



Indian Institute of Science Bangalore

560012

Website : www.IISc.ac.in/opportunities/tenders

Contact: 080-2293 2765/2202/2203

VOLUME – I

**TENDER DOCUMENT
(E-Procurement)**

For

“Supply and Installation of lab infrastructure, namely benches, chemical storage cabinets, fume hoods, exhaust system, electrical and gas piping services and other allied services in Chemical Sciences Building at IISc. Campus, Bangalore

Tender No: IISc/Tender 14/2018-19, dated 31st Oct 2018

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SECTION 1: INVITATIONS FOR TENDERS

Tender Notification

Scope of Work	Supply and Installation of lab infrastructure, namely benches, chemical storage cabinets, fume hoods, exhaust system, electrical and gas piping services in Chemical Sciences Building at IISc. Campus, Bangalore
Estimated Value of work	Rs.24,74,00,000
Period of Work completion	6 months from the date of Work order
Name of the Client	Indian Institute of Science, Bangalore
Address of the Client	The Project Engineer, Centre for Campus Management and Development, Indian Institute of Science, Bangalore – 560 012 Tel No. 080-2293 2765 / 2202/2203 email: office.ccmd@IISc.ac.in
Tender Processing Fee	As per e-procurement portal
Submission of Tender Document	e-procurement portal- https://eproc.karnataka.gov.in Helpline no: 080-25501216/25501227
Amount of Earnest Money to be deposited with the Tender	Rs. 24,74,000 (Rupees twenty four lakhs seventy four thousand only)
Last date and Time for online submission (uploading) of tender	03-12 -2018 at 15.00 hrs.
Date and Time of opening of Tender (Technical Bid)	04-12-2018 at 16.00 hrs.
Date and Time of opening of Tender (Financial Bid)	Shall be intimated to technically qualified bidders.
Date and Time of Pre-bid meeting	16-11-2018 at 15.00 hrs.

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A. General

1. Scope of Tender

The REGISTRAR, Indian Institute of Science invites tenders from eligible Bidders, for **Supply and Installation of lab infrastructure, namely benches, chemical storage cabinets, fume hoods, exhaust system, electrical and gas piping services in Chemical Sciences Building at IISc. Campus, Bangalore** (as defined in these documents).

1.0 The bidders who fulfill the following requirements shall be eligible to apply.

a) Should have experience of having successfully completed works during the last five years ending with the date of submission of tenders; *4 similar works each costing not less than Rs. 4 crores or two similar works each costing not less than Rs. 8 crores or completed one similar work costing not less than Rs 16 crores.*

Components of work executed other than those included in definition of similar work shall be deducted while calculating cost of similar work.

Bidder shall submit abstract of cost of work in support of this. Copy of certificates of work experience as specified in the bid documents shall be scanned and uploaded to the e-tendering website within period of bid submission.

Work completion certificates from competent authority not below the Rank of Executive Engineer or equivalent shall be uploaded. The work completion certificate shall mention the nature of work, items of work executed and the date of commencement and date of completion of the work, including delays if any, with reasons thereof.

The value of executed works shall be brought to current costing level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion to the last date of receipt of bids for this tender.

***Similar work means: Supply and Installation of lab benches, fume hoods, exhaust, gas distribution and allied electrical works. Works executed abroad shall also be considered for the purpose of experience in similar works provided documentary evidence is submitted from the competent authority. Only purchase orders without installations shall not be considered for the purpose of experience in similar works.**

(b) Should have had average financial turnover (Gross) of at least Rs. 20.00 Crore for similar work, during the immediate last five consecutive years, annual financial statements duly audited should be submitted.

(c) In case of foreign company, bidder should have offered services in India for self or parent company for the past five years. The bidder or its parent company in India or abroad should have a well-established (their own) in house manufacturing unit for lab furniture and fume hoods, quality management system as per International standards.

(d) The bidder / parent company should be an Official member with SEFA (Scientific Equipment and Furniture Association).

(e) The bidder should have the ability to do ASHRAE testing at site through self or third party. The bidder should submit back-up documents testifying to similar tests having been conducted at client site in the past.

(f) The bidder should be a registered company in India or should be a subsidiary of the foreign parent company in India dealing with supply & Installation of Lab furniture in India or an authorized Indian dealer of foreign parent company duly authorized by the parent company for submitting the tender on behalf of parent company. Similar work experience of the parent company shall be acceptable provided documentary evidence is produced to the satisfaction of IISc, Bangalore.

(g) Should be solvent for a minimum of Rs **10.00 Crore** as certified by a Scheduled Commercial Bank in India and obtained not earlier than three months before the date of submission of Bid.

(h) Should not have incurred any loss (profit after tax should be positive) during the last two consecutive financial years ending 31st March, 2018, duly certified by a Chartered Accountant in a separate certificate.

(i) Bidder should have sufficient number of Technical and Administrative employees in India for proper execution of the contract. The bidder shall have to submit a list of Key personnel available and proposed to be engaged for management and supervision of this project, their qualifications and experience.

(j) Specialized agency(s) who are to partner with the Bidder must submit their experience certificate complying with the clause 5.4 laid out under special conditions of contract.

2. Eligibility Criteria

Further, the contract eligibility includes the following:

2.1 Bidders who meet minimum criteria will be qualified only if their available bid capacity is more than the estimated value of work. The bid capacity of the contractor shall be determined by the following formula:

$$\text{Bid Capacity} = 2A - B$$

Where,

'A' = Maximum of the total value of similar works, completed in any one financial year, during the last five years, duly enhanced at a simple rate of 7% per annum.

'B' = Value of existing commitments and ongoing similar works to be completed in the next one year, after the issue of the work order for this work (refer to table 1.4 A in Section 3 for this)

2.2 Documentary evidence for evaluation of A and B must be provided. Bids not meeting the minimum eligibility criteria are liable to be rejected.

2.3 The bidders shall upload the valid and present certificate copies of PAN, GST, Contractor's Registration pass book in technical bid, **failing which the tender is liable to be rejected**. If necessary bidder shall produce all the original documents for verification.

2.4 The work shall be carried out as per the directions of the Project Engineer cum Estate Officer and Engineer-in-charge.

2.5 Black listed/ banned contractors/in govt/Quasi govt/boards/BBMP etc., are not eligible to quote, if found such tenders are liable to be rejected.

2.6 The successful Bidder shall execute an Agreement within 10 days from the date of Receipt of intimation from IISc. The Tender Document will form part and parcel of the agreement.

2.7 Material shall be approved by the Project Engineer cum Estate Officer, IISc before execution of the work.

2.8 Further details of the work can be obtained from IISc.

2.9 The rates quoted should reflect all taxes separately. However, bid evaluation will be done inclusive of all taxes. With effect from 1/10/2018, TDS under GST will be enforced.

2.10 IISc reserves the right to accept / reject any or all the bids without assigning any reasons.

2.11 The work shall be commenced with all men and machinery within 10 days from the date of work order, failing which it would be presumed that the successful bidder is not interested in the work and action will be taken to get the work executed through alternate agency at the risk and cost of the bidder.

2.12 Conditional tenders are liable for rejection.

2.13 Bidders who meet the above specified minimum qualifying criteria, shall be eligible.

2.14 Bidders are liable to be disqualified if they have:

- Made misleading or false representations in the forms, statements and attachments submitted in proof of the qualification requirements.
- Recorded poor performance such as abandoning the works, improperly completed the contract, inordinate delays in completion, litigation history, or financial failures etc.

3. Site visit:

The Bidder at his own responsibility is encouraged to visit and examine the Site of Works and its surroundings and obtain all information that may be necessary for preparing the Tender and

entering into a contract for the Works. The cost of visiting the Site shall be at the Bidder's own expense.

B. Tender documents (Two bid system – Technical & Financial)

The Tender document can be downloaded from e-procurement website:

<https://www.eproc.karnataka.gov.in>.

It may be noted that all subsequent notifications, changes and amendments on the project/document would be posted only on the same website

<https://www.eproc.karnataka.gov.in>.

The bidders will be required to register themselves with the Centre for e-governance to participate in the bidding.

Necessary details can be obtained over telephone at 080-25501216/25501227.

4. Content of Tender documents

The bidders should go through the Tender Document and submit online response through e-procurement portal only.

5. Amendment of Tender documents

5.1 Before the deadline for submission of tenders, the IISc may modify the tender documents by issuing corrigendum / addendum.

5.2 Such corrigendum/ addendum thus issued shall be part of the tender documents and shall be published online in e-Procurement portal.

5.3 To give prospective Bidders reasonable time in which to take corrigendum/ addendum into account in preparing their tenders, IISc. shall consider extension as necessary of the deadline for submission of bids.

C. Preparation of Tenders

6. Documents comprising the Tender

6.1 **The technical bid** submitted by the Bidder shall contain the documents:

- (a) Earnest Money Deposit & Tender processing fee paid in any of the payment modes as specified in e-Procurement platform.
- (b) Qualification Information as per formats to comply with the task created in the e-Procurement Portal under General Terms and Conditions and Technical parameters and Documents required from Bidder.

- (c) Any other documents / materials required to be completed and submitted by Bidders in accordance with these instructions. The required documents shall be filled in without exception.

6.2 The financial bid submitted by the Bidder shall contain the documents as follows:

- (a) Priced Bill of Quantities; online through e-procurement portal, no hardcopy of commercials should be attached or disclosed.

7. Tender prices

- 7.1 The contract shall be for category of works / whole works based on the priced Bill of Quantities submitted by the Bidder.
- 7.2 The Bidder shall fill in rates for all items in each category of Works described in the Bill of Quantities. Items for which no rate or price is entered by the Bidder will not be paid for by IISc when executed and shall be deemed covered by the other rates and prices in the Bill of Quantities.
- 7.3 All prevailing duties, taxes, and other levies payable by the contractor under the contract shall be shown separately in the financial bid. TDS under GST will be enforced with effect from 1/10/2018.

8. Tender validity

- 8.1 Tenders shall remain valid for a period not less than **180 days** after the deadline date for tender submission. A tender valid for a shorter period is liable to be rejected by the IISc, as non-responsive.
- 8.2 In exceptional circumstances, prior to expiry of the original time limit, the IISc may request that the Bidders may extend the period of validity for a specified additional period. The request and the Bidders' responses shall be made in writing or by email. A Bidder may refuse the request without forfeiting his earnest money deposit. A Bidder agreeing to the request will not be required or permitted to modify his tender, but will be required to extend the validity of his earnest money deposit for the period of the extension, and in compliance with Clause 9 in all respects.

9. Earnest money deposit

9.1 Earnest Money Deposit/ Bid security

The Bidder shall furnish, as part of his tender, earnest money deposit (EMD) of Rs. 24,74,000 (Rupees twenty four lakhs seventy four thousand only)

The Bidder can pay the Earnest Money Deposit (EMD) in the e-Procurement portal using any of the following payment modes:

- Credit Card
- Direct Debit
- National Electronic Fund Transfer (NEFT)

And taking into account the following conditions:

- a. EMD will be accepted only in the form of electronic form and not through Demand Draft or Bank Guarantee and will be maintained in e-procurement Bank account until the finalization of the Tender.
 - b. The entire EMD amount for the tender has to be paid in a single transaction
- 9.2 The earnest money deposit of unsuccessful Bidders will be refunded after awarding the contract to the successful bidder.
- 9.3 The earnest money deposit may be forfeited:
- (a) If the Bidder withdraws the bid after tender opening during the period of tender validity;
 - (b) If the Bidder fails within the specified time limit to
 - (i) Sign the Agreement; or
 - (ii) Furnish the required Security deposit

10. Format and signing of Tender

Bidder shall sign all the pages of the tender document as a token of acceptance of all the terms and conditions of the contract and upload in the e-Procurement portal.

11. Submission of Tenders

Tenders must be submitted on-line in the e-Procurement portal by the Bidder before the notified date and time.

12. Deadline for submission of the Tenders

The Bidder shall submit a set of hard copies of all the technical documents in a sealed cover to IISc, required as a pre-qualification bid (Technical bid) which were uploaded through e-procurement portal. In the event of any discrepancy between them, the original uploaded document in e-procurement shall govern.

The IISc may extend the deadline for submission of tenders by issuing an amendment in accordance with Clause 5, in which case all rights and obligations of the IISc and the Bidders previously subject to the original deadline will then be subject to the new deadline.

13. Late Tenders

In e-procurement system, Bidder shall not be able to submit the bid after the bid submission time and date as the icon or the task in the e-procurement portal will not be available. IISc will not be liable (or) responsible for any delay due to unavailability of the portal and the Internet link.

14. Modification and Withdrawal of Tenders

14.1 Bidder has all the time to modify and correct or upload any relevant document in the portal till last date and time for Bid submission, as published in the e-procurement portal.

14.2 The Bidder may withdraw his tender before the notified last date and time of tender submission.

14.3 No Tender may be modified after the deadline for submission of Tenders.

14.4 Withdrawal or modification of a Tender between the deadline for submission of Tenders and the expiration of the original period of Tender validity specified in Clause 8.1 above or as extended pursuant to Clause 8.2 may result in the forfeiture of the earnest money deposit pursuant to Clause 9.

15 . Tender opening

15.1 The IISc will open all the Tenders received in the presence of the Bidders or their representatives who choose to attend on the specified date, time and place specified. In the event of the specified date of Tender opening being declared a holiday for the IISc the Tenders will be opened at the appointed time and location on the next working day.

15.2 The IISc will evaluate and determine whether each tender meets the minimum qualification / eligibility criteria.

15.3 The bidder must submit all the Original Documents, which are uploaded in e-procurement portal, to the IISc for verification at the time of opening of the technical bids.

15.4 IISc will record the Tender opening.

16. Process to be confidential

16.1 Information relating to the examination, clarification, evaluation, and comparison of Tenders and recommendations for the award of a contract shall not be disclosed to Bidders or any other persons not officially concerned with such process until the award to the successful Bidder has been announced.

17 Clarification of Tenders

17.1 To assist in the examination, evaluation, the IISc, may, at its discretion, ask any Bidder for clarification of his Tender. The request for clarification and the response shall be in writing or by e-mail along with the section number, page number and subject of clarification, but no change in the price or substance of the Tender shall be sought, offered, or permitted.

17.2 Subject to sub-clause 17.1, no Bidder shall contact IISc on any matter relating to its Tender from the time of the Tender opening to the time the contract is awarded. If the Bidder wishes to bring additional information to the notice of the IISc, he should do so in writing.

17.3 Any effort by the Bidder to influence the IISc Tender evaluation, or contract award decision may result in the rejection of the Bidders' Tender.

18. Examination of Tenders and determination of responsiveness

18.1 Prior to the detailed evaluation of Tenders, the IISc will determine whether each Tender

- (a) meets the eligibility criteria defined in Clause 2
- (b) has been properly signed
- (c) is accompanied by the required earnest money deposit and
- (d) is substantially responsive to the requirements of the Tender documents.

18.2 A substantially responsive Tender is one which conforms to all the terms, conditions, and specifications of the Tender documents, without material deviation or reservation. A material deviation or reservation is one

- (a) which affects in any substantial way the scope, quality, or performance of the Works;
- (b) which limits in any substantial way, inconsistent with the Tender documents, the IISc's rights or the Bidder's obligations under the Contract or
- (c) whose rectification would affect unfairly the competitive position of other Bidders presenting substantially responsive Tenders.

18.3 If a Tender is not substantially responsive, it is liable to be rejected by the IISc, and may not subsequently be made responsive by correction or withdrawal of the nonconforming deviation or reservation.

19. Correction of errors

19.1 Tenders determined to be substantially responsive will be checked by IISc for any arithmetic errors. Errors will be corrected by the IISc as follows:

- (a) Where there is a discrepancy between the rates in figures and in words, the lower of the two will govern; and
- (b) Where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern.

19.2 The amount stated in the Tender will be adjusted by the IISc in accordance with the above procedure for the correction of errors and, with the concurrence of the bidder, shall be considered as binding upon the bidder. If the bidder does not accept the corrected amount the bid is liable to be rejected, and the earnest money deposit may be forfeited.

20. Evaluation and comparison of Tenders

20.1 Opening of the Financial bid will be preceded by the evaluation of the Pre-qualification Offer (Technical bid), vis-a-vis the capability, capacity and credibility of the Bidder. Evaluation of the Pre-qualification Offer will be done by the Evaluation Committee constituted for the purpose. After evaluation is completed, all the Bidders who are qualified will be notified and will be intimated at the time of opening of the Financial bid. Financial bid will be opened in the presence of those who choose to be present or even in the absence of any Bidder.

The IISc will evaluate and compare only the Tenders determined to be substantially responsive in accordance with Clause 18.

20.2 The IISc reserves the right to accept or reject any variation, deviation, or alternative offer. Variations, deviations, and alternative offers and other factors which are in excess of the requirements of the Tender documents or otherwise result in unsolicited benefits for the IISc shall not be taken into account in Tender evaluation.

21 Award of Contract

21.1 TECHNICAL EVALUATION CRITERIA:

The bidders qualifying to the initial eligibility criteria, (as set out in Para 1 & 2) will be evaluated for following criteria by a scoring method, on the basis of details furnished by them and inspection by the technical committee.

