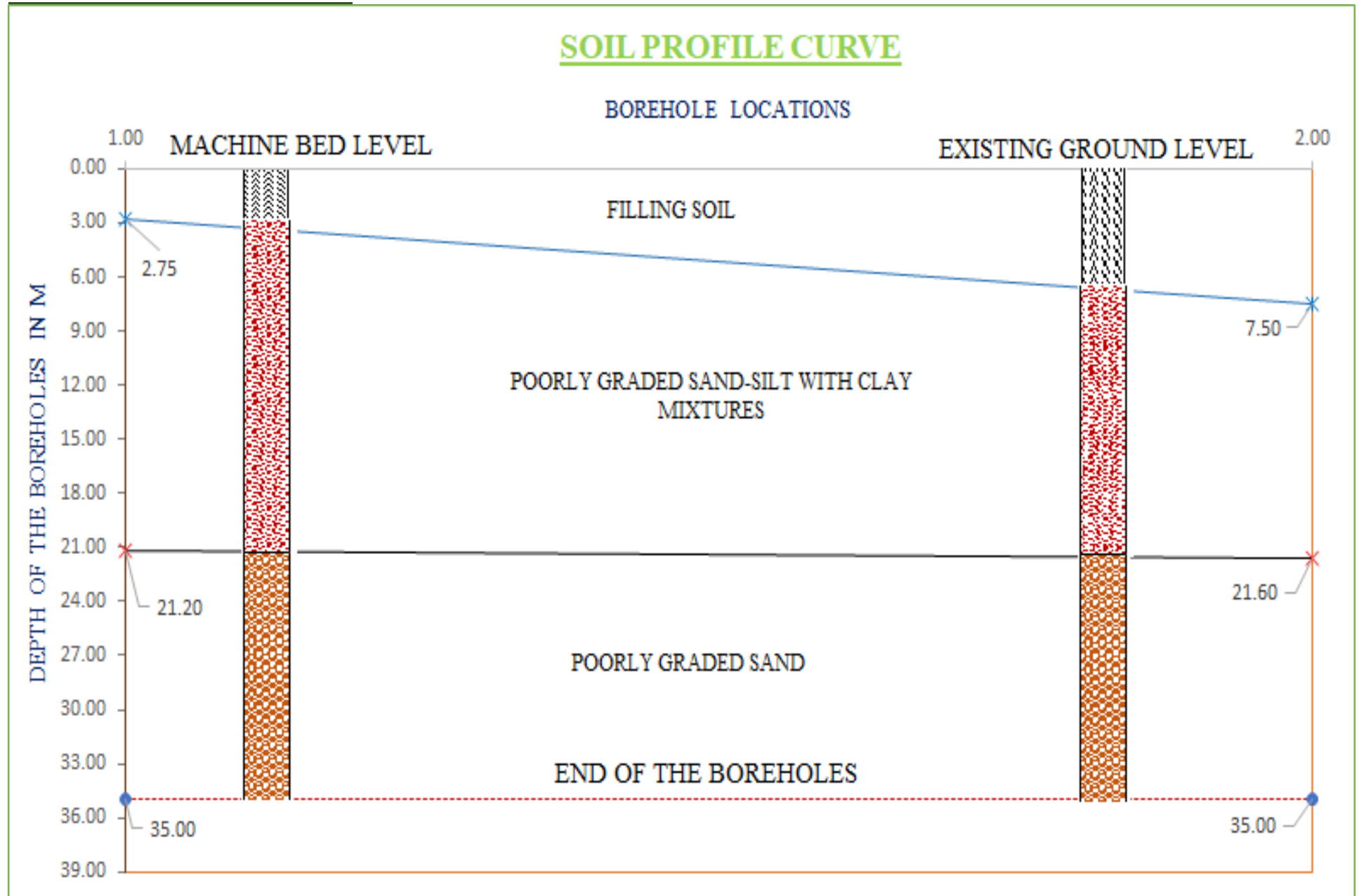


5.1. FIELD BORELOG DATA SHEET-2

NAME OF THE PROJECT: - “THE PROPOSED CONSTRUCTION OF NEW AMMONIA HANDLING CONTROL ROOM IN FACT AT UDYOGAMANDAL COMPLEX, KOCHI, KERALA”															
LOCATION: -BH-2				LOCATION: - AMMONIA CONTROL ROOM				GROUND WATER TABLE: -0.80m							
CHAINAGE: -				GPS LOCATION				DATE OF STARTED: -15.09.2025							
REDUCED LEVEL: -				LATITUDE:10 ⁰ 06’81.00’’N LONGITUDE:76 ⁰ 29’33.00’’ E				DATE OF COMPLETED: -16.09.2025							
Depth below , NGL’ (m)	Soil profile	Description of Strata	Thickness of stratum (m)	Depth of samples collected (m)	SPT- ‘N’ Values Details				Type of samples collected	Relative Density/ Consistency	Graphical representation of SPT- ‘N’ Values				
					N1=15cm	N2=30cm	N3=45cm	N _{VALUE} = N2+N3			20	40	60	80	100
0.00		FILLING SOIL (Blackish silty clay)	7.50	0.00	-	-	-	-	-	-					
7.50				7.50	6	7	9	16	DS	Medium					
21.60		POORLY GRADED SAND-SILT WITH CLAY MIXTURES	14.10	9.00	8	10	13	23	DS	Medium					
				10.00	-	-	-	-	UDS	-					
				11.00	3	4	7	11	DS	Medium					
				12.00	-	-	-	-	UDS	-					
				13.00	50/4	-	-	>50	DS	V.Dense					
				15.00	13	15	23	38	DS	Dense					
				17.00	12	16	26	42	DS	Dense					
				19.00	18	21	27	48	DS	Dense					
				21.00	22	50/3	-	>50	DS	V.Dense					
				23.00	31	50/5	-	>50	DS	V.Dense					
35.00		POORLY GRADED SILTY SAND	13.40	25.00	50/5	-	-	>50	DS	V.Dense					
				27.00	28	-	-	>50	DS	V.Dense					
				29.00	33	-	-	>50	DS	V.Dense					
				31.00	50/8	-	-	>50	DS	V.Dense					
				33.00	50/9	-	-	>50	DS	V.Dense					
				35.00	50/12	-	-	>50	DS	V.Dense					
		End of Borehole													



6.SOIL PROFILE CURVES: -





7. LABORATORY INVESTIGATION:-

Following laboratory tests are conducted on the soil and rock samples

- Natural Moisture Content
- Natural Wet Density
- Natural Dry Density
- Atterberg's Limit
- Sieve Analysis
- Specific Gravity
- Direct Shear Test Parameters
- Triaxial Compression Test Parameters
- Consolidation Test
- Unconfined Compressive Test on the Soil & Rock
- Hardness Test for Rock Samples



7.1. LABORATORY TEST RESULTS-1

NAME OF THE PROJECT: - “THE PROPOSED CONSTRUCTION OF NEW AMMONIA HANDLING CONTROL ROOM IN FACT AT UDYOGAMANDAL COMPLEX, KOCHI, KERALA”																									
LOCATION: BH-1						REDUCED LEVEL: G.W.T:0.80m										DATE OF LAB TESTING STARTED: - 17.09.2025									
CHAINAGE:						LOCATION: -WASTE WATER CLARIFIER										DATE OF LAB TESTING COMPLETED: 24.09.2025									
SOIL PROFILE AND DEPTH IN METRES	DEPTH OF SAMPLING	IS SOIL CLASSIFICATION	NATURAL WET DENSITY (kN/m³)	NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (kN/m³)	INDEX TEST (Atterberg Limit)			SIEVE ANALYSIS % PASSING IS SIEVE ANALYSIS				SPECIFIC GRAVITY	DIRECT SHEAR TEST		TRI-AXIAL COMPRESSION TEST (RS) (UU condition)		CONSOLIDATION TEST		UNCONFINED COMPRESSIVE STRENGTH (Kg/cm²)	STANDARD PENETRATION TEST				
						LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	Gravel (>4.75MIC)	SAND				SILT & CLAY (<75MIC) HYDROMETER ANALYSIS	COHESION (UCC) (C - (kN/m²)	ANGLE OF INTERNAL FRICTION (α)	COHESION (C - (kN/m²)	ANGLE OF INTERNAL FRICTION (φ)	COMPRESSION INDEX (Cc)		INITIAL VOIDS RATIO (Eo)	DEPTH OF TESTING (m)	OBSERVED N VALUE	SAFE BEARING CAPACITY (T/m²)	
										COARSE	MEDIUM	FINE													
	0.00	FL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	-	-		
	2.75		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.00	15	10.61		
			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.60	-	-		
		SC	15.70	15.50	13.59	46	20	26	1	4	7	10	78	2.56	46.15	8.00	19.18	9.00	0.36	0.46	0.88	4.50	15	11.71	
			-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	5.60	-	-
			-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	6.00	8	7.60
			16.15	15.60	13.97	52	23	29	2	3	6	14	75	2.48	41.60	12.0	14.00	11.50	0.29	0.45	0.91	7.50	14	11.61	
			16.80	15.45	14.55	48	21	27	1	3	5	15	74	2.44	39.60	15.0						9.00	16	13.99	
			17.40	15.65	15.40	42	18	24	1	5	8	12	74	2.46	40.20	18.0						11.00	25	20.93	
			-	-	-	-	-	-	-	-	-	-	-	-	-	-						-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15.00	36	31.07		
			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17.00	41	36.08		
			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19.00	42	38.65		
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21.00	>50	45.65			
		18.45	16.20	15.87	32	13	19	11	22	31	10	26	2.39	44.70	29.0	9.80	13.00	-	-	-	23.00	>50	48.50		
		-	-	-	-	-	-	-	-	-	-	-	-	-	-						25.00	>50	50.80		
		-	-	-	-	-	-	-	-	-	-	-	-	-	-						27.00	>50	53.45		
		-	-	-	-	-	-	-	-	-	-	-	-	-	-						29.00	>50	55.93		
		SP	19.20	16.15	16.53	29	14	15	12	25	29	12	22	2.40	42.35	31.0	-	-	-	-	-	31.00	>50	58.80	
			-	-	-	-	-	-	-	-	-	-	-	-	-	-						33.00	>50	64.10	
			19.80	16.30	16.60	26	10	16	10	24	33	13	20	2.36	41.10	35.0						35.00	>50	68.05	

FL- FILLING SOIL, SC- POORLY GRADED SAND SILT WITH CLAY MIXTURES, SP- POORLY GRADED SILTY SAND,
NP- NON-PLASTIC, DS- DISTURBED SAMPLE, UDS- UNDISTURBED SAMPLE, RS- REMOLDED SAMPLE.

“GEOTECHNICAL INVESTIGATION CONDUCTED BY M/S.SUNSTAR FOUNDATION CONSULTANT, COIMBATORE.”



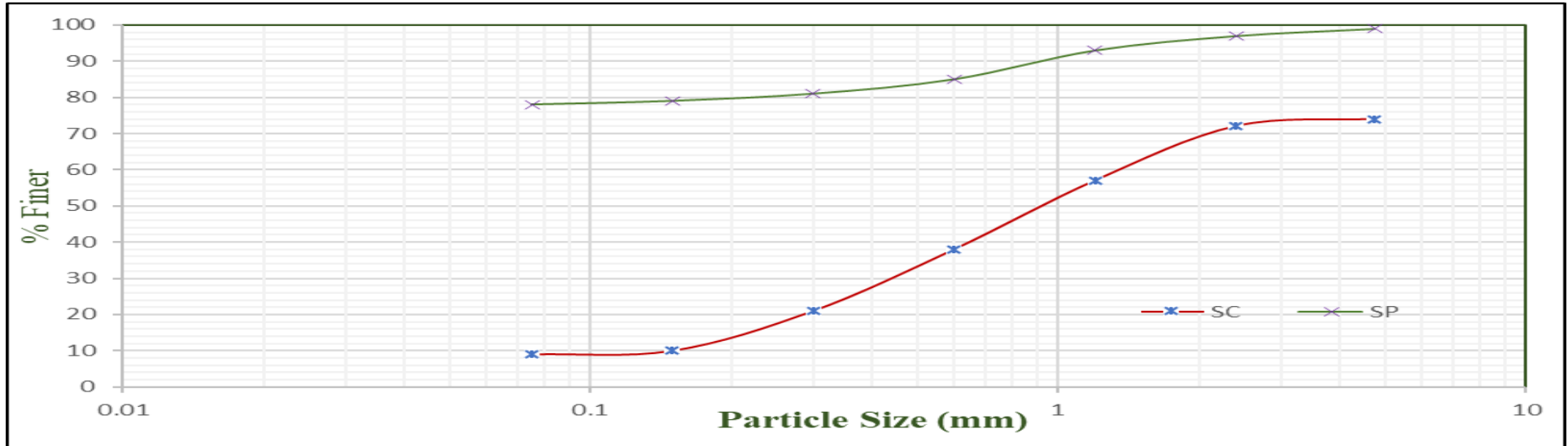
NAME OF THE PROJECT: - “THE PROPOSED CONSTRUCTION OF NEW AMMONIA HANDLING CONTROL ROOM IN FACT AT UDYOGAMANDAL COMPLEX, KOCHI, KERALA”

FL-FILLING SOIL, SC-POORLY GRADED SAND SILT WITH CLAY MIXTURES, SP-POORLY GRADED SILTY SAND,
NP- NON-PLASTIC, DS- DISTURBED SAMPLE, UDS- UNDISTURBED SAMPLE, RS-REMOLDED SAMPLE.

“GEOTECHNICAL INVESTIGATION CONDUCTED BY M/S.SUNSTAR FOUNDATION CONSULTANT,COIMBATORE.”



8.GRAIN SIZE DISTRIBUTION CURVE: -



9. DISCUSSION ON FOUNDATION: -

9.1. Sub Surface Conditions: -

Subsurface profile at this site generally consists of poorly graded sand clay with silt mixtures then by lateritic gravelly sand underlain medium to hard rock. Groundwater accumulation in boreholes was monitored during and after completion of drilling activities. Groundwater was observed in boreholes at depth 0.80m below ground surface. Seasonal and annual fluctuations in ground water levels can be changed.

9.2. Engineering Appraisal: -

Based on field and laboratory results on the samples collected from investigation locations, the shear strength parameters such as c (cohesive strength) and ϕ (angle of internal friction) can be correlated with SPT 'N' values.



9.3. Design Methodology: -

The safe bearing capacity of the soil can be calculated on shear failure criteria and settlement criteria and any foundation system has to satisfy the above said criteria. The former one depends on shear strength and the bearing capacity equation suggested by IS 6403 as follows. Net ultimate bearing capacity is given by

$$C N_c S_c d_c i_c + \gamma D (N_q - 1) S_q d_q i_q + 0.5 \gamma B N_{\gamma} S_{\gamma} d_{\gamma} i_{\gamma} W'$$

The safe bearing capacity is the maximum gross intensity of loading that the soil can carry safely without failing in shear which is obtained by the net ultimate bearing capacity divided by factor of safety (2.5 to 3.0)

The later one follows settlement criteria, that the intensity of the loading will cause within the permissible settlement is termed as allowable bearing pressure given by correcting the field SPT 'N' values.

1. **Correction due to dilatancy (N').** This correction is based on the assumption that critical void ratio occurs at approximately $N = 15$, and in fine grained cohesionless soils, the coefficient of permeability is low that the excess pore water pressure developed by the driving impedes the penetration of split spoon sampler, thus increasing the N value.

$$N' = 15 + 0.5 (N_o - 15)$$

2. **Correction due to overburden pressure**

$$N = 0.77 N' \log_{10} (2000 / P'_o)$$

P'o, effective over burden pressure should be greater than 25 kpa

Net allowable bearing pressure developed by Terzaghi and peck (1948)

$$Q_s = 3.5 (N_{cor} - 3) \left(\frac{B + 0.3}{2B} \right)^2 \times R_{w2} \times F_{D+P}$$

The Allowable Bearing Pressure of Soil = Net Allowable Bearing Pressure of Soil + P'o.

Where

N' = Corrected N value

N'' = Corrected N value due to dilatancy

B = Size of the Footing = Constant 1.00x1.00m

RW = Water Correction= Constant 0.50m

FD = Depth of Factor

P = Over Burden Pressure



10. FOUNDATION RECOMMENDATIONS: -

Based on the sub-soil conditions and possible loads on foundations, following recommendations for “The Proposed Construction of New Ammonia Handling Control Room in FACT at Udyogamandal Complex, Kochi, Kerala”.

S.No	Depth of the Foundation in (m)	Size of the footing in (m)	Shear Criteria in (Ton/m ²)	Settlement Criteria in (Ton/m ²)	Settlement for 40mm in (mm)	Design SBC (Ton/m ²)	Type of the Foundation	IS Soil Classification
1	3.00	1.00 x 1.00	10.61	13.33	50.27	10.61	Raft /Combined Footing	SC-Poorly Graded Sand with Silt
2	3.00	2.00 x 2.00	8.68	10.81	49.82	8.68		
3	3.00	3.00 x 3.00	8.09	9.76	48.24	8.09		
4	3.00	4.00 x 4.00	7.81	9.30	47.64	7.81		
5	4.00	1.00 x 1.00	11.39	12.50	43.90	11.39		
6	4.00	2.00 x 2.00	9.46	10.53	44.51	9.46		
7	4.00	3.00 x 3.00	8.87	9.30	41.95	8.87		
8	4.00	4.00 x 4.00	8.59	8.89	41.39	8.59		
9	5.00	1.00 x 1.00	9.90	10.00	40.40	9.90		
10	5.00	2.00 x 2.00	8.46	8.00	37.83	8.00		
11	5.00	3.00 x 3.00	8.01	7.02	35.04	7.02		
12	5.00	4.00 x 4.00	7.80	6.67	34.19	6.67		

Note: -

- SBC calculated based on SPT- ‘N’ values conducted inside the boreholes.
- Isolated- Square Footing: - Any one dimensions of the footing.
- Isolated- Rectangular Footing: - Least lateral dimensions of the footing.
- Isolated- Strip Footing: - L= Infinite = Width of the footing.
- In case, ground water table is encountered within recommended depth of foundation system, provision shall be made to continuously bail the water out of the foundation pits to keep the surfaces of pit consolidated dry. Excavated fine-grained soil shall be in no case used for back filling purposes.
- Shallow foundations are proposed in this area; the existing fill should be replaced with well-compacted good-quality earth to ensure adequate bearing capacity and minimize differential settlement.



BORED CAST IN –SITU FOR INDIVIDUAL END BEARING PILE: -

Type of Pile	Borehole Locations	Depth of Pile Below E.G.L in (m)	Diameter of Pile in (m)	Safe Compression Capacity of Pile in (kN)	Safe Tension Capacity of Pile in (kN)	Safe Lateral Capacity of Pile in (kN)
Bored Cast in – Situ (Single Pile)	BH-1	35.00	0.45	1051.359	851.357	35.358
			0.60	1664.310	1150.167	56.026
			0.75	2507.626	1456.49	80.066
	BH-2	35.00	0.45	894.052	694.050	35.358
			0.60	1454.568	940.425	56.026
			0.75	2245.448	1194.312	80.066

Er.M.ANANDHAKUMAR,B.E,M.I.G.S,
Project Engineer,
Sunstar Foundation Consultant

Dr.E.RAVI, ME.,PhD (Soil Mechanics),,F.I.E,F.I.G.S.,
Chief Geotechnical Consultant
Sunstar Foundation Consultant

COPYRIGHT AND CONFIDENTIAL: - The information on this document is the property of M/S. Sunstar Foundation Consultant. It must not be used directly or indirectly in any way detrimental to the interest of the company.



11.SAFE BEARING CAPACITY CALCULATIONS: -

11.1. BOREHOLE: -1

3 SAFE BEARING CAPACITY AT			=	3 m				
Observed N value	=	15						
Overburden pressure P	=	0.58	x	3	=	1.74	T/m ²	or 0.174 Kg/cm ²
N factor 0.3	=	1.38						
N factor 0.4	=	1.27						
For N	=	0.174						
	=	1.38	-	0.11	x	-0.126	/	0.1
	=	1.519						
Corrected N value N'	=	1.519	x	15	=	22.79	=	22.79
Corrected N value due to Dilatancy since the stratum consists of fine sand and silt								
N''	=	15 + 0.5(N'-15)						
	=	15 + 0.5 (22.79 - 15)						
N''	=	18.90						
	=	3.5 (18.90 - 3) { (1+0.3)/2 } ² x 0.5 + 1.74						
	=	10.61	T/m ²					
4 SAFE BEARING CAPACITY AT			=	4.5 m				
Observed N value	=	15						
Overburden pressure P	=	0.63	x	4.5	=	2.835	T/m ²	or 0.284 Kg/cm ²
N factor 0.4	=	1.27						
N factor 0.5	=	1.20						
For N	=	0.2835						
	=	1.27	-	0.07	x	-0.117	/	0.1
	=	1.3519						
Corrected N value N'	=	1.3519	x	15	=	20.279	=	20.28
Corrected N value due to Dilatancy since the stratum consists of fine sand and silt								
N''	=	15 + 0.5(N'-15)						
	=	15 + 0.5 (20.28 - 15)						
N''	=	17.64						
SBC	=	3.5(N''-3) { (b+0.3)/2b } ² x R _w x F _d + P						
	=	3.5 (17.64 - 3) { (1+0.3)/2 } ² x 0.5 + 2.835						
	=	11.71	T/m ²					



5 SAFE BEARING CAPACITY AT

= 6 m

Observed N value	=	8							
Overburden pressure P	=	0.65	x	6	=	3.9	T/m ²	or	0.39 Kg/cm ²
N factor	0.5	=	1.20						
N factor	0.6	=	1.14						
For N	=	0.39							
	=	1.2	-	0.06	x	-0.110	/	0.1	
	=	1.266							
Corrected N value N'	=	1.266	x	8	=	10.128	=	10.13	
Corrected N value due to Dilatancy since the stratum consists of fine sand and silt									
	N''	=	15 + 0.5(N'-15)						
		=	15 + 0.5 (10.13 - 15)						
	N''	=	12.56						
SBC	=	3.5(N''-3){(b+0.3)/2b} ² xR _w x Fd+P							
	=	3.5 (12.56 - 3){(1+0.3)/2}					²	x0.5	+ 3.9
		7.60	T/m ²						

6 SAFE BEARING CAPACITY AT

= 7.5 m

Observed N value	=	14							
Overburden pressure P	=	0.68	x	7.5	=	5.1	T/m ²	or	0.51 Kg/cm ²
N factor	0.6	=	1.14						
N factor	0.7	=	1.1						
For N	=	0.51							
	=	1.14	-	0.04	x	-0.090	/	0.1	
	=	1.176							
Corrected N value N'	=	1.176	x	14	=	16.464	=	16.46	
Corrected N value due to Dilatancy since the stratum consists of fine sand and silt									
	N''	=	15 + 0.5(N'-15)						
		=	15 + 0.5 (16.46 - 15)						
	N''	=	15.73						
SBC	=	3.5(N''-3){(b+0.3)/2b} ² xR _w x Fd+P							
	=	3.5 (15.73 - 3){(1+0.3)/2}					²	x0.5	+ 5.1
		11.61	T/m ²						

7 SAFE BEARING CAPACITY AT

= 9 m

Observed N value	=	16							
Overburden pressure P	=	0.7	x	9	=	6.3	T/m ²	or	0.63 Kg/cm ²



N factor	0.7	=	1.10						
N factor	0.8	=	1.06						
For N		=	0.63						
		=	1.1	-	0.04	x	-0.070	/	0.1
		=	1.128						
Corrected N value	N'	=	1.128	x	16	=	18.048	=	18.05
Corrected N value due to Dilatancy since the stratum consists of fine sand and silt									
	N''	=	15 + 0.5(N'-15)						
		=	15 + 0.5 (18.05 - 15)						
	N''	=	16.52						
SBC		=	3.5(N''-3){(b+0.3)/2b} ² xR _w x Fd+P						
		=	3.5 (16.52 - 3){(1+0.3)/2}					²	x0.5 + 6.3
		=	13.99 T/m ²						

8 SAFE BEARING CAPACITY AT

Observed N value		=	25						
Overburden pressure P		=	0.72	x	11	=	7.92 T/m ²	or	0.792 Kg/cm ²
N factor	0.8	=	1.06						
N factor	0.9	=	1.02						
For N		=	0.792						
		=	1.06	-	0.04	x	-0.008	/	0.1
		=	1.0632						
Corrected N value	N'	=	1.0632	x	25	=	26.58	=	26.58
Corrected N value due to Dilatancy since the stratum consists of fine sand and silt									
	N''	=	15 + 0.5(N'-15)						
		=	15 + 0.5 (26.58 - 15)						
	N''	=	20.79						
SBC		=	3.5(N''-3){(b+0.3)/2b} ² xR _w x Fd+P						
		=	3.5 (20.79 - 3){(1+0.3)/2}					²	x0.5 + 7.92
		=	20.93 T/m ²						

9 SAFE BEARING CAPACITY AT

Observed N value		=	31						
Overburden pressure P		=	0.75	x	13	=	9.75 T/m ²	or	0.975 Kg/cm ²
N factor	0.9	=	1.02						
N factor	1	=	1						
For N		=	0.975						
		=	1.02	-	0.02	x	0.075	/	0.1
		=	1.005						
Corrected N value	N'	=	1.005	x	31	=	31.155	=	31.16



Corrected N value due to Dilatancy since the stratum consists of fine sand and silt

$$\begin{aligned}
 N'' &= 15 + 0.5(N' - 15) \\
 &= 15 + 0.5(31.16 - 15) \\
 N'' &= 23.08 \\
 \text{SBC} &= 3.5(N'' - 3) \left\{ \frac{(b + 0.3)}{2b} \right\}^2 \times R_w \times F_d + P \\
 &= 3.5(23.08 - 3) \left\{ \frac{(1 + 0.3)}{2} \right\}^2 \times 0.5 + 9.75 \\
 &= 26.31 \text{ T/m}^2
 \end{aligned}$$

10 SAFE BEARING CAPACITY AT

$$\begin{aligned}
 \text{Observed N value} &= 36 \\
 \text{Overburden pressure P} &= 0.77 \times 15 = 11.55 \text{ T/m}^2 \text{ or } 1.155 \text{ Kg/cm}^2 \\
 \text{N factor} &= 1.00 \\
 \text{N factor} &= 1.00 \\
 \text{For N} &= 1.155 \\
 &= 1 - 0 \times 0.155 / 0.1 \\
 &= 1 \\
 \text{Corrected N value} &= N' = 1 \times 36 = 36 = 36.00
 \end{aligned}$$

Corrected N value due to Dilatancy since the stratum consists of fine sand and silt

$$\begin{aligned}
 N'' &= 15 + 0.5(N' - 15) \\
 &= 15 + 0.5(36.00 - 15) \\
 N'' &= 25.50 \\
 \text{SBC} &= 3.5(N'' - 3) \left\{ \frac{(b + 0.3)}{2b} \right\}^2 \times R_w \times F_d + P \\
 &= 3.5(25.50 - 3) \left\{ \frac{(1 + 0.3)}{2} \right\}^2 \times 0.5 + 11.55 \\
 &= 31.07 \text{ T/m}^2
 \end{aligned}$$

11 SAFE BEARING CAPACITY AT

$$\begin{aligned}
 \text{Observed N value} &= 41 \\
 \text{Overburden pressure P} &= 0.8 \times 17 = 13.6 \text{ T/m}^2 \text{ or } 1.36 \text{ Kg/cm}^2 \\
 \text{N factor} &= 1.1 \times 0.97 \\
 \text{N factor} &= 1.2 \times 0.94 \\
 \text{For N} &= 1.36 \\
 &= 0.97 - 0.03 \times 0.260 / 0.1 \\
 &= 0.892 \\
 \text{Corrected N value} &= N' = 0.892 \times 41 = 36.572 = 36.57
 \end{aligned}$$

Corrected N value due to Dilatancy since the stratum consists of fine sand and silt

$$\begin{aligned}
 N'' &= 15 + 0.5(N' - 15) \\
 &= 15 + 0.5(36.57 - 15) \\
 N'' &= 25.79 \\
 \text{SBC} &= 3.5(N'' - 3) \left\{ \frac{(b + 0.3)}{2b} \right\}^2 \times R_w \times F_d + P \\
 &= 3.5(25.79 - 3) \left\{ \frac{(1 + 0.3)}{2} \right\}^2 \times 0.5 + 13.6 \\
 &= 36.08 \text{ T/m}^2
 \end{aligned}$$


$$=$$

==

==



		=	0.92	-	0.04	x	0.670	/	0.1
		=	0.652						
Corrected N value	N'	=	0.652	x	50	=	32.6	=	32.60
Corrected N value due to Dilatancy since the stratum consists of fine sand and silt									
	N''	=	15 + 0.5(N'-15)						
		=	15 + 0.5 (32.60 - 15)						
	N''	=	23.80						
SBC		=	3.5(N''-3){(b+0.3)/2b} ² xR _w x Fd+P						
		=	3.5 (23.80 - 3) {(1+0.3)/2}					²	x0.5 + 20.7
		=	48.50 T/m ²						
15 SAFE BEARING CAPACITY AT			=				25 m		

Observed N value		=	50						
Overburden pressure P		=	0.92	x	25	=	23 T/m ²	or	2.3 Kg/cm ²
N factor	1.5	=	0.88						
N factor	1.6	=	0.86						
For N		=	2.3						
		=	0.88	-	0.02	x	0.800	/	0.1
		=	0.72						
Corrected N value	N'	=	0.72	x	50	=	36	=	36.00
Corrected N value due to Dilatancy since the stratum consists of fine sand and silt									
	N''	=	15 + 0.5(N'-15)						
		=	15 + 0.5 (36.00 - 15)						
	N''	=	25.50						
SBC		=	3.5(N''-3){(b+0.3)/2b} ² xR _w x Fd+P						
		=	3.5 (25.50 - 3) {(1+0.3)/2}					²	x0.5 + 23
		=	50.80 T/m ²						
16 SAFE BEARING CAPACITY AT			=				27 m		

Observed N value		=	50						
Overburden pressure P		=	0.95	x	27	=	25.65 T/m ²	or	2.565 Kg/cm ²
N factor	1.6	=	0.86						
N factor	1.7	=	0.84						
For N		=	2.565						
		=	0.86	-	0.02	x	0.965	/	0.1
		=	0.667						
Corrected N value	N'	=	0.667	x	50	=	33.35	=	33.35
Corrected N value due to Dilatancy since the stratum consists of fine sand and silt									
	N''	=	15 + 0.5(N'-15)						



$$\begin{aligned}
 N'' &= 15 + 0.5 (33.35 - 15) \\
 &= 24.18 \\
 \text{SBC} &= 3.5(N''-3) \{ (b+0.3)/2b \}^2 \times R_w \times F_d + P \\
 &= 3.5 (24.18 - 3) \{ (1+0.3)/2 \}^2 \times 0.5 + 25.65 \\
 &= 53.45 \text{ T/m}^2
 \end{aligned}$$

17 SAFE BEARING CAPACITY AT

$$\begin{aligned}
 \text{Observed N value} &= 50 \\
 \text{Overburden pressure P} &= 0.97 \times 29 = 28.13 \text{ T/m}^2 \text{ or } 2.813 \text{ Kg/cm}^2 \\
 \text{N factor } 1.7 &= 0.84 \\
 \text{N factor } 1.8 &= 0.82 \\
 \text{For N} &= 2.813 \\
 &= 0.84 - 0.02 \times 1.113 / 0.1 \\
 &= 0.6174 \\
 \text{Corrected N value } N' &= 0.6174 \times 50 = 30.87 = 30.87 \\
 \text{Corrected N value due to Dilatancy since the stratum consists of fine sand and silt} &
 \end{aligned}$$

$$\begin{aligned}
 N'' &= 15 + 0.5(N'-15) \\
 &= 15 + 0.5 (30.87 - 15) \\
 &= 22.94 \\
 \text{SBC} &= 3.5(N''-3) \{ (b+0.3)/2b \}^2 \times R_w \times F_d + P \\
 &= 3.5 (22.94 - 3) \{ (1+0.3)/2 \}^2 \times 0.5 + 28.13 \\
 &= 55.93 \text{ T/m}^2
 \end{aligned}$$

18 SAFE BEARING CAPACITY AT

$$\begin{aligned}
 \text{Observed N value} &= 50 \\
 \text{Overburden pressure P} &= 1 \times 31 = 31 \text{ T/m}^2 \text{ or } 3.1 \text{ Kg/cm}^2 \\
 \text{N factor } 1.8 &= 0.84 \\
 \text{N factor } 1.9 &= 0.82 \\
 \text{For N} &= 3.1 \\
 &= 0.84 - 0.02 \times 1.300 / 0.1 \\
 &= 0.58 \\
 \text{Corrected N value } N' &= 0.58 \times 50 = 29 = 29.00 \\
 \text{Corrected N value due to Dilatancy since the stratum consists of fine sand and silt} &
 \end{aligned}$$

$$\begin{aligned}
 N'' &= 15 + 0.5(N'-15) \\
 &= 15 + 0.5 (29.00 - 15) \\
 &= 22.00 \\
 \text{SBC} &= 3.5(N''-3) \{ (b+0.3)/2b \}^2 \times R_w \times F_d + P \\
 &= 3.5 (22.00 - 3) \{ (1+0.3)/2 \}^2 \times 0.5 + 31 \\
 &= 58.80 \text{ T/m}^2
 \end{aligned}$$

19 SAFE BEARING CAPACITY AT

$$\begin{aligned}
 \text{Observed N value} &= 50 \\
 &= 50
 \end{aligned}$$



Overburden pressure P	=	1.1	x	33	=	36.3	T/m ²	or	3.63	Kg/cm ²
N factor	1.9	=	0.84							
N factor	2	=	0.82							
For N		=	3.63							
		=	0.84	-	0.02	x	1.730	/	0.1	
		=	0.494							
Corrected N value	N'	=	0.494	x	50	=	24.7	=	24.70	
Corrected N value due to Dilatancy since the stratum consists of fine sand and silt										
	N''	=	15 + 0.5(N'-15)							
		=	15 + 0.5 (24.70 - 15)							
	N''	=	19.85							
SBC		=	3.5(N''-3){(b+0.3)/2b} ² xR _w x Fd+P							
		=	3.5 (19.85 - 3){(1+0.3)/2}					²	x0.5	+ 36.3
			64.10				T/m²			
			=				35		m	
20 SAFE BEARING CAPACITY AT										
Observed N value		=	50							
Overburden pressure P		=	1.15	x	35	=	40.25	T/m ²	or	4.025 Kg/cm ²
N factor	2	=	0.84							
N factor	2.1	=	0.82							
For N		=	4.025							
		=	0.84	-	0.02	x	2.025	/	0.1	
		=	0.435							
Corrected N value	N'	=	0.435	x	50	=	21.75	=	21.75	
Corrected N value due to Dilatancy since the stratum consists of fine sand and silt										
	N''	=	15 + 0.5(N'-15)							
		=	15 + 0.5 (21.75 - 15)							
	N''	=	18.38							
SBC		=	3.5(N''-3){(b+0.3)/2b} ² xR _w x Fd+P							
		=	3.5 (18.38 - 3){(1+0.3)/2}					²	x0.5	+ 40.25
			68.05				T/m²			