(a) Financial strength	Maximum 20 Marks
(b) Experience in similar nature of work during last five years	Maximum 20 Marks
(c) Performance on work - (User inputs)	Maximum 20 Marks
(d) Performance and quality of work (committee assessment)	Maximum 40 Marks
Gross Marks Total	100 Marks

	Criteria for evaluation of performance of agency for technical eligibility:				
	Attributes		Evaluation		
a)	Financial strength Maximum (20 marks)				
	(i) Average annual turnover	Maximum 10 marks	(i) 60% marks for minimum eligibility criteria		
	(ii) Solvency certificate	Maximum 4 marks	(ii) 100% marks for twice the minimum eligibility criteria		
	(iii) Bidding capacity	Maximum 6 marks	In between (i) & (ii) – on pro-rata basis		
b)	Experience in similar class of works Maximum (20 marks)		(i) 60% marks for minimum eligibility criteria		
	4 x 4 crores, or 2 x 8 crores or 1 x 16 crores (minimum eligibility)		(ii) 100% marks for twice the minimum eligibility criteria or more		
			In between (i) & (ii) – on pro-rata basis		
c)	Performance on works Maximum (10 marks) (user inputs)				
	Time over run		Calculation For points		
	Parameter		Score		Maximum marks
	If TOR =		1.00	2.00	3.00 >3 10
	(i) Without levy of penalty		10	7.5	5 5
	(ii) With levy of penalty		10	2.5	0 -2.5
	TOR = AT/ST, where AT=Actual Time; ST=Stipulated Time.				
	Note: Marks for value in between the stages will be pro-rated				
d)	Performance of works (Quality) of completed works based on user feedback Maximum (10 marks)		Maximum (10 marks)		
	(i) Very Good		10		
	(ii) Good		7.5		

	(iii) Fair	5.0
	(iv) Poor	0
e)	Attributes (committee assessment)	Evaluation
i)	In house Plant, Equipment, Factory and certification: Based on documentary evidence including In house facilities of manufacturing Lab furniture, CNC machines for cutting and fabrication, in house powder coating facility and complete online manufacturing facilities for furniture and fume hoods, ISO certification, SEFA membership, ability to do ASHRAE testing at site through self or third party (Max. 5 marks)	Maximum 5 marks (refer note 4 below)
ii)	Specialized Agency work completion certificate as per special conditions of contract (Max. 5 marks)	Maximum 5 marks
iii)	Finishing and Performance of Lab furniture benches and fume hood, ease of operation, aesthetics and function (Max. 30 marks)	Maximum (30 marks) (refer note 3 below)
	(i) Very Good	30
	(ii) Good	20
	(iii) Fair	10
	(iv) Poor	0
	Total 100 marks	
	Notes:	
1)	To become technically eligible for short listing the bidder must secure at least fifty percent marks in each SH i.e. (a) to (e) mentioned above, and sixty percent marks in overall aggregate.	
2)	IISc however, reserves the right to restrict the list of such qualified contractors to any number as deemed fit by it.	

3)	Based on the claims made by the bidder, the technical panel of the Institute may visit the sites of the works executed by the bidder and/or factory visit and/or may ask the agency to supply one finished sample of lab furniture to IISC so as to assess whether the quality, operation & finish of the product is up to the mark, as a part of the short listing criteria. The finished products of the company shall be evaluated in comparison to the best in its class in the market by a technical panel appointed by IISc and decision of technical panel shall be final and binding upon the agency.
4)	In house Plant, Equipment, Factory and certification. Documentary evidence including In house facilities of manufacturing Lab furniture, CNC machines for cutting and fabrication, in house powder coating facility and complete online manufacturing facilities for furniture and fume hoods, ISO certification, SEFA membership, ability to do ASHRAE testing at site through self or third party should be provided for further evaluation.

22. Award criteria

The technical bid, as qualified, shall be given 60% weightage and the commercial bid would be given 40% weightage for the overall evaluation. The tenders will be ranked in terms of total points scored. The tender with the highest total points will be considered for award of contract and, if required, called for negotiation.

A bidder has to score the minimum marks under each category mentioned above and also an overall minimum score of 36 (out of 60) in the technical evaluation in order to be technically qualified.

Only the commercial bids of technically qualified bidders will be opened.

The commercial evaluation will be for 40 marks and will be only for the technically qualified bidders. The lowest qualified bidder will get the maximum commercial score (40) while the others will have a pro-rated score lower than 40. More specifically, the commercial score of a technically qualified bidder is calculated as:

Commercial score = $40 * (\text{lowest price bid}) / (\text{price bid of the bidder})$

The bidder with the highest total score (technical + commercial) will be declared as the successful bidder.

22.1 Subject to Clause 23, IISc will award the Contract to the Bidder whose Tender has been determined to be substantially responsive to the Tender documents and who has offered the lowest evaluated Tender Price, provided that such Bidder has been determined to be:

- (a) eligible in accordance with the provisions of Clause A (General) 1.0 and
- (b) qualified in accordance with the provisions of Clause A (General) 2.1.

23. IISc's right to accept any Tender and to reject any or all Tenders

Notwithstanding Clause 22, the IISc reserves the right to accept or reject any Tender, and to cancel the Tender process and reject all Tenders, at any time prior to the award of Contract, without thereby incurring any

liability to the affected Bidder or Bidders or any obligation to inform the affected Bidder or Bidders of the grounds for the IISc's action.

24. Notification of award and signing of Agreement

24.1 The Bidder whose Tender has been accepted will be notified of the award by the IISc prior to expiration of the Tender validity period by e-mail letter. This letter (hereinafter and in the Conditions of Contract called the "Letter of Acceptance") will state the sum that the IISc will pay the Contractor in consideration of the execution, completion, and maintenance of the Works by the Contractor as prescribed by the Contract (hereinafter and in the Contract called the "Contract Price").

24.2 The notification of award will constitute the formation of the Contract, subject only to the furnishing of a performance security in accordance with the provisions of Clause 25.

24.3 The Agreement will incorporate all agreements between the IISc and the successful Bidder / Bidders. It will be kept ready for signature of the successful Bidder in the office of IISc following the notification of award along with the Letter of intent. The successful Bidder will sign the Agreement and deliver it to the IISc

24.4 IISc will issue a formal work order to the successful Bidder upon furnishing of the Security deposit.

25. Fixed Security deposit (FSD)

25.1 FSD shall be deducted on the running bills and final bill in addition to Earnest Money Deposit. When the FSD deducted from R.A Bills of the contractor exceeds Rs. 1.00 Lakh, the amount in excess of Rs. 1.00 Lakh may, at the request of the bidder, be released to him against the production of the bank guarantee issued from a Nationalized Bank only for an equal amount in the prescribed form. The bank guarantee should be valid for 90 days beyond the period of completion.

25.2 If the security deposit is provided by the successful bidder in the form of a Bank Guarantee, it shall be issued either by a Nationalized/Scheduled bank.

25.3 Failure of the successful Bidder to comply with the requirements of this clause shall constitute sufficient grounds for cancellation of the award and forfeiture of the earnest money deposit.

26. Corrupt or Fraudulent practices

26.1 The GoK requires that the Bidders observe the highest standards of ethics during the procurement and execution of such contracts. In pursuance of this policy, IISc:

- (a) will reject a proposal for award if it determines that the Bidder recommended for award has engaged in corrupt or fraudulent practices in competing for the contract in question.
- (b) will declare a firm ineligible, either indefinitely or for a stated period of time, to be awarded a GoK/Gol/IISc contract if it at any time determines that the firm has engaged in corrupt or fraudulent practices in competing for, or in executing, a GoK/GOI/IISc contract.

SECTION 3: QUALIFICATION INFORMATION

The information to be filled in by the Bidder hereunder will be used for purposes of computing Tender capacity as provided in Clause 2 of the Instructions to Bidders. This information will not be incorporated in the Contract.

1.1 Name of Agency as registered :
Postal Address for communication :
Principal Place of business :
Name of the Owner :
Nature of Company/individual/partnership/firm etc :
Name of the authorized person with contact details :
Constitution or legal status of Bidder:
Place of Registration : [Attach self-attested photo copy]

1.2 Total value of executed works and payments received in the last five years
(In Rs. Lakhs)

2013-14 _____
2014-15 _____
2015-16 _____
2016-17 _____
2017-18 _____

1.3 (a)

Details of Works performed as a Prime Contractor (in the same name) on works of similar nature during the five years specified in 1.2 above.

Project Name	Name of Employer	Description of work	Contract number	Value of Contract	Stipulated Period of completion	Actual date of completion	Remarks (Reason for delay)

1.3(b)

Certificate and date of completion from the concerned Engineer-in-charge not below the rank of Executive Engineer or Competent Authority]

Project Name	Name of Employer	Description of work	Contract number	Value of Contract	Stipulated Period of completion	Actual date of completion	Remarks (Reason for delay)

1.4 Information on works for which Tenders have been submitted and works which are yet to be completed as on the date of this Tender.

(A) Existing commitments and on-going works:

Description of work	Place & state	Contract Number And Date	Name & Address of the Customer	Value of contract Rs. Lakhs	Specified period of completion	Value of work remaining to be completed (Rs. Lakhs)	Anticipated date of completion
1	2	3	4	5	6	7	8

[Details to be furnished with necessary work order signed from concerned Engineer-in-charge not below the rank of Executive Engineer or Competent Authority. Work order/Testimonials will be verified, if required]

(B) Works for which Tenders already submitted:

1.5 FINANCIAL INFORMATION

Financial Analysis-Details to be furnished duly supported by figures in balance sheet/profit & loss account for the last five years duly certified by the Chartered Accountant, as submitted by the applicant to the Income tax Department (Copies to be attached.)

Year	2013-14	2014-15	2015-16	2016-17	2017-18
Gross annual turn over					
Profit/ Loss					

[Report on the financial standing of the Bidder, such as profit and loss statements and auditor's report (Audited Financial Statement) for the last five years to be uploaded]

1.6 Evidence of access to financial resources to execute the contract such as bank balance, Letter of Credit such as Certificate from Banker in the suggested format:

BANKER'S CERTIFICATE

This is to certify that M/s. is a reputed company with a good financial standing. If the contract for this work, namely (name of the work) is awarded to the above firm, we shall be able to provide overdraft/credit facilities to the extent of 30% of the estimated value as mentioned in Section 1 to meet the working capital requirements for executing the above contract

Sd/-

Name of the Bank, Senior Bank Manger

Address:.....

Name, address, and telephone numbers of the Bidders' bankers who may provide references if contacted by the IISc.

Income tax clearance certificate to be uploaded duly signed by competent Authority

SECTION 4: FORM OF TENDER

Description of the Works: **“Supply and Installation of lab furniture benches, fume hoods, exhaust system, electrical and gas piping services in Chemical Sciences Building at IISc. Campus, Bangalore”**

To

The Registrar,
Indian Institute of Science
Bengaluru – 560 012

Dear Sir,

We offer to execute the Works described above in accordance with the Conditions of Contract

This Tender and your written acceptance of it shall constitute a binding contract between us. We understand that you are not bound to accept the lowest or any Tender you receive.

We undertake that, in competing, if the award is made to us, in executing the above contract, we will strictly observe the laws against fraud and corruption in force in India namely “Prevention of Corruption Act 1988”.

We hereby confirm that this Tender complies with the Tender validity and Earnest money deposit required by the Tender documents.

We hereby authorize IISc and its authorized representatives to conduct any enquiries or investigations to verify the statements, documents and information submitted (uploaded) for this tender.

We attach herewith our current income-tax clearance certificate.

Yours faithfully,

Authorized Signature:

Name & Title of Signatory: _____

Name of Bidder
Address:

SECTION 5: THE ARTICLES OF AGREEMENT

Articles of Agreement made at Bangalore, this between the INDIAN INSTITUTE OF SCIENCE, BANGALORE 560 012, (hereinafter referred to as the OWNER or EMPLOYER which expression shall include its successors and assigns and all the persons for the time being in the Management of the Institute) represented by its REGISTRAR of the ONE PART, andhereinafter referred to as the "CONTRACTOR", (which expression shall include their partners, their respective heirs, executors, administrators and assigns) on the OTHER PART.

WHEREAS the Employer is desirous of getting the work of **"Supply and Installation of lab furniture benches, fume hoods, exhaust system, electrical and gas piping services in Chemical Sciences Building at IISc. Campus, Bangalore"**

(hereinafter called the work) executed by the Contractor at the rates quoted by him amounting to Rs. /-(Rupees Only).

AND WHEREAS the Contractor has agreed to execute the aforesaid work on terms and conditions mentioned herein and subject to Tender Conditions of Contract and in accordance with the particular specifications, general notes and the schedule of quantities, schedule of rates, payment and penalty condition.

AND WHEREAS the contractor has deposited a sum of Rs /- (Rupees Only) with Employer as security for the due performance of this Contract.

NOW it is hereby agreed and declared by and between the parties hereto as follows;

1. In consideration of the payment to be made to them as hereinafter provided, the contractor shall, subject to the terms, conditions, specifications, schedule of quantities, drawings, etc., more particularly stated in the Schedules aforesaid, execute and complete the work within 6 (Six) Months starting after 10 days of issuance of work order or from the date of handing over of site, whichever is later.
2. The Employer shall pay to the contractor such sums as shall become payable hereunder at the time and in the manner specified in the conditions contained in the schedule aforesaid.
3. The time allowed for carrying out the work as entered in the tender Agreement shall be strictly observed by the contractor and shall be deemed to be the essence of the contract on the part of the contractor and shall be reckoned from 10 days after the date on which the order to commence the work is issued to the Contractor or the date of handing over of site, whichever is later. The work shall throughout the stipulated period of the contract proceed with all due diligence and comply with the time schedule submitted by the contractor and accepted by the Project Engineer-cum-Estate Officer, CCMD. In the event of the Contractor failing to comply with the agreed schedule, he shall be liable to pay as compensation an amount equal to one percent or such amount, as the Director, Indian Institute of Science (whose decision in writing shall be final), may decide on the said estimated cost of the balance work for every day that the due

quantity of work remains incomplete; provided always that the entire amount of compensation to be paid under the provisions of this clause shall not exceed seven and a half (7 ½) percent of the estimated cost of the balance work as shown in the tender.

4. The Registrar of the Indian Institute of Science, without prejudice to his rights under the contract in any respect of any delay or inferior workmanship or otherwise, or to any claim for damages in respect of any breaches of the Contract and without prejudice to any rights or remedies under any of the provisions of this contract or otherwise and whether the date of completion has or has not elapsed, by notice in writing absolutely determine the contract in any of the following cases:-
 - (i) If the contractor having been given by the Architect/Project Engineer-cum-Estate Officer, CCMD a notice in writing to rectify or replace any defective work or that the work is being performed in any inefficient or otherwise improper or un-workmanlike manner, shall omit to comply with the requirements of such notice for a period of seven days of such notice thereafter or if the contractor shall delay or suspend the execution of the work so that in the judgment of the Project Engineer-cum-Estate Officer, CCMD (which shall be final and binding) either he will be unable to secure completion of the work by the date for completion of the work or he has already failed to complete the work by that date.
 - (ii) If the Contractor being a company passes a resolution or if the Court passes an order to wind up the company or if a receiver or a manager is appointed on behalf of the creditors of the company or under circumstances which entitles the Court or the creditors to appoint a receiver or manager which would entitle the Court to make a winding up order.
 - (iii) If the Contractor commits breach of any of the terms or conditions of this contract.
 - (iv) If the contractor assigns or sublets without written approval of the Project Engineer-cum-Estate Officer, CCMD or becomes insolvent.
 - (v) When the Contractor has made himself liable for action under any of the cases aforesaid, the Project Engineer-cum-Estate Officer, CCMD on behalf of the Director of the Institute shall have powers:
 - (a) To determine or rescind the Contract as aforesaid (in which termination or recession notice in writing to the Contractor under hand of the Project Engineer-cum-Estate Officer, CCMD shall be conclusive evidence) Upon such determination or recession the security deposit of the Contractor shall be liable to be forfeited and shall absolutely be at the disposal of Institute.
 - (b) To employ labour paid by the Institute and supply materials to carry out the work or any part by debiting the Contractor with the cost of the labour and the price of the materials (of the amount of which cost and price certified by the Project Engineer-cum-Estate Officer, CCMD shall be final and conclusive against the Contractor) and crediting him with the value of the work done in all respects in the same

manner and at the same rates as if it has been carried out by the contractor under the term of his contract. The certificate of the Project Engineer-cum-Estate Officer, CCMD as to the value of the work done shall be final and conclusive against the contractor, provided always that action under the sub-section shall only be taken after giving notice in writing to the contractor. Provided also that if the expenses incurred by the Institute are less than the amount payable to the contractor at his agreement rates, the difference shall not be paid to the Contractor.

(c) After giving notice to the contractor to measure up the work of the contractor and to take such part thereof as shall be un-executed out of his hands and to give it to another contractor to complete in which case any expenses which may be incurred in excess a sum of which would have been paid to the original contractor if the whole work had been executed by him (of the amount of which excess the certificate in writing of the Project Engineer-cum-Estate Officer, CCMD shall be final and conclusive) shall be borne and paid by the original contractor and may be deducted from any monies due to him from the Institute under this contract or any other account whatsoever, from his security deposit or the proceeds of sales thereof, or a sufficient part thereof as the case may be.

5. In the event of any one or more of the above courses being adopted by the Project Engineer-cum-Estate Officer, CCMD, the contractor shall have no claim to compensation for any loss sustained by him by reason of his having purchased or procured any materials or entered into any engagements or made any advances on account or with a view to the execution of the work or the performance of the contract. And in case action is taken under any of the provisions, aforesaid, this contractor shall not be entitled for recover nor be paid any sum for work thereto/for actually performed under this contract unless the Architect/ Project Engineer-cum-Estate Officer, CCMD has certified in writing the performance of such work and the value payable in respect thereof and he shall only be entitled to be paid the value so certified.

The schedules above mentioned including the General Rules and Directions to Contractors and the following documents, viz.,

- i) Letter of Intent
- ii) Letter of Acceptance
- iii) Conditions of Contract – Volume I
- iv) Contractor's Bid – Bill of Quantities – Volume II
- v) Technical Specifications – Volume III
- vi) Drawings
- vii) The pre-Bid meeting proceedings and corrigendum
- viii) Any other document listed in the Contract document as forming part of the contract shall form an integral part of agreement and the decision of the Project Engineer-cum-Estate Officer, CCMD in reference to all matters of dispute as to material and workmanship shall be final and binding on both the parties.

6. The employer reserves to himself the right of altering the drawings of the works and of adding to or omitting any item of work from or of having portions of the same carried out departmentally or otherwise and such alterations or variations shall not vitiate this agreement.

7. This agreement comprises the work aforesaid and all subsidiary works connected therewith even though such works may not be shown on the schedule appended hereto.
8. Notwithstanding anything contained in the tender submitted by the contractor, all the clauses of this agreement shall be binding on both the parties.
9. Where counter terms and conditions, printed or copied, are offered by the contractor, the same shall not be deemed to have been accepted by the Employer, unless specific written acceptance thereof is furnished by the Employer. Notwithstanding the foregoing, no verbal agreement or inference from conversation with any office members/representatives/employees of the Employer before, during or after the execution of the agreement, shall in any way affect or modify any of the terms/obligations contained herein.
10. In the event the contract is terminated by the Employer due to any aforementioned act/omission on the part of the contractor, or for any reason whatsoever, the Employer shall be entitled to engage the services of any other person, agency or Contractor to meet its requirement, without prejudice to its rights including claim for damages against the Contractor.
11. The Employer shall be indemnified for all losses due to commissions and omissions of persons deployed by the contractor. If any loss or damage is caused to the Employer on account of any negligence, carelessness, acts of omissions. commissions of contractors, his employees or staff, the same shall be made good by the contractor. The contractor shall defend, indemnify and hold the Institute harmless from any liability or damage, law suits, penalties imposed by any State or Central Government Department or statutory body or by a third party for reasons of violation of any of statutory provisions or requirements by the contractor. The Employer shall not be liable for any damage or compensation payable to any workmen or to any person as a consequence of this work and the Employer shall be completely indemnified accordingly.
12. In case of disputes including all questions relating to the performance of the obligations under this agreement and all the dispute and differences which shall arise either during or after the agreement period or other matters arising out of or relating to this agreement or payments to be made in pursuance thereof shall be decided by the Director of IISc whose decision shall be binding on the contractor. The Contractor hereby agrees to be bound by the decision of the Director.

IN WITNESS WHEREOF the parties hereto have set their respective hands the day and the year here in above written.

Signature of Contractor

In the presence of:

Signed by for and on behalf of the said Employer.

In the presence of:

Signed by for and on behalf of the said Employer.

REGISTRAR
INDIAN INSTITUTE OF SCIENCE BANGALORE-12

INDIAN INSTITUTE OF SCIENCE, BANGALORE-12
ITEM RATE TENDER FOR WORK

I/We, hereby tender for the execution for the Indian Institute of Science, Bangalore-12 of the works specified in the under mentioned memorandum within the time specified in such memorandum at the rates specified therein and in accordance, in all respects, with the specifications, designs, drawings and instructions in writing which have been read by me/read and explained to me and with such materials as provided for by and in all other respects in accordance with such conditions as far as possible.

MEMORANDUM OF WORK

1.	GENERAL DESCRIPTION	Supply and Installation of lab furniture benches, fume hoods, exhaust system, electrical and gas piping services in Chemical Sciences Building at IISc. Campus, Bangalore"
2.	ESTIMATED COST	Rs. 24,74,00,000
3.	EARNEST MONEY	Rs. 24,74,000
4.	FURTHER SECURITY DEPOSIT	6.5% on the running account bills and final bill in addition to Earnest Money Deposit. When the F.S.D. deducted from the RA bills of the Contractor @ 6.5% of the bill amount exceeds Rs. 1.00 lakhs, the amount in excess of Rs.1.00 lakh may, at the request of the Contractor, be released to him against the production of a bank guarantee issued by a Nationalized Bank only for an equal amount in the prescribed form. The bank guarantee should be valid for 90 days beyond the period of completion mentioned in Section 1 (Invitation for Tenders)
5.	TIME ALLOWED FOR THE COMPLETION OF WORK IN ALL RESPECTS FROM THE DATE OF COMMENCEMENT OF WORK	6 (Six) Months from issue of Letter of Acceptance/ handing over of site, whichever is later.
6	BILLS OF QUANTITIES.	Enclosed.
7.	SPECIFICATIONS.	The work shall be carried out strictly in accordance with the enclosed specifications and wherever items are not covered by those specifications in accordance with specifications/ drawings/ designs/ requirements and directions of the Project Engineer-cum-Estate Officer, CCMD or his representatives.

I/We hereby agree to abide by and fulfill all the terms and provisions of the conditions contained in the articles of agreement, which have been read by me/us or in default thereof to forfeit and pay to the Registrar, Indian Institute of Science or his successors the sums of monies mentioned in the said conditions.

The sum of **Rs. 24,74,000 /- (Rupees Twenty four lakhs seventy four thousand only)** has been deposited in one of the three modes of e-tender payment as Earnest Money the full value which is to be absolutely forfeited to the Registrar or his successors in Office should I/we fail to commence the work specified in the above memorandum and complete the same.

Dated this

Signature of the Contractor/s

Witness to Contractor/s Signature:

NAME

ADDRESS

OCCUPATION

The above tender is hereby accepted by me on behalf of the Indian Institute of Science, Bangalore-12.

**REGISTRAR
INDIAN INSTITUTE OF SCIENCE BANGALORE**

Indian Institute of Science, Bangalore-12

APPENDIX

1.Name of the work	“Supply and Installation of lab furniture benches, fume hoods, exhaust system, electrical and gas piping services in Chemical Sciences Building at IISc. Campus, Bangalore”
2.Date of commencement of work	Within Ten days from the date of issue of Letter of Acceptance or the date of handing over the site whichever is later
3.Time of Completion	6 (Six) Months
4.Frequency of interim Certificate and payment	Once every month.
5.Further Security deposit	Deducted on the running bills and final bill in addition to earnest money deposit. When the F.S.D. deducted from the R.A. Bills of the contractor exceeds Rs. 1.00 Lakhs, the amount in excess of Rs. 1.00 Lakh may, at the request of the contractor, be released to him against the production of bank guarantee issued from a Nationalized Bank only for an equal amount in the prescribed form. The bank guarantee should be valid for 90 days beyond the period of completion mentioned in Section 1 (Invitation for Tenders)
6. Defects liability period /retention amount from the final bill/release of balance of deposit.	The security deposit lodged/paid by a contractor shall be refunded to him after the final bill is paid or after twelve months from the date of completion of the work, during which period the work so executed should be maintained by the contractor in good order, whichever is later.
7. Penalty for delay	In respect of the shortfall in progress, assessed as due to the delay on the part of contractor as per clause 2 of Section 7, the contractor shall be liable to pay as penalty an amount equal to 1 % of the estimated cost of the balance work assessed according to the program, for every day that the due quantity of work remains incomplete, provided always that the total amount of penalty to be paid under the provisions of this clause shall not exceed 7 ½ percent of the estimated cost of the entire work as shown in the tender, provided further that in the event of the contractor making up the shortfall in progress within the stipulated or extended time of completion, the penalty so recovered may be refunded on an application in writing by the contractor.
8. Period for payment of Running bill.	Three weeks from the date of submission of each Running account bills by the Contractor.

9. Period for submitting the final Bill.	One month from the date of virtual completion of the work by the Contractor.
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SECTION 6: GENERAL RULES AND DIRECTIONS TO CONTRACTORS

- a. A Schedule of Quantities (Bill of Quantities) is attached herewith. It should however, be clearly understood that these quantities are liable to alterations by omission, addition or variation, at the discretion of the Architect/Project Engineer Cum Estate Officer
- b. The drawings together with specifications and conditions of contract are enclosed. These should be studied carefully by the intending tenderers.
- c. The tenderer is expected to inspect the site and acquaint himself with the local conditions and will be deemed to have so done before submitting the tender.
- d. The successful tenderer is required to sign an agreement for the due fulfillment of the contract and start the work immediately on the acceptance of his tender. A draft of the Articles of the Agreement is enclosed. The Earnest Money referred to in item No. 3 of Memorandum contained in the "Item Rate Tender for Works", will be forfeited and at the absolute disposal of the Employer if the Contractor defaults from signing the Agreement or in starting the work.
- e. The rates quoted should reflect all taxes separately. However, bid evaluation will be done inclusive of all taxes. With effect from 1/10/2018, TDS under GST will be enforced.
- f. Water supply: The Contractor has to make his own arrangement for water supply. However, if water supply to the site at one convenient point is made available by the Institute, the charges for the consumption of water will be borne by the Contractor at 1.50% of the value of the work.
- g. Electricity: Electricity required for execution of work shall be arranged by the contractor. Electricity, if supplied to the contractor by the institute, will be metered and amount will be recovered in the bills as per actuals at rate fixed by the Institute. Supply of electricity from the institute is not mandatory. Non-supply of electricity by the institute cannot be held as reason for short fall in progress.
- h. The duration of the work is **6 (Six) Months.**
- i. Institute reserves the right to accept or reject any tender without assigning reasons thereof. It further reserves the right of deleting any item of work.
- j. The bids are valid for a period of 180 days from the date of opening.

- k. This “General Rules and Directions to Contractors” shall also form part of the tender document.
- l. It is entirely the responsibility of the Contractor to arrange for and provide all materials required for successful completion of the work.
- m. The debris arisen during the period of work of execution will have to be cleared then and there to keep the surroundings clean and tidy. Such debris shall be cleared at Contractors risk and cost.
- n. Tenders determined to be substantially responsive will be checked by the Employer for any arithmetic errors. Errors will be corrected by the Employer as follows:
 - i. Where there is discrepancy between the rates in figures and in words, the lower of the two will govern.
 - ii. Where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern.
 - iii. Where there is a discrepancy in entries of unit rate between the Original and Duplicate, the lower will govern.
 - iv. Bidders are requested to clearly indicate GST separately by following the laid down procedures in e-portal on each item.
 - v. **SPECIAL CLAUSE** : The prospective bidders have to enter into pre –contract Integrity pact with the Institute .The format of the integrity pact is available in CVC website .The bidders have to sign the format and upload the same along with Tender Document .

SECTION 7: GENERAL CONDITIONS OF CONTRACT

1. Security Deposit

(a) The person/persons whose tender may be accepted (hereinafter called the contractor which expression shall unless the context otherwise requires, include his heirs, executors, administrators and assigns) shall pay Earnest Money Deposit indicated in Column (ii) of the table given below and shall permit Institute (a) to deduct FSD at the percentage mentioned in Column (iii) of the table given below from all moneys payable for work done under the Contract, at the time of making such payments to him/them and (b) to hold such deductions as Further Security Deposit (FSD).

Estimated cost of the work	E.M.D Percentage	F.S.D Percentage
(i)	(ii)	(iii)
10 crores and above	1%	6 ½%

(b) Addition or Reduction in Security Deposit.

The EMD for the tendered work and additional amount of Security Deposit at the rates mentioned in **Sub-clause 1(a)** above should be paid by the contractor. If a portion of the work is withdrawn from the Contractor under the provisions of Clause 12 of Articles of Agreement, the Project Engineer cum Estate Officer may allow a proportionate reduction in the amount of the Security Deposit.

(c) Dues to Institute, to be set off against Security Deposit.

All compensation or other sums of money payable by the Contractor to Institute under the terms of this contract may be realized or deducted from any Security Deposit payable to him or from any sums which may be due or may become due by Institute to the Contractor on any account whatsoever and in the event of his security deposit being reduced by reason of any such realization or deduction as aforesaid, the Contractor shall, within ten days thereafter, make good in cash any sum or sums which have been deducted from, or raised by sale of his security deposit or any part thereof.

(d) Refund of Security Deposit (EMD & FSD): The Security Deposit lodged/paid by a Contractor shall be refunded to him after the final bill is paid or after twelve months from the date of completion of the work, during which period the work should be maintained by the Contractor in good order, whichever is later.

2. PENALTY FOR DELAY

(a) Written Order to Commence Work

After acceptance of the tender, The Project Engineer cum Estate Officer, CCMD shall issue a written order to the successful tenderer to commence the work. The Contractor shall enter upon or commence any portion of work only with the written authority and instructions of The Project Engineer cum Estate Officer, CCMD. Without such instructions the Contractor shall have no claim to demand for measurements of or payment for, work done by him.

(b) Programme of work

The time allowed for carrying out the work as entered in the tender shall be strictly observed by the contractor. The work shall throughout the stipulated period of the contract be proceeded with, all due diligence (time being deemed to be the essence of the contract on the part of the Contractor). To ensure good progress during the execution of the work, the contractor shall be bound (in all cases in which the time allowed for any work exceeds one month) to comply with the time schedule according to the programme of execution of the work as agreed upon and enclosed to the agreement.

(c) Review of progress and responsibility for delay etc.,

The Project Engineer cum Estate Officer, CCMD shall review the progress of all works with the contractor during the first fortnight of every month. Such a review shall take into account the programme fixed for the previous month, obligations on the part of the Contractor.

(d) Apportioning of responsibility for delay between Contractor and Institute.

In case the progress achieved falls short by more than 25 percent of the cumulative programme, the reasons for such shortfall shall be examined and a record made thereof apportioning the responsibilities for the delay between the contractor and the Institute. This record should be signed in full and dated both by The Project Engineer cum Estate Officer, CCMD and the Contractor

(e) Shortfall in progress made up subsequently.

To the extent the shortfall is assessed, as due to the delay on the part of the contractor, a notice shall be issued to him by The Project Engineer cum Estate Officer, CCMD to make up the shortfall. If the shortfall is not made up before the progress of the work is reviewed during the second month succeeding the month in which the shortfall was observed, the Contractor shall be liable to pay penalty as indicated in **Clause 2 (g) and (h)** below.

(f) Settlement of dispute regarding shortfall in progress.

In case of dispute between The Project Engineer cum Estate Officer, CCMD and Contractor regarding the responsibility for the shortfall in progress, the matter shall be referred to the Registrar, IISc., who shall thereupon communicate the decision of the Director within fifteen days from the date of receipt of reference. The decision of the Director shall be final and binding on the contractor and The Project Engineer cum Estate Officer, CCMD.

(g) Penalty for delay

In respect of the shortfall in progress, assessed as due to the delay on the part of contractor, the contractor shall be liable to pay as penalty an amount equal to one percent of the estimated value of the balance work assessed according to the programme, for every week that the due quantity of work remains incomplete; provided always that the total amount of penalty to be paid under the provisions of this clause shall not exceed 7 ½ percent of the estimated cost of the entire work as shown in the tender, provided further that in the event of the contractor making up the shortfall in progress within the stipulated or extended time of completion, the penalty so recovered may be refunded on an application in writing by the contractor.

Note: *If the Project Engineer cum Estate Officer, CCMD considers it necessary he shall be entitled to take action as indicated in **Clause 3 (b)** also.*

(h) Adjustment of excess/over payments.

Excess/over payments as soon as they are discovered should be adjusted in the next running account bill of the contractor and in case the final bill has already been paid, the excess/over payment made shall be recovered from the Security Deposit of the contractor together with interest at such percentages as Institute may decide from time to time, from the date of such excess or over payment to the date of recovery.

3. ACTION WHEN WHOLE OF SECURITY DEPOSIT IS FORFEITED

In any case in which under any clause or clauses of this contract the contractor shall have rendered himself liable to pay compensation and/or penalty amounting to the whole of his security deposit including the amount deducted in installment from his bills as Further Security Deposit, the Project Engineer cum Estate Officer, CCMD on behalf of the Director, IISc., shall have power to adopt any of the following courses as he may deem best suited in the interest of Institute.

(a) Forfeiture of Security Deposit

Without prejudice to Institute's right to recover any loss from the Contractor under **sub-clauses (b) and (c) of Clause 3** of the Contract, to rescind the contract (of which rescission notice in writing to the contractor under the hand of The Project Engineer cum Estate Officer, CCMD shall be conclusive evidence). And in that case, the security deposit of the contractor including whole or part of the lump sum deposited by him and also the amount deducted from his bills as Further Security Deposit, shall stand forfeited and be absolutely at the disposal of the Institute.

(b) Action against unsatisfactory progress

If the contractor does not maintain the rate of progress as required under **Clause 2** and if the progress of any particular portion of work is unsatisfactory even after taking action under **Clause 2(c)** and **2(d)**, the Project Engineer cum Estate Officer, CCMD shall be entitled to take action under **Clause 3(b)** or **3(c)** at his discretion in order to maintain the rate of progress after giving the contractor 10 days notice in writing whereupon the contractor will have no claim for any loss sustained by him owing to such actions.

(c) No compensation for loss sustained on advance action

In the event of any of the above courses being adopted by the Project Engineer cum Estate Officer, CCMD, the contractor shall have no claim to compensation for any loss sustained by him by reason of his having purchased, or procured any materials, entered into any agreements or made any advances on account of, or with a view to the execution of the work or the performance of the contract. And in case the contract shall be rescinded under the provision aforesaid the contractor shall not be entitled to recover or be paid any sum for any work thereof actually performed by him under his contract, unless and until the Project Engineer cum Estate Officer, CCMD shall have certified in writing the performance of such work and the amount payable in respect thereof, and he shall only be entitled to be paid the amount so certified.

4. CONTRACTOR TO REMAIN LIABLE TO PAY COMPENSATION IF ACTION IS NOT TAKEN UNDER CLAUSE-3.

(a) In any case in which any of the powers conferred upon the the Project Engineer cum Estate Officer, CCMD by **Clause 3** thereof shall have become exercisable and the same shall not have been exercised, the non-exercise thereof shall not constitute a waiver of any of the conditions hereof and such powers shall notwithstanding be exercisable in the event of any future case of default by the contractor for which under any clause hereof he is declared liable to pay compensation or penalty amounting to the whole of his security deposit and the liability of the contractor for past and future compensation or penalty shall remain unaffected.

5. GRANT OF EXTENSION OF TIME

(a) If the contractor shall desire an extension of the time for completion of the work, on the ground of his having been unavoidably hindered in its execution or on any other ground, he shall apply in writing to the Project Engineer cum Estate Officer, CCMD before the expiry of the period stipulated in the tender or before the expiry of 30 days from the date on which he was hindered as aforesaid or on which the cause for asking for extension occurred, whichever is earlier and the Project Engineer cum Estate Officer, CCMD or other competent authority may if in his opinion, there are reasonable grounds for granting an extension, grant such extension as he thinks necessary or proper. The decision of such competent authority in this matter shall be final.