11.2. BOREHOLE: -2

6 SAFE BEARING CAPACITY AT		=	7.5 m				
Observed N value	=	16					
Overburden pressure P	=	0.68	x	7.5	=	5.1 T/m ²	or 0.51 Kg/cm ²
N factor 0.6	=	1.14					
N factor 0.7	=	1.1					
For N	=	0.51					
	=	1.14	-	0.04	x	-0.090	/ 0.1
	=	1.176					
Corrected N value N'	=	1.176	x	16	=	18.816	= 18.82
Corrected N value due to Dilatancy since the stratum consists of fine sand and silt							
N''	=	15 + 0.5(N'-15)					
	=	15 + 0.5					
	=	(18.82 - 15)					
N''	=	16.91					
SBC	=	3.5(N''-3){(b+0.3)/2b} ² xRw x Fd+P					
	=	3.5 (16.91 - 3){(1+0.3)/2}				² x0.5	+ 5.1
		12.79 T/m²					
7 SAFE BEARING CAPACITY AT		=	9 m				
Observed N value	=	23					
Overburden pressure P	=	0.7	x	9	=	6.3 T/m ²	or 0.63 Kg/cm ²
N factor 0.7	=	1.10					
N factor 0.8	=	1.06					
For N	=	0.63					
	=	1.1	-	0.04	x	-0.070	/ 0.1
	=	1.128					
Corrected N value N'	=	1.128	x	23	=	25.944	= 25.94
Corrected N value due to Dilatancy since the stratum consists of fine sand and silt							
N''	=	15 + 0.5(N'-15)					
	=	15 + 0.5					
	=	(25.94 - 15)					
N''	=	20.47					
SBC	=	3.5(N''-3){(b+0.3)/2b} ² xRw x Fd+P					
	=	3.5 (20.47 - 3){(1+0.3)/2}				² x0.5	+ 6.3
		18.13 T/m²					


$$= 11 \text{ m}$$

9 SAFE BEARING CAPACITY AT

$$= 13 \text{ m}$$

10 SAFE BEARING CAPACITY AT

$$= 15 \text{ m}$$

Observed N value	=	38					
Overburden pressure P	=	0.77	x	15	=	11.55	T/m ² or 1.155 Kg/cm ²
N factor	=	1.00					



N factor	1.1	=	1.00						
For N		=	1.155						
		=	1	-	0	x	0.155	/	0.1
		=	1						
Corrected N value	N'	=	1	x	38	=	38	=	38.00
Corrected N value due to Dilatancy since the stratum consists of fine sand and silt									
	N''	=	$15 + 0.5(N' - 15)$						
		=	$15 + 0.5$						
	N''	=	$\left(\frac{38.00 - 15}{26.50 - 15} \right)$						
SBC		=	$3.5(N'' - 3) \left\{ \frac{(b+0.3)}{2b} \right\}^2 \times R_w \times F_d + P$						
		=	$3.5 \left(\frac{26.50 - 3}{32.25 - 3} \right) \left\{ \frac{(1+0.3)}{2} \right\}^2 \times 0.5 + 11.55$						

11 SAFE BEARING CAPACITY AT 17 m

Observed N value		=	42						
Overburden pressure P		=	0.8	x	17	=	13.6	T/m ²	or 1.36 Kg/cm ²
N factor	1.1	=	0.97						
N factor	1.2	=	0.94						
For N		=	1.36						
		=	0.97	-	0.03	x	0.260	/	0.1
		=	0.892						
Corrected N value	N'	=	0.892	x	42	=	37.464	=	37.46
Corrected N value due to Dilatancy since the stratum consists of fine sand and silt									
	N''	=	$15 + 0.5(N' - 15)$						
		=	$15 + 0.5$						
	N''	=	$\left(\frac{37.46 - 15}{26.23 - 15} \right)$						
SBC		=	$3.5(N'' - 3) \left\{ \frac{(b+0.3)}{2b} \right\}^2 \times R_w \times F_d + P$						
		=	$3.5 \left(\frac{26.23 - 3}{36.67 - 3} \right) \left\{ \frac{(1+0.3)}{2} \right\}^2 \times 0.5 + 13.6$						

12 SAFE BEARING CAPACITY AT 19 m

Observed N value		=	48						
Overburden pressure P		=	0.82	x	19	=	15.58	T/m ²	or 1.558 Kg/cm ²
N factor	1.2	=	0.94						
N factor	1.3	=	0.92						
For N		=	1.558						
		=	0.94	-	0.02	x	0.358	/	0.1
		=	0.8684						



$$\text{Corrected } N \text{ value } N' = 0.8684 \times 48 = 41.683 = 41.68$$

Corrected N value due to Dilatancy since the stratum consists of fine sand and silt

$$N'' = \frac{15 + 0.5(N' - 15)}{15 + 0.5}$$

$$N'' = \left(\frac{41.68 - 15}{28.34} \right) + 15$$

$$\begin{aligned} \text{SBC} &= 3.5(N'' - 3) \left\{ \frac{(b + 0.3)}{2b} \right\}^2 \times R_w \times F_d + P \\ &= 3.5 \left(\frac{28.34 - 3}{2} \right) \left\{ \frac{(1 + 0.3)}{2} \right\}^2 \times 0.5 + 15.58 \\ &= 42.20 \text{ T/m}^2 \end{aligned}$$

13 SAFE BEARING CAPACITY AT

$$= 21 \text{ m}$$

$$\text{Observed } N \text{ value} = 50$$

$$\text{Overburden pressure } P = 0.88 \times 21 = 18.48 \text{ T/m}^2 \text{ or } 1.848 \text{ Kg/cm}^2$$

$$N \text{ factor } 1.3 = 0.92$$

$$N \text{ factor } 1.4 = 0.92$$

$$\text{For } N = 1.848$$

$$= 0.92 - 0 \times 0.548 / 0.1$$

$$= 0.92$$

$$\text{Corrected } N \text{ value } N' = 0.92 \times 50 = 46 = 46.00$$

Corrected N value due to Dilatancy since the stratum consists of fine sand and silt

$$N'' = \frac{15 + 0.5(N' - 15)}{15 + 0.5}$$

$$N'' = \left(\frac{46.00 - 15}{30.50} \right) + 15$$

$$N'' = 30.50$$

$$\begin{aligned} \text{SBC} &= 3.5(N'' - 3) \left\{ \frac{(b + 0.3)}{2b} \right\}^2 \times R_w \times F_d + P \\ &= 3.5 \left(\frac{30.50 - 3}{2} \right) \left\{ \frac{(1 + 0.3)}{2} \right\}^2 \times 0.5 + 18.48 \\ &= 46.28 \text{ T/m}^2 \end{aligned}$$

14 SAFE BEARING CAPACITY AT

$$= 23 \text{ m}$$

$$\text{Observed } N \text{ value} = 50$$

$$\text{Overburden pressure } P = 0.92 \times 23 = 21.16 \text{ T/m}^2 \text{ or } 2.116 \text{ Kg/cm}^2$$

$$N \text{ factor } 1.4 = 0.92$$

$$N \text{ factor } 1.5 = 0.88$$

$$\text{For } N = 2.116$$

$$= 0.92 - 0.04 \times 0.716 / 0.1$$

$$= 0.6336$$

$$\text{Corrected } N \text{ value } N' = 0.6336 \times 50 = 31.68 = 31.68$$

Corrected N value due to Dilatancy since the stratum consists of fine sand and silt

$$N'' = 15 + 0.5(N' - 15)$$



$$\begin{aligned}
 &= \frac{15 + 0.5}{31.68 - 15} \\
 N'' &= 23.34 \\
 \text{SBC} &= 3.5(N''-3)\{(b+0.3)/2b\}^2 \times R_w \times F_d + P \\
 &= \frac{3.5}{48.96} \left(\frac{23.34 - 3}{25} \right) \{(1+0.3)/2\}^2 \times 0.5 + 21.16 \\
 &= 25 \text{ m}
 \end{aligned}$$

15 SAFE BEARING CAPACITY AT

$$\begin{aligned}
 \text{Observed N value} &= 50 \\
 \text{Overburden pressure P} &= 0.95 \times 25 = 23.75 \text{ T/m}^2 \text{ or } 2.375 \text{ Kg/cm}^2 \\
 \text{N factor } 1.5 &= 0.88 \\
 \text{N factor } 1.6 &= 0.86 \\
 \text{For N} &= 2.375 \\
 &= 0.88 - 0.02 \times 0.875 / 0.1 \\
 &= 0.705 \\
 \text{Corrected N value } N' &= 0.705 \times 50 = 35.25 = 35.25 \\
 \text{Corrected N value due to Dilatancy since the stratum consists of fine sand and silt}
 \end{aligned}$$

$$\begin{aligned}
 N'' &= \frac{15 + 0.5(N'-15)}{15 + 0.5} \\
 &= \frac{15 + 0.5(35.25 - 15)}{15 + 0.5} \\
 N'' &= 25.13 \\
 \text{SBC} &= 3.5(N''-3)\{(b+0.3)/2b\}^2 \times R_w \times F_d + P \\
 &= \frac{3.5}{51.55} \left(\frac{25.13 - 3}{27} \right) \{(1+0.3)/2\}^2 \times 0.5 + 23.75 \\
 &= 27 \text{ m}
 \end{aligned}$$

16 SAFE BEARING CAPACITY AT

$$\begin{aligned}
 \text{Observed N value} &= 50 \\
 \text{Overburden pressure P} &= 0.98 \times 27 = 26.46 \text{ T/m}^2 \text{ or } 2.646 \text{ Kg/cm}^2 \\
 \text{N factor } 1.6 &= 0.86 \\
 \text{N factor } 1.7 &= 0.84 \\
 \text{For N} &= 2.646 \\
 &= 0.86 - 0.02 \times 1.046 / 0.1 \\
 &= 0.6508 \\
 \text{Corrected N value } N' &= 0.6508 \times 50 = 32.54 = 32.54 \\
 \text{Corrected N value due to Dilatancy since the stratum consists of fine sand and silt}
 \end{aligned}$$

$$\begin{aligned}
 N'' &= \frac{15 + 0.5(N'-15)}{15 + 0.5} \\
 &= \frac{15 + 0.5(32.54 - 15)}{15 + 0.5} \\
 N'' &= 23.77 \\
 \text{SBC} &= 3.5(N''-3)\{(b+0.3)/2b\}^2 \times R_w \times F_d + P
 \end{aligned}$$



$$= \frac{3.5}{54.26} \left(23.77 - 3 \right) \left\{ \frac{(1+0.3)}{2} \right\}^2 \times 0.5 + 26.46 \text{ T/m}^2$$

17 SAFE BEARING CAPACITY AT

$$= 29 \text{ m}$$

Observed N value	=	50							
Overburden pressure P	=	1.05	x	29	=	30.45	T/m ²	or	3.045 Kg/cm ²
N factor	1.7	=	0.84						
N factor	1.8	=	0.82						
For N		=	3.045						

$$= \frac{0.84}{0.571} - 0.02 \times \frac{1.345}{0.1}$$

$$\text{Corrected N value } N' = \frac{0.571}{0.571} \times 50 = 28.55 = 28.55$$

Corrected N value due to Dilatancy since the stratum consists of fine sand and silt

$$N'' = \frac{15 + 0.5(N' - 15)}{15 + 0.5}$$

$$= \left(\frac{28.55 - 15}{15} \right)$$

$$N'' = 21.78$$

$$\text{SBC} = \frac{3.5(N'' - 3) \left\{ \frac{(b+0.3)}{2b} \right\}^2 \times R_w \times F_d + P}{58.25} \text{ T/m}^2$$

$$= \frac{3.5}{58.25} \left(21.78 - 3 \right) \left\{ \frac{(1+0.3)}{2} \right\}^2 \times 0.5 + 30.45$$

18 SAFE BEARING CAPACITY AT

$$= 31 \text{ m}$$

Observed N value	=	50							
Overburden pressure P	=	1.15	x	31	=	35.65	T/m ²	or	3.565 Kg/cm ²
N factor	1.8	=	0.84						
N factor	1.9	=	0.82						
For N		=	3.565						

$$= \frac{0.84}{0.487} - 0.02 \times \frac{1.765}{0.1}$$

$$\text{Corrected N value } N' = \frac{0.487}{0.487} \times 50 = 24.35 = 24.35$$

Corrected N value due to Dilatancy since the stratum consists of fine sand and silt

$$N'' = \frac{15 + 0.5(N' - 15)}{15 + 0.5}$$

$$= \left(\frac{24.35 - 15}{15} \right)$$

$$N'' = 19.68$$

$$\text{SBC} = \frac{3.5(N'' - 3) \left\{ \frac{(b+0.3)}{2b} \right\}^2 \times R_w \times F_d + P}{63.45} \text{ T/m}^2$$

$$= \frac{3.5}{63.45} \left(19.68 - 3 \right) \left\{ \frac{(1+0.3)}{2} \right\}^2 \times 0.5 + 35.65$$

19 SAFE BEARING CAPACITY AT

$$= 33 \text{ m}$$

$$\text{Observed N value} = 50$$



Overburden pressure P		=	1.2	x	33	=	39.6	T/m ²	or	3.96	Kg/cm ²
N factor	1.9	=	0.84								
N factor	2	=	0.82								
For N		=	3.96								
		=	0.84	-	0.02	x	2.060	/	0.1		
		=	0.428								
Corrected N value	N'	=	0.428	x	50	=	21.4	=	21.40		
Corrected N value due to Dilatancy since the stratum consists of fine sand and silt											
	N''	=	$15 + 0.5(N' - 15)$								
		=	$15 + 0.5$								
		=	$(21.40 - 15)$								
	N''	=	18.20								
SBC		=	$3.5(N'' - 3) \{ (b + 0.3) / 2b \}^2 \times R_w \times F_d + P$								
		=	$3.5 (18.20 - 3) \{ (1 + 0.3) / 2 \}^2 \times 0.5 + 39.6$								
		=	67.40 T/m²								
20 SAFE BEARING CAPACITY AT			= 35 m								
Observed N value		=	50								
Overburden pressure P		=	1.21	x	35	=	42.35	T/m ²	or	4.235	Kg/cm ²
N factor	2	=	0.84								
N factor	2.1	=	0.82								
For N		=	4.235								
		=	0.84	-	0.02	x	2.235	/	0.1		
		=	0.393								
Corrected N value	N'	=	0.393	x	50	=	19.65	=	19.65		
Corrected N value due to Dilatancy since the stratum consists of fine sand and silt											
	N''	=	$15 + 0.5(N' - 15)$								
		=	$15 + 0.5$								
		=	$(19.65 - 15)$								
	N''	=	17.33								
SBC		=	$3.5(N'' - 3) \{ (b + 0.3) / 2b \}^2 \times R_w \times F_d + P$								
		=	$3.5 (17.33 - 3) \{ (1 + 0.3) / 2 \}^2 \times 0.5 + 42.35$								
		=	70.15 T/m²								



11.3. FOUNDATION RECOMMENDATIONS SETTLEMENT CALCULATION (AS PER IS:8009(PART-1): -

DEPTH OF THE FOUNDATION =3.00M, SIZE OF THE FOOTING =1.00 X 1.00M: -

Observed N Value =15, $W_c=0.50$, Shear Criteria = 10.61 T/m^2

For 'N' Value 15 & 10 T/m^2

Pressure on the soil the settlement

As per Fig-9 = 15.00 mm

Therefore: for settlement of 40.00mm

Pressure on the soil = $40/15.00 \times 10 \times 0.50 = 13.33 \text{ Ton/m}^2$

Settlement criteria= 13.33 Ton/m^2

Settlement = 50.27mm

S.No	Depth of the Foundation in (m)	Size of the footing in (m)	Shear Criteria in (Ton/m ²)	SPT N Values	water table correction (m)	Settlement per unit pressure from Fig 9 of IS 8009 (mm)	Settlement Criteria in (Ton/m ²)	Settlement For 40mm in (mm)	Design SBC (Ton/m ²)
1	3.00	1.00 x 1.00	10.61	15.00	0.50	15.00	13.33	50.27	10.61



12.1. PILE CARRYING CAPACITY CALCULATIONS: - (BH-1)

12.1.1.DESIGN APPROACH FOR VERTICAL AND LATERAL PILE CAPACITY FOR DEPTH =35.00M & DIA=450 mm:

S.NO	SOIL TYPE	LAYER START DEPTH	LAYER END DEPTH	DEPTH FROM EGL	DEPTH FROM PILE CUTOFF LEVEL	THICKNESS OF LAYER	DIA OF PILE	BASE AREA OF PILE	SURFACE AREA OF PILE	Navg	C	FRICTION ANGLE	NATURAL WET DENSITY	SUBMERGED DENSITY	BEARING CAPACITY FACTORS	
		m	m	m	m	m	m	Sqm	Sqm		kN/ Sqm	Degree	kN/ Cum	kN/ Cum	NY	Nq
1	FL-Filling Soil	0.00	2.75	2.75	2.75	2.75	0.45	0.16	3.89	0	0.00	0.00	15.00	5.19		
3	SC - Poorly Graded Sand Silt with Clay Mixtures	2.75	21.20	18.45	21.20	18.45	0.45	0.16	26.07	20.25	14.00	11.50	16.50	6.69		
2	SP- Poorly Graded Silt Sand	21.20	35.00	13.80	35.00	13.80	0.45	0.16	19.50	50	9.80	13.00	19.00	9.19	109.41	64.20

EFFECTIVE OVERBURDEN PRESSURE TO CENTRE OF LAYER							SKIN FRICTION	COHESION	REMARKS
kN/ Sqm							kN		
7.136			6.750					-27.2	
14.273	61.715						604.24	109.5	Cohesive soil
14.273	123.431	63.411					1357.35		Cohesionless soil
END BEARING PRESSURE							669.028		kN
SUBMERGED WT. OF PILE							84.512		kN
TOTAL PILE CAPACITY = SKIN FRICTION + END BEARING+SYBMERGED ADISM							2712.909		kN
ULTIMATE COMPRESSION PILE CAPACITY = SKIN FRICTION + END BEARING -SUBMERGED WT OF PILE							2628.397		kN
ULTIMATE TENSION PILE CAPACITY = SKIN FRICTION + SUBMERGED WT OF PILE							2128.393		kN
SAFE COMPRESSION LOAD CARRYING CAPACITY OF PILE =ULTIMATE /2.50							1051.359		kN
SAFE TENSION LOAD CARRYING CAPACITY OF PILE =ULTIMATE /2.50							851.357		kN



PILE LATERAL LOAD CARRYING CAPACITY CALCULATION

DIA OF PILE	0.450	m	FIXED HEADED PILE WITH PILE CAP
MOI OF PILE ABT CENTROIDAL AXIS	0.0020	m ⁴	
GRADE OF CONCRETE	35.000	Mpa	
MODULI OF ELASTICITY OF CONCRETE	29580.399	Mpa	
MODULUS OF SUBGRADE REACTION FOR SUBMERGED GRANULAR SOIL	1.400	MN / cum	
$T = (EI / \text{MODULUS OF SUBGRADE})^{0.2}$	2.117		
TOTAL LENGTH OF PILE	35.00	m	
LENGTH OF PILE ABOVE BED LEVEL, L1	0.00	m	
LENGTH OF PILE BELOW BED LEVEL, Le	35.00	m	
PILE BEHAVES AS		LONG (FLEXIBLE) PILE	
L1 / T	0.000		IS 2911; PART 1 ; FIG 4 ; PG 16 ; ANNEX C
Lf / T	2.200		
Lf	4.658	m	
ALLOWABLE LATERAL DEFLECTION = $Q \times (L1 + Lf)^3 / 12EI$	5.000	mm	
LATERAL LOAD CARRYING CAPACITY, Q	35.358	kN	



12.1.2.DESIGN APPROACH FOR VERTICAL AND LATERAL PILE CAPACITY FOR DEPTH =35.00M & DIA=600 mm:

S.NO	SOIL TYPE	LAYER START DEPTH	LAYER END DEPTH	DEPTH FROM EGL	DEPTH FROM PILE CUTOFF LEVEL	THICKNESS OF LAYER	DIA OF PILE	BASE AREA OF PILE	SURFACE AREA OF PILE	Navg	C	FRICTION ANGLE	NATURAL WET DENSITY	SUBMERGED DENSITY	BEARING CAPACITY FACTORS	
		m	m	m	m	m	m	Sqm	Sqm		kN/ Sqm	Degree	kN/ Cum	kN/ Cum	NY	Nq
1	FL-Filling Soil	0.00	2.75	2.75	2.75	2.75	0.60	0.28	5.18	0	0.00	0.00	15.00	5.19		
3	SC - Poorly Graded Sand Silt with Clay Mixtures	2.75	21.20	18.45	21.20	18.45	0.60	0.28	34.76	20.25	14.00	11.50	16.50	6.69		
2	SP- Poorly Graded Silt Sand	21.20	35.00	13.80	35.00	13.80	0.60	0.28	26.00	50	9.80	13.00	19.00	9.19	109.41	64.20

EFFECTIVE OVERBURDEN PRESSURE TO CENTRE OF LAYER							SKIN FRICTION	COHESION	REMARKS
kN/ Sqm							kN		
7.136			9.000					-36.3	
14.273	61.715						805.65	146.0	Cohesive soil
14.273	123.431	63.411					1809.80		Cohesionless soil
END BEARING PRESSURE							1585.845		kN
SUBMERGED WT. OF PILE							150.244		kN
TOTAL PILE CAPACITY = SKIN FRICTION + END BEARING+SYBMERGED ADISM							4311.020		kN
ULTIMATE COMPRESSION PILE CAPACITY = SKIN FRICTION + END BEARING -SUBMERGED WT OF PILE							4160.775		kN
ULTIMATE TENSION PILE CAPACITY = SKIN FRICTION + SUBMERGED WT OF PILE							2875.419		kN
SAFE COMPRESSION LOAD CARRYING CAPACITY OF PILE =ULTIMATE /2.50							1664.310		kN
SAFE TENSION LOAD CARRYING CAPACITY OF PILE =ULTIMATE /2.50							1150.167		kN



PILE LATERAL LOAD CARRYING CAPACITY CALCULATION			
DIA OF PILE	0.600	m	FIXED HEADED PILE WITH PILE CAP
MOI OF PILE ABT CENTROIDAL AXIS	0.0064	m^4	
GRADE OF CONCRETE	35.000	Mpa	
MODULI OF ELASTICITY OF CONCRETE	29580.399	Mpa	
MODULUS OF SUBGRADE REACTION FOR SUBMERGED GRANULAR SOIL	1.400	MN / cum	
T = (EI / MODULUS OF SUBGRADE) ^ 0.2	2.665		IS 2911; PART 1 ; TABLE 5 ; PG 16 ; ANNEX C
TOTAL LENGTH OF PILE	35.00	m	
LENGTH OF PILE ABOVE BED LEVEL, L1	0.00	m	
LENGTH OF PILE BELOW BED LEVEL, Le	35.00	m	
PILE BEHAVES AS	LONG (FLEXIBLE) PILE		
L1 / T	0.000		IS 2911; PART 1 ; FIG 4 ; PG 16 ; ANNEX C
Lf / T	2.200		
Lf	5.863	m	
ALLOWABLE LATERAL DEFLECTION = Q x (L1 + Lf)^3 / 12EI	5.000	mm	
LATERAL LOAD CARRYING CAPACITY, Q	56.026	kN	



12.1.3.DESIGN APPROACH FOR VERTICAL AND LATERAL PILE CAPACITY FOR DEPTH =35.00M & DIA=750 mm:

S.NO	SOIL TYPE	LAYER START DEPTH	LAYER END DEPTH	DEPTH FROM EGL	DEPTH FROM PILE CUTOFF LEVEL	THICKNESS OF LAYER	DIA OF PILE	BASE AREA OF PILE	SURFACE AREA OF PILE	Navg	C	FRICTION ANGLE	NATURAL WET DENSITY	SUBMERGED DENSITY	BEARING CAPACITY FACTORS	
		m	m	m	m	m	m	Sqm	Sqm		kN/ Sqm	Degree	kN/ Cum	kN/ Cum	NY	Nq
1	FL-Filling Soil	0.00	2.75	2.75	2.75	2.75	0.75	0.44	6.48	0	0.00	0.00	15.00	5.19		
3	SC - Poorly Graded Sand Silt with Clay Mixtures	2.75	21.20	18.45	21.20	18.45	0.75	0.44	43.45	20.25	14.00	11.50	16.50	6.69		
2	SP- Poorly Graded Silt Sand	21.20	35.00	13.80	35.00	13.80	0.75	0.44	32.50	50	9.80	13.00	19.00	9.19	109.41	64.20

EFFECTIVE OVERBURDEN PRESSURE TO CENTRE OF LAYER							SKIN FRICTION	COHESION	REMARKS
kN/ Sqm							kN		
7.136			11.250					-45.3	
14.273	61.715						1007.07	182.5	Cohesive soil
14.273	123.431	63.411					2262.25		Cohesionless soil
END BEARING PRESSURE							3097.354		kN
SUBMERGED WT. OF PILE							234.757		kN
TOTAL PILE CAPACITY = SKIN FRICTION + END BEARING+SYBMERGED ADISM							6503.822		kN
ULTIMATE COMPRESSION PILE CAPACITY = SKIN FRICTION + END BEARING - SUBMERGED WT OF PILE							6269.065		kN
ULTIMATE TENSION PILE CAPACITY = SKIN FRICTION + SUBMERGED WT OF PILE							3641.224		kN
SAFE COMPRESSION LOAD CARRYING CAPACITY OF PILE =ULTIMATE /2.50							2507.626		kN
SAFE TENSION LOAD CARRYING CAPACITY OF PILE =ULTIMATE /2.50							1456.490		kN



<u>PILE LATERAL LOAD CARRYING CAPACITY CALCULATION</u>			
DIA OF PILE	0.750	m	<i>FIXED HEADED PILE WITH PILE CAP</i>
MOI OF PILE ABT CENTROIDAL AXIS	0.0155	m^4	
GRADE OF CONCRETE	35.000	Mpa	
MODULI OF ELASTICITY OF CONCRETE	29580.399	Mpa	
MODULUS OF SUBGRADE REACTION FOR SUBMERGED GRANULAR SOIL	1.400	MN / cum	<i>IS 2911; PART 1 ; TABLE 5 ; PG 16 ; ANNEX C</i>
T = (EI / MODULUS OF SUBGRADE) ^ 0.2	3.186		
TOTAL LENGTH OF PILE	35.00	m	
LENGTH OF PILE ABOVE BED LEVEL, L1	0.00	m	
LENGTH OF PILE BELOW BED LEVEL, Le	35.00	m	<i>IS 2911; PART 1 ; FIG 4 ; PG 16 ; ANNEX C</i>
PILE BEHAVES AS	LONG (FLEXIBLE) PILE		
L1 / T	0.000		
Lf / T	2.200		
Lf	7.009	m	
ALLOWABLE LATERAL DEFLECTION = $Q \times (L1 + Lf)^3 / 12EI$	5.000	mm	
LATERAL LOAD CARRYING CAPACITY, Q	80.066	kN	



12.2. PILE CARRYING CAPACITY CALCULATIONS: - (BH-2)

12.2.1.DESIGN APPROACH FOR VERTICAL AND LATERAL PILE CAPACITY FOR DEPTH =35.00M & DIA=450 mm: -

S.NO	SOIL TYPE	LAYER START DEPTH	LAYER END DEPTH	DEPTH FROM EGL	DEPTH FROM PILE CUTOFF LEVEL	THICKNESS OF LAYER	DIA OF PILE	BASE AREA OF PILE	SURFACE AREA OF PILE	N_{avg}	C	FRICTION ANGLE	NATURAL WET DENSITY	SUBMERGED DENSITY	BEARING CAPACITY FACTORS	
		m	m	m	m	m	m	Sqm	Sqm		kN/ Sqm	Degree	kN/ Cum	kN/ Cum	NY	Nq
1	FL-Filling Soil	0.00	7.50	7.50	7.50	7.50	0.45	0.16	10.60	0.00	0.00	0.00	15.00	5.19		
3	SC - Poorly Graded Sand Silt with Clay Mixtures	7.50	21.60	14.10	21.60	14.10	0.45	0.16	19.92	34.75	15.30	9.00	16.50	6.69		
2	SP- Poorly Graded Silt Sand	21.60	35.00	13.40	35.00	13.40	0.45	0.16	18.93	50	8.70	12.50	19.00	9.19	109.41	64.20

EFFECTIVE OVERBURDEN PRESSURE TO CENTRE OF LAYER							SKIN FRICTION	COHESION	REMARKS
kN/ Sqm							kN		
19.463			6.750					-74.2	
38.925	47.165						407.28	91.4	Cohesive soil
38.925	94.329	61.573					1226.07		Cohesionless soil
END BEARING PRESSURE							669.028		kN
SUBMERGED WT. OF PILE							84.512		kN
TOTAL PILE CAPACITY = SKIN FRICTION + END BEARING+SYBMERGED ADISM							2319.642		kN
ULTIMATE COMPRESSION PILE CAPACITY = SKIN FRICTION + END BEARING -SUBMERGED WT OF PILE							2235.130		kN
ULTIMATE TENSION PILE CAPACITY = SKIN FRICTION + SUBMERGED WT OF PILE							1735.126		kN
SAFE COMPRESSION LOAD CARRYING CAPACITY OF PILE =ULTIMATE /2.50							894.052		kN
SAFE TENSION LOAD CARRYING CAPACITY OF PILE =ULTIMATE /2.50							694.050		kN



<u>PILE LATERAL LOAD CARRYING CAPACITY CALCULATION</u>			
DIA OF PILE	0.450	m	<i>FIXED HEADED PILE WITH PILE CAP</i>
MOI OF PILE ABT CENTROIDAL AXIS	0.0020	m ⁴	
GRADE OF CONCRETE	35.000	Mpa	
MODULI OF ELASTICITY OF CONCRETE	29580.399	Mpa	
MODULUS OF SUBGRADE REACTION FOR SUBMERGED GRANULAR SOIL	1.400	MN / cum	
$T = (EI / \text{MODULUS OF SUBGRADE})^{0.2}$	2.117		
TOTAL LENGTH OF PILE	35.00	m	
LENGTH OF PILE ABOVE BED LEVEL, L1	0.00	m	
LENGTH OF PILE BELOW BED LEVEL, Le	35.00	m	
PILE BEHAVES AS		LONG (FLEXIBLE) PILE	
L1 / T	0.000		<i>IS 2911; PART 1 ; TABLE 5 ; PG 16 ; ANNEX C</i>
Lf / T	2.200		
Lf	4.658	m	
ALLOWABLE LATERAL DEFLECTION = $Q \times (L1 + Lf)^3 / 12EI$	5.000	mm	
LATERAL LOAD CARRYING CAPACITY, Q	35.358	kN	



12.2.2.DESIGN APPROACH FOR VERTICAL AND LATERAL PILE CAPACITY FOR DEPTH =35.00M & DIA=600 mm: -

S.NO	SOIL TYPE	LAYER START DEPTH	LAYER END DEPTH	DEPTH FROM EGL	DEPTH FROM PILE CUTOFF LEVEL	THICKNESS OF LAYER	DIA OF PILE	BASE AREA OF PILE	SURFACE AREA OF PILE	Navg	C	FRICTION ANGLE	NATURAL WET DENSITY	SUBMERGED DENSITY	BEARING CAPACITY FACTORS	
		m	m	m	m	m	m	Sqm	Sqm		kN/ Sqm	Degree	kN/ Cum	kN/ Cum	NY	Nq
1	FL-Filling Soil	0.00	7.50	7.50	7.50	7.50	0.60	0.28	14.13	0.00	0.00	0.00	15.00	5.19		
3	SC - Poorly Graded Sand Silt with Clay Mixtures	7.50	21.60	14.10	21.60	14.10	0.60	0.28	26.56	34.75	15.30	9.00	16.50	6.69		
2	SP- Poorly Graded Silt Sand	21.60	35.00	13.40	35.00	13.40	0.60	0.28	25.25	50	8.70	12.50	19.00	9.19	109.41	64.20

EFFECTIVE OVERBURDEN PRESSURE TO CENTRE OF LAYER							SKIN FRICTION	COHESION	REMARKS
kN/ Sqm							kN		
19.463			9.000					-98.9	
38.925	47.165						543.04	121.9	Cohesive soil
38.925	94.329	61.573					1634.76		Cohesionless soil
END BEARING PRESSURE							1585.845		kN
SUBMERGED WT. OF PILE							150.244		kN
TOTAL PILE CAPACITY = SKIN FRICTION + END BEARING+SYBMERGED ADISM							3786.664		kN
ULTIMATE COMPRESSION PILE CAPACITY = SKIN FRICTION + END BEARING -SUBMERGED WT OF PILE							3636.419		kN
ULTIMATE TENSION PILE CAPACITY = SKIN FRICTION + SUBMERGED WT OF PILE							2351.063		kN
SAFE COMPRESSION LOAD CARRYING CAPACITY OF PILE =ULTIMATE /2.50							1454.568		kN
SAFE TENSION LOAD CARRYING CAPACITY OF PILE =ULTIMATE /2.50							940.425		kN



PILE LATERAL LOAD CARRYING CAPACITY CALCULATION

DIA OF PILE	0.600	m	<i>FIXED HEADED PILE WITH PILE CAP</i>
MOI OF PILE ABT CENTROIDAL AXIS	0.0064	m ⁴	
GRADE OF CONCRETE	35.000	Mpa	
MODULI OF ELASTICITY OF CONCRETE	29580.399	Mpa	
MODULUS OF SUBGRADE REACTION FOR SUBMERGED GRANULAR SOIL	1.400	MN / cum	
$T = (EI / \text{MODULUS OF SUBGRADE})^{0.2}$	2.665		
TOTAL LENGTH OF PILE	35.00	m	
LENGTH OF PILE ABOVE BED LEVEL, L1	0.00	m	
LENGTH OF PILE BELOW BED LEVEL, Le	35.00	m	
PILE BEHAVES AS		LONG (FLEXIBLE) PILE	
L1 / T	0.000		<i>IS 2911; PART 1 ; TABLE 5 ; PG 16 ; ANNEX C</i>
Lf / T	2.200		
Lf	5.863	m	
ALLOWABLE LATERAL DEFLECTION = $Q \times (L1 + Lf)^3 / 12EI$	5.000	mm	
LATERAL LOAD CARRYING CAPACITY, Q	56.026	kN	



12.2.3.DESIGN APPROACH FOR VERTICAL AND LATERAL PILE CAPACITY FOR DEPTH =35.00M & DIA=750 mm: -

S.NO	SOIL TYPE	LAYER START DEPTH	LAYER END DEPTH	DEPTH FROM EGL	DEPTH FROM PILE CUTOFF LEVEL	THICKNESS OF LAYER	DIA OF PILE	BASE AREA OF PILE	SURFACE AREA OF PILE	Navg	C	FRICTION ANGLE	NATURAL WET DENSITY	SUBMERGED DENSITY	BEARING CAPACITY FACTORS	
		m	m	m	m	m	m	Sqm	Sqm		kN/ Sqm	Degree	kN/ Cum	kN/ Cum	NY	Nq
1	FL-Filling Soil	0.00	7.50	7.50	7.50	7.50	0.75	0.44	17.66	0.00	0.00	0.00	15.00	5.19		
3	SC - Poorly Graded Sand Silt with Clay Mixtures	7.50	21.60	14.10	21.60	14.10	0.75	0.44	33.21	34.75	15.30	9.00	16.50	6.69		
2	SP- Poorly Graded Silt Sand	21.60	35.00	13.40	35.00	13.40	0.75	0.44	31.56	50	8.70	12.50	19.00	9.19	109.41	64.20

EFFECTIVE OVERBURDEN PRESSURE TO CENTRE OF LAYER							SKIN FRICTION	COHESION	REMARKS
kN/ Sqm							kN		
19.463			11.250					-123.6	
38.925	47.165						678.80	152.4	Cohesive soil
38.925	94.329	61.573					2043.45		Cohesionless soil
END BEARING PRESSURE							3097.354		kN
SUBMERGED WT. OF PILE							234.757		kN
TOTAL PILE CAPACITY = SKIN FRICTION + END BEARING+SYBMERGED ADISM							5848.377		kN
ULTIMATE COMPRESSION PILE CAPACITY = SKIN FRICTION + END BEARING -SUBMERGED WT OF PILE							5613.620		kN
ULTIMATE TENSION PILE CAPACITY = SKIN FRICTION + SUBMERGED WT OF PILE							2985.780		kN
SAFE COMPRESSION LOAD CARRYING CAPACITY OF PILE =ULTIMATE /2.50							2245.448		kN
SAFE TENSION LOAD CARRYING CAPACITY OF PILE =ULTIMATE /2.50							1194.312		kN



DIA OF PILE	0.750	m	FIXED HEADED PILE WITH PILE CAP	
MOI OF PILE ABT CENTROIDAL AXIS	0.0155	m ⁴		
GRADE OF CONCRETE	35.000	Mpa		
MODULI OF ELASTICITY OF CONCRETE	29580.399	Mpa		
MODULUS OF SUBGRADE REACTION FOR SUBMERGED GRANULAR SOIL	1.400	MN / cum		IS 2911; PART 1 ; TABLE 5 ; PG 16 ; ANNEX C
T = (EI / MODULUS OF SUBGRADE) ^ 0.2	3.186			
TOTAL LENGTH OF PILE	35.00	m		
LENGTH OF PILE ABOVE BED LEVEL, L1	0.00	m		
LENGTH OF PILE BELOW BED LEVEL, Le	35.00	m		
PILE BEHAVES AS	LONG (FLEXIBLE) PILE		IS 2911; PART 1 ; FIG 4 ; PG 16 ; ANNEX C	
L1 / T	0.000			
Lf / T	2.200			
Lf	7.009	m		
ALLOWABLE LATERAL DEFLECTION = Q x (L1 + Lf) ³ / 12EI	5.000	mm		
LATERAL LOAD CARRYING CAPACITY, Q	80.066	kN		



13.BRIEF GEOSCIENTIFIC AND ELECTRICAL RESISTIVITY TEST (ERT) PROSPECTING TO FIND OUT THE SOIL RESISTIVITY FOR THE PROPOSED CONSTRUCTION OF NEW AMMONIA HANDLING CONTROL ROOM IN FACT AT UDYOGAMANDAL COMPLEX, KOCHI, KERALA

INTRODUCTION

The aim of this Investigation is to find out the Soil Resistivity for solar plant Construction location. The investigated area situated Conducting Soil Investigation Work at new Ammonia handling control room in FACT at udyogamandal complex, kochi, kerala and to conduct a geophysical prospecting survey. These investigations assess the Soil thickness of soil layer, Weathered Formation bed level and Moisture content, Water bearing layer, Rock Formation of fracture and fissured layer, Structural Disturbance such as Fold, Fault and lineament of the subsurface. This report details the work done and study conducted along with Electrical resistivity test recommendations.