(b) The time limit for completion of the work shall be extended commensurate with its increase in cost occasioned by alterations or additions and the certificate of the Project Engineer cum Estate Officer, CCMD or other competent authority as to such proportion shall be conclusive.

6. ISSUE OF FINAL CERTIFICATE – CONDITIONS REGARDING

(a) On completion of the work the contractor shall report in writing to the Project Engineer cum Estate Officer, CCMD the completion of the work. Then he shall be furnished with a certificate by the Project Engineer cum Estate Officer, CCMD of such completion, but no such certificate shall be given nor shall the work be considered to be complete until the contractor shall have removed from the premises on which the work shall have been executed all surplus materials and rubbish and shall have cleaned thoroughly wall, floor or other parts of any building, in or upon which the work has been executed, or of which he may have had possession for the purpose of executing the work, nor until the works shall have been measured by the Project Engineer cum Estate Officer, CCMD or other competent authority, or where the measurements have been taken by his Engineer-in-charge until they have received the approval of the Project Engineer cum Estate Officer, CCMD or other competent authority, the said measurements being binding and conclusive against the contractor. If the contractor shall fail to comply with the requirements of this clause before the date fixed for the completion of the work the Project Engineer cum Estate Officer, CCMD or other competent authority may, at the expense of the contractor, remove such surplus materials and rubbish, and dispose of the same as he think fit and clean off such dirt etc., as aforesaid and contractor shall be liable to pay the amount of all expenses incurred but shall have no claim in respect of any such scaffolding or surplus materials as aforesaid except for any sum actually realized by the sale thereof.

7. Contractor to submit bills monthly in printed form

(a) A bill shall be submitted by the contractor on or before 15th of each month for all items of work executed in the previous month as required by IISc.

(b) All bills shall be prepared in the prescribed printed or electronic form in PDF format in quadruplicate and handed over to the Engineer-in-charge in charge of the work/ the Project Engineer cum Estate Officer, CCMD's Office and acknowledgment obtained.

(c) The charges to be made in the bills shall always be entered at the rates specified in the tender in full or in part as the case may be, in the case of any extra work ordered in pursuance of these conditions, and not mentioned or provided for in the tender, the charges in the bills shall be entered at the rates hereinafter provided for such work.

(d) Scrutiny of Bills and measurement of work

The details furnished by the Contractor in the bill should be completely scrutinized and the said work should be measured by the Engineer-in-charge/Consulting Agency in the presence of the Contractor or his duly authorized agent. The countersignature of the contractor or the said agent in the measurement book shall be sufficient proof to the correctness of the measurements, which shall be binding on the contractor in all respects. If the contractor does not submit the bills within the prescribed time, the Project Engineer cum Estate Officer, CCMD may depute within seven days of the prescribed date, an Engineer-in-charge to measure up the said work. The countersignature of the contractor shall be obtained in the Measurement Book concerned with reference to which the Institute may prepare the bill.

(e) Filing of objections to measurement by contractor

Before taking any measurement of any work as has been referred to in **Clause 7(d)** above the Project Engineer cum Estate Officer, CCMD or a Engineer-in-charge deputed by him shall give reasonable notice to the contractor. If the Contractor fails to attend at the measurements after such notice or fails to countersign or to the difference, within a week from the date of measurement in the manner required by the Project Engineer cum Estate Officer, CCMD, then in any such event, the measurements taken by the Project Engineer cum Estate Officer, CCMD or by the Engineer-in-charge deputed by him as the case may be, shall be final and binding on the contractor and the contractor shall have no right to dispute the same.

(f) One copy of the passed bill shall be given to the Contractor without any charge.

8. PAYMENT PROPORTIONATE TO WORK APPROVED AND PASSED.

a) No payment shall be made for any work estimated to cost rupees five thousand or less until after the whole of the work shall have been completed and certificates of completion given. But in the case of works estimated to cost more than Rs. 5,000 the contractor shall on submitting the bill and after due verification by the Engineer-in-charge as per **Clause 7(d)** be entitled to necessary payment proportionate to the part of the work then approved and passed by The Project Engineer cum Estate Officer, CCMD or other competent authority whose certificate of such approval and passing of the sum so payable shall be final and conclusive against the contractor.

b) Payment at reduced rates

The rates for several items of works agreed to shall be valid only when the items concerned are accepted as having been completed fully in accordance with the stipulated specifications. In cases where the items of work are not accepted as so completed, the Project Engineer cum Estate Officer, CCMD or other competent authority may make payment on account of such items at such reduced rates as he may consider reasonable in the preparation of final or on account bills.

c) Payment or intermediate certificates be regarded as advances:

All such intermediate payments shall be regarded as payments by way of advance against the final payments only and not as payments for work actually done and completed, and shall not preclude the Project Engineer cum Estate Officer, CCMD or other competent authority from requiring any bad, unsound imperfect or unskillful work to be removed or taken away and reconstructed or re-erected nor shall any such payment be considered as an admission for the due performance of the Contract or any part thereof in any respect or the accruing of any claim, nor shall it conclude determine or affect in any other way the powers of the Project Engineer cum Estate Officer, CCMD or other competent authority as to the final settlement and adjustment of the accounts, or otherwise or in any other way vary or affect the contract.

d) Submission of Final bill and its settlement

The contractor shall submit the final bill within one month of the date of actual completion of the work in all respects. His claims shall be settled (except those under dispute) within two

months thereafter in respect of works costing up to Rs. 1 lakh and within five months thereafter in respect of works costing more than Rs. 2 lakhs.

e) Disputed items

Note: The contractor shall submit a list of the disputed items within 30 days from the disallowance thereof and if he fails to do this, his claim shall be deemed to have been fully waived and absolutely extinguished.

9. Definition of Work:

(a) The expression 'Work' or 'Works' where used in these conditions, shall unless there be something in the subject or context repugnant to such construction, be construed to mean the work or works contracted to be executed under or in virtue of the contract, whether temporary or permanent and whether original, altered, substituted or additional.

(b) Work to be executed in accordance with specifications, drawings, orders etc.

The contractor shall execute the whole and every part of the work in the most sound and substantial and workmanlike manner, and in strict accordance with the specifications both as regards materials and workmanship. The contractor shall also conform exactly, fully and faithfully to the designs, drawings and instructions in writing relating to the work signed by the Project Engineer cum Estate Officer, CCMD or other competent authority and lodged in his office and to which the contractor shall be entitled to have access at such office, or on the site of the work for the purpose of inspection during office hours. The contractor shall also be responsible for the delivery of structure in sound conditions and the execution of the work strictly in accordance with the specifications of the work.

The order of preference in case of any discrepancy as indicated to be read as following:

- a) Nomenclature of item as per Bill of Quantities.
- b) Additional specifications, particular specifications & special conditions.
- c) General Conditions.
- d) Tender drawings and specifications mentioned in drawings.
- e) Tender specifications.
- f) Indian Standard specifications of BIS.
- g) Sound engineering practice as per directions of Project Engineer cum Estate Officer.
- h) Manufactures specifications.

A reference made to any Indian Standard specifications in these documents reference to the latest version of that standard, including such revisions /amendments as issued by Bureau of Indian standards up to last date of receipt of tender. The contractor shall keep at his own cost all such publications of relevant Indian Standards applicable to the work at site.

(c) Action where there is no specification

In the case of any class of work for which there is no such specification, then in such a case of the work shall be carried out in all respects in accordance with the instructions and requirements of the Project Engineer cum Estate Officer, CCMD or other competent authority.

(d) Work as per Specifications and IS Codes.

The detailed specification, which forms a part of contract, accompanies the tender document. In carrying out the various items of work as described in Vol. II (General Specifications) of the tender documents and the additional, substituted, altered items of work these detailed specifications shall be strictly adhered to, supplemented by relevant provisions of the Indian standard specifications. Any work, not covered by the detailed technical specifications, shall be executed in accordance with the instructions and requirements of the engineer and the relevant provisions of the Indian standard specifications.

10. Alteration in quantity of work, specifications and designs, additional work, deletion of work

(a) The Project Engineer cum Estate Officer, CCMD shall have power to make any alterations in, omissions from additions to or substitutions for the original specification, drawings, designs and instructions that may appear to him to be necessary or advisable during the progress of the work. For that purpose or if for any other reason it shall in his opinion be desirable, he shall have power to order the Contractor to do and the contractor shall do any or all the following: -

- (i)** Increase or decrease the quantity of any work included in the contract.
- (ii)** Omit any such work.
- (iii)** Change the character or quality or kind of any such work,
- (iv)** Change the dimensions of any part of the work,
- (v)** Execute additional work of any kind necessary for the completion of the works and
- (vi)** Change in any specified sequence, methods or timing of construction of any part of the work.

(b) Contractor bound by Project Engineer cum Estate Officer, CCMD's instructions

The Contractor shall be bound to carry out the work in accordance with any instructions in this connection which may be given to him in writing signed by the Project Engineer cum Estate Officer, CCMD or other competent authority and such alteration shall not in any way vitiate or invalidate the contract.

(c) Orders for variations to be in writing

(i) No such variations shall be made by the Contractor without an order in writing of the Project Engineer cum Estate Officer provided that no order in writing shall be required for increase or decrease in the quantity of any work where such increase or decrease is the result of the quantities exceeding or being less than those stated in Volume III (Bill of quantities) provided also that if for any reason the Project Engineer cum Estate Officer, CCMD shall consider it desirable to give any such order verbally, the Contractor shall comply with such order without any confirmation in writing of such verbal order given by the Project Engineer cum Estate Officer, CCMD, whether before or after the carrying out of the order, shall be deemed to be an order in writing within the meaning of the clause; provided further that if the Contractor shall within seven days confirm in writing to the Project Engineer cum Estate Officer, CCMD and if such confirmation is not contradicted in writing within fourteen days by the Project Engineer cum Estate Officer, CCMD, it shall be deemed to be an order in writing by the Project Engineer cum Estate Officer, CCMD.

(ii) Any additional work which the contractor may be directed to do in the manner above specified as part of the work shall be carried out by the Contractor on same conditions in all respects on which he agreed to do the main work at the same rates as are specified in the tender for the main work. However, change in the unit rates tendered and accepted shall be considered in respect of items under which the quantity of work performed exceeds tendered quantity by more than 25 percent and this actual change in rate will be restricted only to such excess quantity (i.e. beyond 125 percent of the tendered quantity).

(d) Determination of rates for items not found in Bill of Quantities

If the rates for additional, substituted or altered work cannot be determined in the manner specified in sub **clauses (b) and (c)** above, then the contractor shall within 7 days of the date of receipt by him of the order to carry out the work, inform The Project Engineer cum Estate Officer, CCMD of the rates which it is his intention to charge for such class or work, supported by analysis of the rate or rates claimed. Thereupon the Project Engineer cum Estate Officer, CCMD shall determine the rate or rates on the basis of observed data and failing this, on the basis of prevailing market rates. Under no circumstances the contractor shall suspend the work on the plea of non-settlement of rates for items falling under this clause. In the event of any dispute regarding the rates for such items the decision of the Director, IISC shall be final.

11. TIME LIMITS FOR UNFORSEEN CLAIMS

Under no circumstances whatever shall the contractor be entitled to any compensation from Institute on any account unless the contractor shall have submitted claim in writing to the Project Engineer cum Estate Officer, CCMD or other competent authority

12. ACTION AND PENALTY IN CASE OF BAD WORK

If at any time before the security deposit is refunded to the contractor, it shall appear to the Project Engineer cum Estate Officer, CCMD or other competent authority that any work has been executed with unsound, imperfect or unskillful workmanship or with materials of inferior quality, or that any materials or articles provided by him for the execution of the work are unsound or of a quality inferior to that contracted for, or are otherwise not in accordance with the contract, it shall be lawful for the Project Engineer cum Estate Officer, CCMD or other competent authority to intimate this fact in writing to the contractor and then notwithstanding the fact that the work, materials or articles complained of may have been paid for, the contractor shall be bound forthwith to rectify, or remove and reconstruct the work so specified on whole or in part as the case may require, or if, so required shall remove the materials or articles at his own charge and cost and in the event of his failing to do so within a period to be specified by the Project Engineer cum Estate Officer, CCMD or the competent authority in the written intimation aforesaid, the contractor shall be liable to pay a penalty not exceeding one percent on the amount of the estimate for every day not exceeding ten days during which the failure, so continues and in the case of any such failure the Project Engineer cum Estate Officer, CCMD or other competent authority may rectify or remove, and re-execute the work or remove and replace the materials or articles complained of, as the case may be at the risk and expense in all respects of the contractor. Should the Project Engineer cum Estate Officer, CCMD

or other competent authority for any valid reasons consider that any such inferior work or materials as described above is to be accepted or made use of, it shall be within his discretion to accept the same at such reduced rates he may fix thereof.

13. CONTRACTOR LIABLE FOR DAMAGE DONE, AND FOR IMPERFECTIONS FOR TWELVE MONTHS AFTER CERTIFICATE OF COMPLETION

If the Contractor or his workmen shall break, deface, injure or destroy any part of a building in which they may be working, or any building, road fence, enclosure or grassland or cultivated ground contiguous to the premises on which the work or any part thereof is being executed, or if any damage shall be done to the work, while it is in progress from any cause whatever or if any imperfections become apparent in it within Twelve months of the grant of a certificate of completion, final or otherwise, by the Project Engineer cum Estate Officer, CCMD or other competent authority the contractor shall make good the same at his own expenses, or in default the Project Engineer cum Estate Officer, CCMD or other competent authority may cause the same to be made good by other workmen, and deduct the expenses (of which the certificate of the Project Engineer cum Estate Officer, CCMD or other competent authority shall be final) from any

sums that may be due or may thereafter become due to the contractor, or from his Security Deposit or the proceeds of sale thereof, or of a sufficient portion thereof.

14. Work on Notified Holiday

No work shall be done on any notified holiday without the sanction in writing of the Project Engineer cum Estate Officer, CCMD or other competent authority

15. SETTLEMENT OF DISPUTES -TIME LIMIT FOR DECISION

(a) If any dispute or difference of any kind whatsoever were to arise between the Project Engineer cum Estate Officer, CCMD and the contractor regarding the following matters namely,

(i) The meaning of the specifications designs, drawing and instructions herein before mentioned,

(ii) The quality of workmanship or materials used on the work and

(iii) Any other question, claim right, matter, thing whatsoever, in any way arising out of or relating to the contract, designs, drawings, specification, estimates, instructions, or orders, or those conditions, or failure to execute the same whether arising during the progress of the work, or after the completion, termination or abandonment thereof, the dispute shall, in the first place, be referred to the Director, IISc. The Director, IISc shall within a period of fifteen days from the date of being requested by the Contractor to do so give written notice of its decision to the Contractor.

(b) Director's decision final.

Subject to other form of settlement hereafter provided, the Director's decision in respect of every dispute or difference so referred shall be final and binding upon the contractor. The said

decision shall forthwith be given effect to and contractor shall proceed with the execution of the work with all due diligence.

(c) Remedy when Director's decision is not acceptable to contractor

In case the decision of the Director is not acceptable to the contractor, he may approach the Law Court at Bangalore for settlement of dispute after giving due written notice in this regard to the Director within a period of ninety days from the date of receipt of the written notice of the decision of the Director.

(d) Time limit for notice to approach Court of law by contractor

If the Director has given written notice of his decision to the contractor and no written notice to approach the law court has been communicated to him by the contractor within a period of ninety days from receipt of such notice, the said decision of Director shall be final and binding upon the contractor.

(e) Time limit for notice to approach law court by contractor when decision is not given by Director, IISc as at (b).

If the Director fails to give notice of his decision within a period of ninety days from the receipt of the contractor's request in writing for settlement of any dispute or difference as aforesaid, the Contractor may within ninety days after the expiry of the first named period of ninety days approach the Law Courts at Bangalore giving due notice to the Director.

(f) Contractor to execute and complete work pending settlement of dispute.

Whether the claim is referred to the Director or to the Law Courts, as the case may be, the contractor shall proceed to execute and complete the works with all due diligence pending settlement of the said dispute or differences.

(g) Obligations of The Project Engineer cum Estate Officer, CCMD and contractor shall remain unsettled during considerations of dispute.

The reference of any dispute or difference to the Director or the Law Court may proceed notwithstanding that the works shall then be or be alleged to be complete, provided always that the obligations of the Project Engineer cum Estate Officer, CCMD and the contractor shall not be altered by reason of the said dispute or difference being referred to the Director or the Law Court during the progress of the works.

16. CONTRACTOR TO PAY COMPENSATION UNDER WORKMEN'S COMPENSATION ACT.

(a) The contractor shall be responsible for and shall pay any compensation to his own workmen payable under the relevant Workmen's Compensation Act for injuries caused to the workmen. If Institute pays such compensation on behalf of the contractor, it shall be recoverable by Institute from the contractor under the relevant clauses.

(b) Contractor to pay expenses of providing medical aid to workmen.

The contractor shall be responsible for and shall pay the expenses of providing medical aid to any workman who may suffer a bodily injury as a result of an accident. If Institute incurs such expenses, the same shall be recoverable from the contractor forthwith and be deducted without prejudice to any other remedy of Institute, from any amount due or that may become due to the contractor.

17. CONTRACTOR TO PROVIDE PERSONAL SAFETY EQUIPMENT FIRST AID APPARATUS, TREATMENT

The contractor shall provide all necessary personal safety equipment and first aid apparatus for the use of the persons employed on the site and shall maintain the same in good condition suitable for immediate use, at any time and shall comply with the following regulations in connection therewith: -

- i. The worker will be required to use the equipment so provided by the contractor and the contractor shall take adequate steps to ensure proper use of the equipment by those concerned.
- ii. Adequate provision shall be made for prompt first - aid treatment of all injuries likely to be sustained during the course of his work.