PHYSIOGRAPHY:

The investigated area is a flat terrain. The top black in color. Geologically, the entire district can be classified into a part of peninsular gneiss the widest spread group of backwater, river line and coastal alluvium, alongside hydromorphic soils particularly backwater regions conditions of poorly graded silt and sand mixtures with clay in many parts of Ernakulam Kerala. The southern domain of Keral is characterized by low lying areas are characterized by sedimentary deposits. The rock type is leucocratic euhedral, medium to fine grained clay and silty sand, equigranularity and well-developed gneissic banding of alternate layers of dark and light mineral is the specialty of this area which denotes the indicative of flow pattern of the rock mass. Mostly it is a concealed deposit under soil cover.



ELECTRICAL RESISTIVITY TESTING (ERT) SURVEY:-

Geophysical survey in the form of Electrical Resistivity Testing (ERT), had conducted in the investigated area to assess the lateral variations, vertical in homogeneities and the sub surface geology with respect to the Resistivity of Soil Formation. In these studies, 02 ERT stations have conducted within the investigated area. The details of Electrical Resistivity Testing stations have furnished below. The depth probed is around 10.00m below ground level.

METHODOLOGY AND DATA ACQUISITION:-

Electric Resistivity Method is well established for delineating lateral as well vertical discontinuities in the resistive structure of the Earth's subsurface. The present study makes use of Electric Resistivity Testing (ERT) to delineate the Vertical Resistivity structure at depth. Schlumberger four electrode set up was employed for making sounding measurements. Since it is least influenced by lateral in homogeneities and is capable of providing higher depth of investigation. This is four electrodes collinear set up where in the outer electrodes send current into the ground and the inner electrodes measure the potential difference.

The present study utilizes maximum current electrode separation $AB/2$. The data from this survey are commonly arranged and contoured in the form of Pseudo-section that gives an approximate of the subsurface resistivity. This technique is used for the inversion of Schlumberger ERT data to predict the layer parameter namely layer resistivity and Geo electric layer thickness. The main goal of the present study is to search the vertical in homogeneities that is consistent with the measured data.

For a Schlumberger among the Apparent resistivity can be calculated as follows

$$\rho_a = \frac{G \Delta V}{I}$$

ΔV = potential difference between receiving electrodes

G = Geometric Factor.

Rocks show wide variation in resistivity ranging from 10^{-8} more than 10^{14} ohmmeter. On a broad classification, one can group the rocks falling in the range of 10^{-8} to 1 ohmmeter as good conductors. 1 to 10^6 ohmmeters as intermediate conductors and 10^6 to 10^{12} ohmmeter as more as



poor conductor. The resistivity of rocks and subsurface lithology, which is mostly dependent on its porosity and the pore fluid resistivity is defined by Archie's Law,

$$\rho_r = F \rho_w = a \phi^m \rho_w$$

ρ_r = Resistivity of Rocks

ρ_w = Resistivity of water in pores of rock

F = Formation Factor

ϕ = Fractional pore volume

a = Constants with values ranging from 0.50 to 2.50.

SURVEY LAYOUT:-

The layout for a resistivity survey depends on the choice of the current and potential electrode arrangement, which is called electrode array. Here the present study is considered with Schlumberger array. In which the distance may be used for current electrode separation while potential electrode separation is kept on third to one fifth of the same. One interesting aspect in ERT is the principle of reciprocity, which permits interchange of the potential and current electrode without any effect on the measured apparent resistivity.

EQUIPMENT:

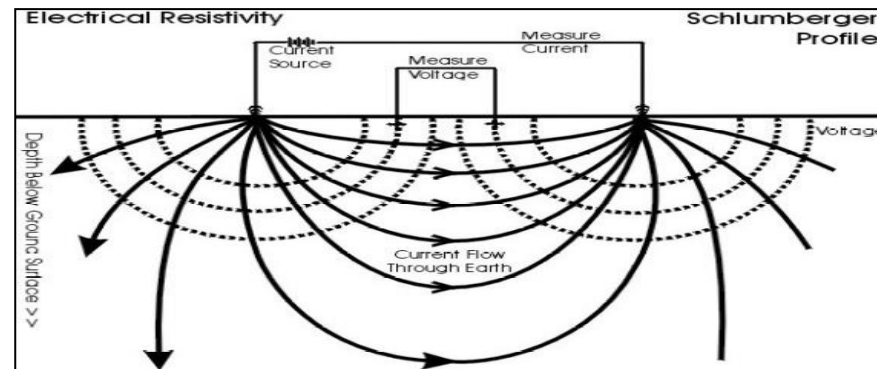


The field equipment deployed for the study is in a deep resistivity meter with a model of DDR-3. This Signal stacking Resistivity meter is a high-quality data acquisition system incorporating several innovation features for Earth resistivity. In the presence of random earth Noises the signal



to noise ratio can be enhanced by $\sqrt{N}$ where N is the number of stacked readings. This DDR-3 meter in which running averages of measurements $[1, (1+2)/2, (1+2+3)/3 \dots (1+2 \dots +16/16)]$ upto the chosen stacks are displayed and the final average is stored automatically, in memory utilizing the principles of stacking to achieve the benefit of high signals to noise ratio. Based on these above significations the signal stacking resistivity meter was used for (ERT) Electric Resistivity Testing.

MEASUREMENTS:-



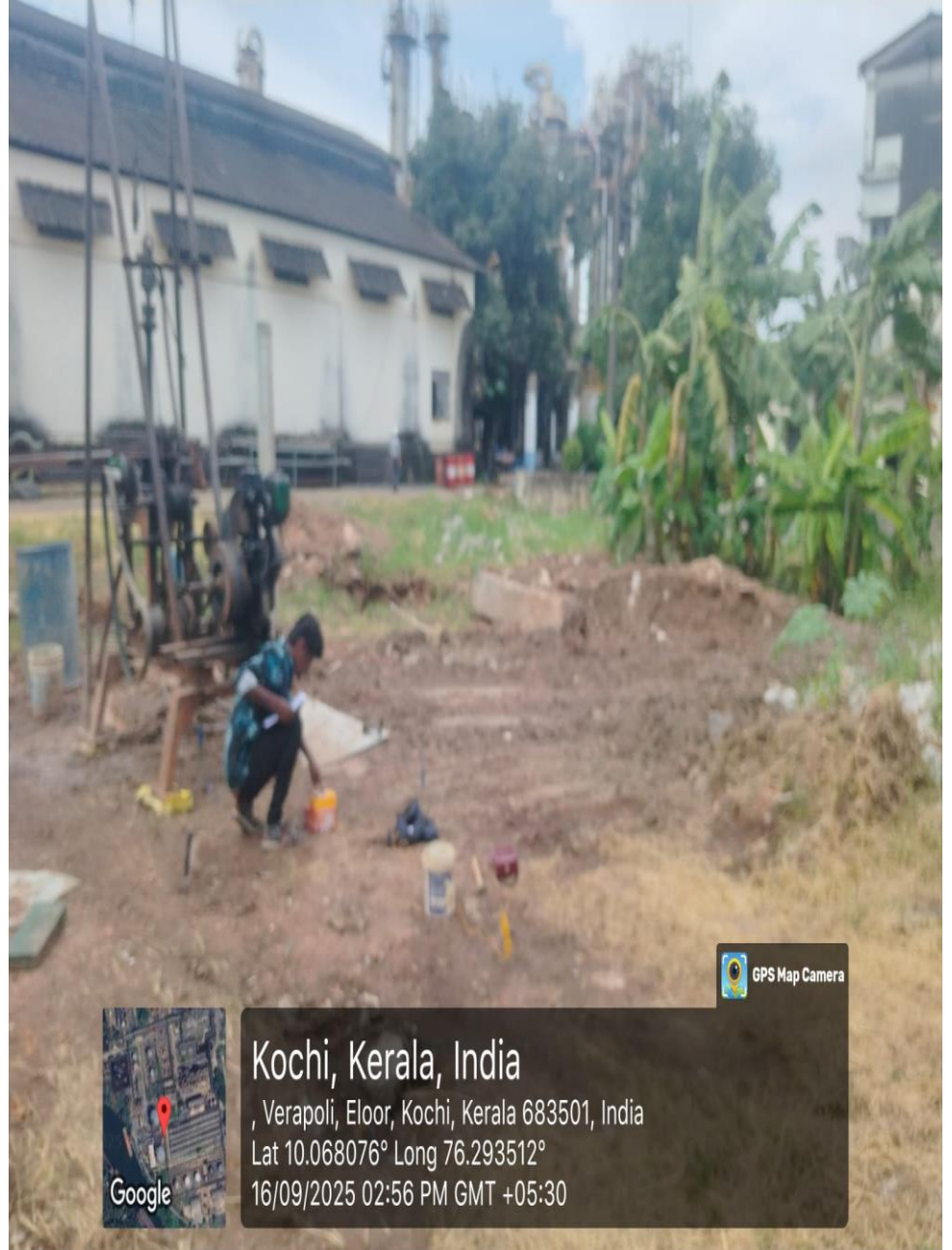
Measurements of ground Resistivity is essentially done by sending a current through two electrodes called current electrodes (C_1 & C_2) and measuring the resulting potential by two other electrodes called potential electrode (P_1 & P_2). The amount of current required to be sent into the ground depends on the contact resistance at the current electrode, the ground resistivity and the depth of interest (10.00m).

GEOPHYSICAL DATA INTERPRETATION: -

The geophysical data was obtained to study the lateral variations, vertical in homogeneities in the sub – surface with respect to the Resistivity of Soil Formation. From the interpreted data, it has inferred that the area has well for Building Construction in the investigated area.



ELECTRICAL RESISTIVITY TESTING:-





RECOMMENDATIONS

Geo physical prospecting in the form of ERT was conducted in different Stations. About location were investigated and the results are as follows:

ERT STATION - 1			
GPS LOCATION			
(LATITUDE:10 ⁰ 06'82.00"N LONGITUDE:76 ⁰ 29'35.00" E)			
LOCATION (NORTH-SOUTH SIDE)			
SL.No	AB/2 Depth in mts	Resistance R	Apparent Resistivity in Ohms
1.00	1.00	0.87	2.05
2.00	2.00	0.79	9.30
3.00	3.00	0.65	17.86
4.00	4.00	0.60	29.67
5.00	5.00	0.57	44.30
6.00	6.00	0.51	57.25
7.00	7.00	0.47	71.95
8.00	8.00	0.30	60.05
9.00	9.00	0.18	45.64
10.00	10.00	0.05	15.66
		Average Measured Resistance (ohms)	Average Calculated Resistivity (ΩMts)
		0.499	35.373
LOCATION (EAST - WEST SIDE)			
SL.No	AB/2 Depth in mts	Resistance R	Apparent Resistivity in Ohms
1.00	1.00	0.67	1.58
2.00	2.00	0.58	6.83
3.00	3.00	0.46	12.64
4.00	4.00	0.41	20.28
5.00	5.00	0.36	27.98
6.00	6.00	0.32	35.92
7.00	7.00	0.21	32.15
8.00	8.00	0.18	36.03
9.00	9.00	0.10	25.36
10.00	10.00	0.07	21.93
		Average Measured Resistance (ohms)	Average Calculated Resistivity (ΩMts)
		0.336	22.068



ERT STATION - 02			
GPS LOCATION			
(LATITUDE:10 ⁰ 06'82.00"N LONGITUDE:76 ⁰ 29'35.00" E)			
LOCATION (NORTH-SOUTH SIDE)			
SL.No	AB/2 Depth in mts	Resistance R	Apparent Resistivity in Ohms
1.00	1.00	1.96	4.62
2.00	2.00	1.65	19.43
3.00	3.00	1.51	41.49
4.00	4.00	1.43	70.72
5.00	5.00	1.17	90.93
6.00	6.00	1.054	118.32
7.00	7.00	0.89	136.24
8.00	8.00	0.64	128.11
9.00	9.00	0.52	131.85
10.00	10.00	0.36	112.76
		Average Measured Resistance (ohms)	Average Calculated Resistivity (ΩMts)
		1.118	85.445
LOCATION (EAST - WEST SIDE)			
SL.No	AB/2 Depth in mts	Resistance R	Apparent Resistivity in Ohms
1.00	1.00	1.74	4.10
2.00	2.00	1.57	18.49
3.00	3.00	1.32	36.27
4.00	4.00	1.13	55.88
5.00	5.00	0.86	66.83
6.00	6.00	0.71	79.70
7.00	7.00	0.65	99.50
8.00	8.00	0.41	82.07
9.00	9.00	0.30	76.07
10.00	10.00	0.22	68.91
		Average Measured Resistance (ohms)	Average Calculated Resistivity (ΩMts)
		0.891	58.782



RECOMMENDATIONS

Location – 1 & 2

The interpreted results are given in Locations **1 & 2** east side, west side, south and north side of the locations reveals that the upper layer having a resistivity of various from 3.00 to 136.00 ohm.m indicates the presence of sub-surface mixed sand silt with clay mixtures soil then poorly graded sand with silt to be up to 10.00m. The average cumulative resistivity varying from 50.00 ohm.m up to 10.00m are present in poorly graded sand. Recommendation for this study construct to the Earth work up to 5.00m depth.

SOIL CORROSION RESISTIVITY:

(No special precautions required since the soil is non-corrosive to moderate corrosive)

Pin Spacing (Meters)	Soil Resistivity (ohm-m)	Effective Resistivity
Location – 1 & 2	2.00 to 136 ohm.m	Essentially moderate Corrosive Soil



14.CHEMICAL ANALYSIS OF SOIL AND WATER SAMPLES: -

14.1. CHEMICAL ANALYSIS OF SOIL SAMPLES: -

Borehole Location	pH Value	Chloride as Cl (%)	Sulphate as SO₄ (%)	Carbonate as CaCO₃ (%)
<i>Test Method</i>	<i>IS 2720 Part 26</i>	<i>IS 3025 Part 32</i>	<i>IS 2729 Part 27</i>	<i>IS 2720 Part 23</i>
1	7.40	0.59	0.73	1.86
2	6.90	0.63	0.80	2.05

Note:-

- If you want to calculate the results in mg/kg, multiply with 10^4 with the result percentages.



14.2. CHEMICAL ANALYSIS OF WATER SAMPLES: -

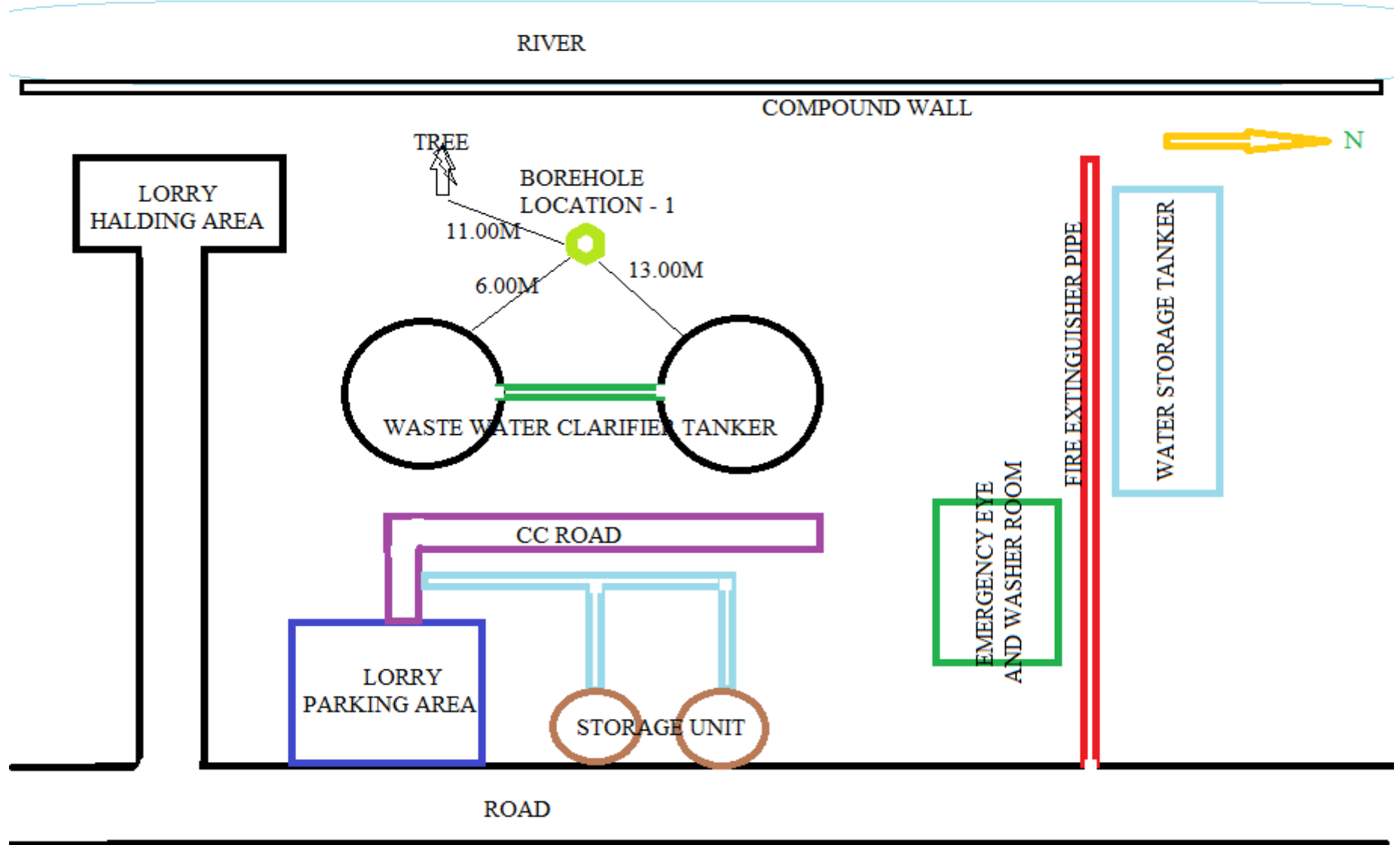
S.NO	PARAMETERS	RESULTS		LIMITS (IS 10500:2012)	TEST METHOD
		BH -1	BH -2		
1	pH	7.11	7.30	6.50 – 8.50	IS :3025 (Part 11):2022
2	Chloride as Cl	35 mg/l	42.00 mg/l	250 mg/l	IS :3025 (Part 32):1988 – RA -2019
3	Sulphate as So ₄	176 mg/l	168 mg/l	200 mg/l	IS :3025 (Part 24):1986
4	Carbonate CaCO ₃ (Carbonate Alkalinity)	15 mg/l	10 mg/l	-	IS :3025 (Part 23):2023

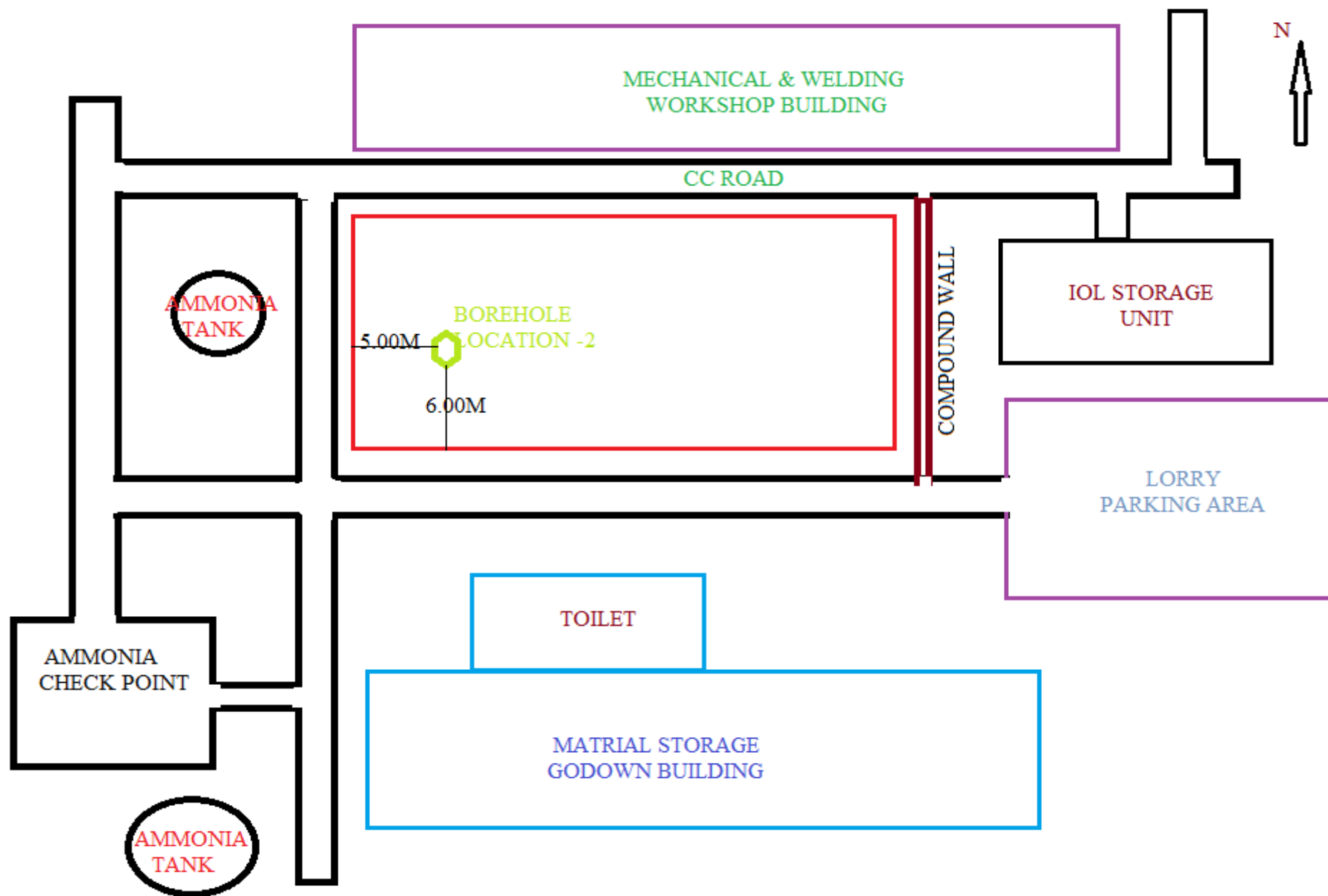
Note: -

- NTU- Nephelometric Turbidity Unit.
- 1mg/l = 1 ppm/μmhos – micromhos
- BDL – Below Detectable Level (Detectable Level – 0.001 Mg/l)



15. BOREHOLE LOCATION DRAWING: -







16.BIS CODE & REFERENCES: -

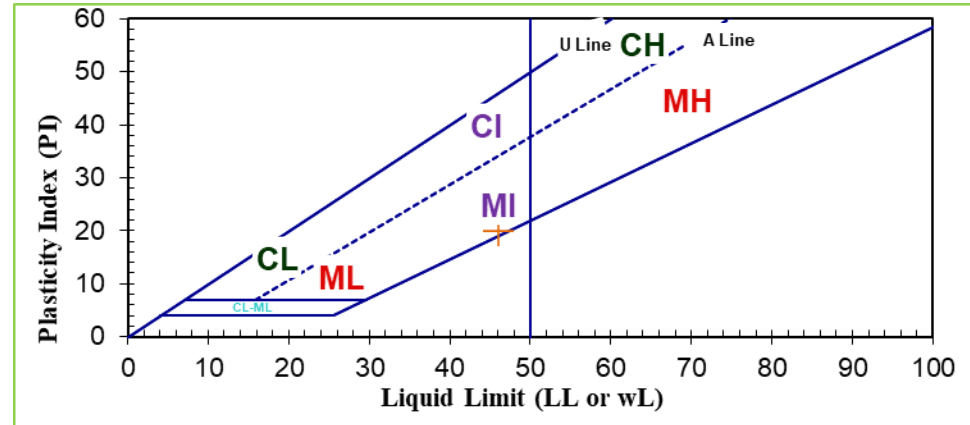
S. NO	CODE NUMBERS	DESCRIPTION
1	IS 1888: 1982	Method of load tests on soils
2	IS 6403: 1981	Code of practice for Determination of Bearing capacity of foundation.
3	IS 1892: 1979	Code of practice for subsurface investigations for foundations.
4	IS 8009(Part-1&2) 1976	Code of practice for calculation of settlement of foundations
5	IS 2131: 1981	Method of standard penetration test for soils
6	IS 2132: 1986	Code of practice for thin-walled tube sampling of soils
7	IS 2720 Part 1 to Part 31 & IS 2720 Part 33 to Part 41	Methods of Test of Soils
8	IS 3043 :1987	Code of practice of Earthling
9	IS 4464: 1985	Code of practice for presentation of drilling information and core description in foundation investigation
10	IS: 2911 (PART 1/ SEC 1- 4) - 1979	Code of practice for pile design
11	IS 6935: 1973	Method of determination of water level in a borehole



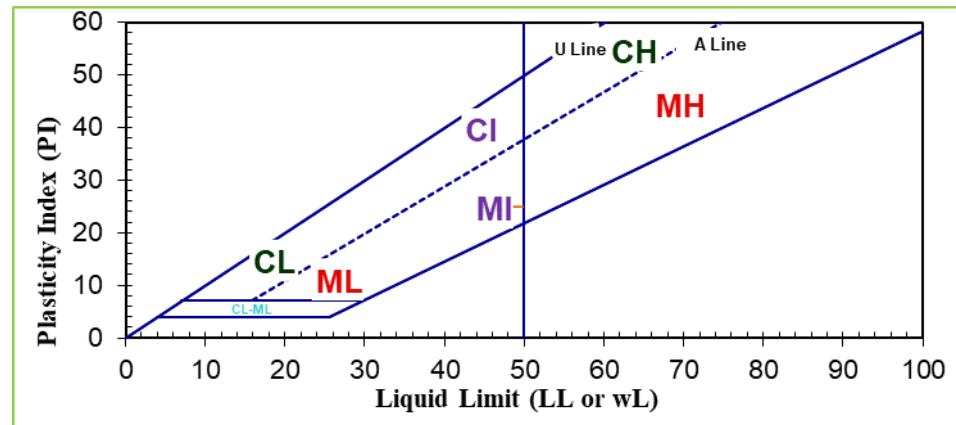
17.LABORATORY TEST RESULT GRAPHS: -

17.1. INDEX TEST (Atterberg Limit): -

Liquid Limit (LL or w_L) (%):	46
Plastic Limit (PL or w_P) (%):	20
Plasticity Index (PI) (%):	26



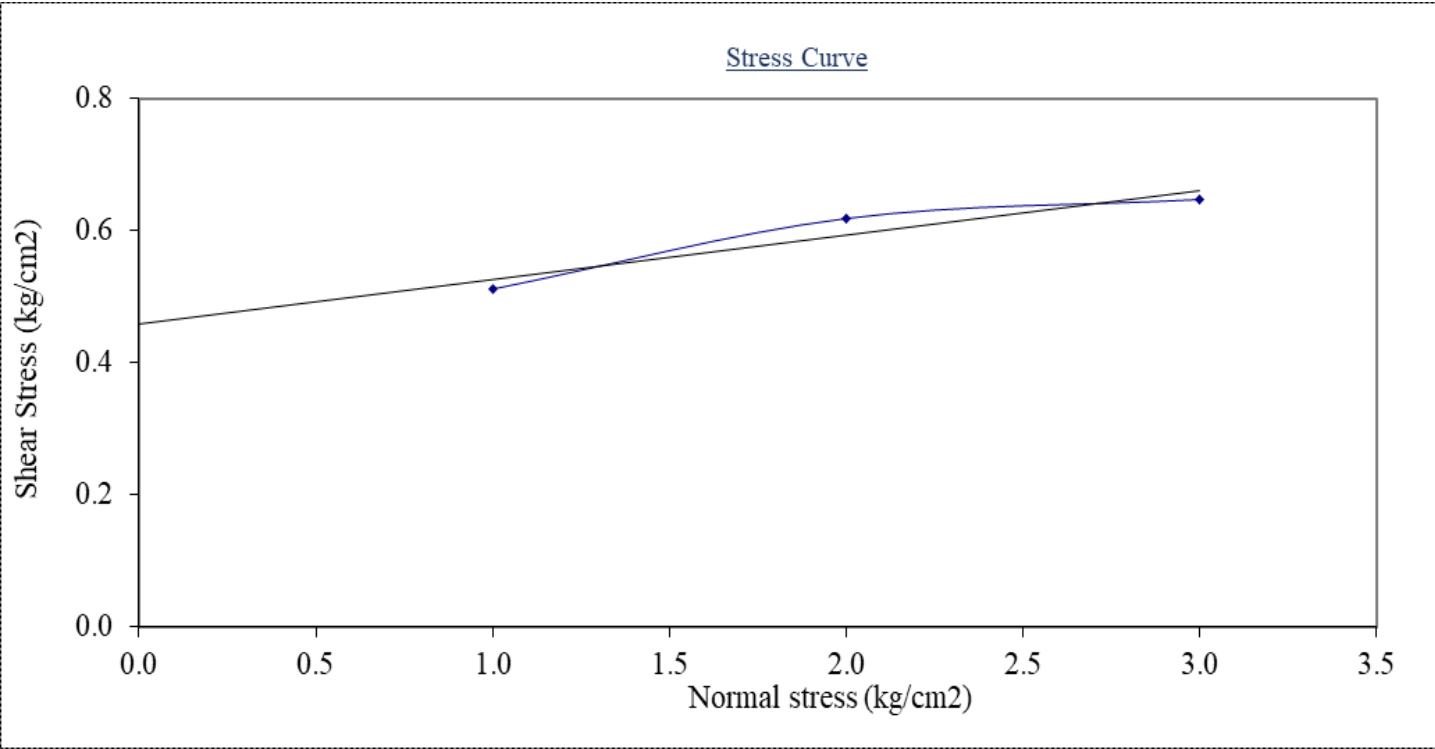
Liquid Limit (LL or w_L) (%):	48
Plastic Limit (PL or w_P) (%):	25
Plasticity Index (PI) (%):	23