18. Minimum age of persons employed by contractor

- (a) No contractor shall employ any person who is under the age of 18 years.
- (b) The contractor shall provide potable water facilities to the workers. Similar amenities shall be provided to the workers engaged on large works in urban area.
- (c) Removal of persons not satisfying conditions (a)

The Project Engineer cum Estate Officer, CCMD or other authority is authorized to direct the removal or to remove through his own agency, from the work any person referred to in sub-clauses (a) above not satisfying these conditions and no responsibility shall be accepted by the Institute for any delay caused in the completion of the work by such directions for removal.

- (d) Payment of fair and reasonable wages by contractor.

The contractor shall pay fair and reasonable wages, which shall not be less than the minimum wages fixed by Govt. of Karnataka from time to time to the workmen employed by him in the contract undertaken by him. In the event of any dispute arising between the contractor, and his workmen on the ground that the wages paid are not fair and reasonable the dispute shall be referred without delay to The Project Engineer cum Estate Officer, CCMD or other competent authority, who shall decide the same.

The decision shall not in any way affect the conditions in the contract regarding the payment to be made by Institute at the agreed tender rates.

19. METHOD OF PAYMENT OF BILLS

Payment to contractors shall be made by cheques drawn by the Institute / Bank transfer.

20. SET OFF AGAINST ANY CLAIM OF INSTITUTE

Any sum of money due and payable to the contractor (including the security deposit refundable to him) under this contract may be appropriated by the Institute and set off against any claim of Institute in respect of a payment of a sum of money arising out of or under any other contract made by the contract with the Institute.

21. RATES INCLUSIVE OF ALL TAXES.

(a) The rates to be quoted by the contractor shall be inclusive of all taxes like GST etc., No extra payment on this account will be made to the contractor.

22 Refund of Security Deposit (EMD & FSD):

The Security Deposit lodged/paid by a Contractor shall be refunded to him after the final bill is paid or after **TWELVE** months from the date of completion of the work, whichever is later during which period the work should be maintained by the Contractor in good order,.

SECTION 8: SPECIAL CONDITIONS FOR WORKS

1. DEFINITION:

In the Contract (as hereinafter defined) the following definitions words and expressions shall have the meaning hereby assigned to them except where the context otherwise required.

- i. Institute shall mean the IISc Bangalore.
- ii. The Engineer-in-charge, who shall administer the work, shall be nominated by the Project Engineer cum Estate Officer, IISc Bangalore.
- iii. Accepting authority shall mean the Chairman, Building and Works Committee- Director, IISc Bengaluru or his authorized representative.
- iv. Consultant shall mean the firm M/s Chandroo Iyer Associates, Bangalore, appointed by the Institute for the work and in the event of ceasing to be the Consultants, such other firms or persons as may be appointed by the Institute.

2. ASSIGNMENT & SUBLETTING:

The contractor shall not assign the contract or any part thereof without the written consent of the Engineer in-charge. The whole of the works included in the contract shall be executed by the contractor except where otherwise provided in the contract and he shall be responsible for the acts, defaults and neglects of sub-contractor.

3. SCOPE OF CONTRACT:

The contract comprises the supply, Installation, completion of works within six (6) months and maintenance of the works for twelve (12) months after actual date of completion and handing over to IISC, Bengaluru. The contractor shall carry out and complete the said work in every respect in accordance with this contract and as per the directions/ written instructions of the Engineer in-charge. These pertain to the following:

- i. The variation or modification of the design, quality or quantity of works or the addition or omission or substitution of any work.
- ii. All materials are to be supplied as per approved shop drawings. Any excess material brought to site shall be taken back by the agency and no claim for payment of the same shall be entertained by IISc
- iii. Removal and substitution of material from the site.
- iv. The dismissal from the works of any persons employed.
- v. The opening up for inspection of any work covered up.
- vi. Any civil modifications required for installation of services (electrical, piping or exhaust system)
- vii. Amending / making good of any defects.

The contractor shall forthwith comply with and duly execute any instructions of work in Project Engineer cum Estate Officer's instructions, provided always that the verbal instructions and explanations given to the contractor or his representative upon the works shall, if involving a variation, be confirmed in writing by the contractor within seven days and if not dissented in writing within a further seven days by the Project Engineer cum Estate Officer, shall be deemed to be instructions of the Engineer in-charge within the scope of the contract.

1) CONTRACT DOCUMENT:

- 1.1 All documents, forming the contract, are to be taken as mutually explanatory of one another and in case of ambiguities or discrepancies the same shall be explained and adjusted by the Project Engineer cum Estate Officer who shall thereupon issue to the contractor its interpretation directing in what manner the work is to be carried out.
- 1.2 The successful tenderer shall be required to enter into an agreement with IISc as per approved format given in the tender document. The Bill of Quantities & rates filled by the successful tenderer, technical bid document, minutes of the pre-bid meeting, negotiation letter and the award letter shall form part of the agreement to be signed by the successful tenderer. The cost of stamp paper and stamp duty, required for the agreement, shall be borne by the contractor.
- 1.3 The contractor shall study the Tender drawings thoroughly before the commencement of work. In case of any discrepancy the contractor shall seek clarification before proceeding with the works.

2) AS BUILT DRAWINGS:

On completion of work, the Contractor shall submit at his own cost six prints of “as built’ drawings and commissioning reports along with O&M manual to the Project Engineer cum Estate Officer within 6 weeks of completion of the work.

a) The drawings shall have the following information.

- i. Layout showing lab benches and fume hoods.
- ii. Layout of Exhaust system with all details.
- iii. Layout of all Gas Distribution with locations of all control valves and connections.
- iv. Layout of connection to water supply and drainage line including locations of control valves etc.
- v. All drawings related to electrical installations.

b) The commissioning report for the Exhaust system, gas piping system and electricals shall be submitted in the format to be agreed upon.

c) The O&M manual for the Lab Furniture, Exhaust System, Gas piping and Electrical works shall be submitted.

3) The contractor shall make recesses, holes, opening etc. as may be required, nothing extra shall be payable on this account, including finishing the same.

4) The contractor shall be fully responsible for the safe custody of materials brought by him to site.

5) SPECIALISED WORK

Following specialized works should be got executed only through agencies specialized in the field and the contractor shall be required to submit the details of such agencies to the Project Engineer cum Estate Officer and obtain necessary approval:-

- a) Exhaust Piping and Scrubbing system.
- b) Gas Utility Piping System.
- c) Electrical works.

5.1 The specialized agency should have an experience of minimum five years in his area of specialization.

5.2 The specialized agency should have successfully completed at least one work of similar nature having a magnitude equal to at least 80% of the value of the specialized work provided in the tender.

5.3 The specialized agency shall have sufficient experience in execution of turnkey projects.

5.4 The contractor shall submit the following details of the specialized agency along with the Technical bid

- a. Proof of the agency in operation since last five years.

- b. List of works carried out by the agency in last five years along with the name of work, name and address of clients, year of execution, value of work done and brief specification of the work
- c. Completion certificate of one work of similar nature of magnitude equal to at least 80% of the value of the specialized work provided in the tender.

6) SAFETY, HEALTH AND ENVIRONMENT

- i. The Contractor(s) shall take all precautions to avoid accidents by exhibiting necessary caution boards. He shall be responsible for all damages and accidents caused to existing/new work due to negligence on his part. In case of any accident of labour / contractual staff the entire responsibility will rest on the contractor and any compensation under such circumstances if becomes payable shall be entirely borne by the contractor.
- ii. Appropriate personnel protective equipments such as helmets, gloves, goggles, aprons, safety belts etc.. shall be provided to the workers employed at work site.
- iii. All hazardous materials shall be labeled with the name of the materials, the hazards associated with its use and necessary precaution to be taken.
- iv. Contractor shall ensure that during the performance of the work, all hazard to the health of personnel, have been identified, assessed and eliminated.
- v. The contractor has to keep a record of all the workers employed at site, mark daily attendance along with the location of the work. All the labour record shall be made available for inspection and verification as and when required.

7) PROGRAMME CHART:

The Contractor shall prepare an integrated bar chart for the execution of work, showing clearly all activities from the start of work to completion, with details of manpower, material and equipment required for the fulfillment of the contract within the stipulated period or earlier and submit the same for approval within ten days of award of the contract.

The programme chart should include the following:

1. Descriptive note explaining sequence of the various activities.
2. Network (PERT / CPM / BAR CHART).
3. Programme for procurement of materials / equipment / labour by the contractor.

If at any time, it appears that the actual progress of work does not conform to the approved programme referred above, the contractor shall produce a revised programme showing the modifications to the approved programme to ensure completion of the work. The modified schedule of programme shall be approved by the Engineer in charge.

The submission for approval of such programme or the furnishing of such particulars shall not relieve the contractor of any of the duties or responsibilities under the contract. This is without

prejudice to the right of Project Engineer cum Estate Officer to take action against the contractor as per terms and conditions of the agreement.

8) QUALITY ASSURANCE:

- i. The contractor shall establish, document and maintain an effective quality assurance system as outlined in the specifications and various codes and standards.
- ii. The bidder shall understand scope of the work, drawing, specifications and standards etc. attached with the tender or to be followed and shall seek clarification, if any before submission of the tender
- iii. The quality assurance system plans / procedures / method statement to be followed shall be furnished in the form of quality assurance manual. It should cover quality assurance, plan procedure, specifications, frequency of the inspection, testing, acceptance criteria, method of sampling, testing etc. to be followed for quality.
- iv. The approval of quality assurance does not absolve the contractor of the contractual obligations towards executing the work as laid down in the specification of the work.
- v. The contractor shall produce quality control records in the formats approved by Engineer-in-charge in the quality assurance plan.
- vi. The contractor shall ensure the enforcement of quality assurance plan by all his specialized agencies as approved. The Project Engineer cum Estate Officer reserves the right to inspect, witness, review any stage of the work at shop / site as deemed necessary for quality assurance and / or timely completion of work.
- vii. The contractor shall procure required materials in advance so that there is sufficient time for testing of the materials and clearance of the same before use in the work. The contractor shall provide at his own cost suitable measuring arrangements at site for checking the dimensions as may be necessary for execution of work.

9) TESTING OF MATERIALS

All the required tests as per Technical Specification should be conducted at the cost of the contractor, unless specifically mentioned otherwise. All materials which are to be tested at the manufacturer's works shall satisfactorily pass the tests in the presence of the authorized representative of IISC before being used in the work. In case all requisite testing facilities are not available at the manufacturer's premises, such testing shall be conducted at approved laboratory. The charges for such testing shall be borne by the contractor.



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VOLUME -II

TECHNICAL SPECIFICATIONS

Name of work: Supply, Installation of lab furniture, fume hoods, services and lab exhaust system in Chemical Sciences Building, IISc Bengaluru.

DATE OF SUBMISSION OF TENDER: 03-12-2018,1500Hrs

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INTRODUCTION:

IISC proposes to set up Laboratories in their New Chemical Science Building inside the IISC campus Bengaluru.

There are six blocks in the proposed in **New Chemical Science Building**. The salient features of this block are as mentioned below,

1. Blocks are named as under:
 - a. 'A' Top Block.
 - b. 'B' Top Block.
 - c. 'C' Top Block.
 - d. 'A' Bottom Block.
 - e. 'B' Bottom Block.
 - f. 'C' Bottom Block.
2. Each block consists of Four Floor – Ground Floor + Three Floors.
3. Each Floor consists of Two Labs on eastern & western side of the floor with common corridor running north to south in between these labs.
4. Each lab space shall be owned / shared by different Faculty of the Chemistry Department.
5. For further details, refer the Lab General Arrangement Drawings enclosed in annexure.

The Scope of works shall include for furnishing of the Laboratories with Lab Furniture, Fume Hoods, Fume Exhaust System, Bench Mounted Electrical & Services.

SUB HEAD- 1: **LABORATORY FURNITURE & ACCESSORIES**

1.0 LAB FURNITURE & FUME HOOD:

1.1 SCOPE OF WORKS

Scope of work includes design, supply, installation, commissioning & handing over of laboratory furniture's & Fume Hood's for all floors. Lab requirements like laboratory work benches, wash sink, Tall Storage Cabinets, Emergency Showers etc. as envisaged in the Tender drawings & BOQ and described in the **Sub Head 1 for Lab Furniture & Accessories & Sub Head 2 for Fume Hood and Accessories.**

1.2 DESIGN CRITERIA

1.2.1 PURPOSE

It is the Intent of the work to provide high quality CRCA / GI Powder Coated Steel Cabinets with Phenolic Resin Work Top specifically designed for Laboratory Environment.

1.2.2 TYPE

CRCA / GI powder coated with minimum 60 to 80 microns high chemical resistant epoxy powder /80 to 100 microns Polyurethane powder coating "Free Standing PLINTH Mounted Cabinets" type assemblies complete with knee space panels, filler panels, Metal type Base cabinets etc., with 16 mm thick Phenolic resin Work Top.

1.3 LAB FURNITURE DESIGN BRIEF

- Wall Bench - Free Standing PLINTH Mounted under bench units steel cabinets
- Island Bench – Free Standing PLINTH Mounted under bench units & Sink unit at one end (As per the Tender Drawings).
- Island Bench - 2 stage Centre reagent rack with lattice assembly (As per the Tender Drawings).
- CRCA / GI Powder Coated Base Cabinets.

1.4 FUME HOOD DESIGN BRIEF

- Constant Air Volume type Fume Hood of different sizes described in the Tender BOQ.
- Separate Fume Hood for Acid Reaction.
- Fume Hood with 20mm thick Phenolic Resin Work Top.
- Factory Mutual (FM) Approved Acid & Solvent Base Cabinets
- Inbuilt Fire Extinguisher considered for fume hoods having Hydrogen & Methane as gas utility.
- Utility Points – Compressed Air, Cooling Water, Nitrogen, Effluent drain and Condensate Drain.

2.0 MODULAR LAB FURNITURE WITH “FREE STANDING PLINTH MOUNTED CABINETS”

2.1 GENERAL SCOPE OF WORK:

- 2.1.1** The supplier shall furnish all cabinets and casework, including tops, ledges in “Free Standing PLINTH Mounted Cabinets” type assemblies complete with knee space panels, filler panels etc., as per the Tender Bill of Quantities & drawings including delivery to the building, set in place, properly levelled and handing over with documentation after commissioning.
- 2.1.2** The supplier shall furnish and deliver all utility service outlet accessory fittings as mounted on the laboratory furniture like electrical sockets, switches, Gas & Water valves identified on drawings & as listed in the Tender Bill of quantities.
- 2.1.3** The supplier shall furnish and deliver all laboratory sinks, cup sinks, drains, drain troughs, overflows and sink outlets with integral tailpieces, which occur above the floor, and where these items are part of the equipment. All tailpieces shall be furnished with the couplings required to connect them to the drain piping system.
- 2.1.4** The supplier shall furnish service strip supports where specified, setting in place service tunnels, service turrets, supporting structures and reagent racks of the type shown on the drawings.
- 2.1.5** All various equipment fittings, assemblies, accessories, hardware, foundation bolts, supports, terminal lugs for electrical connections, cable glands, junction boxes and other sundry items for proper assembly and installation of various equipment and components of the work shall be deemed to be included in the tender, irrespective of the fact whether such items are specifically mentioned in the tender or not.
- 2.1.6** The supplier shall remove all debris, dirt and rubbish accumulated as a result of the installation of the laboratory furniture to an onsite container, leaving the premises broom clean and orderly.
- 2.1.7** After award of work, bidder has to integrate all the components of the work in consultation with the IISC appointed Lab consultant i.e. (Lab furniture, fume hoods, exhaust system, integration with Electrical and all other services included in the BOQ with the help of respective specialised agencies), prepare shop drawings and get it approved from Engineer in charge before taking up the production/placing order for supply, checking/ensure the efficiency of the overall design and get it vetted from the IISC appointed consultant.
- 2.1.8** Submit 6 sets of hard copies along with the soft copy of Lab wise and complete master plan of as built drawings of all the components.
- 2.1.9** Quoted rates shall includes the cost of all the components specified in the specifications, all necessary tests in the factory and the tests conducted after receipt of materials at site in approved testing labs, performance tests, all taxes as per bid document, all minor accessories not specified in the BOQ item but necessary/ required to make the component operational /functional. Clarification if any can be asked during the pre-bid meeting.

3.0 STANDARDS:

Conformity with Statutory Acts, Rules, Standards and Codes.

- 3.1 All components shall conform to relevant upto date Indian Standard Specifications, wherever existing irrespective of whether explicitly mentioned or not.
- 3.2 All electrical work shall be carried out in accordance with the provision of Indian Electricity Act 2003 and Indian Electricity Rules 1956, amended to date.
- 3.3 All lab fixtures shall conform to relevant international standards or guidelines and should provide documentary evidence to this effect. These include the following:
 - a. SEFA 3 – Scientific Equipment and Furniture Association for Worksurface.
 - b. SEFA 8M - Scientific Equipment and Furniture Association for Steel Caseworks.
 - c. SEFA 8 - Scientific Equipment and Furniture Association.
 - d. SEFA 10 - Scientific Equipment and Furniture Association for C Frame.
 - e. NFPA 30 - National Fire Protection Association
 - f. NFPA-45 - National Fire Protection Association
 - g. UL - Underwriters Laboratories
 - h. ASTM D522 - Bending Test
 - i. ASHRAE 110-2016

(OR)

- 3.4 BGI/GUV-I 850-0 Laboratories
- 3.5 TRGS 526 Laboratories
- 3.6 DIN 12898 Laboratory fittings; hose nozzles
- 3.7 DIN 12918 Laboratories - laboratory fittings – part 1:Water taps
- 3.8 DIN 12918 Laboratories – laboratory fittings – part 2:Taps for combustion gases
- 3.9 DIN 12918 Laboratories-laboratories fittings – part 3:Taps for industrial gases
- 3.10 DIN/EN 13792 Labels for laboratory fittings
- 3.11 DIN/EN 15154-1 Safety emergency showers – part 1:Body showers with water connection for laboratories
- 3.12 DIN/EN 15154-2 Safety emergency showers – part 1 : Eye showers with water connection
- 3.13 DIN/EN 14470-1 Fire resistance storage cabinets – part 1 : Safety cabinets for flammable liquids
- 3.14 DIN/EN 14470-2 Fire resistance storage cabinets – part 2 : Safety cabinets for pressurised gas cylinders
- 3.15 DIN/EN 14175-2 Fume cupboards– part 2: requirements for safety and performance capacity
- 3.16 DIN/EN 14175-2 Fume cupboards – part 3: design test procedures
- 3.17 DIN 12924-2 Laboratories – fume cupboards – part 2: high performance fume cupboards
- 3.18 DIN 12924-4 Laboratories – fume cupboards – part: fume cupboard for pharmacies.