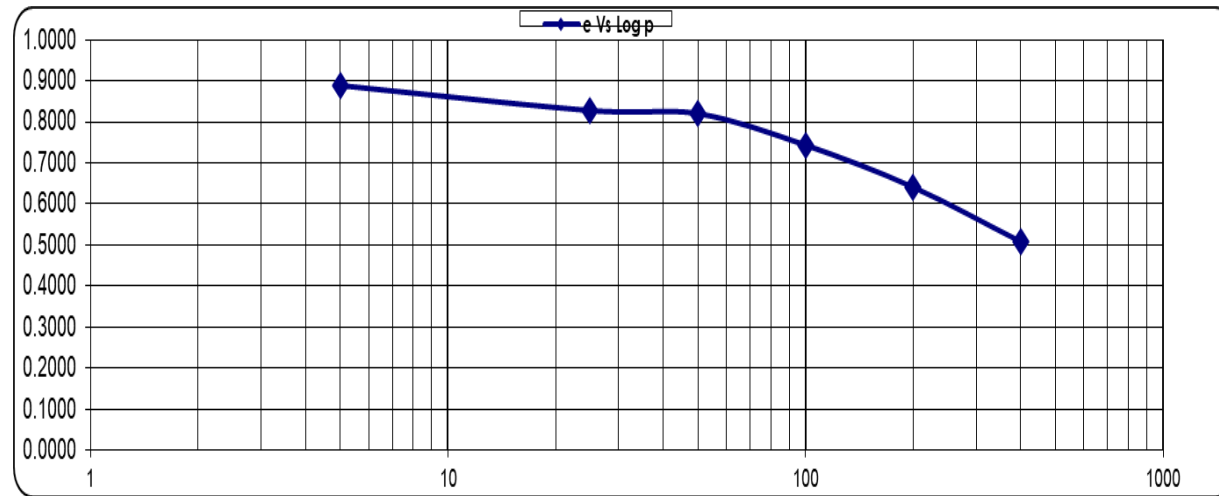
17.2. DIRECT SHEAR TEST: -

Shear Stress ' δ ' (kg/cm ²)	Normal Stress ' σ ' (kg/cm ²)
0.51	0.5
0.62	1.0
0.65	1.5
c (kg/cm ²)	ϕ (Deg)
0.46	8

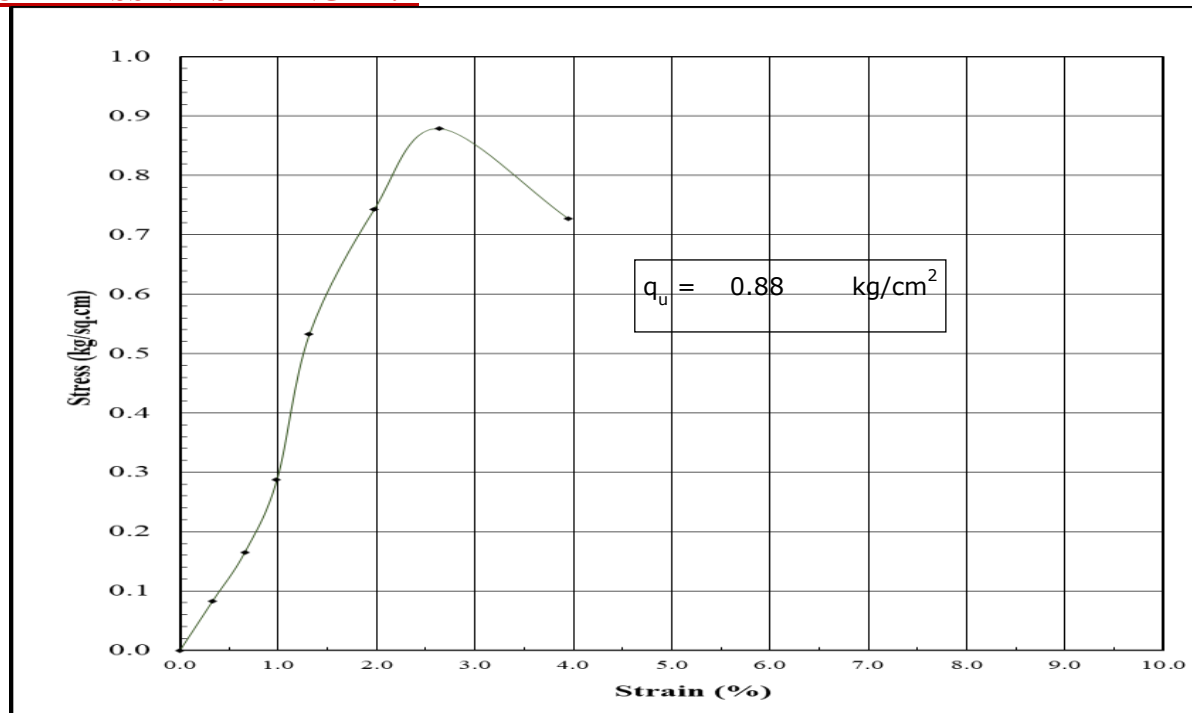




17.3. CONSOLIDATION TEST: -



17.4. UNCONFINED COMPRESSIVE STRENGTH: -



**PROJECT : NEW DCS CONTROL ROOM FOR AMMONIA HANDLING
FACILITY IN PETRO UC**

**MECHANICAL SCOPE OF WORK FOR ENGAGING ENGINEERING
DESIGN CONSULTANT FOR CONSTRUCTION OF DISTRIBUTED
CONTROL SYSTEM(DCS) BUILDING FOR AMMONIA HANDLING
AT FACT UC**

**ENGAGING ARCHITECTURAL AND ENGINEERING DESIGN CONSULTANT
FOR CONSTRUCTION OF DCS BUILDING FOR FACT UC AT
UDYOGAMANDAL, ELOOR.**

1	21.02.26	Second issue	BVN	LA	RM
0	24.01.26	First issue	BVN	LA	RM
REV. NO.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED

A. SCOPE OF WORK

1. GENERAL

1.1 The Engineering and design consultant shall prepare

- a) The tender documents & drawings required for the construction of DCS building and allied facilities.
- b) The estimates required for the procurement, erection, commissioning, and testing of items.

Below listed items (2(I), 2(II), 3(III)) shall be considered for 1.1(a), 1.1(b) on item rate basis.

1.2 Post tendering activities such as issue of Good for construction/fabrication drawings.

1.3 Site visit and necessary intervention and document generation for addressing site related queries/issues.

1.4 Preparation of As-built drawings.

1.5 Vendor document review for mechanical items is included in the scope of Engineering and design consultant.

1.6 Vendor document review for instrumentation items is excluded in the scope of Engineering and design consultant.

2. Bidder to submit tender documents and estimate for:

I. HVAC SYSTEM INCLUDING PRESSURISATION AND CHEMICAL FILTRATION

- a. Complete HVAC system including pressurisation and chemical filtration for designated areas including Rack room, console room, Uninterruptible Power Supply room (UPS), passage, and airlock room. Chemical filtration shall address ammonia and other possible toxic/hazardous gases in the premises of Air Handling Unit (AHU) and fresh air intake point.
- b. Ventilation to be provided in AHU Rooms, Dining room, Toilets, Rest Room and Clean agent Room. System shall include refrigeration unit, Condenser unit, Insulation, acoustic control, vibration isolation, Air handling unit, chillers, volume control dampers, filters, chemical filters, louvers, ducting with adequate support, refrigerant piping, condenser water piping (Cooling water shall be supplied at the battery limit by purchaser) etc as applicable.
- c. Conditions to limit Ozone Depletion Potential (ODP) and Global Warming Potential (GWP).
- d. Recommend Heating Ventilation and Air Conditioning (HVAC) system type.
- e. Detailed requirements as per specifications/design philosophy attached shall be considered.

II. CLEAN AGENT SYSTEM

- a. Flooded type Clean agent system for the designated area having both automatic and manual activation.
- b. Integration with HVAC.
- c. Compliance with statutory requirement
- d. Detailed requirements as per specifications/design philosophy attached shall be considered.

III. TESTING & COMMISSIONING

- e. Full testing and commissioning of all mechanical systems shall be included in the tender documents for the DCS building and allied facilities.
- f. Includes shop tests and site tests, from raw material to final site acceptance test, including following items such as test certificate verification, visual, Non-Destructive Testing (NDT),

painting tests, functional checks, performance guarantee test run, equipment alignment, noise level, vibration and submission of test reports.

- g. Third Party Inspection by reputed agency shall be considered. Cost for the same shall be included in supplier scope.

However the above mentioned scope shall be considered as indicative. Engineering and design consultant shall finalise specification with due diligence and understanding. Any other drawings or technical specification, not defined in the scope of work but required for the satisfactory completion of the Project shall be under the scope of the Bidder.

B. SPECIFIC REQUIREMENTS OF THE PROJECT

- 1.1 The tender documents prepared by the Engineering and design consultant shall cover engineering, design, cost estimation, supply, installation, inspection, testing, and commissioning of all mechanical systems listed in this document.
- 1.2 All works shall comply with applicable codes, standards, and statutory regulations.
- 1.3 Equipment shall be located ensuring easy access for maintenance.
- 1.4 Suitable lifting provisions (lifting beam/Chain Pulley Block (CPB)/hook) shall be considered for all necessary equipment.
- 1.5 The Engineering and design consultant shall be held responsible for the correctness of the deliverables issued by them.

C. DELIVERABLES UNDER THE SCOPE OF ENGINEERING AND DESIGN CONSULTANCY

Contractor's deliverables shall be comprehensive and cover all documents necessary for the Tendering /procurement activity. Contractor's deliverables shall include, but not be limited to, the following:

i. Deliverables During Tender Preparation for DCS Building and Allied Facilities

- 1.1 Detailed Estimate with split-up of item-wise cost.
- 1.2 Scope of work for HVAC & Clean agent system for DCS building.
- 1.3 Design philosophy/Special requirements of the project (i.e HVAC & Clean agent system)
- 1.4 List of items/equipment
- 1.5 Duly filled Equipment and System Datasheets
- 1.6 Technical specifications, data sheets, and other engineering deliverables such as performance curve, General arrangement (GA) drawings along with native files and soft copies, equipment sizing documents etc.,.
- 1.7 Specific vendor acceptance criteria for HVAC system including pressurisation, Clean Agent System along with list of credentials to be submitted for vendor approval.
- 1.8 List of Mandatory spares.
- 1.9 Vendor data requirement at offer stage, post award of contract, and as built.
- 1.10 General conditions of offer evaluation, vendor data submission, and vendor data review.
- 1.11 Statutory requirements
- 1.12 HVAC Design Calculations with native files including
 - a) Refrigeration tonnage calculation,
 - b) CFM calculation for fresh air, pressurisation, and recirculation.
 - c) Pressurisation level calculation/basis.
 - d) Blower suction & discharge pressure and capacity calculation,

TECHNICAL PROCUREMENT SPECIFICATION	SCOPE OF WORK, SPECIFIC REQUIREMENTS & DELIVERABLES MECHANICAL ITEMS	32775 -01-PS-001 SW- DC
		Page 4 of 4 R1
e) Duct sizing f) Power calculation. g) Other relevant calculation if applicable. 1.13 Clean Agent Design Calculations with native files including a) Clean Agent quantity and cylinder capacity calculations. b) Pressure requirement and flow rate calculations. System flow calculations shall be performed using a calculation method listed or approved by the authority having jurisdiction (e.g. LPCB/FM/UL/NFPA). c) System design including computerized flow calculations shall be submitted. d) Clean Agent Selection basis. 1.14 Layout and elevation drawings for HVAC and Clean Agent system. 1.15 GA, cross sectional drawings 1.16 List of all applicable codes and standards to be followed including NBC, ASHRAE, and NFPA. 1.17 Scope of inspection & Test procedures including reference standard. 1.18 Ducting and refrigerant/Clean Agent piping layout. 1.19 Equipment foundation size and load data. 1.20 Check list of critical parameters/specification/scope/test/code compliance. ii. Deliverables During Construction of DCS Building and Allied Facilities 1.1 Equipment foundation size and load data. 1.2 Good for construction/fabrication/manufacturing drawings. 1.3 Site visit and necessary intervention and document generation for addressing site related queries. Per diem rates for site visits after award of contract shall be quoted separately (Refer 32775-12-SW-001). 1.4 Preparation of As-built drawings.		
FACT ENGINEERING AND DESIGN ORGANISATION		 FEDO

**The following documents ([Mechanical Specifications – HVAC & Clean agent](#))
are for reference purpose to the
Design Consultant**

MECHANICAL SPECIFICATION (Reference Purpose)		32775-01-PS-001 AC			
		PAGE 1 OF 1			
TPS No	32775-01-PS-001				
STATUS	☒ ENQUIRY ☐ COMMITMENT				
ORIGINATING DEPT.	M&MH				
P.O. / W.O. No.					
PROJECT	NEW DCS CONTROL ROOM FOR AMMONIA HANDLING FACILITY IN PETRO UC				
LOCATION	FACT UC				
CLIENT	FACT UC				
PURCHASER	M/s FACT				
VENDOR	_____				
ITEM : HVAC SYSTEM INCLUDING PRESSURISATION AND CHEMICAL FILTRATION FOR DCS CONTROL ROOM					
4					
3					
2	12.03.26	FOR TENDER PURPOSE	BVN	LA	RM
1	23.02.26	FOR TENDER PURPOSE	BVN	LA	RM
0	09.01.26	ENQUIRY ISSUE	BVN	LA	RM
REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED
FACT ENGINEERING AND DESIGN ORGANISATION  FEDO					

TECHNICAL PROCUREMENT SPECIFICATION	ATTACHMENTS	32775-01-PS-001	ATT-AC
		PAGE	1 OF 1

[illegible]

1. INTRODUCTION

- 1.1. This specification gives the minimum user requirements for a new energy efficient inverter ductable water cooled air conditioning system, including pressurization and chemical filtration, which shall be provided in the proposed ammonia DCS control room building in FACT Udyogamandal Complex. The system offered by the vendor shall ensure proper environmental conditions as required for the men and equipment in the proposed areas in the proposed DCS Control Room for Ammonia Handling Facility in Petro UC.
- 1.2. The Fertilisers And Chemicals Travancore (FACT) is a Government of India Enterprise engaged in the manufacture of fertilizer/chemical/petrochemical products, engineering consultancy and engineering fabrication. FACT-Udyogamandal Complex (FACT-UC) is a division of FACT located at Udyogamandal, Kochi, Kerala that manufactures intermediate and products like sulphuric acid, oleum, ammonia, ammonium phosphate, ammonium sulphate, caprolactum etc.
- 1.3. New DCS Control Room for Ammonia Handling Facility in Petro UC is to house the new DCS system including operating stations, system and marshalling cabinets, UPS, other related equipment and control room personnel.
- 1.4. The total area to be air conditioned is approximately 180 M2. Height to Ceiling is approximately 3m. The layout of proposed control room building is attached. Final area shall be considered as per THE latest layout.
- 1.5. Estimated cooling and air flow rate are indicative. Vendor shall guarantee the inside conditions throughout the year irrespective of variation in outside weather condition. Various sensible and latent Heat loads such as infiltration, fresh air, conduction, fenestration, occupancy, equipment, etc. shall be considered and pressurization, air change, recirculation and refrigeration tonnage calculation in line with ASHRAE design standard shall be submitted.
- 1.6. The system, including each and every component/ part in it, shall be completely new and unused.
- 1.7. The Vendor shall provide system warranty as specified in this specification.
- 1.8. Along with the technical bid, the Vendor (Item rate contractor) shall also quote rate per annum for AMC of the system for a period of two years from date of expiry of guarantee. The AMC shall include all maintenance services including supply of spares (comprehensive) year wise. Please see

2	12.03.26	Third issue	BVN	LA	RM
1	23.02.26	Second issue	BVN	LA	RM
0	10.01.26	First issue	BVN	LA	RM
REV. NO.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED

Section "Annual Maintenance Contract". AMC quote shall not be considered for price bid evaluation.

- 1.9. An unpriced copy of the price bid for supply, installation & Commissioning shall be submitted along with the technical bid, for technical evaluation by the Item rate contractor.

2. CODES AND STANDARDS

- 2.1. The design, selection of equipment, fabrication, installation, testing and commissioning of the Air Conditioning System including pressurisation, chemical filtration and all connected accessories shall conform to the widely acceptable codes and standards. Latest revisions at the time of tendering shall be considered. ASHRAE design standard and NBC requirements shall be considered. The system shall be in compliance with all statutory requirements.

3. BUILDING DETAILS

- 3.1. The following rooms in the Control Room building are to be provided with conditioned air.

Ground Floor	
Room-1	(i) Rack room (ii) Console room
Room-2	UPS room
Room-3	Passage

- 3.2. All the rooms on ground floor, mentioned above except airlock have both false flooring and false ceiling and UPS room will have tiled floor and false ceiling. Approximate effective ceiling height of the rooms will be 3 m from false/ tile floor.

- 3.3. Approximate electrical loads in the respective rooms are shall be filled by bidder as given below.

ROOM	ROOM DESCRIPTION	KW	REMARK
Room-1	Shall be filled	Shall be filled	Shall be filled
Room-2	Shall be filled	Shall be filled	Shall be filled
Room-3	Shall be filled	Shall be filled	Shall be filled

- 3.4. Approximate number of persons occupying the Room 1 shall be considered as 6. For other rooms 2 nos of occupancy shall be considered for design purpose.

- 3.5. Vendor shall submit the heat load calculation considering all relevant details including the room dimensions, doors, windows, electrical loads, number of persons occupying the room and spare unit requirement.

4. SCOPE OF SUPPLY AND WORK

Vendor's (Item rate contractor) scope shall include:

- 4.1. Design, manufacture, supply, erection, inspection (Including Third Party Inspection), shop tests, onsite tests and commissioning of the inverter ductable water cooled Air Conditioning system including pressurization, chemical filtration and all accessories as specified herein with 100% capacity spare unit.
- 4.2. Vendor shall furnish psychrometric mixture conditions and the processes which air undergoes in the conditioning equipment.
- 4.3. Vendor shall furnish all data sheets and drawings for purchaser's review before commencement of fabrication/ construction.
- 4.4. Purchaser shall review the data during detailed engineering after award of contract, within the framework of this requisition. All comments of Purchaser shall be taken care without any cost and time effect.
- 4.5. Chipping of RCC slab for duct hangers is not allowed. Vendor shall provide anchor fasteners. Complete supporting structure for duct/cable/pipe etc. shall be provided by vendor.
- 4.6. Air Conditioning units shall provide cooling and dehumidification in summer/monsoon by handling mixture of fresh and return air. Reheating shall be provided in monsoon to achieve specified inside conditions by means of finned strip heaters actuated by humidistat, backed up by safety thermostat.
- 4.7. Noise level in A/C Plant/Equipment Room shall not exceed 85 dBA at 1 meter away from source.
- 4.8. Vendor shall ensure that fixing arrangement of diffusers is such that there is no load on false ceiling. Diffusers shall be firmly fixed with the ductwork.
- 4.9. All couplings, gears and exposed rotating parts shall be provided with appropriate guards.
- 4.10. Pneumatic operated combined Fire and Smoke Dampers shall be provided in supply air duct and return air opening/path and in fresh air intake arrangement.
- 4.11. Two-stage air filtration shall be provided. In first stage, pre-filters shall be provided, these shall have 80% efficiency upto 20 microns. In second stage, fine filters at downstream shall be provided,

- these shall have 95% efficiency upto 5 microns.
- 4.12. Additional chemical filtration shall be provided for fresh air intake from Ammonia and petrochemical atmosphere.
 - 4.13. Air-conditioning equipment shall be interlocked with gas/smoke detection and fire fighting system. Supply air shall be cut off and isolated for fire scenario and activation of clean agent.
 - 4.14. All the piping inside the battery limit for the equipment shall be in vendor scope.
 - 4.15. Supply of all ducting and piping for the system and their erection including fixing of anchor fastener on walls and ceilings. Fabrication, supply and installation of insulated refrigerant lines/ control lines/ other lines shall be under the scope of the vendor.
 - 4.16. Moving, handling and safe storage of items of the system at the site.
 - 4.17. Supply and fixing of diffusers for supply air and return air.
 - 4.18. Supply and fixing of all insulation materials required for efficient operation of the system. This includes thermal and acoustic insulation of the supply air ducts, plenum, refrigerant lines etc.
 - 4.19. Supply and laying of all required power and control cables for the new system including the connection at purchaser's Load Centre and vendor's end, in the same building.
 - 4.20. All incidental works /minor civil works associated with the installation and commissioning of the system including supply of materials for such work. All floors/surfaces modified/reworked shall be brought to the original finish after the erection work including painting thereof.
 - 4.21. First charge of consumables like oil, refrigerants etc. as required including their filling shall be in vendor's scope. Specification for the same shall be included in the technical bid.
 - 4.22. Structural work required for installing the units, plenum, ducts etc.
 - 4.23. All commissioning spares required during erection, startup and initial operation of all the units/systems till successful commissioning and taking over of the system shall be under the vendor's scope.
 - 4.24. Drain piping shall be under the scope of the vendor.
 - 4.25. Vendor's scope shall include clearing of all debris and scrap items from the site after the installation work. Scrap items shall be deposited only at the place earmarked for the same.
 - 4.26. Furnishing all drawings/documents as per the TPS.
 - 4.27. Any other work or supply of any other item that may not be specifically mentioned in this specification but found required for the efficient working of the system and the successful

completion of the job.

- 4.28. Vendor's scope shall include fixing of thermostat and measuring instruments with suitable digital/analog indicators for display of instantaneous temperatures /humidity in (i) Control room (ii) UPS room.

5. SPECIAL REQUIREMENTS OF THE PROJECT

- 5.1. The Air Conditioning System shall consist of inverter type compressor units with water cooled condensers, Air handling unit, refrigerant piping, pre filters, fine filters, chemical filters, supply duct, return duct, fresh air duct with additional blower if required, recirculation duct, louvers, flow control dampers, fire dampers, electrical panel, operating and control devices including remote control operation from the conditioned space, indoor condition displays for temperature and humidity.
- 5.2. The proposed tentative total operational capacity of the HVAC system for the control room building is minimum 30 TR. Standby capacity shall be 100%. Total installation capacity including standby shall be minimum 60 TR. However vendor shall calculate the refrigeration tonnage requirement to meet the specified indoor condition, and offer higher capacity if required, without any cost implication to Client.
- 5.3. Power isolation of individual units shall not affect the functioning of other units and humidity controller Duct heater units in each room shall be provided so as to prevent any type of condensation inside the control room and shall be auto controlled.
- 5.4. Ventilation to be provided in AHU Rooms, Dining room, Toilets, Rest Room and Clean agent Room.
- 5.5. It shall be the responsibility of the vendor to ensure that the system is well accommodated in the allotted space. Offers that cannot satisfy this requirement shall be rejected outright.
- 5.6. The supply air main ducting shall run above the false ceiling to the conditioned spaces and the conditioned air shall be distributed through diffusers which are to be mounted on ceiling.
- 5.7. The compressors shall be inverter scroll type.
- 5.8. Refrigerant shall be eco –friendly R 407C/equivalent
- 5.9. Before starting manufacturing/ fabrication, it shall be vendor's responsibility to take approval from the purchaser for the system layout, data sheets and equipment general arrangement.
- 5.10. All MS/CS materials must be shot-blasted as per FACT/FEDO standard.
- 5.11. The control system shall preferably be Microprocessor/ Microcontroller/ PLC based. Switching on/

off of individual compressors in the units and duct heaters shall be done automatic, depending upon the air conditioning load/ air quality at that particular time.

- 5.12. Plenum required for the new system shall be fabricated using GI sheet of thickness not less than SWG 22. Adequate size of the plenum shall be ensured for noise-free, vibration-free operation of the system. All the air conditioning units including stand-by units shall be connected to the plenum. It shall be possible to switch between the working and standby units without any difference in performance of the system.
- 5.13. Motor operated dampers shall be provided between each unit and plenum for isolating the idle/ standby units and the operation can be performed from ground level.
- 5.14. Supply and installation of electrics for the system including motor starters, contactors, fuses, overload relays, push buttons, selector switches, indication lamps, digital indicators, meters, gauges, thermometers, connectors etc. required for the operation of compressor, blower etc. shall be in the scope of the vendor.
- 5.15. All internal connections required like power and control wiring shall be under the scope of the vendor.
- 5.16. Necessary protective devices shall be provided for all electrical/ electronic equipment.
- 5.17. Necessary control devices like temperature sensors, transmitters, thermostat, pressure switch etc. as required shall be provided for smooth functioning of the system.
- 5.18. All meters, gauges, thermometers provided shall be duly calibrated.
- 5.19. The vendor is advised to visit the site and confirm the site conditions before quoting.

6. Design Data

6.1.1. Outside design data

Location	DBT (°C)	WBT (°C)	% RH
ASHRAE KOCHI, India	As per ASHRAE for KOCHI, India	As per ASHRAE for KOCHI, India	As per ASHRAE for KOCHI, India

6.1.2. Inside design data

	DBT (°C)	% RH	Air Quantity
Control room building	23	55 ± 5	In line with filter specifications

6.1.3. Equipment Heat Load Calculations (AS PER DETAILED ENGINEERING)
6.1.4. Vendor shall also consider the following

i	Pressurization	:	Considered for all air-conditioned areas including console room, rack room, UPS room, and passage
ii	Air changes / Hour	:	As per standard.
iii	Refrigerant	:	Environment friendly R407C/equivalent
iv	Hours of operation	:	24 Hrs/ 365 Days
v	Inside Over Pressurisation	:	Min. 5 mmWC (Fresh air intake shall be from safe area located approximately 40 M away from AHU room, additional blower, if required, shall be supplied by vendor. Ducting with adequate support for the same in vendor scope)
vi	Occupancy (min.)	:	6 for room 1, 2 each for room 2 and room 3
vii	Fresh Air Requirement (Pressurization) (min.)	:	Approximately 1,000 CFM (Please review and provide standard specification)
viii	Recirculation Air (min.)	:	14,000 CFM (Please review and provide standard specification)
ix	Equipment configuration	:	Refrigeration: 2 Working + 2 Standby; AHUs: 1 Working + 1 Standby
x	Refrigeration Capacity	:	30 TR Operating (Vapour Compression Refrigeration), 60TR including standby)
xi	Noise level (AHU unit)	:	<85dB
xii	Cooling Water Availability	:	Yes
xiii	Air Filters for fresh air and recirculation air	:	Pre-filter and fine filter
xiv	Additional Chemical Filtration	:	Yes for fresh air in Ammonia and petrochemical atmosphere.

xv	Electric Air Heater	:	Yes, after AHU
xvi	AHU Plant Room Ventilation	:	Wall-mounted exhaust fan
xvii	Ducting & Insulation (Supply, Return, Fresh Air)	:	Yes
xviii	Acoustic Insulation	:	Yes
xix	Air Diffusers/Grilles (Supply & Return)	:	Yes
xx	Flow Control Damper	:	Yes
xxi	Electrical (Cables & MCC Panel)	:	Yes
xxii	Controls & Instruments	:	Yes

- 6.1.5. Vendor shall calculate/ furnish equipment heat dissipation load and consider this during design load calculation.

7. SYSTEM REQUIREMENTS

7.1. COMPRESSORS

- 7.1.1. Compressors shall be of approved make and suitable for operation on R-407C /equivalent.
- 7.1.2. The compressor units shall be of inverter scroll type having adequate capacity and should be capable of operating round the clock at the stipulated ambient conditions.
- 7.1.3. Separate independent refrigeration circuit shall be incorporated for each unit along with isolation of power so that one compressor and refrigerant circuit can be undertaken for maintenance keeping the spare unit into operation.
- 7.1.4. The compressor unit shall incorporate both High Pressure and Low Pressure cutoff.
- 7.1.5. Gauge Ports should be provided at appropriate location to measure suction and discharge pressures.
- 7.1.6. Installation of compressors within the cabinet shall be on spring mounted floating platform/ anti vibration rubber pads / manufacturer's recommended approved mounting. Details of mounting to be indicated in technical bid.

7.2. CONDENSER

- 7.2.1. Material of construction for condenser tubes shall be copper and that for fins shall be aluminum.
- 7.2.2. Condenser unit fan motor shall be IP 55 or better with weatherproof outdoor grade terminal boxes.

The motors shall be capable of operating continuously in outdoor.

7.2.3. The area of tubes and fins must be designed suitably to achieve required heat discharge at design ambient and saturated condensing temperatures and to withstand the corrosive Sulphuric acid/ SO₂ atmosphere. Data regarding same must be furnished in the technical bid.

7.2.4. The fins shall be treated with anti – corrosive coating to withstand corrosive/ humid weather.

7.2.5. Supply and return cooling water piping from the battery limit shall be within the vendor's scope.

7.3. AIR HANDLING UNIT

7.3.1. Supply, installation, testing and commissioning of Double Skin Air Handling Units (DX) of horizontal configuration, constructed with 25 ± 2 mm thick thermal break profile panels with PUF insulation and epoxy-coated casing, base frame and fasteners, suitable for corrosive, ammonia/petrochemical atmosphere. Each unit shall include filter sections with non-corrosive frames, factory-assembled direct expansion refrigerant coil (minimum 6-row deep, seamless SS316L tubes with SS316L welded headers, epoxy-coated aluminium/stainless steel fins, SS flanged connections), direct-driven backward curved DIDW fan with outlet velocity not exceeding 9.2 m/s, driven by IS-certified explosion-proof IE3 motor (Zone-1/2, IP55) with guard and earthing.

7.3.2. Fresh air blower shall have standby. Chemical filtration for PM, SO₂, NO_x, NH₃ & Benzene shall also be provided..

7.3.3. Units shall be provided with SS316L low-leak volume control dampers, fire-retardant and hydrocarbon-resistant flexible connections, mixing box, thermal break profile, access doors with view windows, and electrically interlocked Ex-proof safety switches. Refrigerant piping shall be seamless SS316L, welded with TIG/orbital welding and tested for leak-proof performance. Control panels, junction boxes and all power/control wiring shall be explosion-proof/intrinsically safe with FRLSH/XLPE armoured cables. AHUs shall be integrated with Fire & Gas detection and ESD system for safe operation. Complete units shall conform to NFPA/OISD/IS hazardous area codes and be delivered in fully tested and operational condition.

7.3.4. For testing, cooling capacity of various air handling unit models shall be computed from the measurements of air flow, dry and wet bulb temperatures of air entering and leaving the coil. Flow measurements be accurately calibrated mercury-in glass thermometers. Computed results shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

7.4. FILTERS

7.4.1. Supply, installation, testing and commissioning of Fresh Air Intake Louver with filter assembly,

fabricated from heavy-duty extruded aluminium / stainless steel (SS 304/316) with epoxy / chemical-resistant coating, complete with bird mesh (SS 304), weather-resistant blades and drainable profile, suitable for outdoor installation in Ammonia and Petrochemical atmosphere. The louver shall be provided with easily removable, washable, chemical-resistant synthetic / aluminium / SS pre-filters (efficiency 90% down to 10 micron) housed in a rigid GI/SS/Aluminium frame. The assembly shall include all fixing arrangements, fasteners (hot-dip galvanized / SS), supports and sealing to prevent air leakage, as per approved drawings and specifications.

7.4.2. Additional chemical filtration shall be provided for fresh air intake from Ammonia and petrochemical atmosphere.(Shall be detailed)

7.5. FRESH AIR INTAKE

7.5.1. The fresh air intake shall be complete with

- a) Air intake louvers
- b) insect screen
- c) Manual volume control damper.
- d) Fresh air intake shall be from safe area located approximately 40 M away from AHU room, additional blower, if required, shall be supplied by vendor. Ducting with adequate support for the same in vendor scope.

7.5.2. Dampers

- a) All dampers shall be opposed blade type dampers of robust construction and tight fitting. They shall be made of G.S. sheet minimum 16 g thick and shall have brass bushes. The design, method of handling and control shall be suitable for the location and service required.
- b) Dampers shall be provided with suitable links, levers and quadrants as required for their proper operation control or setting devices shall be made robust, easily operatable and accessible through suitable access doors in the ducts. Every damper shall have an indicating device clearly showing the damper position at all times. Handles will be provided with extended arms to account for insulation thickness.
- c) Dampers shall be placed in ducts and at every branch supply or return air duct connection, whether or not indicated on the drawings, for the proper volume control and balancing of the system.

7.5.3. Motorised combination smoke & fire damper.

All supply/return air duct or path at AHU room wall or slab crossing shall be provided motorised combined smoke and fire damper. The fire rating shall be of 90 minutes fire damper blades and outer frame shall be formed of 1.6mm galvanised sheet steel. The damper blade shall be privoted spindles in self lubricated bronze bushes, stop seals shall be provided on top and bottom of the damper housing made of 16g galvanised sheet steel. Side seal shall be provided to preventing fine leakages. Fire damper shall be kept open during normal mode with the help of 230 V operated electric actuators (spring return) to providing maximum air passage without creating any noise or actuated either through electric actuator or through UL stamped electro-thermal link. The actuator shall be energized with the help of a signal from smoke detector. The fire damper shall also close due to temp rise in SA. Ducts through the electric temp sensor factory set at 165 deg F, micro switches with bakelite base will be provided to stop fan motor & give open & close signal at remote panel in case of motorised damper. In case of power failure the damper shall closed and automatically open (with spring) in case of power is 'ON'.

7.6. AIR DISTRIBUTION

7.6.1. Duct Materials:

- a) All ducts shall be fabricated from galvanized steel sheets/ aluminium sheets of minimum thickness corresponding to SWG 22.
- b) All ducts shall be fabricated and installed with best workmanship and shall be machine made with proper quality of construction and appearance. Round exposed ducts shall be die-formed for achieving perfect circle configuration.
- c) Ducts shall be sufficiently rigid, adequately supported and braced with standing seams, tees or angles of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing. All ducts shall be totally free from vibration under all conditions of operation.
- d) Spacing of flange joints shall be at 3 meters maximum. All flanges shall be joined using corrosion resistant/ passivated bolts, nuts & washers at about 125 mm center to center. Rubber lining 4 mm thick shall be used between duct flanges instead of felt, in all ducting installation.
- e) All flanges and supports shall be primer (epoxy) coated on all surface before erection and painted with epoxy paint thereafter.
- f) Duct supporting hangers shall be used at a spacing not exceeding 3 meters. Hangers shall be supported from anchor fasteners (to be provided by vendor) in the roof.