4.0 QUALITY ASSURANCE, TESTING AND WARRANTY

- 4.1 The supplier shall have a history of successful projects of similar size and complexity.
- 4.2 Single Source Responsibility: The supplier shall provide complete “Free Standing PLINTH Mounted Cabinets” type assemblies work top, modesty panel, shelves, storage, service fixtures and accessories, fume hoods, exhaust ducting, exhaust blowers and scrubbers, as a single responsibility.
- 4.3 The supplier shall submit test results for SEFA-3 & 8, 8M compliance as indicated in performance criteria of the respective codes for a minimum of any 2nos Cabinets of different sizes as listed in the BOQ. The supplier shall at his own expense and at no cost to the purchaser carry out all such tests and inspections of goods and related services as specified in Tender. Fume hoods shall be type tested at manufacturers own test facility by reputed third party testing agency & relevant certificates to be submitted.
- 4.4 Whenever the supplier is ready to carry out such tests, reasonable advance notice shall be given to the purchaser including obtaining necessary permission or consent from third party agency to enable the purchaser or its designated representative to attend the test and/or inspection.
- 4.5 Warranty of equipment should be for a period of 12 months from the date of completion of work. Free upgrades of software, if any, should be provided during this period.

5.0 GENERAL SPECIFICATION

- 5.1 The steel frames, panels & shutters should be made from Prime Quality CRCA (Cold Rolled Cold Annealed) Steel. All cabinet bodies shall be of over closing design with fully KD (knock down) construction and having a Main and Add On construction to avoid any gaps in between two units. All units have interlocking type construction to form a rigid integral structure. The units are supported on base channels. Each unit should have a locking facility with 180° and 10 lever cam lock mechanism.

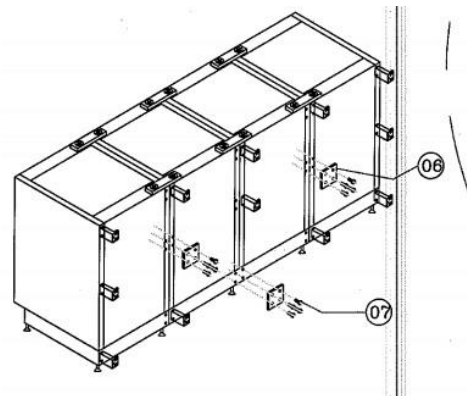
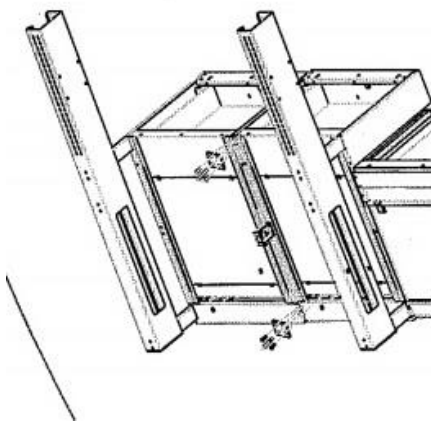
- Floor cabinets made of hollow tubular square cross sections would not be acceptable
Welded joints in the floor cabinets would not be acceptable

5.2 Under Bench Free Standing PLINTH Mounted Cabinets & Sink Base Unit.

- a. Free Standing PLINTH Mounted Cabinets mounted & Sink Base Unit should be flush face construction with doors in the same plane as the cabinet face frame, without overlap.
- b. All cabinets shall be flush front construction with intersection of all surfaces in same plane without overlap. Exterior corners shall be spot welded with heavy back up reinforcement at exterior corners. All face joints shall be welded and ground smooth to provide a continuous flat plane.
- c. Thickness of CRCA / GI powder coated with minimum 60 to 80 microns high chemical resistant epoxy powder /80 to 100 microns Polyurethane powder coating steel used in

construction of cases shall be 1.2mm thk.

- d. Base molding to be provided for the free-standing base units. Base moulding shall be sealed at the bottom to prevent dust accumulation beneath the cabinet.
- e. Support struts shall consist of two 1.6mm thk channel uprights fastened top and bottom by two adjustable "U" shaped spreaders, each 2.6mm thk, 1- 37.5mm x length required formed from galvanized steel. Struts shall be furnished to support drain troughs, and to support worktop at plumbing space under fume hood superstructures or other heavy loads.
- f. The sinks should be with self draining base and should be suitable for mounting on top or underside of the work benches. Sinks shall have bottle trap.
- g. Internal size of PP Single Moulded Sinks -750mm (W) x 450mm(D) x 350mm(H)
- h. Polyethylene cup drains shall be moulded in one-piece of acid-resistant polyethylene. They shall have an integral mounting flange and an integral tailpiece with 38mm I.P.S. male straight thread outlet with Bottle Trap.

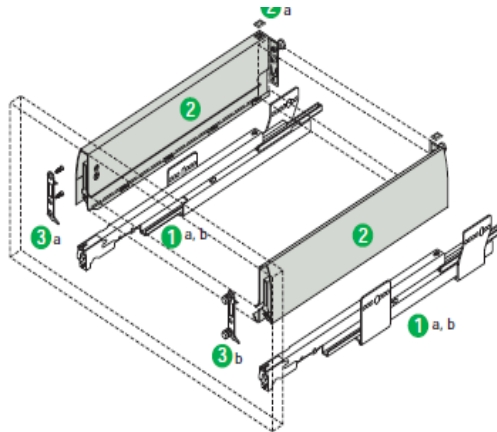


5.3 Under Bench Cabinets

- a. Under bench cabinets should be flush face construction with doors and drawers in the same plane as the cabinet face frame, without overlap. Thickness of CRCA / GI powder coated with minimum 60 to 80 microns high chemical resistant epoxy powder /80 to 100 microns Polyurethane powder coating steel used in construction of cases shall be 1.2 mm thick except as follows:
 - i. Case and drawer suspension channels, 2mm thk.
 - ii. Top and intermediate front horizontal rails, table aprons, hinge reinforcements, and reinforcement gussets, 1.6mm thk.
 - iii. Drawer assemblies, door assemblies, bottom, bottom back rail, toe space rail, and

adjustable shelves, 1mm thk.

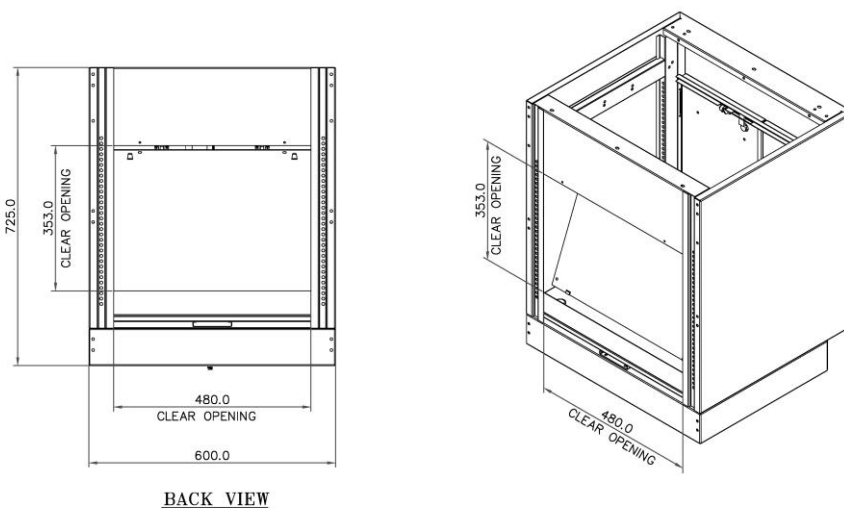
- b. The overall load carrying capacity of under bench cabinet should be 80 kg of UDL (40kg on the shelf and 40kg on the bottom)
- c. Door shutters and drawers facias shall be bent to 19mm thick square edges, recessed aluminium pull, offering a comfortable handgrip, shall be securely fastened to doors and drawers with screws. All pulls shall be satin finish aluminium, with a clear, lacquer finish.
- d. Drawer cabinets shall be made in one-piece construction including the bottom, two sides, back and front. They shall be fully coved at interior bottom on all four sides for easy cleaning. The top front of the inner drawer body shall be offset to interlock with the channel formation in drawer head providing a 19mm thick drawer head.
- e. Drawer slides shall consist of high precision, fully extendable, double extension slides with minimum 40 kg load carrying capacity. Drawer slides shall be equipped with soft closure mechanism by air suspension, self-closing when the drawer reaches 80% closure. Drawer channels shall maintain alignment of drawer and provide an integral stop, but the drawer shall be removable without the use of tools. Drawers shall provide minimum 340mm front to back clearance when fully extended. Drawers shall rise when opened thus avoiding friction with lower drawers and/or doors.



- f. Hinges shall be made of Type 304 stainless steel 2.2mm thick, 62.5mm high, with brushed satin finish with a five-knuckle bullet-type barrel. Hinges shall be attached to both door and case with two screws through each leaf. Welding of hinges to the door or case shall not be accepted. Doors under 900mm height shall be hung on one pair of hinges, and doors over 900mm high shall be hung on 3 hinges.
- g. Handles shall be anodized aluminium, recessed type- 100mm x 50mm size.

All storage units except sink units shall be provided with locks. Locks shall be a 5-disc tumbler with heavy duty interchangeable cylinder and 2 sets of keys

- h. A two-piece heavy-duty cam action positive catch shall be provided on all base cupboard doors and shall be positioned near the pivoting edge of door to provide a clean unobstructed opening. Main body of the catch shall be confined within an integral cabinet divider rail, while latching post shall be mounted on the hinge side of door. Nylon roller type catches are not acceptable.
- i. Adjustable shelves shall be formed down 19mm, returned back 22.5mm and up 6.5mm into a channel formation front and rear; formed down 19mm at each end, shelves over 1050mm long shall be further reinforced with a channel formation welded to underside of shelf. Shelf adjustment clips shall be nickel-plated steel.
- j. Shelves and Drawers: CRCA / GI powder coated with minimum of 60 to 80 microns high chemical resistant epoxy powder /80 to 100 microns Polyurethane powder coating steel shelves and drawers shall have a load bearing capacity of 40kg of UDL.
- k. Configuration of Storage Units: The storage units should be available in three configurations:
 - l. Storage unit with one/two shutters and one adjustable shelf
 - m. Storage unit with one drawer, one/ two shutters and one adjustable shelf
 - n. Storage unit with 4 drawers
- o. All storages are fitted with 10 levers, 180-degree cam locks when not specified.
- p. Hinged back panel (as shown in diagram) for easy access to services behind.



5.4 Over Head Cabinets

Wall storage units shall be constructed of 1.2mm thick CRCA / GI, powder coated with minimum 60 to 80 microns high chemical resistant epoxy powder /80 to 100 microns Polyurethane powder coating, double wall construction for side walls with sound dampening technology or side and back wrap around body with corner posts with holes to support shelf supports, shelves shall be provided, constructed from 1.0mm thick CRCA / GI steel 60 to 80 microns high chemical resistant epoxy powder /80 to 100 microns Polyurethane powder coating with all around 27mm strengthening edge, load capacity of 90 kg/ shelf , height should be adjustable to optimise the storage space inside the cabinet. Framed glass sliding / hinged door leaf shall be constructed from 1.2mm thick CRCA/GI powder coated with minimum 60 to 80 microns high chemical resistant epoxy powder /80 to 100 microns Polyurethane powder coating, steel panels, bent to 20mm thickness all around, dampened with contact cushions with 6mm thick float glass with polished edges fixed to shutter frame with pvc gasket. A guide runner shall be provided at the bottom with plastic coated ball bearings or the shutter should be top hung, supported on a ball bearing nylon roller running in a track attached to the top of the cabinet with a guide rail at the bottom. All cabinets should have load carrying capacity of 90 kg per cabinet. All cabinets should have a magnetic label to show details about its content. All storage cabinets should be provided with interchangeable cylinder locks.

5.5 Storage Cabinets

5.5.1 Full Height solid swing door Cabinets

- i. Swinging door full height storage cabinets shall have a completely finished interior same as exterior.
- ii. End uprights shall be formed at the front in a 25mm channel formation with the inside flange formed to provide a 775/800mmx 12.5mm door recess. The back of the upright shall be formed to a 62mm formation. A 1.6mm thk hinge reinforcement, same as specified for BASE CABINETS, shall be welded to inner side of front uprights.
- iii. Cabinet tops shall be formed into a 25mm x 1.5mm channel shape at front, with a 775/800mm x 12.5mm offset for door recess, and with flange at rear and sides for electro-welding cabinet top to cabinet back and ends.
- iv. Cabinet bottoms for storage cabinets shall be formed down on sides and back to create a square edge transition welded to cabinet end panels, and front edge shall be offset to create a seamless drawer and door recess rabbet for dust stop. Cabinet bottoms shall be formed to provide a flush 25mm face rail with a return flange to give a 14mm deep x 125mm high toe space.
- v. Cabinet backs shall be welded to the top, bottom and ends. Backs shall be perforated for

shelf adjustment holes on not more than 25mm centers. Holes shall be set in a channel formation in cabinet back and enclosed by end uprights.

- vi. Adjustable shelves shall be formed down 19mm, returned back 22mm and up 6mm into a channel formation front and rear, formed down 19mm at each end, shelves over 1050mm long shall be further reinforced with a channel formation welded to underside of shelf.
- vii. Toe space rails shall interlock in back of bottom rail and with end panel to provide a welding plate and shall extend to the floor with a flange turned back 13mm and turned up 9mm for support.
- viii. Glazed swinging doors shall be 19mm thick and consist of an inner and outer door pan welded to form a single unit. Outer door pan shall be 1.2mm thk steel, formed into a channel or flanged shape at all four sides. It shall be pierced and formed to create a 75mm wide frame with a beveled edge around the glass opening in the center of the door. Inner door pan shall be 1.2mm thk steel, flanged at all four sides, pierced for a glass opening in center of the door, with a 1.6mm thk hinge reinforcements welded in place. Doors shall be glazed with 6mm thick toughened glass, held in place by a rubber or vinyl gasket around the entire edge of the glass. Outer door pan shall be pierced for a recessed flush pull, as described under HARDWARE.
- ix. Solid panel swinging doors (two-piece) shall consist of an inner and outer pan formation, mechanically assembled after painting. All exterior surfaces shall be welded and ground smooth. Inner door pan shall be flanged for mechanical assembly. Door shall have a 2mm thick hinge reinforcement welded at hinge slot; as well as a full-height channel formation welded to inner pan. Doors shall be 19mm thick with sound deadening material.

5.5.2 FM Storage Cabinets:

a) Acid Storage Cabinets:

FM approved Acid storage cabinets shall utilize the same thickness of steel and construction features as other except they shall be completely lined with a one-piece Polyethylene corrosion resistant liner. The liner shall be 6mm thick, molded into a seamless tub, including top, sides and bottom, with a 25mm lip at the bottom front to contain spills. Each door shall have a set of louvers at the top and bottom and have a 3mm sheet polyethylene liner. Where specified, each cabinet shall be vented through top exhaust duct connection with a 40mm vent pipe.

b) Solvent Storage Cabinets:

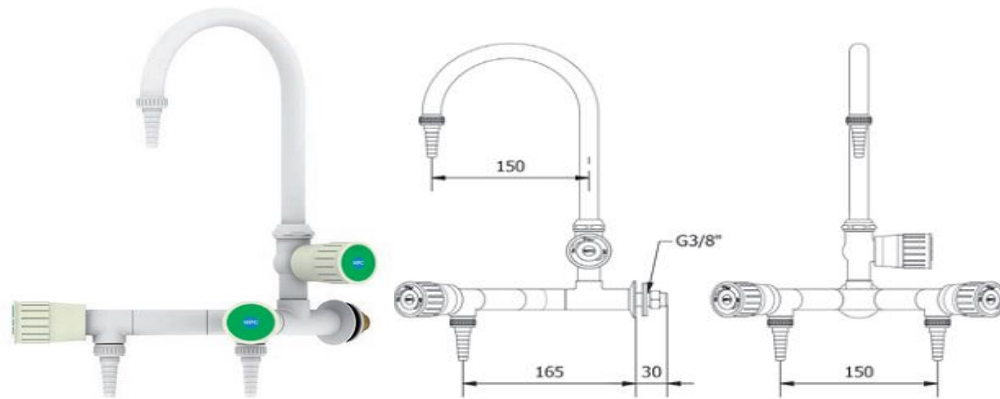
FM approved 90minutes Fire rating Solvent storage cabinets shall be UL labelled and specifically designed for the storage for the storage of flammable and combustible liquids. Construction shall be based upon the requirements listed by UL, UFC, OSHA, and NFPA No. 30 – 1993. The bottoms, top, sides and doors shall be fabricated of 1.2mm thk steel and shall

be all double panel construction with a 40mm air space between panels. All joints shall be welded, or screwed, to provide a rigid enclosure. The doors shall swing on full-length stainless-steel piano hinges and shall be fully insulated. The right-hand door shall be equipped with a three-point latching device and the left-hand door shall have a full height astragal. The doors are self-closing and synchronized so that both doors will always fully close. The right-hand door is equipped with a three-point latching system that automatically engages when the doors close. Each door is equipped with a fusible-link hold-open feature that will ensure the door closes should the temperature outside the cabinet exceed 165 degrees Fahrenheit. Units 600mm long have only one door, self-closing, and equipped with a three-point latching system and hold-open feature. A 50mm deep liquid tight pan that covers the entire bottom of the cabinet shall be furnished to contain liquid leaks and spills. A full-depth adjustable shelf is also provided. The shelf is perforated to allow air circulation within the cabinet. Two diametrically opposed vents with spark screens are provided in the back of the cabinet as well as a grounding screw. The cabinet shall have interior finish same as exterior. The cabinet shall be labelled: "FLAMMABLE – KEEP FIRE AWAY".