- g) Ducts shall be straight and smooth on the inside with neatly finished joints. All joints shall be made airtight with the help of sealant.
- h) Ducts shall be acoustically lined with thermal insulation as described in the Cl. 8.9.
- i) Ducts and accessories within ceiling spaces, visible from air-conditioned areas shall be provided with two coats of epoxy black finish paint.
- j) Wherever ducts of different shape/ dimensions are joined, suitable reducers/ expanders shall be used such that changes in shape /dimensions occur gradually.
- k) Whenever duct work is connected to fans, air handling units or fan coil units that may cause vibration in the ducts, a flexible connection constructed of fire retarding flexible heavy canvas sleeve at least 10 cm long securely bonded and bolted on both sides. Sleeve shall be smooth and additional independent supports shall be provided on both ends of the connecting ducts to hold them rigidly at the ends. The flexible connection shall be suitable for the pressure at the point of installation.
- l) There shall be suitable volume control dampers in the ductwork for balancing the supply air. All duct dampers shall be of GSS 16G opposed blade & of robust construction and sufficiently tight fitting. The design, method of handling and control shall be suitable for the location and service required. Dampers shall be provided with proper links, levers and quadrants as required for easy operation. Control or setting devices shall be made robust, easily operable and accessible through suitable access doors in the ducts. The position of the handle of the damper operating mechanism shall be clearly visible and shall indicate the position of the damper in the duct.

7.6.2. Supply Air & Return Air Diffusers

- a) All diffusers for supply air & return air in specified air conditioning spaces shall be in the scope of the vendor.
- b) The supply air and return air diffusers shall be of extruded aluminium sections and powder coated.
- c) Volume control dampers shall be provided with each supply air diffuser. Volume control dampers shall be key operated from the front face of the diffuser. The diffusers shall be with removable central core and concealed key.
- d) Each diffuser shall have a soft continuous rubber/foam gasket between the periphery of the diffuser and surface on which it is mounted.
- e) In no case shall any diffuser be supported on the false ceiling. The load of the diffuser shall

be borne by the duct and the collar.

- f) The diffusers shall be true to shape and will be checked with level guage before being secured in position. No distortion or warping is permitted.

7.7. PIPING

This section details requirements with respect to supply, laying and testing of pipes and balancing of all drain water and refrigerant piping required for the complete installation. All piping inclusive of fittings shall follow the applicable Indian Standards.

7.7.1. Drain Piping:

- a) Pipes for condensate drain and their fittings shall be Rigid PVC type.
- b) All pipe supports, nuts and bolts shall be mild steel, hot dip galvanized.

7.7.2. Refrigerant Piping:

- a) Supply, installation, testing and commissioning of refrigerant piping between DX condensing unit and AHU, using seamless stainless steel (SS 304L or SS 316L) heavy-duty pipes, schedule 40/80 as per design pressure. Piping shall be complete with welded joints, necessary reducers, elbows, supports with anti-vibration pads, insulation with closed-cell elastomeric / nitrile rubber insulation (with external aluminium cladding in petrochemical areas), pressure testing with nitrogen, vacuuming and charging. All materials, welding electrodes, insulation and cladding shall be suitable for use in ammonia and petrochemical atmosphere. All joints in copper piping shall be sweat joints using low temperature brazing and/ or silver solder. Before joining any copper pipe or fittings, its interiors shall be thoroughly cleaned using acetone/equivalent. The piping shall be continuously kept clean of dirt etc. while constructing the joints. Subsequently, it shall be thoroughly blown out using carbon dioxide/ nitrogen.
- b) The sizing of refrigerant lines shall be compactable to the individual unit capacity.

- 7.7.3. All standard practice/ tests as per standards shall be conducted and recorded before the final commissioning activity. The commission report shall contain all details of each activity.

7.7.4. Piping Installation:

- a) For laying of pipes vendor shall use the specific openings already provided in buildings and other structures.
- b) Piping shall be properly supported on, or suspended from stands, clamps or hangers as specified. The vendor shall give adequate design for all brackets, saddles, anchors, clamps

and hangers and be responsible for their structural adequacy.

- c) Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor slab by clamps or collars attached to pipe and with a 15 mm thick rubber pad or any resilient material.
- d) Where pipes pass through the terrace floor, suitable flashing shall be provided to prevent water leakage. Risers shall have a suitable clean out at the lower point and air vent at the highest point.
- e) All piping work shall be carried out with excellent workmanship, causing minimum disturbance to the existing services, buildings, roads and structure.

7.8. THERMAL INSULATION WITH FRP COATING INSULATION

- 7.8.1. SITC of Closed cell Nitrile Rubber/chemically Cross Linked XLPE Thermal insulation. The density of the insulation shall be 48 kg / m³ & using high quality Low VOC adhesive as per OEM recommended and standard. The thermal conductivity should be 0.035 W/m Deg K@ 20deg cel. The temperature range should be + 85 deg C to -40 deg C. insulation shall be of Class 'O'.

7.9. ACCOUSTIC INSULATION

- 7.9.1. Supply, installation, testing and commissioning of Open Cell Nitrile Rubber/Chemically Cross Linked XLPE Accoustic insulation of initial duct with 15 mm thick. The density of the insulation shall be 140 - 180 kg / m³ & using high quality Low VOC adhesive as per OEM recommended and standard. The thermal conductivity should be 0.047 W/m Deg K@ 20deg cel. The temperature range should be + 105 deg C to -20 deg C. The insulation shall be of Class '1'.

8. CONTROLLER

- 8.1. A microprocessor/ microcontroller/ PLC based control mechanism shall be supplied for keeping the temperature and relative humidity of the air conditioned spaces within the specified limits.
- 8.2. The system shall have suitable control strategies for accurate temperature and humidity control.
- 8.3. The controller should be provided with a backlit LCD /LED display of sufficient size and clear visibility for text and graphics. It should be possible to view the status of various parameters of the unit in the controller display.
- 8.4. Provision should be given for adjustment of temperature set points, range of control, alarm set points through front panel depending on the site requirement / remote controlled.
- 8.5. The LCD/ LED screen shall display the following as a minimum

- a) Temperature (actuals)
- b) Relative humidity (actuals)
- c) Operating status of various units.

8.6. The control system shall allow programming of the following conditions as a minimum:

- a) Temperature set point
- b) Humidity Set point
- c) High Temperature Alarm
- d) Low temperature Alarm

8.7. Switching on/ switching off of individual compressors in each unit shall be done automatically, depending upon the air conditioning load at any time. Switching on/ switching off of stand-by unit is to be done manually.

8.8. The display and control buttons shall be accessible on unit front face without opening/ removing any doors / panels/ covers.

8.9. The controller should have fault diagnosis and anti-recycle feature.

8.10. The controller should auto restart on restoration of power after power failures.

8.11. In case of a fault in any of the units, the respective unit should be switched OFF and taken out of the running sequence. Suitable alarm with indication shall be available on the front panel to indicate any fault in the unit.

9. POWER SYSTEM DETAILS

9.1. Refer Electrical section.

10. SCOPE OF INSPECTION AND TESTS

10.1. Inline with industrial practice. Shall be detailed

11. WARRANTY AND PERFORMANCE GUARANTEE

11.1. Inline with industrial practice. Shall be detailed

12. ANNUAL MAINTENANCE CONTRACT

12.1. Inline with industrial practice. Shall be detailed

13. TRAINING

13.1. Inline with industrial practice. Shall be detailed

14. PAINTING

14.1. Inline with industrial practice. Shall be detailed

TECHNICAL PROCUREMENT SPECIFICATION		SCOPE OF WORK		32775-01-PS-001 SW-AC	
				PAGE 1 OF 3	
TPS NO.		32775-01-PS-001			
ITEM :		HVAC SYSTEM INCLUDING PRESSURISATION AND CHEMICAL FILTRATION			
EQPT. NO.					
The scope of work for the equipments listed above shall include design, engineering, manufacture, supply of materials, Inspection and Testing with 100% standby capacity as detailed below.					
Sl. No	Description		Reqd.	Remarks	
1.0	Air Handling Unit (AHU)		✓	1W + 1S	
	Pre Filters & Fine filters for fresh air and return air		✓		
	Fresh Air Chemical Filters		✓		
	Blower		✓		
	Drive Motor		✓		
	Cooling Coil (Air chiller)		✓		
	Expansion Valve		✓		
	Air heater		✓		
2.0	Refrigeration Unit			2W + 2S	
	Compressor		✓		
	Drive Motor		✓		
	Condensing unit (Water Cooled)		✓		
	Oil System		✓		
	Louvers/Grilles		✓		
	Fan		✓		
3.0	Refrigerant piping network with insulation and supports		✓		
4.0	Supply air, Fresh air & Return air Ducting with		✓		
	Supports		✓		
	Diffuser with frame & fitting		✓		
	Fire & Smoke dampers		✓		
	Face & bypass damper		✓		
	Thermal insulation		✓		
	Acoustic insulation		✓		
	Relief dampers		✓		
	Louvers/Grilles		✓		
6.0	Drain piping network with insulation and supports		✓		
1	23.02.26	FOR TENDER PURPOSE	BVN	LA	RM
0	09.01.26	ENQUIRY	BVN	LA	RM
REV.NO.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED
FACT ENGINEERING AND DESIGN ORGANISATION				 FEDO	

01FT001/03

TECHNICAL PROCUREMENT SPECIFICATION		SCOPE OF WORK		32775-01-PS-001	SW-AC
				PAGE 2	OF 3
Sl. No	Description	Reqd.	Remarks		
7.0	Prefilter	✓			
	finefilter	✓			
	Chemical Filter	✓			
	Additional fresh air blower	✓			
8.0	Electrical panel and controls				
	(Shall be detailed)	✓			
9.0	Thermal insulation of roof				
10.0	Other Accessories				
	Thermostat, Humidistat and measuring instruments with	✓			
	suitable digital/analog indicators for display of				
	instantaneous temperatures and humidity in				
	(i) Control room (ii) System Cabinet room (iii) UPS room.				
	Instrument tubing	✓			
11.0	All Electrical and Instrumetation items required for safe and	✓			
	satisfactory performance of the system				
12.0	First charge of consumables like oil, refrigerants etc.	✓			
	as required				
13.0	Inspection and Testing	✓			
14.0	Painting				
	Prime coating only				
	Prime coating and finish paint	✓			
15.0	Packing				
	Domestic packing	✓			
	Export packing				
	Rust prevention for long term storage	✓	6 months		
16.0	Special tools	✓	IF ANY		
17.0	Spare parts				
	Construction and commissioning	✓			
18.0	Foundation bolts and nuts	✓			
19.0	Erection & commissioning	✓			
20.0	Drawings & documents	✓	As per VDR & VDSP		
21.0	Comprehensive Annual Maintenance Contract	✓	For 3 year after warantee period		
FACT ENGINEERING AND DESIGN ORGANISATION					
					FEDO

[illegible]

[illegible]

TECHNICAL PROCUREMENT SPECIFICATION		VENDOR DATA REQUIREMENTS			32775-01-PS-001 VDR-AC		
					PAGE 1 OF 1		
PROJECT : NEW DCS CONTROL ROOM FOR AMMONIA HANDLING FACILITY IN PETRO UC				ITEM : HVAC SYSTEM INCLUDING PRESSURISATION AND CHEMICAL FILTRATION FOR DCS CONTROL			
CLIENT :		FACT UC		TPS No :		32775-01-PS-001	
STATUS :		☒ ENQUIRY ☐ COMMITMENT		WO No :		\$ -	

Sl. No	Grp Code	Description	Offer	After Commitment			Final@@	
			Qty	Qty	Lead time in weeks		Qty	
					Reqd	Prop@	Agred	
1.0	A	Schematic flow sheets	1S	1S	4			3P+1S
2.0	A	Air condition arrangement room layout		1S	4			3P+1S
3.0	A	Data Sheets of:						
		Refrigeration unit	1S	1S	4			3P+1S
		Air Handling Unit	1S	1S	4			3P+1S
		Filters	1S	1S	4			3P+1S
		Refrigerant pipnig and drain piping	1S	1S	4			3P+1S
		Blower						
4.0	A	Dimensioned GA drawing of:						
		Refrigeration unit		1S	4			3P+1S
		Air Handling Unit		1S	4			3P+1S
		Filters		1S	4			3P+1S
		Blower		1S	4			3P+1S
		Refrigerant pipnig and drain piping		1S	4			3P+1S
5.0	A	Cross sectional drawing with material of construction of each part of:						
		Refrigeration unit		1S	4			3P+1S
		Air Handling Unit		1S	4			3P+1S
		Refrigerant pipnig and drain piping		1S	4			3P+1S
		Blower		1S	4			3P+1S
6.0	A	Foundation drawings with Load detail for:						
		Refrigeration unit		1S	4			3P+1S
		Air Handling Unit		1S	4			3P+1S
		Filters		1S	4			3P+1S
		Blower		1S	4			3P+1S
7.0	A	Piping and instrumentation diagram		1S	4			3P+1S
8.0	A	Duct work layout		1S	4			3P+1S
9.0	A	Duct support and insert details of duct work		1S	4			3P+1S
10.0	A	Control Panel						
		Dimensioned GA drawing		1S	4			3P+1S
		Schematic wiring drawing		1S	4			3P+1S
11.0	A	QAP		1S	4			3P+1S
12.0	A	Utility Consumption	1S	1S	4			3P+1S
13.0	B	Equipment lubrication data sheets		1S	4			3P+1S
14.0	B	Inspection & Tests Proceedure		1S	4			3P+1S
15.0	C	Material test certificates			*			3P+1S
16.0	C	Test records			*			3P+1S
17.0	C	Installation, operation & maintenance manual						3P+1S
18.0	C	Technical literature & catalogs	1S					3P+1S
19.0	C	Reference list of previous supplies	1S					3P+1S
20.0	C	Strogae instructions (if any)		1S				3P+1S
21.0	C	Safety Instructions		1S				3P+1S
22.0	B	Compliance statement	1S					3P+1S

Legend :

Group code : A - For review and detailed Engineering , B - For review , C - For information and record

Document type : R - Reproducible , P - Print , S - Soft copy

Notes :

' @ ' Vendor shall fill in proposed lead time if different from the required lead time

' @@ ' Each set of final documents shall be submitted in a folder. Two such folders shall be packed and despatched with the equipment.

* After Tests

1	23.02.26	FOR TENDER PURPOSE	BVN	LA	RM
0	09.01.26	ENQUIRY	BVN	LA	RM
REV NO	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED

FACT ENGINEERING AND DESIGN ORGANISATION



FEDO

TECHNICAL PROCUREMENT SPECIFICATION		EQUIPMENT LUBRICATION DATA		32775-01-PS-001 LD-AC	
				PAGE	1 OF 1
PROJECT : NEW DCS CONTROL ROOM FOR AMMONIA HANDLING FACILITY IN PETRO UC					
PROJECT NO : 32775		LOCATION : FACT UC			
TPS NO : 32775-01-PS-001		VENDOR :			
CLIENT : FACT UC					
SL NO	DESCRIPTION		ITEM NO		
1	Type of Lubrication System (State Grease-Gun, Grease Packed, Drip, Splash, Continuous)				
2	Recommended Lubrication for Break in (list two Indian alternatives by trade name and number)				
3	Quantity of Lubricant required for initial fill (Litres or Kg)				
4	Recommended Break - in period for Initial application (Hours)				
5	Recommended Lubrication for normal operation (List two Indian alternatives by trade name and number)				
6	Refill quantities if different from initial charge (Litres or Kg)				
7	Quantity of Lubricant shipped with initial order (Litres or Kg)				
8	Recommended time between changes of Lubricant (Hours)				
9	Expected annual consumption of Lubricant (Litres or Kg)				
Remarks :					
1	23.02.26	FOR TENDER PURPOSE	BVN	LA	RM
0	09.01.26	FOR ENQUIRY	BVN	LA	RM
REV NO	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED
FACT ENGINEERING AND DESIGN ORGANISATION					

01FT304/03

MECHANICAL SPECIFICATION (For Design Consultant)			32775-01-PS-001		CA
			PAGE	1	OF 1
TPS No	32775-01-PS-001				
STATUS	☐ ENQUIRY ☐ COMMITMENT				
ORIGINATING DEPT.	M&MH				
P.O. / W.O. No.					
PROJECT	NEW DCS CONTROL ROOM FOR AMMONIA HANDLING FACILITY IN PETRO UC				
LOCATION	FACT UC				
CLIENT	FACT UC				
PURCHASER	M/s FACT				
VENDOR	_____				
ITEM : CLEAN AGENT SYSTEM					
4					
3					
2	12.03.2026	FOR TENDER PURPOSE	BVN	LA	RM
1	23-02-2026	FOR TENDER PURPOSE	BVN	LA	RM
0	09-01-2026	ENQUIRY ISSUE	BVN	LA	RM
REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED
FACT ENGINEERING AND DESIGN ORGANISATION  FEDO					

TPS No. 32775-01-PS-001

[illegible]

4					
3					
2	12-03-2026	FOR TENDER PURPOSE	BVN	LA	RM
1	23-02-2026	FOR TENDER PURPOSE	BVN	LA	RM
0	09-01-2026	ENQUIRY ISSUE	BVN	LA	RM
REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED

1. INTRODUCTION

- 1.1. This specification gives the minimum requirements of design, supply, installation, testing and commissioning of Centralised Clean Agent based on total flooding system, for the fire protection of **rack room, console room, UPS room** of New Control Room building at FACT UC.
- 1.2. The Fertilisers And Chemicals Travancore (FACT) is a Government of India Enterprise engaged in the manufacture of fertilizer/chemical/petrochemical products, engineering consultancy and engineering fabrication. FACT-Udyogamandal Complex (FACT-UC) is a division of FACT located at Udyogamandal, Kochi, Kerala that manufactures intermediates and products like sulphuric acid, oleum, ammonia, ammonium phosphate, ammonium sulphate, caprolactum etc.
- 1.3. The common DCS Control Room Building is to house the new DCS system including operating stations, system and marshalling cabinets, UPS, other related equipment and control room personnel.
- 1.4. The selection and design of clean agent system for **rack room, console room, UPS room** shall follow the Standard on “Clean Agent Extinguishing systems NFPA Standard 2001 (2022 or Latest Edition) including its safety guidelines with respect to “Hazards to Personnel”, electrical clearance and environmental factors in line with environmental considerations.
- 1.5. Clean agents to be considered: IG-541/ IG-55/ IG-01 or IG-100 as per NFPA-2001.
- 1.6. For conflict/contradiction between specifications/requirements/codes/standards, stringent conditions shall be followed in general, however such conflicts/contradictions shall be intimated to the PMC/Client before proceeding further. Direction of PMC/Client shall be followed in such cases.

2. CODES AND STANDARDS

- 2.1. The design, selection of equipment, fabrication, installation, testing and commissioning of Centralised Clean Agent total flooding system and all connected accessories shall conform to the latest codes and standard as listed below.
 - a) NFPA 2001 (2022 or Latest/ Revised) : Standard on Clean Agent Fire Extinguishing Systems
 - b) BS - 5445, 5446, 5839 : For detectors
 - c) SMPV Rules, 1981 CCE Nagpur : For Storage Containers
 - d) PESO (approval for storage cylinders)
 - e) BIS (Latest editions) : As applicable.

2	12.03.26	Third issue	BVN	LA	RM
1	21.02.26	Second issue	BVN	LA	RM
0	09.01.26	First issue	BVN	LA	RM
REV. NO.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED

The clean agent systems to be provided shall meet the requirements of NFPA-2001 (2022 or latest/revised). Anything specified as "Mandatory" or specified as requirement in NFPA-2001 even if not specifically mentioned in this specification, shall form part of this specification and scope of work for the job to be executed.

3. SCOPE OF SUPPLY AND WORK

- 3.1. Refer Document *scope of work* 32775-01-PS-001 SW -CA
- 3.2. Smoke/gas/fire/heat Detection system are excluded from bidder scope, however integration with the detection system for automatic activation of clean agent system shall be included in the scope of bidder.
- 3.3. Scope shall include all necessary items/works to meet this Technical Procurement Specification requirement.

4. DESIGN REQUIREMENTS

Vendor shall design the system to meet the minimum requirements of total flooding fire extinguishing clean agent systems as per NFPA 2001 (2022 or latest/revised). The system design shall be as defined in the Schedule of Rates, special requirements and scope of work of tender document.

4.1. SELECTION OF CLEAN AGENT

Technical criteria for selection of the Clean agent will be as follows: -

- a) Offered clean agent must be suitable for protection of said hazards, i.e Industrial process control rooms, instrumentation panels, Electrical Panels, PLC panel, Open Cables, Cables inside trenches etc at Server Room. Offered Clean Agent shall be listed in NFPA 2001 (2022 or latest version).
- b) Offered Clean agent must be of Zero ODP value. The list mentioned in NFPA 2001 (2022 or latest version) will be considered for the purpose.
- c) Offered clean agent based systems must be FM/UL/LPCB approved for installation in specific hazards / protected areas.
- d) Offered product must be environmentally preferred alternative to Halon 1301. Its Global Warning potential values should be less than that of Halon 1301 and not more than that of CO2.
- e) Offered clean agent shall not have atmospheric life time more than 1 month.
- f) The clean agent fire suppression system shall be designed to ensure in no case the minimum oxygen concentration after agent discharge does not fall below 12%, with personnel exposure at this concentration limited to a maximum of 5 minutes.

4.2. AUTOMATIC OPERATION

- 4.2.1. System shall work automatically through actuation of detection system of protected area.

TECHNICAL PROCUREMENT SPECIFICATION	DESIGN PHILOSOPHY CLEAN AGENT – FLOODING SYSTEM	32775 -01-PS-001 DP-CA Page 3 of 5 R2
	4.2.2. The clean agent systems shall be discharged / actuated automatically after an adjustable time delay based on the smoke/fire/heat/gas detection signal received. The delay shall be maximum 3 minutes; however, it shall be adjustable from 0 to 3 minutes, with a least count of 12 seconds or less. 4.2.3. Integration with the detection system for automatic activation of clean agent system shall be included in the scope of bidder. 4.2.4. In the local control panel of clean agent systems, there shall be one hooter which activates once the gas is released. 4.2.5. Provision to actuate system manually must also be provided with the system. 4.2.6. Integration with HVAC/AHU shall be done to ensure the HVAC/AHU air inlet/outlets to the room are isolated before the activation of clean agent. 4.3. LOCAL MANUAL OPERATION 4.3.1. Clean agent systems shall be released from Emergency push button provided on clean agent panel. Also, manual actuation has to provide from an appropriate push button (Electrical switch) to be installed at entry / exit of protected area/ room. In case the provision does not exist in present room/ control panel or both, same shall be provided by vendor of clean agent systems. 4.3.2. System shall also design to operate manually from cylinder's head (or valve of master cylinder of bank). 4.3.3. Operating instructions shall be displayed on a name plate fitted permanently on the clean agent skid. 4.4. SYSTEM FLOW CALCULATIONS 4.4.1. System flow calculations shall be performed using A CALCULATION METHOD LISTED OR APPROVED BY THE AUTHORITY HAVING JURISDICTION (e.g. LPCB/FM/UL/NFPA). 4.4.2. System design including computerized flow calculations shall be submitted. 4.5. CLEAN AGENT QUANTITY 4.5.1. Minimum design concentration of Clean Agent gas shall be 37.5%(min) for IG-541, IG-55, IG-01 and IG-100 at 70°F by volume or as per UL design, whichever is more. 4.5.2. Volume Requirements of Agent per Unit Volume of Hazard ($V_{\text{agent}}/V_{\text{enclosure}}$) shall be minimum 0.47 M^3/M^3 4.5.3. The quantity of agent shall be worked out by the bidder, as per NFPA-2001. Any changes on above specified design concentration/volume ratio if unavoidable shall be based on NFPA calculation and shall be subjected to the approval of PMC/Client. 4.6. CLEAN AGENT STORAGE CYLINDERS 4.6.1. Minimum container design, level, working pressure of storage container shall be as per NFPA 2001. 4.6.2. The containers shall be charged only to a fill density or super pressurization level as per manufacturer's listing (super pressurization means the addition of a gas to fire suppression agent	
FACT ENGINEERING AND DESIGN ORGANISATION		 FEDO

- container necessary to achieve the pressure required for proper–system operation).
- 4.6.3. The cylinder shall be approved, brand new, never retested and year of manufacture shall be 2025 or later.
- 4.6.4. The vendor shall preferably select the capacity of cylinder keeping the filling ratios as per NFPA.
- 4.6.5. The design pressure for cylinders shall be suitable to withstand the maximum pressure developed at 130°F (55°C).
- 4.6.6. Each container shall have a permanent name plate specifying the agent, tare and gross weight in addition to the pressurization level, normal agent volume and OEM hardware manufacturer.
- 4.6.7. All clean agent cylinders must satisfy the following:
- They shall be designed to hold clean agent at ambient temperature.
 - They must be seamless and brand new.
 - They must bear the mark of manufacturer and the serial number of individual cylinder.
 - They must have test certificates issued by authority having jurisdiction and shall be duly approved by competent authority (FM/UL/LPCB).
 - In addition, they must have approval of PESO of India. Cylinders without the approval certificate will not be accepted.
 - Each container shall have pressure relief valve to protect the cylinders against excess pressure conditions.
- 4.6.8. Clean agent cylinders shall be arranged in the following manner:
- In a battery of cylinders manifold together and leading to common distribution pipe and discharge nozzles for the risk to be protected including below floor board and above false ceiling spaces.
 - A reserve (standby) battery of cylinders with manifold and automatic changeover after actuation of main cylinders to be provided in each risk area i.e. 100% reserve.
 - Check valve shall be provided to prevent agent loss if the system is operated when any containers are removed for maintenance.
 - Clean agents should be supplied in cylinders having a validity of 15 Years from the date of tender enquiry.
- 4.7. PIPING, FITTINGS AND DISCHARGE NOZZLE
- 4.7.1. All the piping inside the battery limit for the equipment shall be in vendor scope.
- 4.7.2. Suitable piping as per NFPA and pipe wall thickness as per ASME B31.1 shall be provided.
- 4.7.3. The internal pressure used for this calculations shall be the maximum pressure in the cylinder at a maximum storage temperature of not less than 55 Dec C, but in no case shall the value for the pressure be less than as mentioned in NFPA 2001.
- 4.7.4. Non Metallic & cast Iron pipes will not be acceptable in any case.
- 4.7.5. The pressure reduction (relief) device shall be easily identifiable in the piping system. So that it not

- poses a hazard or cause personnel injury
- 4.7.6. Pipe joints: All pipe joints shall be of welded type. The locations where welding will be felt difficult during execution of job due to operational / safety reasons, the threaded / flanged joints will be acceptable as per standard engineering practice & requirements.
- 4.7.7. The Discharge nozzles shall conform to NFPA 2001 and shall be FM/UL/LPCB approved. Discharge nozzles used in this system shall be listed for the use intended for discharge characteristics. The selection of nozzle orifice shall be such that entire quantity of clean agent system is discharged in not more than 10 sec through the number of nozzles of the system. Each nozzle shall be permanently marked to be identified by the part number, orifice code, or other suitable marking as specified by the authority having jurisdiction.
- 4.7.8. The clean agent system piping may have to clear the beams and ribs which criss cross the ceiling, Path of AC ducts, Cabling in false flooring.
- 4.7.9. The vendor shall have to lay the clean agent system piping. All necessary works including breaking the existing facilities shall be in the scope of work.
- 4.7.10. Valves and pipe fittings shall be listed or approved for the intended use with clean agent system. The specifications of fittings shall meet its use with clean agent piping.
- 4.8. PAINTING:
- 4.8.1. Surface finishing, application of two coats of primer and painting of pipelines, clean agent system storage containers, supports etc., will be done with two coats of fire red paint and this will be in the scope of contractor. Nozzles will not be painted as they are of stainless steel.
- 4.9. LOCAL CONTROL PANEL FOR CLEAN AGENT SYSTEM
- 4.9.1. The system shall have a main control console and shall consist of :
- Two alarms and one fault indicator lamp for each zone to be protected.
 - Combination of alarm silence and alarm off switch.
 - Combination of fault silence and trouble lamp switches.
 - Alarm test switch
 - Alarm re-set switch.
- 4.10. Electrical and Instrumentation specifications/requirements if provided separately elsewhere, stringent conditions shall be followed. However before proceeding further the contradiction/conflict/ambiguity shall bring to the attention of PMC/Client and decision/directive of PMC/Client shall be followed.
- 4.11. MATERIALS OF CONSTRUCTIONS
- 4.11.1. If not specifically indicated in this Technical Procurement Specification (TPS), the materials of construction used in the system shall be in accordance with NFPA-2001 or as specified by the equipment manufacturer for the intended use if the same is not specified in NFPA-2001 and TPS.

[illegible]

TECHNICAL PROCUREMENT SPECIFICATION		SCOPE OF WORK		32775-01-PS-001 SW-CA	
				PAGE 1 OF 2	
TPS NO.		32775-01-PS-001			
ITEM :		CLEAN AGENT SYSTEM			
EQPT. NO.					
The scope of work for the equipment listed above shall include design, engineering, manufacture, supply of materials, installation/fabrication/erection, Inspection and Testing as detailed below but not limited to.					
Sl. No	Description			Reqd.	Remarks
1.0	Clean Agent system as listed in this TPS elsewhere. (Including clean agent, cylinders, pipes, valves, fittings, nozzles, instrumentation, actuator, cables, AC/ DC feeders, all electrics, control panels, push button stations, alarms, pressure gauges, Manual release switch, Abort switch, integration with HVAC/AHU Integration with smoke & gas detection system, automatic actuation and manual bypass, cylinder supports, operating devices and other accessories etc.)			✓	
2.0	SS material embossed name plates including brief technical - data/Tag numbers etc.			✓	
3.0	Initial charge of lubricants required			✓	
4.0	Special Tools & Tackles				If applicable.
5.0	Spares			✓	
i	Mandatory spares (As listed elsewhere in the TPS)			✓	
ii	Commissioning spares			✓	
6.0	Statutory approvals (Documentation and Liaisoning)			✓	As applicable.
7.0	Standby power supply and change over facility			✓	
8.0	Standby filled cylinders (100%)			✓	Connected to manifold
9.0	Tools/ accessories required at the time of Installation/mounting			✓	As applicable.
10.0	Other Accessories			✓	
11.0	All Electrical and Instrumentation items required for safe and satisfactory performance of the system			✓	
12.0	First charge of consumables like oil, clean agent etc. as required			✓	
13.0	Inspection and Testing			✓	Refer scope of Inspection and tests
1	23-02-2026	FOR TENDER PURPOSE	BVN	LA	RM
0	09-01-2026	ENQUIRY	BVN	LA	RM
REV.NO.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED
FACT ENGINEERING AND DESIGN ORGANISATION				 FEDO	

01FT001/03

[illegible]

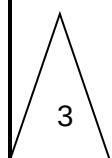
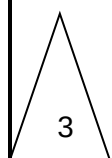
TECHNICAL PROCUREMENT SPECIFICATION	VENDOR DATA REQUIREMENTS	32775-01-PS-001 VDR-CA PAGE 1 OF 1						
PROJECT : NEW DCS CONTROL ROOM FOR AMMONIA HANDLING FACILITY IN PETRO UC ITEM : CLEAN AGENT SYSTEM CLIENT : FACT UC TPS No : 32775-01-PS-001 STATUS : ☒ ENQUIRY ☐ COMMITMENT WO No :								
Sl. No	Grp Code	Description	Offer Qty	After Commitment Qty	Lead time in weeks			Final@@ Qty
					Reqd	Prop@	Agrd	
1.0	A	Schematic flow sheets	1S	1S	4			3P+1S
2.0	A	System Description	1S	1S	4			3P+1S
3.0	A	Clean agent system arrangement layout		1S	4			3P+1S
4.0	A	Data Sheets of system and equipment:		1S	4			3P+1S
5.0	A	Dimensioned GA drawings		1S	4			3P+1S
5.0	A	Design Calculations including gas quantity requirement		1S	4			3P+1S
6.0	A	Cross sectional drawing with material of		1S	4			3P+1S
7.0	A	Foundation drawings with Load details		1S	4			3P+1S
8.0	A	Piping and instrumentation diagram		1S	4			3P+1S
9.0	A	Piping layout		1S	4			3P+1S
10.0	A	Support and insert details of work		1S	4			3P+1S
10.0	A	Electrical documents		1S	4			3P+1S
11.0	A	Control Panel						
11.0		Dimensioned GA drawing		1S	4			3P+1S
11.2		Schematic wiring drawing		1S	4			3P+1S
12.0	A	QAP		1S	4			3P+1S
13.0	A	Utility Consumption		1S	4			3P+1S
14.0	B	Equipment lubrication data sheets		1S	4			3P+1S
15.0	B	Inspection & Tests Procedure		1S	4			3P+1S
16.0	C	Material test certificates			*			3P+1S
17.0	C	Test records, certifications etc.			*			3P+1S
18.0	C	Installation, operation & maintenance manual						3P+1S
19.0	C	Technical literature & catalogs	1S					3P+1S
20.0	C	Reference list of previous supplies	1S					3P+1S
21.0	C	Strogae instructions (if any)		1S				3P+1S
22.0	C	Safety Instructions		1S				3P+1S
23.0	B	Signed copy of TPS documents as acceptance of conditions	1S					
24.0	B	Compliance statement	1S					3P+1S
Legend : Group code : A - For review and detailed Engineering , B - For review , C - For information and record Document type : R - Reproducible , P - Print , S - Soft copy Notes : ' @ ' Vendor shall fill in proposed lead time if different from the required lead time ' @@ ' Each set of final documents shall be submitted in a folder. Two such folders shall be packed and despatched with the equipment. * After Tests and before despatch								
1	23-02-2026	FOR TENDER PURPOSE	BVN	LA	RM			
0	09-01-2026	ENQUIRY	BVN	LA	RM			
REV NO	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED			
FACT ENGINEERING AND DESIGN ORGANISATION								