5.6 Above Bench 2 stage reagent shelves

- Reagent shelves shall be complete modular design consisting of 2 stage horizontal storage shelves. The ends and intermediate vertical supports should be 1.2mm and horizontal shelves of 1.0mm thick CRCA / GI steel 60 to 80 microns high chemical resistant epoxy powder /80 to 100 microns Polyurethane powder coating supported on 2mm thick aluminium extrusion with MS brackets of 2mm thick. Each shelf should have a load bearing capacity of 50 kg of UDL for a length of 1000mm
- It should have provision for placing Solid Grade EBC (Electron Beam Cured) Laminate as per material specification /Glass shelves (as per requirement in BOQ).

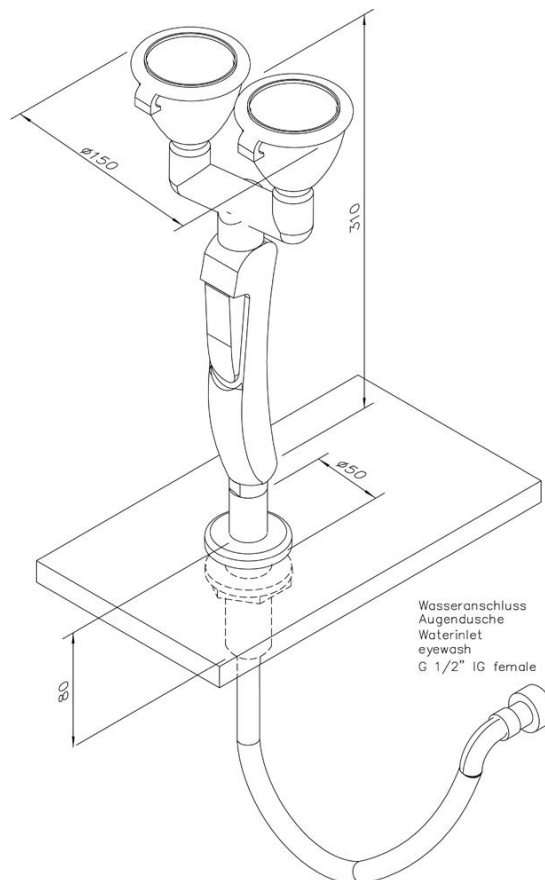
5.7 Water Tap:



3 Way Wall Mounted Fittings with Swivelling GOOSENECK Spout

Wall mounted Water Tap shall be made up of PP Handle & Brass with surface protected by Epoxy Powder Coating RAL 7035 having male connection thread G3/8" & G1/2". Waterflow capacity of around 30 l/mn at 3 bar pressure & working temperature range of 70°C with test pressure 9 bars & max working pressure of 10 bar.

5.8 Twin cup eye wash:

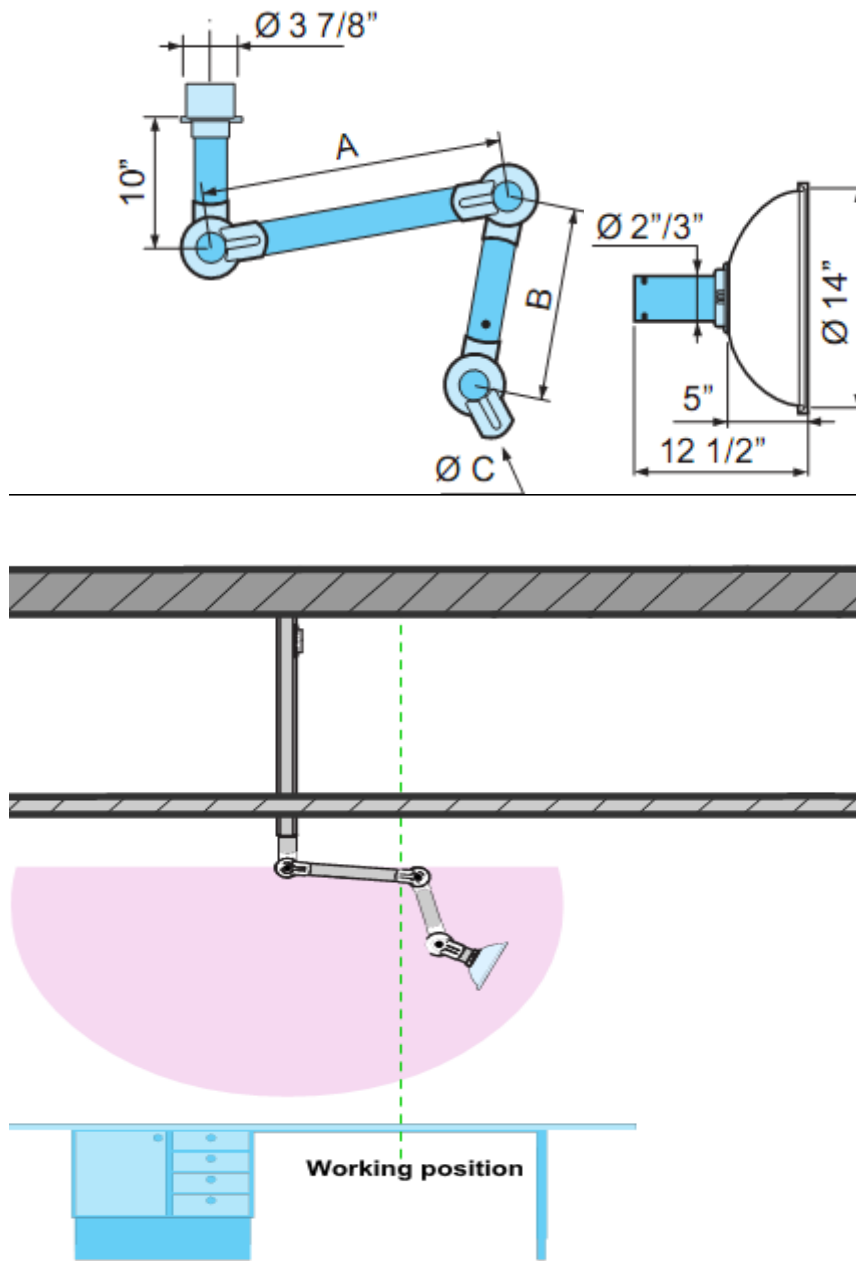


Twin cup eye wash shall comprise of the following:

- all water-bearing parts made of brass

- handle with integrated, adjusting activation made of plastics, valve not self-closing
- high-performance spray heads made of brass, for large-scale dispersion of water, chemical resistant powder coated, largely scale-free, with rubber sleeves and sealed dust caps
- integrated flow regulation 14 litre / minute
- integrated backflow preventer
- stainless steel covered hose, length 1.5-meter, water inlet 12.5mm dia. female, DIN-DVGW tested and certificated
- table mounting accessories M28x1,5x80mm made of brass, incl. fastening-parts kit with nut M28x1,5mm and 2 screws M5 for mounting difficult to access, chrome-plated rosette, sealing to table surface with O-Ring
- sign for eye shower according to DIN 4844-2-D and BGV A8, self-adhesive PVC-film, 100 x 100 mm
- Twin cup eye wash shall conform to the following codes; DIN 1988 und DIN EN 1717, DIN EN 15154-2:2006 and ANSI Z358.1-2004 Manufacturer: Broen or Water saver or Brown all

5.8 Spot Extractor:



Spot extractor shall be made of Poly Propylene with joints and tube in recyclable PP. All vertical drops from slab shall be made up of corrosion resistance SS 316. Extraction arm shall be $\text{Ø } 75$, Lengths A=750 & B=450 with 360° rotation. SS pipe length upto 1500mm, which shall be mounted from ceiling with ms brackets with chemical resistance epoxy powder coating. Arms are provided with dampers, tight down to under pressure of 3500pa & air temperature of -10° to 70°C .

5.9 Worktop

" 16 mm Solid Grade laminate made of Composite wooden fibers with "Electron Beam Cured" surface which is free of melamine resins" and resistance to Bacteria and various chemical/Biological spillage as well as fumes. SEFA 3.0 Certified from authorized SEFA approved agency with 10 years

written Product Guarantee for all properties mentioned in material property data sheet. 10 years of proven testimonials in Global and Indian reputed Government & Private Research Laboratories. The bottom of the worktop should have a V-groove throughout the length of the exposed edges to protect the cabinets from coming in contact with the spillages. The overhang on the storage cabinet is 25 mm at the front side and 30 mm at the sides

5.10 Sinks:

Should be made up of injection moulded from pure polyolefins/ co-polymer material with inside corners coved, rectangular without border, having good resistance to organic solvents. Overall size (L x W x D) vary as per the BOQ.

5.11 Pegboard:

Single faced stainless-steel pegboard having a tray hole for water drainage and detachable pegs. The essence is made up of 1 mm thick stainless steel (SS 304) whereas the pegs are made up of polypropylene and are adjustable with a minimum 10mm distance between each peg (L x W x H is 750 x 750).

5.12 Bench Mounted/Suspended Laboratory Fittings

The laboratory fitting manufacturer shall be certified to **ISO 9001 / EN 29001 / BS 5750 Part 1**, or equivalent.

The manufacturer should guarantee the availability of spare parts and replacement products for a period of minimum 10 years.

All external surfaces of the fittings shall be surface treated with a chemical resistant **polyester powder coating** that shall be highly resistant to most chemicals and provides excellent light fastness. Minimum thickness of coating shall be **50µm**.

The fittings should be delivered with an "easy-to-mount" inlet connection, where it is possible to connect hoses, Cu-, SS-, or PEX pipes directly into the inlet of the valve, depending on the applications.

The fittings should be delivered with **color and media indication in accordance with EN 13792:2002**.

Every fitting should be **leak-tested** before leaving the factory. Certificate of leak testing of each fitting to be provided.

Laboratory fittings must be supplied with an **integrated service ball** valve to provide the features Pre-setting of media flow, Local shut-off for maintenance purpose & Safety lock

5.13 Laboratory Fittings for Water

The fittings must be supplied with a 2x360° open/close function rubber headwork for fine regulation. The sealing must be made of EPDM and the lubrication must be silicone-based. The

fittings should be capable of operating at **maximum operating pressure of 10 bar (145 psi)**.

The water fittings should be delivered with a flange and anti-rotational safety pins in order to keep the fitting fully locked in its position and to prevent unintentional turning that would result in leaks.

The handles of the valve must be mounted with "**zero gap**" on the spindle of the headwork. The handle should be made of polypropylene and the handle must have a clear closing/opening indication.

The fittings must be equipped with a hose nozzle according to DIN 12898. Depending on user requirement and preferences, the hose nozzle be made of polypropylene or powder coated brass and can be either fixed or removable type.

5.14 Laboratory Fittings for Non-burning 2.0 Gases

The fittings must be supplied with a fine regulating needle headwork having 3x360 degrees open/close operation for fine regulation of media flow. The sealing must be made of FKM/FPM and the lubrication must be Perfluoropolyether based. The fittings should be capable of operating at **maximum operating pressure of 16 bar (232 psi)**.

The 2.0 non-burning fittings should be delivered with a flange and anti-rotational safety pins in order to keep the fitting fully locked in its position and to prevent unintentional turning that would result in leaks.

The handles of the valve must be mounted with "**zero gap**" on the spindle of the headwork. The handle should be made of polypropylene and the handle must have a clear closing/opening indication.

The fittings must be equipped with a hose nozzle according to DIN 12898. Depending on user requirement and preferences, the hose nozzle be made of polypropylene or powder coated brass and can be either fixed or removable type.

5.15 Laboratory Fittings for Vacuum

The fittings must be supplied with a high-flow headwork having 1.5x360 degrees open/close operation for high-flow regulation of media flow. The sealing must be made of FKM/FPM and the lubrication must be Perfluoropolyether based. The valves should be capable of handling an **operating pressure of -1 to 16 bar (-14.5 to 232 psi)**.

The vacuum fittings should be delivered with a flange and anti-rotational safety pins in order to keep the fitting fully locked in its position and to prevent unintentional turning that would result in leaks.

The handles of the valve must be mounted with "**zero gap**" on the spindle of the headwork. The

handle should be made of polypropylene and the handle must have a clear closing/opening indication. The fittings must be equipped with a hose nozzle according to DIN 12898. Depending on user requirement and preferences, the hose nozzle be made of polypropylene or powder coated brass and can be either fixed or removable type.

5.16 Laboratory Fittings for Burning Gases

Fittings must be delivered with a ceramic press/turn safety headwork with 90° open/close function, which prevents from unintentional opening of the valve. The sealing of the fittings for burning gases must be made of Nitrile and the lubrication must be mineral oil based. **Fittings for burning gases should be capable of operating at maximum working pressure of 7 bar (100 psi).**

The burning gas fittings should be delivered with a flange and anti-rotational safety pins in order to keep the fitting fully locked in its position and to prevent unintentional turning that would result in leaks.

Fittings for burning gases must be delivered with a metal handle with “POP-UP “indication buttons that make it possible visually to observe if the valve is open. Handles must be painted with the same quality polyester powder coating as the valve bodies.

Outlet must be equipped with a fixed metal serrated hose nozzle according to DIN 12898.

5.17 Laboratory Stool

PU lab swivel chair without handle with castor, adjustable ht 420-540MM

The seat is made injection moulded polyurethane foam (Density = 45+/-2 kg/m³ and are upholstered with replaceable synthetic leather covers. The manual height adjustment should be very easy to operate with help of a knob. It can be easily locked at the most comfortable position. It should have twin wheel castors, injection moulded in black nylon.



5.18 ELECTRICAL RACEWAYS SWITCHES, SOCKETS AND ACCESSORIES:

Under Floor Raceways

- a. The under-floor duct for “in screed” system shall be of “UPVC” in combination of single, double or triple runs in compliance with the relevant sections of standard EN 50085 & DIN VDE 0634. The under floor UPVC ducts shall be of trapezoidal shape in one form for better load withstanding capacity. The UPVC under floor ducts shall have to be provided with required rigidity with a standard loading capacity of 750N according to VDE 0634 (before screed laying) and shall prevent the seepage of concrete and screed water. The single UPVC ducts shall have dimension of 90 x 35 mm / 60 x 25mm and standard length of the duct shall be of 3 mtrs. Single, double or triple runs of ducts need to be used to accommodate different types of cables - Power, Data & Telecommunication. Coupler shall be used to connect the standard lengths of the ducts in screed covered system. Single or multiple runs of UPVC ducts need to be secured to the structural slab by means of fastening clamps.
- b. The UPVC under floor ducts shall be made up of Lead free, LSOH grade Poly vinyl chloride material as per EN 50085-2-1 and shall be ROHS compliant. The UPVC ducts shall have smooth surface finish without sharp edges and Burrs. The UPVC ducting shall have IP 40 Protection against access to hazardous parts and shall be non-flame propagating.
- c. Under floor Junction and Service Outlet Boxes suitable for Carpet / Ceramic tiles Application.
- d. Under floor Junction and service outlet boxes shall be robust in its construction with a base plate and side walls manufactured from 1.5 mm thick (+ or - 0.1 mm tolerance) galvanized sheet steel. The base box bodies shall be made from galvanized sheet steel with a zinc coating in accordance with EN 10327 DX51D + Z275-N-A-C.
- e. Height of the under-floor junction and service outlet boxes shall be 38 mm as minimum. The floor service and Junction outlets shall be self-leveling suitable for variable screed depth from 38-65mm.
- f. The Trap and frame of Junction and service outlets shall be manufactured from hard wearing, Halogen free material polyamide with matt surface. The frame shall be fitted with the floor covering protection flange of 10 mm all around for protection of the cut edges of the floor finishing material – carpet or ceramic tiles. Polyamide trap shall have a 4mm thick galvanized sheet steel completely encased within Polyamide for ensuring maximum rigidity and providing adequate load bearing capacity. The junction and service outlet boxes shall be able to withstand a load of 1.5KN per sq inch as per DIN VDE 0634 and also conforming to EN 50085.
- g. Junction and service outlet base boxes should have knock outs for either single or multiple duct entry of size 90mm width and 35mm height, 60mm width and 25mm height respectively in all the four sides for quick and easy installation.
- h. Junction and service outlet boxes shall be substantially dimensioned to eliminate congestion and provide ample working space within. Junction boxes shall be supplied with cross over bridges for segregation of power, data and telecommunication cables. The trap of Junction and service outlets shall be with a standard 5 mm recess however adjustable to 3, 8 or 10 mm to accommodate various carpet and or ceramic tile floor coverings.

- i. Service outlet trap and frames need to be hinged and shall be easily removable for installation / wiring of sockets and reversible to facilitate connection to floor box from either side. Color of carpet protection frame shall be Grey or Graphite black to match with the final floor finish unless otherwise specified.
- j. The service outlet trap and frames shall be fitted with Polyamide cord cap with locking mechanism to facilitate wire (Power / Data and Voice) exit from floor into the equipment. The service outlets need to be supplied with cable retainers to guide the wires smooth from the cord outlets.
- k. The service outlets need to be fitted with ladder assembly to facilitate the raising or lowering of the accessory plates in steps of 5 mm to a total of 20 mm irrespective of the height of the floor box. Mounting supports need to be supplied suitable for the ladder mechanism for mounting of accessory plates complete with dividers for segregation of Power, Voice and Data services. The Polyamide trap and frames for Junctions and Service outlets need to be embossed product logo and need to be with VDE and CE marked for the necessary compliance.