TECHNICAL PROCUREMENT SPECIFICATION		EQUIPMENT LUBRICATION DATA		32775-01-PS-001 LD-CA	
				PAGE	1 OF 1
PROJECT : NEW DCS CONTROL ROOM FOR AMMONIA HANDLING FACILITY IN PETRO UC					
PROJECT NO : 32775		LOCATION : FACT UC			
TPS NO : 32775-01-PS-001		VENDOR :			
CLIENT : FACT UC					
SL NO	DESCRIPTION		ITEM NO		
1	Type of Lubrication System (State Grease-Gun, Grease Packed, Drip, Splash, Continuous)				
2	Recommended Lubrication for Break in (list two Indian alternatives by trade name and number)				
3	Quantity of Lubricant required for initial fill (Litres or Kg)				
4	Recommended Break - in period for Initial application (Hours)				
5	Recommended Lubrication for normal operation (List two Indian alternatives by trade name and number)				
6	Refill quantities if different from initial charge (Litres or Kg)				
7	Quantity of Lubricant shipped with initial order (Litres or Kg)				
8	Recommended time between changes of Lubricant (Hours)				
9	Expected annual consumption of Lubricant (Litres or Kg)				
Remarks :					
1	23-02-2026	FOR TENDER PURPOSE	BVN	LA	RM
0	09-01-2026	FOR ENQUIRY	BVN	LA	RM
REV NO	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED
FACT ENGINEERING AND DESIGN ORGANISATION					

01FT304/03

ELECTRICAL DEPARTMENT	DESIGN PHILOSOPHY-ELECTRICAL		32775-13-PS-01 DP R3 PAGE 1 OF 7		
1.0 SCOPE					
The Scope of work include the Design, detailed engineering, conforming to the specifications including M.V. Switchboard, Cables, Cabling, Wiring, Earthing, Lightning protection, Lighting, etc. required for Control room building at FACT, Petrochemical Division. Layout along with BOM shall be furnished as per this design philosophy, which contains specifications to indicate the basic requirement and serve as a guideline.					
2.0 CODE AND STANDARDS					
The general design shall follow relevant Indian/International standards and codes for practices for various electrical items. In their absence the standards of country of manufacture shall be followed. Other codes, Regulations and Standards applicable for design and detailed engineering of electrical system are as follows. ○ National Building Code ○ Bureau of Indian Standards ○ Indian Electricity Act 1910 ○ Indian Electricity Rules 1956 ○ Indian Electricity Supply Act 1948 ○ Indian Factories Act. ○ Fire Insurance Regulations. ○ Guidelines, instructions, directions issued by Pollution Control Boards of state as well as central government. Guidelines, instructions, directions issued by Chief Controller of Explosives (CCoE), CPCB, CMRI, DGMS, CEA etc.					
3.0 SCOPE OF WORK					
The Engineering and design consultancy shall prepare all the tender documents and estimate required for the procurement, erection, commissioning, and testing of items specified below, on item rate basis. The main scope of work for bidder shall include the following activities with submission of documents. a) Lighting layout with position of lights, switches, plug points, DB details with circuit divisions, location of switchboards etc. b) Earthing layout and lightning protection layout indicating location of earth pits, route of earthing conductor, size of conductors etc. c) FA system layout indicating position of detectors, FA panel, Response Indicators, call points, cable route etc. d) Telephone layout with location of telephone with cable layout e) Submission of Drawings for tendering purpose, work execution purpose as GFC and As-Built drawings f) Schedule of items of work with cost and specification of items included in the schedule. g) Submission of calculation for lighting design, earthing design and lightning protection design. h) Technical Procurement specification with detailed Data sheet for the M.V. Switchboards, Motors, etc. TPS shall include Engineering specification, Vendor Data requirements, scope of inspection and test and Technical particulars. The above referred work is not conclusive. The materials considered for the building shall be as per the project requirements mentioned in the tender document. Any other drawings or technical specification, not defined in the scope of work, but required for the satisfactory completion of the Project shall be under the scope of the Bidder.					
3	04.03.2026	Revised as per Client comments	LN	SM	SM
2	21.02.2026	Revised as per Client comments	LN	SM	SM
1	12.01.2026	Issued for Tender	SM	MS	MS
0	12-11-2025	Original Issue	LN	SM	MS
REV. NO.	DATE	DESCRIPTION	PRPD	CHKD	APPRD
FACT ENGINEERING AND DESIGN ORGANISATION					

ELECTRICAL DEPARTMENT	DESIGN PHILOSOPHY-ELECTRICAL	32775-13-TP-01 DP R3 PAGE 2 OF 7
Incoming cables/ cabling for M.V. Switchboard, Emergency DB and DCDB shall be provided by the Client.		
4.0 DESIGN CRITERIA		
4.1 <u>Supply voltage levels</u>		
415 V ± 10%, 50 Hz ±5%, 3 phase, 4 wire with solidly earthed neutral.		
240V ± 10%, 50 Hz ±5%, single phase with solidly earthed neutral.		
Instrument power/control voltage is 110V/ 240V AC through UPS.		
Critical lighting through 110V DC.		
4.2 <u>Voltage Rating of consumers</u>		
a)	Lighting-Normal & Emergency	: 240V, single phase & neutral, 50 Hz, AC.
b)	Power socket outlets for welding sockets.	: 415V, 50 Hz, 3 phase, 63A power socket
5.0 CABLING/ CONDUIT AND WIRING SYSTEM		
Internal electrical installation shall be carried out as per the requirement of the Indian electricity rules and acts. The wiring shall be carried out in concealed PVC conduit with suitable size of PVC copper conductor cable of required size for the wiring mains and sub mains.		
All cable entry to the control room shall be through MCT.		
The following Electrical Cables have to be considered along with additional requirement, if any:		
a)	4C x 185sq mm: 2 Nos.	
b)	4C x 70sq mm: 2 Nos.	
c)	4C x 10sq mm: 2 Nos.	
d)	Spare cables of 2 Nos. each of each type of Electrical cables.	
A combination of earth leakage circuit breaker and MCB for distribution to safeguard against any fire due to earth leakage is proposed. Surge protection device shall be provided to safeguard against surges.		
The conduit and wiring shall be carried out in recessed/ surface with ISI marked FRLSH copper wires and power accessories (switches, socket etc.) shall be ISI marked.		
Minimum size of copper conductor shall be 1.5 sq.mm for lighting (from switchboard to light fitting) and 2.5 sq.mm (from DB to Switchboard) and 4 sq.mm for power and AC.		
Fire alarm system	:	1.5 sq mm (copper) XLPE insulated armoured cable
The cables used for lighting and wires in conduits shall have appropriate junction boxes with adequately sized terminals.		
All power cables shall be XLPE insulated, armoured and PVC sheathed with Copper conductor up to 10Sq.mm and above10 Sq.mm Aluminium conductor shall be used.		
The sizes of cables shall be so chosen that they are rated to carry the full load current continuously after allowing for necessary derating factors for the service conditions of installation, and also that the voltage drop in cables does not exceed 3% for full load running. For motor starting, voltage drop up to 15% shall be permitted.		
FACT ENGINEERING AND DESIGN ORGANISATION		 FEDO



6.0 LIGHTING SYSTEM

Lighting system shall cover lighting of the control room with LED light fittings/recess mounted fittings.

Lighting distribution boards/ panels shall be located inside the building. For outdoor areas/road where sufficient lighting is not available area lighting shall be provided. In the AHU room, cable wiring shall be considered with minimum 2.5 sq mm XLPE insulated armoured Copper cable. Industrial type (well-glass) light fittings shall be provided inside the AHU room. Outdoor lighting shall be flame proof type.

Control room lighting system shall comprise:

- a) Normal lighting
- b) Emergency lighting
- c) Critical lighting.

Total lighting load to be furnished for cable sizing calculation. Normal and emergency lighting shall be fed by AC supply (415/240V), three phase four wire while critical lighting shall be fed by 110V DC supply which will be provided at one point. Lighting feeders shall be grouped together and fed from Emergency DB, the incomer to which is in the Client scope. 30% of total lighting system shall be connected to emergency system. Load data to be furnished for cable sizing calculation.

During normal operation, both emergency and normal lighting shall be fed by normal power source. On failure of normal supply, emergency lighting load shall be transferred to emergency power supply source. Critical (DC) lighting shall be normally kept 'ON' and during failure of AC power; battery bank shall feed the critical lighting system. Location of these lights shall be judiciously decided from safety considerations.

Complete lighting shall be through LED lamps only, unless specified otherwise. Accordingly, LED lamp fixtures shall be provided for all types of lighting i.e. AC & DC lighting, indoor & outdoor lighting, hazardous area lighting, building lighting, decorative fixtures, etc.

Battery room shall be provided with exhaust fans and louvered opening in opposite wall/door. A sink with water tap shall be provided with water connection. Floor of the battery room and walls up to 2M height shall have acid/alkali resistant protective epoxy coating. Light fittings, exhaust fan, on/off switches etc. in this room shall be chemical resistant type and flame proof type.

Lighting system shall consist of lighting distribution boards (LDBs), lighting and power panels, lighting fixtures, junction boxes etc. as required. Separate DBs for all power Distribution (both AC & DC) including normal lighting/emergency lighting/critical lights shall be considered. The lighting and power panels shall be provided with MCB, ELCB and surge protector device as incomer and Miniature Circuits Breakers (MCBs) for outgoing feeders control & protection of lighting circuits. A minimum of 25% of MCBs of each board shall be left as spares. In general, the load on each circuit shall be limited to 1.5 kW and MCB rating shall not be more than 20A. 15A plug sockets shall be fed through separate circuit of lighting sub-distribution boards/junction box having ELCB of 30mA. LED lighting fixtures with luminous efficacy $\geq 100\text{lm/watt}$ shall be provided. Ceiling fans shall be BLDC type.

The following average lighting intensity for various area shall be maintained

Area **Illuminance (lux).**

Control room	:	400
Battery room	:	150
Office, Operator room	:	300
Exterior walkways, stairs/ladders	:	50
AHU room	:	150

ELECTRICAL DEPARTMENT	DESIGN PHILOSOPHY-ELECTRICAL	32775-13-TP-01 DP R3 PAGE 4 OF 7
	Switch gear/ UPS room : 200 Outdoor yard/area : 20 Escape route : 25 Corridor : 70 However, lighting levels in all areas shall take into consideration the requirements from point of view of safety, ease of operation and maintenance. Maintenance factor shall not be more than 0.65 for indoor lighting and shall not be more than 0.6 for outdoor lighting. Utilization factor shall not be more than 0.8, however depends on light reflecting property of the material. Further, for dusty areas, maintenance factor as per relevant codes and standards shall be considered. Wiring for lighting and convenience outlets in outdoor areas shall be carried out with XLPE insulated armored FRLS cables run along the column/platforms and structures. For outdoor/ indoor safe area equipment, double/single compression cable glands shall be used respectively. Adequate number of ceiling fan points shall be provided in Control room, Offices, rooms allocated for operating and maintenance personnel etc. Two pole isolation devices shall be used for controlling lighting fixtures and sockets in hazardous areas to isolate phase as well as neutral. For buildings with false ceiling, concealed conduit wiring shall be employed below the false ceiling and surface conduit wiring above the false ceiling. Adequate number of pull boxes shall be used to aid wire pulling and inspection. No joints shall be allowed inside these pull boxes.	
6.0	EARTHING SYSTEM	
6.1	<u>System Earthing</u>	
	The earthing system envisages an earthing network with designed number of earth electrodes. Earthing system shall be designed as per IS: 3043, 2018 and as per standards. The following shall be earthed. • Metallic non-current carrying parts of all electrical apparatus. • Steel structures, cable trays All utility process pipe lines and flanges shall be earthed. In addition, steel pipe racks in the process units shall be earthed as per standard.	
	Type of earth electrode : GI/ Copper plate earth electrode	
	Earth pit interconnection & other equipment : PVC covered Aluminium Conductor cables.	
	Minimum Earthing cable size shall be as given below 1. M.V switchboard -2R x 120Sq.mm PVC insulated Al. Cable. 2. Motors ≤ 30KW & local control stations- 2Rx16 sq.mm PVC insulated Al. Cable 3. Motors >30KW, ≤37KW- 2Rx 35Sq.mm PVC insulated Al. Cable. 4. Motors >37KW, ≤55KW-2Rx50Sq.mm PVC insulated Al. Cable 5. Motors >55kW, ≤65kW-2Rx70Sq.mm PVC insulated Al. Cable 6. Motors>65kW, ≤75kW-2Rx 120Sq.mm PVC insulated Al. cable 7. Size of static earthing minimum-16Sq.mm PVC insulated Al. Cable	
FACT ENGINEERING AND DESIGN ORGANISATION		 FEDO

ELECTRICAL DEPARTMENT	DESIGN PHILOSOPHY-ELECTRICAL	32775-13-TP-01 DP R3 PAGE 5 OF 7
6.2 <u>Lightning Protection</u> Lightning protection system shall be provided to buildings and structures as per guidance in IS/IEC:62305 Part 1-4. Necessary earth pits, air terminations, down conductors, earthing conductors etc. shall be provided. Earth electrode for lightning protection - GI pipe electrode Material of air termination Conductors, down conductors, Earth conductors - GI strip (25x6mm min.) Earth electrode of lightning protection shall be interconnected to earth electrodes of main plant earthing system using PVC sheathed conductors. 7.0 TELEPHONE SYSTEM The telephone system in the Control room shall comprise required number of telephones connected to a Junction box. Telephone TBs and LAN cable TBS are required at various points in the Control Room. 8.0 FIRE ALARM SYSTEM The design and installation of fire detection and alarm system shall conform to Indian standard institution specification IS: 2157-1962, IS: 2189-1976 or latest revision of any. Without restricting to the generality of the foregoing the fire detection and alarm system shall also including the following: a) Smoke detectors/ optical detectors/ rate of rise cum fixed temperature heat detector/ manual call point/ electronic hooters/ response indicator and accessories. b) Armored cable / glands/ tees/ junction boxes etc. c) Microprocessor based main control panels/ zonal panel (floor panel) repeater panels, batteries, battery charges etc. d) In-built battery back-up shall be provided for the fire alarm panel for 30minutes. The entire fire alarm shall give audio/visual alarm signals when temperature smoke density exceeds the Permissible limit. The system shall be completely safe guarded against all fault conditions like A.C main failure battery discharge and battery charger failure; open circuit and earth fault in detector cabling etc. Clean agent system is envisaged for the control room. Input signal cabling shall be considered for the same. 9.0 MOTORS All drive motors required for the system shall be included in the scope of the vendor. Motors provided shall have adequate performance characteristics such as starting torque, pull out torque, etc. and rating for meeting the driving and starting duty of the driven equipment. All motors shall be squirrel cage induction type with insulation Class F with temperature rise limited to Class B and totally enclosed fan cooled enclosure with IP 55 degree of protection; except in cases of special types of motors such as slip- ring motors, variable speed motors, etc. required to meet special drive requirements, and environmental conditions. In all such cases, motors with necessary special features shall be provided and approval for the same shall be obtained from the purchaser. All motors are envisaged to be started on Direct-On-Line and suitable for Three numbers of successive cold starts. Motor frame sizes shall be in accordance with IEC recommendations / relevant Indian Standards Motors shall have a starting time, which is less than hot locked rotor withstand time of motor by at least two seconds at the rated conditions of voltage and frequency specified with driven machine coupled. Motors shall be suitable for starting at 80% of the rated voltage against torque speed characteristics of the driven equipment. The terminal box of Medium Voltage motors shall be capable of withstanding the calculated fault level in terms of the let through energy of combination starter unit at the place of installation.		
FACT ENGINEERING AND DESIGN ORGANISATION		 FEDO

ELECTRICAL DEPARTMENT	DESIGN PHILOSOPHY-ELECTRICAL	32775-13-TP-01 DP R3 PAGE 6 OF 7
10.0 M.V. SWITCHBOARD M.V. Switchboard shall be rated for minimum 25 MVA symmetrical fault level with MCCB incomers and shall conform to the following stipulations: Number of switchboards shall be selected in such a way to limit the incomer rating to 630 Amps. Switchboard shall have two numbers of incoming feeders and one bus coupler. All outgoing feeders shall be of SFU type. Outgoing feeders are for Lighting, Power sockets, Clean agent, Fire alarms, HVAC System & UPS (with three feeders) and another three numbers of spare feeders. M.V. Switchboard shall be of self-standing, dust, damp and vermin proof construction in fully compartmentalized cubicle type execution. The switchboard shall be single / double front, draw out type. The enclosure shall be of folded sheet steel construction. Thickness of sheet steel shall not be less than 2 mm except for certain non-load bearing members like instrument mounting plates, partitions, doors, etc. for which a minimum thickness of 1.6 mm shall be ensured. The construction of switchboard shall be in such a way that each vertical row of modules shall have separate vertical bus bars, vertical bus bar chamber and cable alleys. The width of the cable alley shall be sufficient to accommodate all the cables and shall have free access for cable terminations and in any case shall not be less than 150 mm. For draw out type switchboard, the following stipulations shall also be adhered to: (i) Power and control contacts shall be of fully draw out, self-aligning type which get automatically disconnected when the module is withdrawn. (ii) A distinct and stable "TEST" position for each module shall be provided. Test push button for checking the control circuitry shall be provided, if specified in Data Sheet. (iii) Identical feeder types shall be interchangeable with each other. Also all modules shall carry labels identifying KW rating & type of control wiring. (iv) Necessary earthing arrangements shall be provided for the draw out module in TEST and SERVICE positions. M.V. switchboard shall be provided with incoming feeders comprising of suitably rated AC 22 duty Moulded Case Circuit Breakers, voltmeter with 3 way and off selector switch & fuses (connected on the incoming cable side), CT fed ammeter with necessary CTs & 3 way and off selector switch and CT operated KWh meter. CTs & meters shall be of accuracy class 1.5 and meters shall be of size 96mm x 96mm Outgoing motor starter feeders shall comprise of suitably rated AC 23 duty load break switches, HRC fuses, 100% capacity AC 3 category Air break contactors and bimetal overload relays. Feeder switches shall have AC 23 rating corresponding to the full load current of the motors connected. Rating of load break switch shall not be less than the rating of the HRC fuses. Control supply for the motor starters shall be 110V AC, 50 Hz, single phase AC. For control voltages less than 240 Volts separate control transformers (cast resin insulated type) for each module shall be provided. Earth centre tap for secondary winding of control transformers is to be provided. In each motor feeder module, at least one Normally Open and one Normally Closed auxiliary contact shall be wired up to the terminal block as spare. The terminal block shall have at least 10% spare terminals, subject to a minimum of two. Horizontal busbars shall be of uniform cross section throughout the length of the switchboard. Vertical busbars of all vertical panels of the switchboard shall also be of uniform cross section. Power wiring shall be carried out with PVC insulated, stranded copper / aluminium conductors of 650 Volts grade having adequate current carrying capacity. Minimum size of conductor for power wiring shall be 4Sq.mm copper. Control wiring shall be carried out with 650 V grade, PVC insulated, copper conductor of size not less than 2.5 Sq.mm.		
FACT ENGINEERING AND DESIGN ORGANISATION		 FEDO

For draw out switchboard, provision of control supply in the test position of draw out modules shall be available. In draw out switchboards with module control supply, required test control supply feeder (complete with switch fuse/ and test control supply transformer with double pole MCB on secondary, centre tap of secondary winding earthed, etc., associated test supply bus / wiring, etc. shall be provided.

The feeder arrangement shall be such that the operating height (i.e., operating handle, switches, push buttons, etc.) lies within 1828 mm, but above 300mm, from the floor level.

11.0 LAN SYSTEM

Suitable number of LAN points as required shall be provided. All indoor copper cabling if any required shall be CAT6 only. All the LAN sockets, network switch, power supply to network switch etc. shall be provided. The size of network switch shall be selected based on the number of users.

12.0 MANDATORY SPARES

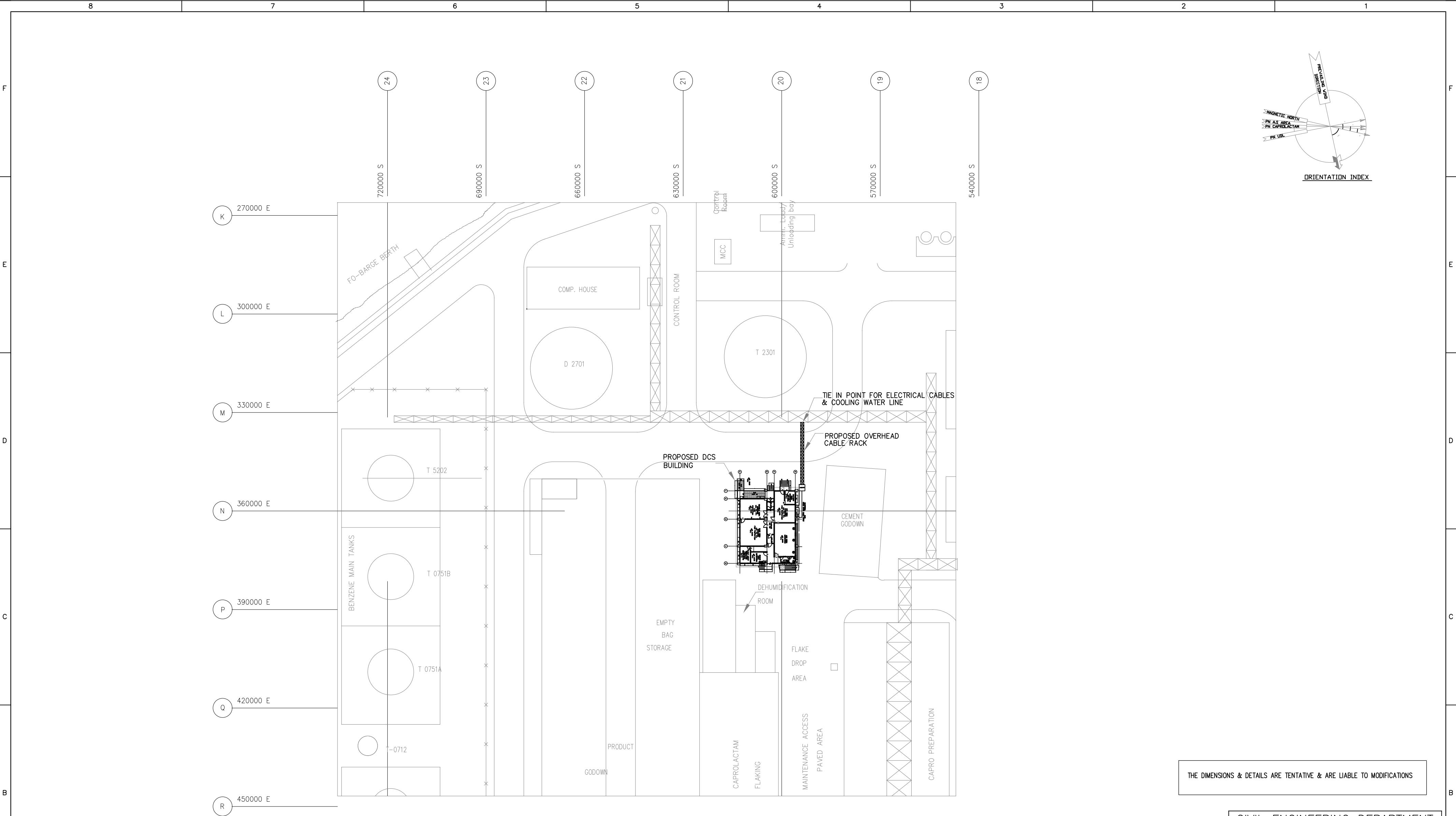
Mandatory Spares should be included in the scope of the bidder for M.V. Switchboard as follows:

S. No.	Description	Quantity
1.	1NO + 1NC auxiliary contact for MCCB	5 Nos
2.	MCB for control supply	2 nos. of each rating
3.	Auxiliary contactor	2 nos. of each rating
4.	Indication lamp assembly and lamps	3 nos. of each type
5.	Power Contactor	1 no. of each rating
6.	Overload relay	1 no. of each rating
7.	SFU	1 no. of each rating

CIVIL DEPARTMENT		SCHEDULE OF ITEMS OF WORK			CUSTOMER: M/s FACT UC		32775-12-SW-001 A R1	
							PAGE 1 OF 1	
NAME OF WORK: ENGAGING ENGINEERING DESIGN CONSULTANT FOR CONSTRUCTION OF DISTRIBUTED CONTROL SYSTEM(DCS) BUILDING FOR AMMONIA HANDLING AT FACT UC							DATE: 20.04.2026	
SL. (1)	DESCRIPTION OF ITEM (2)			UNIT (3)	QUANTITY (4)	RATE (Rs) (5)		AMOUNT(Rs) (6)
						FIG.	WORDS	

1	Engineering Consultancy services for the Distributed Control system (DCS) building and associated facilities including Preparation of Tender documents (comprising Tender purpose drawings, Technical specifications and detailed BOQ of materials), Preparation of elevation and section drawings as per approved plan, Good for construction drawings of structural and MEP services, HVAC, Clean Agent, site visit for addressing site related queries and preparation of As built drawings.	LS	1			
2	Site visit by consultant (Rate per site visit by the consultant shall be quoted in line with tender conditions, inclusive of all expenses such as travel, accommodation, daily allowances, and any other associated costs)	No. of visits per person	6			
	TOTAL AMOUNT					

NKV	NJ	NJ	FACT ENGINEERING AND DESIGN ORGANISATION	
PRPD. BY:	CHKD. BY:	APPRD. BY:		

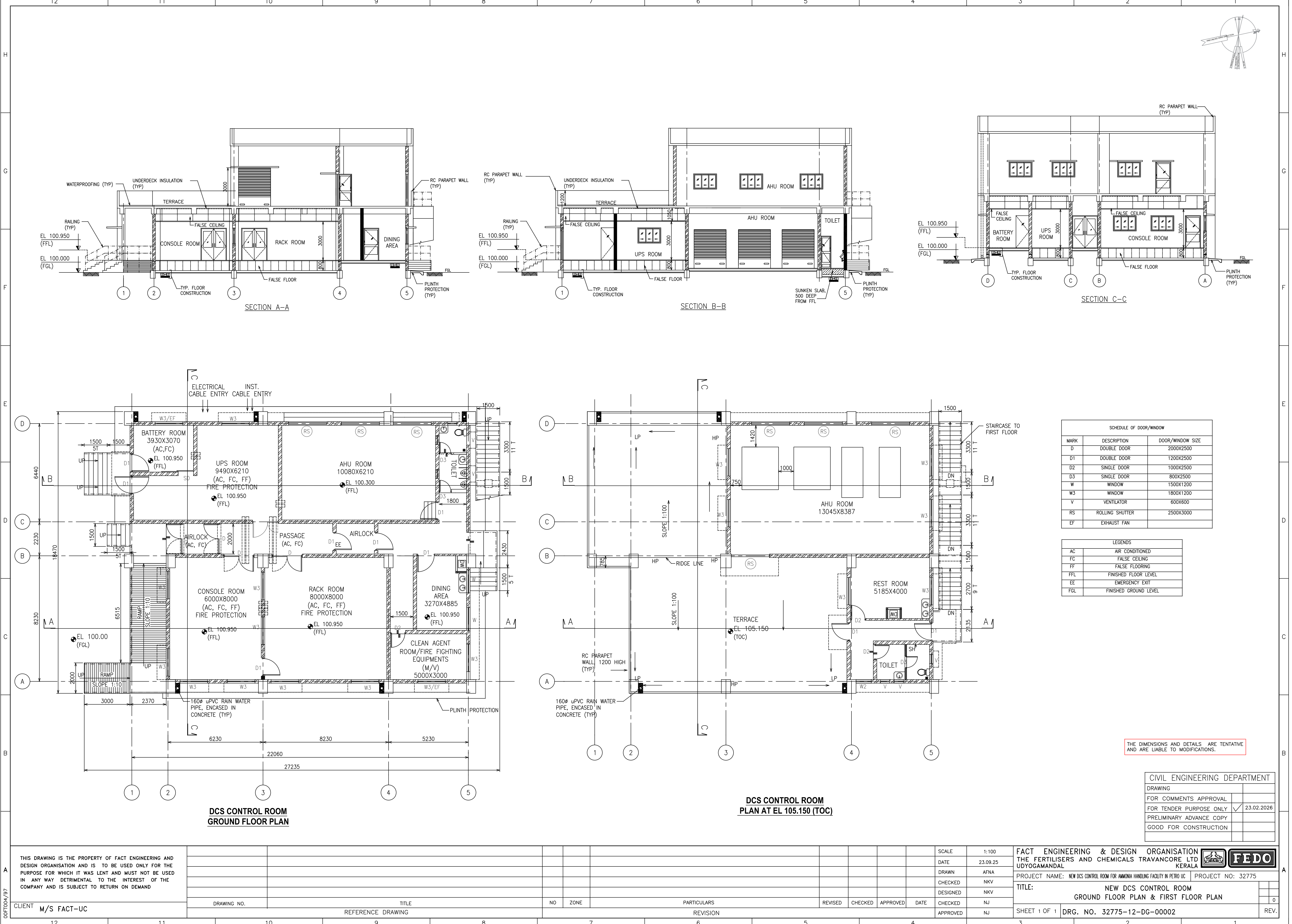


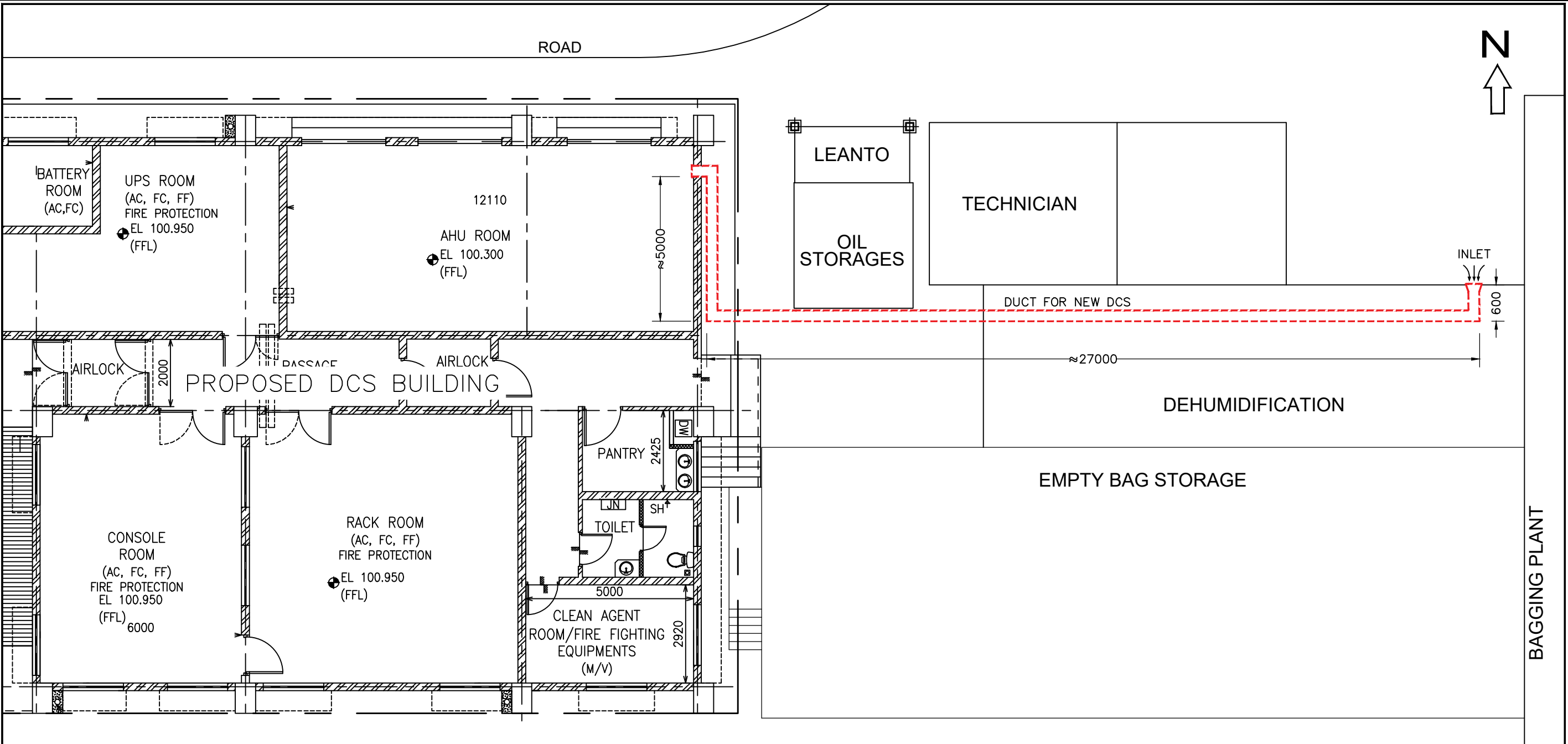
LAYOUT PLAN
SCALE 1:800

THE DIMENSIONS & DETAILS ARE TENTATIVE & ARE LIABLE TO MODIFICATIONS

CIVIL ENGINEERING DEPARTMENT			
DRAWING			
FOR COMMENTS APPROVAL			
FOR TENDER PURPOSE ONLY		✓	21/01/2026
PRELIMINARY ADVANCE COPY			
GOOD FOR CONSTRUCTION			

A	THIS DRAWING IS THE PROPERTY OF FACT ENGINEERING AND DESIGN ORGANISATION AND IS TO BE USED ONLY FOR THE PURPOSE FOR WHICH IT WAS LENT AND MUST NOT BE USED IN ANY WAY DETERIMENTAL TO THE INTEREST OF THE COMPANY AND IS SUBJECT TO RETURN ON DEMAND																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
---	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--





NOTE:-
1. ALL DIMENSIONS ARE IN 'MM' UNLESS OTHERWISE SPECIFIED.

				SCALE	PROP	 UDYOGAMANDAL COMPLEX PETROCHEMICAL PLANTS, KOCHI, KERALA TITLE LAYOUT OF DUCT FOR PROPOSED DCS BUILDING -AMMONIA HANDLING DRG. NO: FPTS-KP-27-1752SHEET NO. 1 OF 1R₀			
				DATE	22-09-2025				
				DRAWN	VKG				
				DESIGNED	KNB				
				CHECKED	SJP				
REFERENCE DRG. NO.	R. NO.	PARTICULARS	SIGN/ DATE	APPROVED					
		REVISION							



SAFETY REGULATIONS

For

CONTRACT WORKS

FACT/UC/F&S/SRFC; Rev 0
30-July -2022

Contents

1. GENERAL.....	2
2. SAFETY TRAINING	2
3. CLOTHING.....	2
4. MEDICAL FITNESS.....	2
5. INTOXICATING DRINKS & DRUGS AND SMOKING	3
6. MOTOR VEHICLE MOVEMENT.....	3
7. RESTRICTION OF MOBILE PHONES.....	4
8. PERSONAL PROTECTIVE EQUIPMENT (PPE).....	4
9. HOUSEKEEPING	4
10. WORK PERMIT SYSTEM.....	4
11. WORKING AT HEIGHT	5
12. CONFINED SPACES.....	5
13. EXCAVATION	6
14. COMPRESSED GAS CYLINDERS.....	6
15. GAS CUTTING EQUIPMENT	7
16. CONTRACTORS EQUIPMENTS AND MACHINERY.....	7
17. USE OF OWNER'S EQUIPMENT	7
18. USING LIFTING TOOLS/ TACKLES / MACHINERIES.....	8
19. ELECTRICAL SAFETY	8
20. FIRE SAFETY	10
21. EMERGENCIES	10
22. UNSAFE ACTS / CONDITIONS	11
23. REPORT ON ACCIDENTS /INCIDENT/ NEAR MISSES	11
24. QUALIFICATION AND EXPERIENCE OF MANPOWER TO BE EMPLOYED	11
25. PERSONAL CONDUCT	12
26. SPECIAL SAFETY CONDITIONS.....	12
27. FINANCIAL DETERRENT FOR VIOLATION OF SAFETY NORMS BY CONTRACTORS	13
ANNEXURE -I	16
ANNEXURE -II.....	17
ANNEXURE -III.....	19

1. GENERAL

All contractors shall comply with OWNER's Safety and Security Regulations set forth herein. These regulations are applicable for performing any work in FACT Udyogamandal Complex and any facilities belonging to FACT- UC

Contractor shall be bound by all the Safety provisions as per Indian Standards Institution, The Petroleum Act 1934, The Factories Act 1948, The Kerala Factories Rules 1957, The Gas Cylinder Rules 2016, The Indian Electricity Act and such other Acts, Rules and Regulations formulated by Local, State or Central Governments and other statutory bodies from time to time.

In addition to statutory rules and regulations applicable, Safety Practices to be followed in FACT Udyogamandal Complex are being described in this document for strict observance. The CONTRACTOR shall be held responsible for all lapses of these rules by his sub-contractors/employees.

2. SAFETY TRAINING

All Contractors, Contract supervisors, Contract labours and Drivers/ Helpers of Hazardous goods transportation vehicles shall undergo Fire and Safety Induction Training before the issuance of gate passes by the CISF.

The contractor shall submit a duly filled training request form (Annexure I) to the safety department. The training date will be informed by the safety Dept. All contract employees shall appear for refreshment training after the due date.

3. CLOTHING

All contract employees are forbidden to wear loose dresses like dhotis, saree, neckties scarfs and loose shawls inside the factory premises

4. MEDICAL FITNESS

The contractor shall employ only medically fit personnel for any work and the medical fitness certificate from a registered medical practitioner shall be submitted to the concerned Officer-in-Charge and Security department while taking an entry pass

The contractor shall submit the fitness certificate from a registered medical practitioner for the workers who are involved in working at a height of more than 30 metres using temporary structures and confined spaces. (Annexure-2 Pre-placement medical examination record)

5. INTOXICATING DRINKS & DRUGS AND SMOKING

- a. The Contractor shall ensure that all personnel working for him comply with the “No-Smoking” requirements of the Owner as notified from time to time. Cigarettes, lighters, auto ignition tools, torches or appliances as well as intoxicating drugs, dry tobacco powder, etc. shall not be allowed inside the factory premises
- b. The Contractor shall not allow any workmen who are under the influence of alcohol/drugs or any other intoxicating substances to carry out any work at FACT UC.
- c. The violators of above rules shall be sent of the premises immediately with temporary barring from entering the premises for two weeks.

6. MOTOR VEHICLE MOVEMENT

The contractor shall ensure that all traffic regulations and Motor Vehicle Rules are complied while driving inside the factory premises. In addition following rules shall also be followed. All vehicles shall carry only the number of passengers authorised to travel as per rules.

- a. Speed limit
The speed limit for all vehicles inside the factory premises is 20 km/h.
- b. Parking
All vehicles of contractors shall be parked in such a way that it doesn't create hindrance to the movement of fire tender and other vehicles. No vehicle shall be parked in front of fire station, hydrants and monitors etc. Vehicles shall be parked only in designated parking area and shall not be parked in plant premises.
- c. Safe Load
Vehicle shall carry only the load it is authorized to carry as per rules. Goods carried shall be properly secured so that they will not accidentally fall off /spill while vehicle is in motion. Goods shall not protrude beyond the platform of the vehicles carrying the goods, if protruding a red flag / red light (at night) shall be provided at the tail end of the protruded object.
- d. Passengers in Vehicles
No person shall be allowed to travel by sitting / standing / lying on the goods. Tractors/ Forklift etc. shall not be used for transporting personnel.
- e. Spark Arrestor
All vehicles shall be fitted with spark arrestor before entering the company premises.

7. RESTRICTION OF MOBILE PHONES

Use of non-intrinsic safe mobile phone and other wearable items like smart watch, ear phones etc is strictly prohibited in company premises. Contractor has to take clearance from CISF and safety department in case of using intrinsically safe mobile phones.

8. PERSONAL PROTECTIVE EQUIPMENT (PPE)

Helmet, safety shoes, required PPEs and proper dress codes are mandatory to enter company premises, all contract workers shall wear YELLOW coloured safety helmets.

Contractor shall provide his workers PPEs required to carry out the work free of cost. PPEs shall be conforming to the relevant Indian standard.

In addition to the above requirement, any PPE which is required for safe execution of the job as per recommendations from Engineer-in-charge or Safety officers or any authorised person of that area shall also be used/ supplied by contractor to his workers. All PPEs used by contract workers shall be inspected periodically for any damages and replaced by contractor if found damaged.

Apart from respiratory apparatus (BA set & Canister Mask), if the contractor utilises any other PPEs issued by the safety Dept, FACT UC, Contractor will have to pay charges as per laid down procedure. In case of damages or loss of any materials / equipment provided by FACT on loan/returnable basis, same shall be recovered from the contractor's bill at the rate decided by FACT.

9. HOUSEKEEPING

The contractor should ensure proper housekeeping of worksite. All the scrap materials to be removed to scrap yard regularly. Materials and equipment should be stored in a safe and orderly manner so that they will not block exits to roads, buildings, aisles, passages and approach to fire fighting equipment such as fire hydrants, fire hoses and fire extinguishers or areas where emergency safety showers, electrical switch panels, manual call points and switch rooms are located.

10. WORK PERMIT SYSTEM

All works carried out in the company premises must be covered by a valid work permit issued by an authorised / competent person of the area. Presently permit system available are Cold work Permit, Hot work Permit, Work at higher elevation Permit/ Height Work Permit, Confined space work Permit, Excavation work Permit, Radiography work Permit, Electrical energizing/ de-energizing Permit.

All the Seven types of Work Permits are currently in electronic format and print out of the same will be issued upon approval, the print out shall be kept at site by contract supervisor and shall be shown to the safety officer for verification.

Note: For radiography work permit the contractor shall submit details of source along with decay certificate at Safety department and get prior approval of the Senior Manager (F&S). Before commencement of the work contract supervisor shall submit the serial number in the torch and decay chart for verification by the shift safety officer. The contractor shall be responsible for the safe storage and handling of any radiographic sources.

If there is any road cutting, the contractor shall submit a copy of the permit to safety department by stating the location of road cutting and get clearance.

11. WORKING AT HEIGHT

a. Scaffolding

Construction of Scaffolding shall be as per IS: 3696, scaffold clamp shall be used for scaffold erection. Use of any other material, such as coir, binding wire and plastic rope for scaffold erection shall not be permitted. Using materials such as bamboo, wooden poles, wooden platforms etc. for scaffolding is strictly prohibited

b. Ladder

Ladder used shall be of standard material like wooden/steel and be sufficiently strong conforming to IS: 3696 (Part 2). Ladder shall be secured at both end with ladder clamp, Ladder shall be in good condition.

c. Personal protective equipment's

Good quality full body harness with double lanyard conforming to relevant Indian standard shall be used for height works. If the anchoring point for safety harness is not available, provision of lifeline is mandatory. If the lifeline is a wire rope then the diameter shall be more than 8 mm and in case of Polyvinyl or polyamide lifeline, the diameter of the rope shall be more than 16 mm.

d. Isolation of the working area

While carrying out work at height, the area under the work shall be barricaded and proper sign board written as "HEIGHT WORK IS IN PROGRESS" shall be displayed to prevent unwanted access of other personnel.

12. CONFINED SPACES

a. Confined Space Entry Permit

Confined space entry permit shall be obtained from the area-in-charge prior to commencement of the jobs such as entry in to process vessels, storage tanks, reactors, sumps, ducts and excavations beyond 1.2 meters of depth etc. Contractor

shall maintain a register of personnel entering the confined space. The same shall be displayed at the entrance.

- b. Personal protective equipment: PPEs advised by Safety department to be used while commencing work at confined space.
- c. Only 24 volt DC electrical equipment shall be permitted to use inside confined spaces.
- d. Additional precautions advised by Safety department are applicable to commence work inside confined space considering the hazardous nature of the confined space.

13. EXCAVATION

All safety precautions as per IS: 3764 shall be followed while carrying out excavation. Contractor shall obtain clearance from Electrical, Instrumentation, Civil and Process departments before starting the work. He/she shall also ensure that the excavation does not damage any existing underground cables, pipelines, foundation of adjoining buildings or structures etc. Wherever possible excavation shall not be close and deep as to undermine safety of any adjoining building or structure.

When excavation work is to be undertaken, the contractor shall start digging manually to locate the buried utilities (water line, cables etc.) and thereafter use mechanical means. Cables scanning using instruments will be required in areas around high voltage cables.

The contractor shall maintain sufficient angle of repose during excavation, shall also provide battering and shoring wherever required to prevent collapse of edge of excavation.

The contractor shall arrange protective fencing / hard barricading with warning signal around excavated pits, trenches. Soil heaps shall keep at least 1.5M away from the edge or distance equal to the depth of pit (whichever is more).

14. COMPRESSED GAS CYLINDERS

Compressed gas cylinders shall be kept (both full & empty) in upright position and shall only be handled in trolley only.

Gas cylinders shall not be left at site after completing the work; it shall be shifted to the designated areas provided in plants before leaving the site. Compressed gas cylinders must never be stored or placed near hot equipment or lines. They must be protected against direct sunlight, high temperatures and contact with electrical circuits.

Storage and handling of gas cylinders shall be as per the regulations of gas cylinder rules 2016.

15. GAS CUTTING EQUIPMENT

Gas cutting equipment shall confirm to relevant Indian standard, approved flash back arrestors are to be provided on both cylinder and torch side. Contract supervisor shall ensure that all the parts of gas cutting equipment such as pressure gauges, regulator, hose and torch shall be in good working condition before starting the work. Contract supervisor shall conduct regular inspection of the unit for any damage.

Hoses used for oxygen gas and fuel gas shall be of two different colours. Two stage regulators with two gauges are mandatory. Oxygen gas and other gas hoses should be without any joint. If joint becomes essential, only approved connector with jubilee clips to be used. Hoses should not be wound over the cylinders.

Contractor has to ensure the availability of suitable fire extinguisher with each Welding and gas cutting set.

Equipments shall not be left at site after works; it shall be kept at designated locations of the plant or in contractor's workshop/store.

16. CONTRACTORS EQUIPMENTS AND MACHINERY

All the tools and tackles, lifting machines and gas cylinders shall get certified by a competent person and a copy of test certificates shall be submitted and got approved from Safety department. The tools and tackles, lifting machines, gas cylinders and other equipment's shall be inspected by the contract supervisor on a daily basis before the use. Contractor Name, Equipment Identification No. shall be printed on all the equipment. Equipment's safety systems shall not be tampered or bypassed.

Maintaining shed inside factory for storing tools and tackles, permission from competent authority shall be obtained. Permission will be against the work orders only. Contractors shall submit a declaration about the items stored inside their shed. The store shall be subjected to inspection of Safety and Maintenance dept with the presence of Contractors. If anyone is not allowing to inspect shed, the same shall be break opened in the presence of CISF after giving notice to contractor. If any contractor is not having any contracts inside FACT UC for 2 years from the date of completion of last contract, he/she shall vacate the shed.

Under no condition shall any CONTRACTOR'S personnel tamper with or use any property belonging to the FACT- UC without obtaining prior sanction from the Engineer in charge/ authorized person of area concerned.

17. USE OF OWNER'S EQUIPMENT

Owner's equipment must not be handled or tampered with by contractor's employees. Owner may grant permission to contractor to operate his equipment, if conditions so

require. Contractor shall not use Owner's equipment and tools without obtaining permission from Owner's representative.

18. USING LIFTING TOOLS/ TACKLES / MACHINERIES

The crane, lifting tackles, slings, D shackles, etc. used for the work at site shall comply with the statutory requirement and shall accompany with valid test certificates duly approved by statutory authority. Copy of the test certificate shall be submitted to the Engineer-in-Charge before commencement of site work. Safe work load and copy of the test certificate shall be displayed on the crane. Load chart shall be always available inside the crane. The cranes and all types of vehicles shall be fitted with reverse horns. Contractor shall not bypass safety switches/fittings such as hoist limit switch, boom limit switch, safe load indicator etc.

The operator/driver of crane / hydra shall possess HMV driving license and valid licence from statutory authority to operate crane/hydra.

19. ELECTRICAL SAFETY

- a. Safety precautions stipulated in IS 5216 and CEA regulations 2010 shall be adhered to while carrying out electrical works.
- b. In no circumstances the contractor shall be permitted to interfere with fuses and electrical equipment's belonging to the owner or other contractors.
- c. Earth Leakage Circuit Breaker (ELCB)/Residual Current Circuit Breaker (RCCB) of suitable rating shall be provided in the Electrical Distribution board of contractor's installation as per statutory requirement. The ELCB shall be checked once in a month for short term/shut down jobs.
- d. All distribution boards and plug tops shall of industrial type only. Domestic type power boards, double adapters, 3 pin plug adapters and homemade power boards shall not be used.
- e. All hand lamps shall be of 24 volts rating connected using 3 core double insulated flexible cables. The third core shall be used for earthing the hand lamp.
- f. All Electrical DBs and switchboards shall be standard industrial type, identifiable with Contractor's name displayed on it and cleared by Electrical dept.
- g. Flexible cables for portable lamps, tools, and apparatus shall be regularly examined, tested periodically and maintained to ensure safety and protected against mechanical damages.
- h. Unless certified as double-insulated, electrical tools must have the casing grounded.
- i. For getting electrical connections to the Contractor's equipments he shall give a written request to Electrical Shift in charge and satisfy him that the equipment is in good condition. And shall inform the in charge about maximum current rating, voltage and phase of the appliance. Permission for power connection will not be

granted until Owner/Engineer -in-charge is satisfied that the appliance is in good working condition and proper earthing connection provided.

- j. Only authorized persons shall carry out operation and maintenance of electrical systems.
- k. Work permit and isolation of the electrical system before taking up the work must be ensured.
- l. Do not overload electrical equipment. Do not fit make shift fuse wire.
- m. All electrical equipments like wires, switch board etc. shall be protected against rains or leaking water lines etc. in wet condition switches shall not be operated until it is dried up properly. Switches, starters shall be placed well above ground level.
- n. All welding jobs shall be properly earthed in work spot. Do not use structural earth.
- o. After the completion of work, please inform electrical dept. for power disconnection.
- p. All welding sets shall be double earthed with suitable capacity cables.
- q. The contractor shall bring power distribution boards, cables of sufficient length, power tools and other electrical equipments of adequate rating and capacity for the successful completion of work.
- r. All temporary connections to distribution boards, welding sets, power tools, etc. shall be given from industrial type sockets available at different locations in plant area. The contractor shall bring industrial type plugs of suitable rating for availing temporary connections.
- s. No work must be carried out on any live equipment. The equipment must be made safe and a work permit issued by Technician in Charge shall be taken before any work is carried out.
- t. Electrical tools shall be checked to ensure that the supplied voltage is comparable to the machine's design. Where required, electrical tools shall be properly earthed. High speed rotating equipment's such as grinders shall be fitted with protective guards. Power tools shall never be left operating unattended. Spark arrestors shall be fitted to all equipment exhausts where a risk of combustible gases in the atmosphere exists.
- u. Contractor shall ensure the following General safety precautions in electricity:
 - Proper protective equipment's shall be used.
 - Check for defective cables, loose joints in conduits, damaged fuse boxes, loose pins, faulty sockets, and defective earth wire.
 - Use right type of tools for the jobs.
 - After maintenance of flameproof fittings, ensure that the fittings meet requirements of flameproof standards.
 - Power supply cable shall be laid normally underground from source to the work place whether permanent or temporary.

- Jointing of cable shall always be made using proper junction box and flameproof junction box when in hazardous areas even in case of temporary connections.
- All equipments LT or HT which are likely to cause hazard shall be turned off and segregated. All base terminals etc, shall be insulated. Rubber mats shall be used for LT/HT switch room, where applicable.
- Proper earthing shall be provided for all electrical items and effectiveness of earthing shall be checked from time to time.
- Electrical items shall be handled after isolation and care shall be taken to identify and replace damaged electrical items. Guard wire shall be provided for A/G HT wires.
- Ensure all fuses are of good quality and conform to correct ratings. Use MCB's as far as possible.
- Electrical maintenance workmen working around a wet area near a fuse box must use wooden platform with rubber mat, insulated tools and rubber boots.
- The contractor shall bring adequately rated switch board / junction box, fitted with ELCB and other safety devices for getting temporary electrical connections to portable tools, lighting supply etc.
- No electric cable in use by other Contractor/Owner will be disturbed without prior permission. No weight of any description will be imposed on any such cable and no ladder or similar equipment will rest against or be attached to it.
- All equipments shall be properly earthed, and cables properly insulated and connected.

20. FIRE SAFETY

The contractor shall take all necessary precautions to prevent outbreak of fires at the site. Handling and storage of flammable materials shall be as per the regulation of the company.

Permission must be obtained from concerned authority prior to CONTRACTOR'S personnel drawing water from the owner's fire water network. After the requirement of water is over, it shall be COMMUNICATED to the Fire station.

For storing flammable / explosive materials permission from safety department shall be obtained and storage shall be in compliance with all applicable rules.

All hot work sites shall have suitable type and number of fire extinguishers. If needed, fire extinguishers will be provided from fire station-petro against the work order upon request of the contractor.

21. EMERGENCIES

On hearing the emergency Siren or reporting any emergency (Fire, Acid spillage, oil spillage, gas leak, etc.) contractor's personnel shall safely stop their works and

proceed to the nearest assembly point. Before recommencement of the work, they should obtain clearance of Engineer in charge/ authorized person of the area.

Before commencement of any work contractor's personals shall identify following;

- i. Assembly point close to the location of the work.
- ii. Location of MCPs (Manual Call Points), Safety Showers & pond, Fire extinguisher and ambulance point number close to the area of work.

22. UNSAFE ACTS / CONDITIONS

No contract workers shall carryout unsafe acts or disregard of normal safe working practices. Any unsafe acts / conditions pointed out by any FACT employees or from Fire and Safety Department shall be immediately corrected.

The Safety Department is empowered to suspend any activity of the Contractor or his workmen and send them out if they fail to follow safe system of work with information to concerned Department Head.

Any contract personnel involved in violation of safety norms will be charged with fine as indicated in the Financial Deterrent norms of FACT.

23. REPORT ON ACCIDENTS /INCIDENT/ NEAR MISSES

- a. All accidents/ incidents shall be reported to Safety department through concerned engineer-in-charge / shift-in-charge immediately after occurrence.
- b. Medical treatment for injured Contractor's personnel will be entirely the responsibility of the Contractor. However, if required, emergency first aid treatment will be given at OHC.
- c. If any injured contract personnel fails to report back on duty in 48 hours after incident, status of the injured personnel and the date of return to duty shall be informed to Engineer-in-Charge and Safety Department.
- d. The contractor's personnel shall also report all near miss incidents at the work site to and Safety department through the near miss reporting boxes.
- e. All Accidents/ Incidents/ First Aid cases shall be reported to Safety department in prescribed format (accident report) though engineer in charge within 24 hrs.

24. QUALIFICATION AND EXPERIENCE OF MANPOWER TO BE EMPLOYED

- a. If a contractor is employing less than 30 employees, he shall designate one dedicated supervisor as a safety steward. For every 30 persons or more, contractor shall appoint one qualified safety steward (Diploma in industrial safety or equivalent qualification such as NEBOSH etc). In addition to above contractor shall also appoint one safety officer for every 100 workers. Safety officer shall have Diploma in Industrial Safety or any equivalent qualification from Government Recognized Institute and minimum 2 years of relevant industry experience. In

both the cases, the contractor must specify in writing the name of such persons to the engineer in-charge.

- b. Contractors shall deploy only experienced and qualified supervisors and workmen, who are well conversant with the Safety Regulations of FACT-UC.
- c. Also supervisors shall have sufficient knowledge of English language to understand Work permit system, work instructions, drawings and they should be able to assimilate the safety training inputs provided by FACT-UC Safety Officers.
- d. Past experience must be for same type of job for which the supervisors would be engaged.
- e. Contractor's skilled workmen like riggers, scaffolders, welders, fitters, crane operators, other specialized equipment operators like hydro-jetting, shot blasting, use of jacks, diamond cutting etc must have sufficient past experience and skills on relevant jobs.
- f. All workmen shall be capable of following instructions and training.

25. PERSONAL CONDUCT

The following activities / behaviours on the part of Contractor's personnel are strictly forbidden:

- a. Entering the factory premises while in possession of any type of weapons.
- b. Fooling on the work, mock fighting or fighting within the factory premises.
- c. Gambling within the factory premises
- d. Contractor's personnel shall not pick up quarrel or get into arguments with FACT employees/consultants'/ other contractor's personnel/ any other persons.
- e. Contractor's employees shall furnish / submit their security pass to Safety department whenever asked to do so, and failing which it will be considered as violation of safety regulations.

26. SPECIAL SAFETY CONDITIONS

1. Contractor shall maintain a register to record name of the persons engaged at a particular site on a daily basis.
2. Contractor supervisors and workers shall always carry their entry passes with them and it has to be produced on demand.
3. Contract personnel shall not use Plant areas, Pump houses, cable cellar rooms, substations, etc. for changing clothes, taking food, resting, etc.
4. The contractor shall notify FACT UC of his intention to bring on site any equipment or container holding liquid or gaseous fuel or other substances, which might create a hazard. The Owner will have the right to prohibit the use of such equipments or to prescribe the conditions under which such equipment may be used.
5. No workers/ contractors shall take rest or have food from plant premises. Sleeping and sitting below equipments/machines or in plant premises are not allowed.
6. Safety Department have the right to seize equipments, tools or PPEs used by contractors inside FACT which are non-standards or unsafe to use.

7. In addition to the Safety Regulations for Contract works, contractor shall follow all instruction of Safety department.

27. FINANCIAL DETERRENT FOR VIOLATION OF SAFETY NORMS BY CONTRACTORS

All contractors working in FACT Udyogamandal Complex have to strictly follow safety and security regulations. Contractors who are violating safety norms while executing the job will be penalized financially. Apart from financial deterrence, serious violations shall result in temporary or permanent de-listing and barring of the contractor. Penalty amount for violation / non adherence of various safety norms is given below.

CODE	Violation	Penalty Amount
SV-01	Working without proper Authorization / Permit	Rs.1000/- per case & holiday listing of 3 years if repeated.
SV-02	Violation of any of the conditions specified in the permit	Rs.500/- per permit
SV-03	Failure to keep work permit/ site reference copy at site.	Rs.500/- per case
SV-04	Working at height without safety belt./ Arrangement as required	Rs 1000/- per person per case.
SV-05	Not wearing Mandatory PPEs or wearing defective PPEs	Rs.500/- per person per case.
SV-06	Not following dress code inside Factory premises.	Rs. 200/- per person per case.
SV-07	Non-use of ELCB or use of faulty ELCB , using poor joints of cable, using naked wire without top plug into the socket , laying wire/cables on the roads, carrying out electrical jobs by incompetent person/Any unsafe activity on electrical equipment	Rs 1000/- per each case.
SV-08	Over speeding of vehicles, rash driving, wrong side parking, wrong side driving, not wearing seat belt or any other road safety violation.	Rs.500/- per case
SV-09	Unauthorized parking of contractor's vehicles/cranes inside the factory. Parking vehicles/cranes beyond the allotted time/date without parking permission after the completion of work.	Rs.500/- per case/day
SV-10	Non usage of trolley, flash back arrestor in gas cutting equipment or using damaged	Rs.500/- per item per case

CODE	Violation	Penalty Amount
	hoses for gas cutting	
SV-11	Unauthorised Use of Mobile phones inside the company.	Rs.1000/- per each case
SV-12	Carrying or use of prohibited material like match box, cigarette, tobacco, lighter and other ignitable materials	Rs.1000/- per each case
SV-13	Leaving gas cylinders unattended in site after completing work	Rs.200/- per day/item/person
SV-14	Use of non-certified lifting tools and tackles	Rs.100/- per day/item/person
SV-15	Failure to report accidents / incidents	Rs.300/- per day/item/person
SV-16	Intoxication / smoking inside company	Rs.1000/- per day/item/person Along with temporary barring of person from entering company for two weeks
SV-17	Any other serious violation of safety and security norms.	Rs.1000/- per day/item/person
SV-18	Accidents inside factory premises with damages to property*	

**The compensation for the damages caused will be decided by company and amount will be deducted from the bill*

First violation - warning
 Second Violation - fine
 Third Violation - barring of the personal

Notes:

The above penalties will be applicable for all the contracts jobs carried out inside the factory and covered by FACT HSE norms / work permit system.

Person will be sent out from the company premises in case of violations more than 3 times.

In case of frequent penalties for a particular contractor, necessary action such as holiday listing / delisting will be taken.

Implementation of above financial penalties for violation of HSE norms does not absolve contractors from their responsibilities to take at all times due and proper precautions to avoid injuries and accidents.

Contractors shall own the full responsibility for any accident and injury to any of the workers or to any person or persons or property arising due to violation of HSE norms by contractors even though financial penalty is not applied for such violation

Sample of Financial Deterrent Acknowledgment Form is attached as *Annexure III*

Fine amounts of safety violations will be deducted from the bills of contractors.

Signature :

Name of Contractor :

ANNEXURE -I
TRAINING REQUEST FORM

Name of Contractor

W O No:Details of work.....

Sl No	Details	Stamp size photo	Remarks
1.	Name: _____ Date of Birth: _____ Aadhar No: _____ ESI / Insurance No: _____ Emergency Contact No: _____ ☐ Contractor ☐ Supervisor ☐ Worker		
2.	Name: _____ Date of Birth: _____ Aadhar No: _____ ESI / Insurance No: _____ Emergency Contact No: _____ ☐ Contractor ☐ Supervisor ☐ Worker		
3.	Name: _____ Date of Birth: _____ Aadhar No: _____ ESI / Insurance No: _____ Emergency Contact No: _____ ☐ Contractor ☐ Supervisor ☐ Worker		
4.	Name: _____ Date of Birth: _____ Aadhar No: _____ ESI / Insurance No: _____ Emergency Contact No: _____ ☐ Contractor ☐ Supervisor ☐ Worker		

One stamp size photo shall be submitted in safety department with name written on back side for the purpose of training card. Safety Training will be on Saturdays except on national holydays. Form Shall be submitted in safety department 3 days prior to training day.

Signature & Seal of Contractor

Signature & Seal of Safety Officer

ANNEXURE -II
PRE-PLACEMENT MEDICAL EXAMINATION RECORD

Date:

Name :	D.O.B :
Sex : M / F	Reg. No. :
Post :	Dept. :

I. GENERAL EXAMINATION

1.Height :	2. Blood Group :
3. Weight :	4. BMI
5. Chest :	6. Past History of :
a) Normal :	a) HTN :
b) Expansion :	b) Asthma :
	c) Others :
	d) Present Symptoms :
7. Skin :	
8. Lymph Nodes :	9. Habits :
	a) Alcohol
	b) Smoking
	c) Others
9. Thyroid :	
10. Eyes :	Family History
a) Acuity of vision :	
b) Colour vision :	
c) Titmus Vision Testing :	
11. Ear, Nose, Throat	
12. Oral Cavity Teeth	

ANNEXURE -III


The Fertilizers and Chemicals Travancore Ltd.
 Udyogamandal Complex

Financial Deterrent Acknowledgment Form

Date: .../...../..... Time: Location:

Name:

Training Card No:

Contractor:

WO No:

Violation:

.....

.....

.....

.....

.....

Amount:

SIGNATURE OF SAFETY OFFICER

ROUTING: SM (F&S) / CONCERNED DEPT. DGM / DGM (FIN)



Job: Engaging Engineering Design Consultant for Construction of Distributed Control System (DCS) Building for Ammonia Handling at FACT UC

CONTENTS

- 1. CONTRACTOR TO INFORM HIMSELF**
- 2. RATES**
- 3. ISSUE OF MATERIALS BY COMPANY (FACT)**
- 4. SECURITY DEPOSIT AND MAINTENANCE PERIOD**
- 5. TIME OF COMPLETION AND COMPENSATION FOR DELAY**
- 6. PAYMENTS**
- 7. GST**
- 8. EXTRA ITEMS**
- 9. SAFETY AND SECURITY**
- 10. TERMS OF ENGAGING LABOUR**
- 11. TECHNICAL SUPERVISOR**
- 12. DISPUTES**
- 13. EMERGENCY**
- 14. DAMAGES**
- 15. TEST EQUIPMENTS**
- 16. ENVIRONMENT MANAGEMENT**
- 17. AGREEMENT**
- 18. FRAUD PREVENTION POLICY**
- 19. SUB LETTING**
- 20. SUSPENSION AND TERMINATION**

PRPD. BY :AS	CHKD. BY :SNK	APPRD. BY :SNK	Pg. No: 1
FACT CORPORATE MATERIALS		FERTILISERS AND CHEMICALS TRAVANCORE LIMITED	

1. CONTRACTOR TO INFORM HIMSELF

- 1.1 The Contractor is deemed to have visited the site and have gathered a clear idea of the nature and extent of work, probable area of operation, working space, leads, restrictions, labour situation with respect to availability, working hours, wages, benefits, terms of services etc. No claim on the grounds of ignorance of above conditions or change in above conditions will be entertained by the Company at any stage. Additional information may be collected from the Plant Manager / Engineer-in-Charge of the work before quoting, if required. Contractor is also deemed to have examined specifications, Schedules, drawings, Special Conditions and all other attachments. PAN No _____ & GST No _____ (To be indicated by the Tenderer)

2. RATES

- 2.1 The accepted rates shall be for all the operations as per Schedule of Work and shall be inclusive of all labour charges such as daily wages, holiday wages, overtime wages, leave wages, canteen subsidy, bonus, retrenchment benefits etc., incidental charges and profits, overheads etc. Rates shall also include elements of accident and medical expenses of labour, if required. The rates shall be firm till the completion of the work including extended period, if any, and no claim for revision of rates on any account will be entertained. Also no claim due to any variation of quantities of individual items will be entertained. Contractor shall execute work at agreed rates up to +/- 25% of the initial Contract Value, if required.

3. ISSUE OF MATERIALS BY COMPANY (FACT)

- 3.1 Issue of materials for the work by COMPANY (FACT) free of cost from its General or other Stores will be as mentioned in the Special Conditions of Contract. Contractor shall arrange to transport the materials to site, hold the materials in safe custody and maintain proper accounts of their use. No item of such materials shall be removed from the site without written approval of Plant Manager / Engineer-in-Charge.
- 3.2 Contractor shall return to Owner's/Company Store all balance materials, cut pieces, scrap etc., and obtain receipt.
- 3.3 The maximum permissible limits of wastage / cut pieces / excess or under consumption of materials supplied by Owner/Company will be decided by Engineer-in-Charge. For any portion of materials exceeding these limits or for any quantity of material remaining unaccounted, such amount will be recovered from Contractor/s bill as per book value or market rate whichever is higher plus 15% thereof or based on the latest orders issued by FACT management in this regard.
- 3.4 Site shall be cleared on completion of the job and clearance shall be obtained from the site-in-charge of the work/concerned departments.
- 3.5 In case the Company provides covered space in connection with the work, the contractor shall vacate and hand over the premises to the authorities immediately after the completion of the work in the same condition in which it was taken over.

4. SECURITY DEPOSIT AND MAINTENANCE PERIOD:

- 4.1 **The Security Deposit** for the work shall be **5%** of the Work Order value and the Contractor shall remit it online through 'State Bank Collect' portal using the link given below or by Bank guarantee from a Nationalised/Scheduled Bank in the prescribed

PRPD. BY :AS	CHKD. BY :SNK	APPRD. BY :SNK	Pg. No: 2
FACT CORPORATE MATERIALS		FERTILISERS AND CHEMICALS TRAVANCORE LIMITED	

format issued by FACT within 15 days of receipt of the work order.

[https://onlinesbi.sbi.bank.in/sbicollect/icollecthome.htm?corpID=9303&categoryName=Earnest%20Money%20Deposit%20\(EMD\)%2FSD%20Remittance](https://onlinesbi.sbi.bank.in/sbicollect/icollecthome.htm?corpID=9303&categoryName=Earnest%20Money%20Deposit%20(EMD)%2FSD%20Remittance)

The link is also available on of our website www.fact.co.in (Tenders → ‘Click Here to Pay EMD/ Security Deposit’)

Defects noted in the work during the Guarantee/Maintenance period, if any, due to poor quality of material supplied by the contractor or bad workmanship shall be rectified by the Contractor at his own cost. **The S.D. will be released only on completion of the Guarantee/Maintenance period, if any, as specified in the special terms & condition of the contract, provided the contractor has cleared all dues and rectified defects, if any.**

In case the bidder whose bid is accepted, fails to deposit the prescribed Security Deposit or fails to execute the agreement or fails to commence the execution of the work within the specified time, the contract issued to him is liable to be cancelled and the Earnest Money already deposited by the contractor shall be forfeited without any further reference to the contractor and alternative arrangements made at the risk and cost of the Contractor

5. TIME OF COMPLETION AND COMPENSATION FOR DELAY:

- 5.1 The total period for completion of the work shall be as specified in the Notice Inviting Tenders from the date of start of work / Work-To-Proceed Notice / date of clearance from the plant whichever is later. The work may be taken up in different areas and completed within the contract period as per priorities fixed by the Plant Manager / Engineer-in-Charge. Urgent works shall be completed within period fixed by the Plant Manager / Engineer-in Charge. The entire work shall be carried out to a mutually agreed programme with the Plant Manager / Engineer-in Charge.
- 5.2 Neither CONTRACTOR nor COMPANY (FACT) shall be considered in default in performance of CONTRACT if such performance is prevented or delayed due to circumstances of Force Majeure provided that the party so affected notifies the other in writing promptly, in any case within fifteen (15) days of its occurrence, of the existence of a situation of Force Majeure giving evidence thereof. For the purposes of this Article Force Majeure means: (i) War or hostilities, (ii) riot or civil commotion (iii) earthquake, flood, tempest, lighting or other natural calamities (iv) accident, fire or explosion on SITE not caused by wilful negligence of CONTRACTOR, and / or (v) Labour strike or lock-out exceeding ten (10) days in duration not caused by any deliberate act of indiscretion by CONTRACTOR. If the work is delayed due to reasons attributable to the Contractor, Liquidated Damages will be recovered from the Contractor
- 5.3 If the work is delayed due to reasons attributable to the Contractor, compensation for delay shall be recovered from the Contractor at the rate of 1/2 (Half percent) of the Contract Value per WEEK/Day of delay, subject to a maximum of 7.5% of the contract Value.
- 5.4 If in the opinion of the Engineer-in Charge, the works are unduly delayed, COMPANY (FACT) shall have the right to get such delayed items of work executed through any other Agency of its own choice at the risk and cost of the Contractor.

PRPD. BY :AS	CHKD. BY :SNK	APPRD. BY :SNK	Pg. No: 3
FACT CORPORATE MATERIALS	FERTILISERS AND CHEMICALS TRAVANCORE LIMITED		

- 5.5 The contractor should engage sufficient number of workers as required so as to complete the entire work within the specified time schedule of work.

6. PAYMENTS:

- 6.1 Payments shall be as mentioned in Special conditions.
- 6.2 Final Contract Price will be paid after completion of work in all respects and taking over by COMPANY(FACT), clearance of site, settlement of pending claims on account of Labour employed by Contractor and after deducting all payments already made, Liquidated Damages if any, income Tax, any other amount due to COMPANY(FACT) etc.
- 6.3 Payment towards GST portion shall be released only after uploading of invoice details by the supplier/service provider and the same is reflected in GSTR2B.

7. GST

The rate quoted by the Vendor for all the works as per this tender /WO shall be exclusive of applicable GST. GST, if applicable for the work as per any statutory notification, shall be extra. If the GST is to be paid by the Contractor as per the relevant notification, he shall arrange to remit the same to the concerned authority and FACT shall reimburse the same to the Contractor based on documentary evidence. If the same is to be paid by FACT, the above shall be done by FACT directly.

I. FACT's Provisional ID in the state of Kerala is 32AAACT6204C1Z2.

II. The supplier/contractor shall confirm the following:

- a) Submit GST compliant tax invoice to FACT with FACT's GSTIN as 32AAACT6204C1Z2.
- b) Shall ensure uploading the above invoice as per statute & File monthly returns in time enabling FACT to claim the input tax credit.

III. GST charged by the supplier/contractor shall be released separately to the supplier/contractor only after filing of:-

- (i) The outward supply details & the monthly return on GSTN portal by the Supplier/contractor and
- (ii) On matching the input tax credit to such invoice with the corresponding details of outward supply of the supplier/contractor.

IV. In case FACT incurs any liability (like interest, penalty etc.,) due to denial/reversal of such input tax credit in respect of the invoice submitted by the supplier/contractor, for the reasons attributable to the supplier/contractor, the same shall be recovered from the supplier/contractor

V. Further in case FACT is deprived of the input tax credit due to any reason attributable to the supplier/contractor, the same shall not be paid or recovered if already paid to the supplier/contractor.

8. EXTRA ITEMS

- 8.1 If any extra item of work is found necessary during the course of execution, the Contractor shall carry out such works also as per the instructions of the Plant

PRPD. BY :AS	CHKD. BY :SNK	APPRD. BY :SNK	Pg. No: 4
FACT CORPORATE MATERIALS	FERTILISERS AND CHEMICALS TRAVANCORE LIMITED		

Manager / Engineer-in-Charge. The rates for such items will be worked out in the following manner:

- i) Derived from similar items in the Contract.
- ii) Worked out from data on the basis of which estimate for the work was prepared, adding the rate or deducting there from, the overall tender variation or
- iii) Based on actuals, if the rates cannot be arrived at in any of the above manner. In this case the actual cost of materials, labour, incidental charges and all that is necessary for the work plus 10% towards overheads and profit will be paid to the Contractor. For working out rates on the basis of actuals, the Contractor shall produce documentary evidence of various expenses incurred by him and details such as labour engaged, materials purchased, etc. shall be reported to Plant Manager / Engineer-in-Charge as and when such expenditure occurred.

9. SAFETY AND SECURITY

- 9.1 The Contractor shall strictly observe all safety precautions and Security regulations of COMPANY (FACT) and shall comply with the instructions of the Plant Manager / Engineer-in-Charge or his deputies in this regard. The contractor shall strictly follow all safety regulations laid by Safety Department. Precautions regarding use of electrical equipment, chemicals etc., shall be strictly followed during execution of the work.

10. TERMS OF ENGAGING LABOUR:

- 10.1 CONTRACTOR shall comply with all Acts, Rules, Orders, and Regulations. By-laws of Government of India, State Government, Local Bodies or an Office, authority or unit, including BOCW & Companies Acts there under pertaining to employment or labour at SITE and procure any licence that is required for such employment.
- 10.2 CONTRACTOR shall be deemed Employer for these purposes and shall discharge all obligations of Employer. CONTRACTOR shall maintain such registers and records and display such information and notices as are required under these provisions and such registers shall at all-time be available for inspection by OWNER. Any information or reports required from CONTRACTOR by OWNER, periodically or otherwise, for discharge of OWNER'S obligations under such laws shall be provided promptly.
- 10.3 Payment of workmen Compensation and implementation of labour laws with regard to workmen employed by CONTRACTOR are CONTRACTOR'S liability and in case, OWNER is compelled to incur any expense or any other amount on behalf of CONTRACTOR'S workmen, OWNER is entitled to recover that amount from any bills payable to CONTRACTOR or in any other manner as deemed fit by FACT.
- 10.4 Tenderers shall submit the Registration certificate with Labour Dept/ PF / ESIC if available. If the tenderer is not registered under ESI/PF Act; tenderer shall submit PF/ESI Registration Certificate before commencement of the work. Failure to produce the original certificates at the stage of starting the work, would result in disqualification and forfeiture of EMD and also liable for debarring from participation in future tenders.
- 10.5 The Contractor shall obtain valid registration under The Employees' Provident Funds and Miscellaneous Provisions Act, 1952 (PF) & The Employees' State

PRPD. BY :AS	CHKD. BY :SNK	APPRD. BY :SNK	Pg. No: 5
FACT CORPORATE MATERIALS		FERTILISERS AND CHEMICALS TRAVANCORE LIMITED	

Insurance Act, 1948 (ESI) and shall ensure full compliance with the above Acts. The workers deployed by the Contractor for the work shall be covered under the PF & ESI Acts. The Contractor shall be responsible for making all payments to his workmen, including ESI and Provident Fund benefits etc., as applicable. If the workers are not presently registered with PF & ESI, necessary applications signed by the workers shall be submitted by the Contractor for enabling their registration. The Contractor shall regularly remit the PF/ESI contributions in respect of their employees and file regular returns, as prescribed under the respective Acts. Copies of monthly PF/ESI remittance challans along with periodic returns shall be furnished together with the subsequent monthly bills. It is also made clear that FACT shall not make any payments to the Contractor other than the rates agreed for the work. All extra payments, if any, to be made to the Contractor's workmen during the course of contract period shall be borne entirely by the Contractor. In case the Contractor fails to discharge his statutory obligations leading to a situation wherein FACT is to incur any expenditure/loss in their capacity as the Principal Employer due to non-compliance on the part of the Contractor of these Acts, such expenditure/loss shall be realized/recovered from the Contractor.

- 10.6 CONTRACTOR indemnifies OWNER against any claims from any person(s) engaged by CONTRACTOR in connection with WORK and in the event OWNER becomes directly liable for any payment consequent to breach or non-observance by CONTRACTOR of the provisions hereof, such amounts shall be payable by CONTRACTOR to OWNER, and OWNER may recover such dues from any amount receivable by CONTRACTOR under CONTRACT without prejudice to any other mode of recovery.
- 10.7 In the event of any dispute between CONTRACTOR and persons engaged by CONTRACTOR at SITE, CONTRACTOR shall amicably resolve and disputes in such a way that WORK can be proceeded with uninterruptedly. In the event such disputes cannot be resolved in the above said manner, CONTRACTOR shall immediately notify PLANT MANAGER / ENGINEER-IN-CHARGE of the existence of such a dispute and the nature thereof, but CONTRACTOR shall himself be responsible to take such measures as are necessary and permissible to have the situation resolved.
- 10.8 Contractor MAY HAVE ACCESS TO OWNER / OWNER's qualified first-aid personnel and ambulance in case of accidents where such facility is available. CONTRACTOR shall however provide a first-aid post for attending to minor injuries.
- 10.9 The contractor shall keep Muster Rolls of all the labourers employed by him at the site, noting their daily attendance and wages. The signature or thumb impressions of the employees shall be obtained in respect of wages on rolls. A copy of the attendance and wage register shall be produced to the Finance Department within one week after wage disbursement as per forms supplied by FACT.
- 10.10 The contractor shall employ only those adult workers (above 18 years of age) who are not disabled, mentally unsound, women in advanced stage of pregnancy or very old persons etc.
- 10.11 The Contractor shall produce the license from the competent authority as per provisions of Contract Labour (Regulation and Abolition) Act, 1970. The Contractor shall obtain a valid license from the Regional Labour Commissioner (Central), Kochi. The contractor shall abide by all the provisions of the various

PRPD. BY :AS	CHKD. BY :SNK	APPRD. BY :SNK	Pg. No: 6
FACT CORPORATE MATERIALS	FERTILISERS AND CHEMICALS TRAVANCORE LIMITED		

statutes and the rules framed there under in respect of the above.

- 10.12 All contract workers shall be enrolled with Kerala Labour Welfare Fund as per Government of Kerala Order No.3989/B1/2010/LBR. FACT shall deduct both employees and employer's contribution from the contractor's bill and remit the same to the fund.
- 10.13 The contractor shall be liable for payment of all claims, compensation or expenses payable as a result of any accident or injury sustained by workmen employed or hired by the contractor in the execution of the contract, which the contractor is liable to pay by rule, law and order of Government. The expenses, if any, incurred by FACT on the above will be realized from any amount that may be due to the contractor from FACT. Also, the Contractor shall be liable to pay all damages and expenses suffered by the company due to his negligence to perform any of the services mentioned in the contract or due to any action or omission of his employees.
- 10.14 The contractor shall observe all statutory labour rules / laws / regulations of Govt. of India, State Government, Local Bodies or any office or authority pertaining to employment of labour. Payment of daily wages, holiday wages, leave salary, bonus, ESI / P.F., retrenchment compensation etc. will be the responsibility of the Contractor. If any expense is incurred to COMPANY (FACT) on the above accounts, the same shall be recovered from the Contractor. The Contractor shall maintain wage register, muster roll, etc. required as per Law. Entry passes to the contract workers will be issued by CISF. For entry pass the contractor shall submit an application to CISF through work executing department and HR Department. The following documents shall be submitted along with the request.
- Copy of Age proof
 - Police clearance certificate
 - Copy of bank pass book
 - Copy of Aadhar
 - Two copies of passport size photographs
 - Duly filled application for ESI & PF enrolment.
- 10.15 The contractor shall pay the wages to the workers only through banks. Proof of bank remittance certified by banks is to be submitted along with the wage roll to the work executing department before 5th of every month. A copy of the same proof of bank remittance is also to be attached along with the bills to Finance Department.
- 10.16 The Contractor and his employees are expected to abide by discipline and traffic regulations as directed by FACT and CISF Personnel from time to time within the Offices or Plant premises. FACT reserves the right to demand the removal of the contractor or his employees who have been declared by FACT as offending its directives, without relieving the contractor from his obligations under the contract.
- 10.17 If any work entrusted with other parties by FACT is obstructed by, interfered with or caused to be interfered, detrimental to FACT's interest by the contractor or his employees, the contract shall be terminated without notice and the remaining work for the un-expired period of the contract shall be arranged by FACT through other parties at the contractor's risk and cost. The matter whether FACT's work

PRPD. BY :AS	CHKD. BY :SNK	APPRD. BY :SNK	Pg. No: 7
FACT CORPORATE MATERIALS		FERTILISERS AND CHEMICALS TRAVANCORE LIMITED	

has been interfered with or obstructed shall be decided by FACT and its decision shall be final.

- 10.18 The contractor shall maintain the safety practice during the applicable works, shall ensure that the workers are reported for job with proper PPE's and working dress applicable.

11. TECHNICAL SUPERVISOR:

- 11.1 The Contractor shall appoint a full time Technical Supervisor as required and approved by the Plant Manager / Engineer-in-Charge. He will be responsible for the proper conduct of the work. The instructions given to him or to any other authorized person of the Contractor shall be considered as instruction given to the Contractor. The Technical Supervisor or an authorized agency shall be available at Site during all working hour throughout the contract period to receive instructions from the Plant Manager / Engineer-in-Charge.
- 11.2 Material Specifications of works, measurements and any other condition not mentioned herein shall be as per relevant Indian Standard Specifications, Codes, Regulations, Laws, etc. or as directed by Plant Manager / Engineer-in-Charge. Tests if required before taking over of the work by COMPANY (FACT) shall be done by Contractor at his cost.
- 11.3 Single Phase Electricity and water if required for the work will be given free or cost at one point. The Contractor shall make his own arrangements for taking connection from that point.

GST is applicable as per GST Act of Government of India

12. ARBITRATION/DISPUTES:

- 12.1 If the Seller is a Central Public Sector Enterprise / Central Government Department: In the event of any dispute or difference relating to the interpretation and application of the provisions of this contract(s) between Central Public Enterprises (CPSEs)/Port Trusts inter-se and also between CPSEs and government departments / Organizations (excluding disputes concerning taxation), such dispute/ difference shall be taken up by either Party for resolution through AMRCD as mentioned in DPE OM No. 4(1)2013-DPE(GM)/FTS-1835 dated 22.05.2018."
- 12.2 For contracts other than (12.1) above:
If any dispute arises out of or relating to or in connection with this CONTRACT, between the CONTRACTOR and the OWNER/FACT, the same shall be amicably settled through mutual discussions, failing which, the unresolved dispute(s) shall be referred to arbitration in accordance with the provisions of the Arbitration and Conciliation Act, 1996, as amended from time to time and number of Arbitrator shall be one. The venue of the Arbitration shall be at Ernakulam and the proceedings shall be in ENGLISH. Any legal proceedings relating to or in connection with this contract shall be limited to the exclusive jurisdiction of the High Court of Kerala.

13. EMERGENCY

- 13.1 In case of emergencies or if required to meet the time schedule, Contractor shall arrange work beyond the normal working hours as per the instructions of the Plant Manager / Engineer-in-Charge and no extra payment will be payable for such work carried out.

PRPD. BY :AS	CHKD. BY :SNK	APPRD. BY :SNK	Pg. No: 8
FACT CORPORATE MATERIALS		FERTILISERS AND CHEMICALS TRAVANCORE LIMITED	

14. DAMAGES

- 14.1 The Contractor shall take care to see that none of the existing structures, fittings, other contractor's properties, etc. are damaged due to carelessness on his part or on the part of his workers. If such damages occur the company will have the right to recover such damages from the Contractor. The Contractor shall keep the site clean and neat at all times. All dismantled materials, debris etc. shall be conveyed and deposited at places pointed out by the Plant Manager / Engineer-in-Charge.
- 14.2 All scrap materials shall be transported to Material Conservation yard after weighing.
- 14.3 During execution of work COMPANY (FACT) reserves the right to delete any items full or part as per schedule of work due to site conditions or other reasons.

15. TEST EQUIPMENTS

- 15.1 Contractor shall use only calibrated test equipment / instruments for the works and valid calibration / test certificates shall be available for all such instruments.

16. ENVIRONMENT MANAGEMENT:

- 16.1 We are a company having Environmental Management System according to ISO 14001 standard. The contractor shall ensure that none of their activities cause damage to the environment. Special care shall be taken in packing and transportation to avoid spillages, or release of any hazardous gases / dust to the atmosphere. The worker employed by the contractor shall be properly trained for handling of the materials and for dealing with emergencies arising out of spillages or releases. Suppliers of chemicals shall provide us with Material Safety Data Sheets (MSDS) of the chemicals. Contractor shall ensure that all waste material/debris from the work site will be removed to the area earmarked or the purpose immediately after completion of the work.

17. AGREEMENT:

- 17.1 For contracts amounting to Rs.3.00 lakhs and above, the contractor shall execute a formal agreement between FACT as per preform on a stamped paper worth Rs.200/- before starting the work.
- 17.2 The company will not be responsible for payment of any compensation or idle wages for any hold up of work due to a general strike or reasons beyond the control of the company. Crane / Heavy Equipment will be given free of cost provided facilities are absolutely required for the execution of work at the discretion of Plant Manager / Engineer-in-Charge.

18. FRAUD PREVENTION POLICY:

- 18.1 Bidders shall comply with Fraud Prevention Policy of FACT 2012 (FPPF 2012). The said Policy is available in FACT Website www.fact.co.in

19. SUB LETTING:

- 19.1 CONTRACTOR shall not sub-let or sub-contract any or all of its obligations under CONTRACT to any other party without prior written consent of COMPANY (FACT). In the event of CONTRACTOR sub-letting the WORK or part thereof to any other party or engaging any sub-contractor, CONTRACTOR shall still be responsible to COMPANY (FACT) for performance of the whole CONTRACT and shall ensure that such other party to whom WORK or part thereof is sub-let or subcontracted perform the portion of WORK so sub-let or subcontracted as per provisions herein and the

PRPD. BY :AS	CHKD. BY :SNK	APPRD. BY :SNK	Pg. No: 9
FACT CORPORATE MATERIALS		FERTILISERS AND CHEMICALS TRAVANCORE LIMITED	

persons employed at SITE by such other party shall be deemed employed by CONTRACTOR.

20. SUSPENSION AND TERMINATION

- 20.1 In the event FACT is unable or unwilling to complete or is compelled to postpone its activities relating to PROJECT at any stage during the currency of CONTRACT, FACT may either suspend or terminate CONTRACT by giving CONTRACTOR thirty (30) days notice.
- 20.2 If CONTRACTOR shall fail or neglect to execute work with all due diligence and expedition or shall refuse or neglect to comply with any reasonable orders given to him in writing by FACT in connection with work or shall otherwise commit breach of any of the provisions of CONTRACT, FACT may give CONTRACTOR notice in writing requiring to make good such failure, neglect or breach. Should CONTRACTOR fail to comply with the notice within the time specified therein, then FACT shall, without prejudice to other rights of FACT under CONTRACT, be at liberty to have such WORK or portion of WORK as CONTRACTOR has failed or neglected to execute, executed directly or through any other agency FACT deems fit at the risk and cost of CONTRACTOR; and FACT shall have the free use of all of CONTRACTOR'S equipment, materials and other things for the time being available at SITE for getting the WORK completed in the above- said manner to the exclusion of any right of CONTRACTOR for fair wear and tear thereof.

FACT shall further be entitled to apply the proceeds of such equipment and unused materials of CONTRACTOR and any balance amount that may be due to CONTRACTOR for WORK actually executed towards any claims on FACT from third parties in consequence of failure, neglect, refusal or contravention by CONTRACTOR and / or towards any expense that FACT might have incurred in getting the WORK completed in the above -said manner, in excess of what FACT would have had to pay CONTRACTOR as per CONTRACT.

- 20.3 If CONTRACTOR shall become bankrupt or insolvent or have a receiving order made against him or shall compound with his creditors or shall commence to be wound up otherwise than for the purpose of reconstruction or shall carry on its business under a Receiver for the benefit of its creditors, FACT may at its sole discretion either;
- a) Terminate CONTRACT forthwith by notice in writing to CONTRACTOR or the Receiver or the Liquidator or to any other person in whom the CONTRACT may become rested and have the remaining WORK executed at the risk and cost of CONTRACTOR in the same manner as specified in Article-20.2 above, or
 - b) Give such Receiver, Liquidator or other person as aforesaid the option of carrying out the CONTRACT subject to his providing security for the due and faithful performance of CONTRACT up to such amount as may be mutually agreed upon.
- 20.4 In the event of suspension of CONTRACT vide Article-20.1 above, immediately on receipt of notice therefore from FACT, CONTRACTOR shall suspend all activities at SITE except those essentially to be carried out to safe-guard and secure WORK for the time being in progress in a safe manner without wastage of materials and temporarily disband or reassign CONTRACTOR'S workmen except those essentially required at SITE such as for security of CONTRACTOR'S equipments and materials. CONTRACTOR

PRPD. BY :AS	CHKD. BY :SNK	APPRD. BY :SNK	Pg. No: 10
FACT CORPORATE MATERIALS	FERTILISERS AND CHEMICALS TRAVANCORE LIMITED		

shall re-mobilise its workmen and re-commence WORK within fifteen (15) days of receipt of notice from FACT requiring CONTRACTOR to do so. All costs reasonably incurred by CONTRACTOR in connection with temporarily winding up WORK, maintenance of SITE during period of suspension and remobilisation on withdrawal of suspension order shall be paid by FACT in addition to Contract Price specified herein, and the amount of such additional sum shall be mutually agreed to between the parties base on detailed information provided by CONTRACTOR. CONTRACTOR shall further be entitled for extension of time- schedule corresponding to the period of suspension including permitted period for re-mobilisation.

20.5 In the event of termination of CONTRACT vide Article-20.1 above, immediately on receipt of notice therefore from FACT, CONTRACTOR shall take all steps for winding up work such as cancellation of any pending orders and termination of any sub-contracts that CONTRACTOR might have entered into with others in connection with WORK, safe-guarding and securing of any WORK in progress in a safe manner, disbanding of workmen, removal of temporary construction made by CONTRACTOR at SITE and return of all EQUIPMENT, special tools, un-used materials and documents that FACT has supplied to CONTRACTOR. FACT shall pay CONTRACTOR for the portion of WORK executed till such termination less amounts already paid, together with any reasonable cost necessarily incurred by CONTRACTOR pursuant to such termination as may be mutually agreed upon between the parties hereto based on detailed information provided by CONTRACTOR. CONTRACTOR shall not be entitled for any payment in respect of the portion of WORK left unexecuted.

20.6 Upon termination of CONTRACT for any reason, obligations of the parties hereto shall cease except for the liabilities of either party to the other in respect of obligations that accrued prior to, the date of such termination.

OTHER TERMS AND CONDITIONS: In case of any contradiction between Technical Terms & Conditions of the Contract and General Conditions of Contract or any other terms and conditions anywhere, the ***Special Conditions*** shall prevail.

PRPD. BY :AS	CHKD. BY :SNK	APPRD. BY :SNK	Pg. No: 11
FACT CORPORATE MATERIALS	FERTILISERS AND CHEMICALS TRAVANCORE LIMITED		



AGREEMENT FORMAT

Tender no. 08004/2026-
2027/E33803

Agreement shall be made on Rs. 200/- Non –Judicial Stamp Paper)

W.O. No dtd.

BETWEEN

THE FERTILISERS AND CHEMICALS, TRAVANCORE LIMITED, UDYOGAMANDAL
AND

.....
.....
.....

For

.....
.....

THIS CONTRACT made and entered into this the day of by and between THE FERTILISERS AND CHEMICALS, TRAVANCORE LIMITED, a Company registered in India with Registered Office at Eloor, Udyogamandal P.O., Kerala State, hereinafter referred to as 'OWNER' which expression shall unless repugnant to the context and meaning thereof include its legal successors and permitted assigns of the one part, and

.....
.....
.....

hereinafter referred to as 'CONTRACTOR' which expression shall unless repugnant to the context and meaning thereof include its legal successors and permitted assigns, of the other part.

WHEREAS contractor submitted in response to invitation by Owner, tender for providing materials, labours, construction equipment and other related services and supervision thereof for the work first above mentioned in the title of this document and WHEREAS OWNER conveyed to CONTRACTOR vide Work Order No..... dt..... OWNER's intention to entrust the WORK to CONTRACTOR under certain terms and conditions and CONTRACTOR accepted the same for a total amount of ` .....-( ` Only).

NOW THEREFORE, in consideration of the promises and mutual covenants contained herein, it is hereby agreed between the parties hereto as follows:

WHEREAS the contractor has agreed, subject to the conditions and specifications contained in the documents under Work Order No..... dt..... (hereinafter referred to as the said conditions) to execute the works shown upon descriptions in the said specifications and set forth in the schedule of items of works as the probable quantities and comply with the rate of progress as indicated in the statement Work Order No. dt..... for a sum of `..... ( `Only) or such other sum high or low as may be arrived at by final measurement at unit prices.

Now these presents witness and it is hereby mutually agreed as follows:

1. In consideration of the payment of the said sum of `..... ( ` Only).or such other sum high or low as may be arrived at by final measurement at unit prices, the contractor will upon and subject to the said conditions execute and complete the works as shown upon the said conditions and descriptions in the specifications and to the extent of the probable quantities shown in schedule of items of works with such variations by way of alterations or additions to, or deductions from the said works and method of payment therefore in the said conditions.
2. Time shall be considered as the essence of this agreement and the contractor hereby agreed to commence the work as specified in the said conditions and agrees to complete the work withinMonths from the date of Work to proceed notice.

It is hereby mutually agreed that the Work Order No.....dt..... the General and Special terms and conditions and the schedule, the scope of work and annexures thereto shall be read and construed as forming part of this agreement and the parties hereto will respectively abide by and submit themselves to the conditions and stipulations and perform the agreement on their parts respectively.

If the 'contractor' is a Central Public Sector Enterprise or Central Government Department:

In the event of any dispute or difference relating to the interpretation and application of the provisions of this contract(s) between Central Public Enterprises (CPSEs)/Port Trusts inter-se and also between CPSEs and government departments / Organizations (excluding disputes concerning taxation), such dispute/ difference shall be taken up by either Party for resolution through AMRCD as mentioned in DPE OM No. 4(1)2013-DPE(GM)/FTS-1835 dated 22.05.2018.”

Or

(II) For contracts other than (i) above:

If any dispute arises out of or relating to or in connection with this CONTRACT, between the CONTRACTOR and the OWNER/FACT, the same shall be amicably settled through mutual discussions, failing which, the unresolved dispute(s) shall be referred to arbitration in accordance with the provisions of the Arbitration and Conciliation Act, 1996, as

amended from time to time and number of Arbitrator shall be one. The venue of the Arbitration shall be at Ernakulam and the proceedings shall be in ENGLISH.

Any legal proceedings relating to this contract shall be limited to courts of law under the jurisdiction of the Kerala High Court at Ernakulam.

Upon the terms and conditions of this agreement being fulfilled and performed to the satisfaction of the officers of the OWNER/empowered by the owner in this behalf.

IN WITNESS WHEREOF the parties thereto have executed this agreement by their duly authorised representatives on the day and year first above written.

Signed by the Contractor :

In the presence of the witnesses:

1)

2)

THE FERTILISERS AND CHEMICALS, TRAVANCORE LIMITED,
UDYOGAMANDAL Senior Manager - (Materials) Contracts.

In the presence of witnesses:

1)

2)



BANK GUARANTEE FORMAT

Tender no. 08004/2026-
2027/E33803

FORM OF BANK GUARANTEE IN LIEU OF SECURITY DEPOSIT IN INDIVIDUAL CONTRACT

(TO BE OBTAINED FROM A NATIONALISED BANK/SCHEDULED BANK IN Rs.500 STAMP PAPER)

SECURITY DEPOSIT

The Fertilisers And Chemicals Travancore Ltd.
FACT Udyogamandal Division

WHEREAS Fertilisers And Chemicals Travancore Ltd., Udyogamandal P.O. Kerala (hereinafter called referred to as the Company) has placed a Work Order No..... datedwith M/s..... (hereinafter called the Contractor), for the..... work.....and whereas it is one of the conditions of the said work order that the Contractor shall either remit a Sum of Rs..... (Rupees.....only) or furnish a Bank Guarantee for Rs.....(Rupees..... only) as Security Deposit for the due fulfillment of the said Work Order by the said Contractor.

In consideration of the company having agreed to accept a Bank Guarantee from us towards such Security Deposit in lieu of the Cash Deposit in accordance with the Terms and Conditions of the above Work Order, we..... The Bank (hereinafter referred to as the Bank) do hereby undertake to pay the company merely on demand any sum or sums from time to time demanded by the Company up to a maximum of Rs.....(Rupees..... only) being the amount of the Security Deposit against any loss or damage caused to or suffered by or would be caused to or suffered by the Company by reason of any breach by the said Contractor if any of the terms and conditions contained in the said Work Order.

We the said Bank, do hereby unconditionally and irrevocably undertake to pay the amount, upon first written demand from the Company, without any demur or protest. We, the bank further confirms that the Company is not required to state the reasons or show grounds for such demand. Any such demand made by the Company shall be binding and conclusive as regards the amount due and payable by the Bank under this Guarantee.

We undertake to pay to the Company any money so demanded notwithstanding any dispute or disputes raised by the said Contractor in any suit or proceeding pending before any court or Tribunal relating there to our liability under this present being absolute and unequivocal.

The payment so made by us under this guarantee shall be a valid discharge of our liability for payment thereunder and the said Contractor shall have no claim against us for making such payment.

We.....further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said contract and that it shall continue to be enforceable till all the dues of the Company under or by virtue of the said contract have been fully paid and its claim satisfied or discharged or till the Company certifies that the Terms and Conditions of the said Contract have been fully and properly carried out by the said Contractor and accordingly discharges this guarantee.

We..... further agree with the said Company that they shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said contract or to extend time of performance by the said contractor or postpone for any time and from time to time any of the powers exercisable by it against the said Contractor and either to enforce or forebear from enforcing any of the terms and conditions governing the said Contract or Securities available to the Company and the said Bank shall not be released from its liability under these presents by any exercise by the Company of the liberty with reference to the matters aforesaid or by reason of time being given to the said Contractor or any other forbearance, act or omission on the part of the Company or any indulgence by the Company to the said Contractor or any other matter or thing whatsoever which under the law relating to sureties, but for the provision, have the effect of so relieving us.

This guarantee shall not be affected by any change in the constitution of the Bank or the Company or the said Contractor nor shall this guarantee be affected by any change in the constitution of the Company or the said Contractor by absorption with any other body or corporation and this guarantee shall be available to or enforceable by such body or corporation.

Our guarantee shall remain in force until..... unless a claim or demand is made within six months after the expiry of the above date, all the Company's rights under the guarantee shall be deemed as waived I forfeited and we shall be relieved and discharged from all liabilities thereunder. Notwithstanding anything contained herein before, our liability under this guarantee shall be limited to an amount not exceeding Rs.....(Rupees..... only)

Any notice by way of request, demand or otherwise hereunder may be sent by post or submit to the Bank addressed as aforesaid or any local branch of the bank in Ernakulam District, Kerala State and if sent by post, it shall be deemed to have been given at the time when it would be delivered in due course of post and in proving such notice when given by post, it shall be sufficient to prove that the envelope containing the notice was posted and certificate signed by an officer of the Company that the envelope was so posted shall be conclusive.

Disputes, differences if any relating to or arising out of guarantee shall be settled by courts having jurisdiction over Udyogamandal In Kerala State where the registered office of the Company is situated and no other court shall have jurisdiction in this matter.

We.....Bank lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Company in writing.

Any notice by way of request, demand or otherwise hereunder may be sent by post or submitted to the bank addressed as aforesaid or any local branch of the bank in Ernakulam District, Kerala State.

Dated this..... day of.....

Two Thousand.....

For (Name of Bank)

Authorised Official

Name:

Designation:

Place:

Full address of the

Branch issuing this

guarantee:

(BANK SEAL)

FERTILISERS AND CHEMICALS TRAVANCORE LIMITED (FACT)**VENDOR DATA FORM (FOR FACT NEW VENDORS)**

Sl. No.	Description	To be filled in by Vendor
	Company Profile	
1	Name of Vendor	
2	Name and address of Chief Executive	
3	Address:	a: Regd. Office
		b: Factory
4	PIN Code	
5	Telephone Nos	
6	Tele Tax Nos	
7	E mail ID	
8	Contact Person	
9	Details of Local Office/ Representatives/ Liaison Agents	
10	PAN No	
11	GST Registration No.	
12	Bank Details (Payment will be made through RTGS. Please Upload the Format verified by Bank along with a cancelled Cheque)	

(New Vendors please return this format duly filled along with Part-I: Technical Bid of the offer)

Master Data required for Online Payments
(RTGS / NEFT / Fund Transfer)

To,

The Deputy General Manager (Finance)
The Fertilizers and Chemicals Travancore LTD
Udyogamandal
Kerala

1	Vendor Code, Vender Name	To be filled by FACT
2	Income Tax PAN No	
3	Name of the Bank	
4	Address of bank branch	
5	City & State	
6	IFS Code of the bank branch	
7	Name of the bank branch	
8	Bank Account No.	
9	Account Holder's Name	
10	Email address	

For Name

Signature & Seal

Verification by the Bank

We hereby certify that all the above particulars relating to Bank Account are verified and found to be correct as per the records of the bank.

Signature and Seal of the Authorized signatory of the bank.

UNPRICED BID**SCHEDULE F1**

Please do not fill in Rates in this Bid format. Kindly indicate “Quoted/Not Quoted” in the column provided.

Dear Sir,

Sub:	Engaging Engineering Design Consultant for Construction of Distributed Control System (DCS) Building for Ammonia Handling at FACT UC
Ref:	Tender no. 08004/2026-2027/E33803

<u>UNPRICED BID</u>					
Sl No.	Description	Unit	Qty	GST	RATE
1	Engineering Consultancy services for the Distributed Control system (DCS) building and associated facilities including Preparation of Tender documents (comprising Tender purpose drawings, Technical specifications and detailed BOQ of materials), Preparation of elevation and section drawings as per approved plan, Good for construction drawings of structural and MEP services, HVAC, Clean Agent, site visit for addressing site related queries and preparation of As built drawings.	LS	1.000	Quoted/Not quoted	Quoted/Not quoted
2	Site visit by consultant (Rate per site visit by the consultant shall be quoted in line with tender conditions, inclusive of all expenses such as travel, accommodation, daily allowances, and any other associated costs)	NO	6.000	Quoted/Not quoted	Quoted/Not quoted

Place:

Date:

Name of the Bidder:

Signature of the Bidder:



COMPLIANCE STATEMENT

**Tender no. 08004/2026-
2027/E33803**

We state that our offer against Enquiry No: 08004/2026-2027/E33803 is in full compliance with the documents issued against the enquiry, without any deviations and we have read and understood the Schedule of Work, Special Conditions, TPS and General conditions attached with this enquiry referred above and hereby confirm our acceptance to the same.

Name of bidder:

Signature of the Bidder:

Place:

Date:

(Seal)