5.19 Installation:

Under floor trunking system shall be installed strictly as per manufacturer's instructions and to a level of workmanship to ensure that all the under-floor boxes are consistently in level with the screed in line with the final finish floor level. Contractor has to ensure that any part of the boxes is not detected below and or above the final finish floor level. Failure to comply in this respect, the affected boxes shall be re-installed by the contractor, as required by the engineer.

Cross-over bridges shall be installed at the junctions as required, to ensure that adequate separation of power, data and telecommunication cables are maintained. Equipotential earth bonding shall be carried out as per manufacturer's recommendations.

5.20 General Requirements power sockets:

All sockets, 5A/6A & 6A/16A ratings, shall be of modular type, flush mounting type with control switches of piano- key type design of the same rating as that of the sockets. All sockets outlet shall be of 3 pin / 5 pin type. The socket shall be of high-quality polycarbonate with pins made of brass alloy and plated with a noble metal. Sockets shall be provided with PVC surface outlet plates with round corners and bevelled edges. All the sockets shall be provided with plug tops of approved quality and design.

5.21 Industrial type sockets:

Industrial type sockets shall be provided wherever specifically called for. Industrial sockets shall be totally metal clad with porcelain base incorporating the pins. Sockets shall have 3 pins for single phase applications and 4 pins and scraping earth of 3 phase applications. The sockets shall be provided with suitable metal clad plug top with suitable cable entry. Sockets shall have metal covers with chain. It shall have a suitable interlocked switch. Industrial type

sockets shall be provided with a suitable sheet steel housing made of 16 gauge with the socket mounted in flush with cover of the housing.

5.22 Installation of switches, sockets & accessories:

All the switches shall be wired on phases. Connections shall be made only after testing the wires for continuity, cross phase etc., with the help of a megger. Switches, sockets fan regulators etc., shall be housed in proper GI factory boxes. The arrangement of switches and sockets shall be neat and systematic. Covers for enclosure shall be moulded accommodating switches, sockets etc., Outlets shall be terminated into a ceiling rose for fan points. For wall plug sockets, the conductor may be terminated directly into the switches and sockets. The outlets point control boxes etc. shall be set out as shown on the drawings. Before fixing these, the contractor shall obtain clearance from the Architect / consultant / project manager with regard to their proper locations. The enclosure of sockets and 3rd pin of the sockets shall be connected to the ground through a proper size earth continuity wires.

PART 1: PERFORMANCE REQUIREMENTS

1.0 Steel Casework Construction Performance (SEFA 8 & 8M)

- a. Each adjustable and fixed shelf upto 1200 mm length shall support an evenly distributed load of per 25 kg per square ft. up to a maximum of 80 kg per sq ft, with nominal temporary deflection, but without permanent bend.
- b. Drawer construction and performance shall allow 340mm clear when in an extended position and suspension system shall prevent friction contact with any other drawer or door during opening or closing. All drawers shall operate smoothly, a minimum of 10,000 cycles with an evenly distributed load of 70 kg.
- c. Swinging doors on floor mounted casework shall support 90 kg. Suspended at a point 300mm from hinged side, with door swung through an arc of 160 degrees. Weight load test shall allow only a temporary deflection, without permanent distortion or twist. Door shall operate freely after test and assume a flat plane in a closed position.

2.0 Steel Paint System Finish (SEFA 8 & 8M)

a. Steel Paint System Finish:

After Cold Rolled Steel component parts have been completely welded together and before finishing, they shall be given a pre-paint treatment to provide excellent adhesion of the finish system to the steel and to aid in the prevention of corrosion. Physical and chemical cleaning of the steel shall be accomplished by washing with an alkaline cleaner, followed by a spray treatment with a complex metallic phosphate solution to provide a uniform fine-grained crystalline phosphate surface that shall provide both an excellent bond for the finish and enhance the protection provided by the finish against humidity and corrosive chemicals.

After the phosphate treatment, the steel shall be dried and all steel surfaces shall be coated with a

chemical and corrosion-resistant, environmentally friendly, electrostatically applied powder coat finish. All components shall be individually painted, insuring that no area be vulnerable to corrosion due to lack of paint coverage. The coating shall then be cured by baking at elevated temperatures to provide maximum properties of corrosion and wear resistance.

Steel Paint System Finish: All steel coated surfaces to follow the following testing standards:

Sl. No	Characteristic	Specification	Method Used	Standards References
1	DFT (DRY FILM THICKNESS)	35 micron	ELCOMETER OR DFT METER	ASTM-D: 1186 (93), IS – 13871(1993), IS – 101
2	GLOSS AT 600	70 ±5 units	GLOSS METER	ASTM-D 523-89 Reapproved (1994)
				ISO – 2813
				DIN – 67530, IS – 13871(1993), IS – 101
3	SCRATCH HARDNESS	3 kgs	SCRATCH HARDNESS TESTER	BS – 3900 Part E2 1970
				IS – 101 (Part- /Sec-2) 1988, IS – 13871:1993
4	IMPACT RESISTANCE	275 Kg.cm	IMPACT TESTER	ASTM-D: 2794-93
				BS – 3900 Part E3 1979, IS – 101
				JISK – 5400 (1979), IS – 13871(1993)
5	CROSS CUT ADHESION	1x1 mm or GT=0		DIN – 53151
				ISO – 2409
				ASTM – 3002
				ASTM – 3359
				JISK – 5400 (1979), IS – 13871(1993)
6	FLEXIBILITY	3.25 mm	CYLINDRICAL MANDREL BENDING TESTERS	DIN – 53152, ISO – 1519
				ASTM – D: 522
				BS – 3900 PART E1, IS – 101 (Part-5/ Sec-2) 1988

Sl. No	Characteristic	Specification	Method Used	Standards References
7	ERICHSEN CUPPING	8 mm	ERICHSEN CUPPING TESTER	JISK – 5400 (1990)
				IS – 101 (Part 5/Sec 2) 1988, IS – 13871(1993)
8	SALT SPRAY	1000 hours	SALT SPRAY CHAMBER	IS – 101 (Part 6/Sec 1)1988

The completed finish system in standard colors shall meet the performance test requirements specified under PERFORMANCE TEST RESULTS.

1. Performance Test Results (Chemical Spot Tests):

a. Testing Procedure:

Chemical spot tests for non-volatile chemicals shall be made by applying 5 drops of each reagent to the surface to be tested and covering with a 1-1/4" dia. watch glass, convex side down to confine the reagent. Spot tests of volatile chemicals shall be tested by placing a cotton ball saturated with reagent on the surface to be tested and covering with an inverted 2-ounce wide mouth bottle to retard evaporation. All spot tests shall be conducted in such a manner that the test surface is kept wet throughout the entire test period, and at a temperature of 77° ±3° F. For both methods, leave the reagents on the panel for a period of one hour. At the end of the test period, the reagents shall be flushed from the surface with water, and the surface scrubbed with a soft bristle brush under running water, rinsed and dried. Volatile solvent test areas shall be cleaned with a cotton swab soaked in the solvent used on the test area. Immediately prior to evaluation, 16 to 24 hours after the reagents are removed, the test surface shall be scrubbed with a damp paper towel and dried with paper towels.

b. Test Evaluation:

Evaluation shall be based on the following rating system.

Level 0 – No detectable change.

Level 1 – Slight change in color or gloss.

Level 2 – Slight surface etching or severe staining.

Level 3 – Pitting, cratering, swelling, or erosion of coating. Obvious and significant deterioration.

After testing, panel shall show no more than three (3) Level 3 conditions.

c. Test Reagents

Test No.	Chemical Reagent	Test Method
1.	Acetate, Amyl	Cotton ball & bottle

2.	Acetate, Ethyl	Cotton ball & bottle
3.	Acetic Acid, 98%	Watch glass
4.	Acetone	Cotton ball & bottle
5.	Acid Dichromate, 5%	Watch glass
6.	Alcohol, Butyl	Cotton ball & bottle
7.	Alcohol, Ethyl	Cotton ball & bottle
8.	Alcohol, Methyl	Cotton ball & bottle
9.	Ammonium Hydroxide, 28%	Watch glass
10.	Benzene	Cotton ball & bottle
11.	Carbon Tetrachloride	Cotton ball & bottle
12.	Chloroform	Cotton ball & bottle
13.	Chromic Acid, 60%	Watch glass
14.	Cresol	Cotton ball & bottle
15.	Dichlor Acetic Acid	Cotton ball & bottle
16.	Dimethylformanide	Cotton ball & bottle
17.	Dioxane	Cotton ball & bottle
18.	Ethyl Ether	Cotton ball & bottle
19.	Formaldehyde, 37%	Cotton ball & bottle
20.	Formic Acid, 90%	Watch glass
21.	Furfural	Cotton ball & bottle
22.	Gasoline	Cotton ball & bottle
23.	Hydrochloric Acid, 37%	Watch glass
24.	Hydrofluoric Acid, 48%	Watch glass
25.	Hydrogen Peroxide, 3%	Watch glass
26.	Iodine, Tincture of	Watch glass
27.	Methyl Ethyl Ketone	Cotton ball & bottle
28.	Methylene Chloride	Cotton ball & bottle
29.	Mono Chlorobenzene	Cotton ball & bottle
30.	Naphthalene	Cotton ball & bottle
31.	Nitric Acid, 20%	Watch glass
32.	Nitric Acid, 30%	Watch glass
33.	Nitric Acid, 70%	Watch glass
34.	Phenol, 90%	Cotton ball & bottle
35.	Phosphoric Acid, 85%	Watch glass
36.	Silver Nitrate, Saturated	Watch glass
37.	Sodium Hydroxide, 10%	Watch glass
38.	Sodium Hydroxide, 20%	Watch glass
39.	Sodium Hydroxide, 40%	Watch glass
40.	Sodium Hydroxide, Flake	Watch glass
41.	Sodium Sulfide, Saturated	Watch glass
42.	Sulfuric Acid, 33%	Watch glass
43.	Sulfuric Acid, 77%	Watch glass

44.	Sulfuric Acid, 96%	Watch glass
45.	Sulfuric Acid, 77% and Nitric Acid, 70%, equal parts	Watch glass
46.	Toluene	Cotton ball & bottle
47.	Trichloroethylene	Cotton ball & bottle
48.	Xylene	Cotton ball & bottle
49.	Zinc Chloride, Saturated	Watch glass

* Where concentrations are indicated, percentages are by weight.

2. Performance Test Results (Heat Resistance):

Hot water (190° F - 205° F) shall be allowed to trickle (with a steady stream at a rate not less than 6 ounces per minute) on the finished surface, which shall be set at an angle of 45° from horizontal, for a period of five minutes. After cooling and wiping dry, the finish shall show no visible effect from the hot water treatment.

3. Performance Test Results (Impact Resistance):

A one-pound ball (approximately 2" diameter) shall be dropped from a distance of 12 inches onto the finished surface of steel panel supported underneath by a solid surface. There shall be no evidence of cracks or checks in the finish due to impact upon close eye-ball examination.

4. Performance Test Results (Bending Test):

An 18-gauge steel strip, finished as specified, when bent 180° over a 1/2" diameter mandrel, shall show no peeling or flaking off of the finish.

5. Performance Test Results (Adhesion):

Ninety or more squares of the test sample shall remain coated after the scratch adhesion test. Two sets of eleven parallel lines 1/16" apart shall be cut with a razor blade to intersect at right angle thus forming a grid of 100 squares. The cuts shall be made just deep enough to go through the coating, but not into the substrate. They shall then be brushed lightly with a soft brush. Examine under 100 foot-candles of illumination. Note: This test is based on ASTM D2197-68, "Standard Method of Test for Adhesion of Organic Coatings".

6. Performance Test Results (Hardness):

The test sample shall have a hardness of 4-H using the pencil hardness test. Pencils, regardless of their brand are valued in this way: 8-H is the hardest, and next in order of diminishing hardness are 7-H, 6-H, 5-H, 4-H, 3-H, 2-H, F, HB, B (soft), 2-B, 3-B, 4-B, 5-B (which is the softest).

The pencils shall be sharpened on emery paper to a wide sharp edge. Pencils of increasing hardness shall be pushed across the paint film in a chisel-like manner until one is found that will cut or scratch the film. The pencil used before that one-that is, the hardest pencil that will not rupture the film-is then used to express or designate the hardness.

FITTINGS

1. Laboratory Service Fittings:

Service fittings shall be laboratory grade, and water faucets and valve bodies shall be cast red

brass alloy or bronze forgings, with a minimum content of 85%.

2. Plastic Coated Finish (Sepia Bronze):

When specified, laboratory service fittings shall have an acid resistant plastic coating applied over a fine sand-blasted surface. Surfaces shall be sprayed and baked three times with a minimum thickness of .0005 to .0010 mils.

3. Service Indexes:

Fittings shall be identified with service indexes with color coding:

4. PERFORMANCE:

Maximum Line Pressures:

Laboratory Ball Valves (Gas and Air) 75 PSI

Needle Point Cocks (Gas and Air) 65 PSI

Vacuum 28.5" Mercury

Hot and Cold Water 80 PSI

Steam 30 PSI

PART 2 — EXECUTION

1.0 SITE EXAMINATION

Agency shall visit site before bidding for the tender and get himself acquainted with site conditions, type of buildings, lifts and leads and scope of work and no claim shall be entertained on this ground at later date. The work shall be executed as per direction of Engineer in charge.

2.0 INSTALLATION

2.1 Preparation:

Prior to beginning installation of casework, check and verify that no irregularities exist that would affect quality of execution of work specified.

2.2 Coordination:

Coordinate the work of the Section with the schedule and other requirements of other work being prepared in the area at the same time both with regard to mechanical and electrical connections to and in the caseworks and the general construction work.

2.3 Performance:

2.3.1 Casework:

- a. Set casework components plumb, square, and straight with no distortion and securely anchor to building structure. Shim as required using concealed shims.
- b. Bolt continuous cabinets together with joints flush, tight and uniform, and with alignment of adjacent units within 1.5mm tolerance.
- c. Secure wall cabinets to solid supporting material, not to plaster, lath or gypsum board.

- d.** Abut top edge surfaces in one true plane. Provide flush joints not to exceed 3mm.

2.4 Worksurfaces:

- a.** Where required due to field conditions, scribe to abutting surfaces.
- b.** Only factory prepared field joints, located per approved shop drawings, shall be permitted.
- c.** Secure the joints in the field, where practical, in the same manner as in the factory.
- d.** Secure work surfaces to casework and equipment components with materials and procedures recommended by the manufacturer.

2.5 Adjust and Clean:

- a.** Repair or remove and replace defective work, as directed by IISC representative upon completion of installation.
- b.** Adjust doors, drawers and other moving or operating parts to function smoothly.
- c.** Clean shop finished casework; touch up as required.
- d.** Clean work surfaces and leave them free of all grease and streaks.
- e.** Casework to be left broom clean and orderly.

2.6 Protection:

- a.** Provide reasonable protective measures to prevent casework and equipment from being exposed to other construction activity.
- b.** Advise IISC representative of procedures and precautions for protection of material, installed laboratory casework and fixtures from damage by work of other trades.

SUB HEAD-2:
FUMEHOOD & ACCESSORIES

1.0 GENERAL SPECIFICATIONS

1.1 General Description of Work:

Furnishing and installing Fume hood, Base Units with Vent connection to the hood, Ceiling Cover Panels, Filler Panels and scribes as shown on drawings.

1.2 Accessories:

Furnishing and delivering all service outlets, accessory fittings, electrical receptacles and switches, as listed in these specifications, equipment schedules or as shown on drawings. Fittings attached to the fume hood superstructure shall be mounted on the front fascia of the hood as per the drawings. Furnishing and delivering all service outlets, accessory fittings, electrical receptacles and switches, as listed in these specifications, equipment schedules or as shown on drawings. Plumbing fixtures mounted on the fume hood superstructures shall be pre-plumbed up to 150mm above the Fume hood with SS-304 TUBING / Hoses. Electrical fixtures shall be prewired up to the Junction box provided on top of every Fume hood. Final plumbing and electrical connections are the responsibility of Plumbing & Electrical contractor.

Removal of all debris, dirt and rubbish accumulated as a result of the installation of the fume hoods to an on-site container provided by others, leaving the premises clean and orderly.

1.3 Related Publications:

1. ASHRAE Standard 110.1995 - Method of Testing Performance of Laboratory Fume Hoods
2. NSF STD#49 – Photometric Method of Testing
3. NIH03-112C - National Institute of Health Specification
4. UL – Underwriters Laboratories
5. ASTM D552 – Bending Test
6. NFPA-45 – National Fire Protection Association

PART I- MATERIAL OF CONSTRUCTION

A. Fume Hood Superstructure Frame:

A free-standing rigid frame structure of steel angle shall be provided to support exterior panels and interior liner and baffle panels. To allow for maintenance and replacements, the interior liner panels shall be removable without disassembly of the frame structure and outer steel panels. Likewise, the exterior steel panels shall be removable without disassembly of the frame structure and inner liner panels. Fume hoods that require disassembly of the superstructure for liner replacement are not acceptable.

B. Fume Hood Interior Walls:

Double wall ends, not more than 100mm wide, shall be provided to maximize interior working area. The area between the double wall ends shall be closed to house the remote-control valves. The front vertical fascia section shall have a full 135-degree 25mm radius at the front leading edge to provide a streamlined section and insure smooth even flow of air into the hood. The vertical facias shall contain the required service controls, electrical switches and

receptacles. The hood interior end panels and sash track shall be flush with the facia to prevent eddy currents and back flow of air.

C. Fume Hood Airfoil:

A streamlined airfoil shall be integral at the bottom of the hood opening on bench and distillation hoods. This foil shall provide a nominal 25mm open space between the foil and the top front edge of the work surface to direct an air stream across the work surface to prevent back flow of air. The airfoil shall extend back under the sash, so that the sash does not close the 25mm opening. The foil shall be removable to allow large equipment into the hood. The foil shall be of 12-gauge 2.6mm thk steel to resist denting and flexing. Walk-in hoods shall have a stop located at the bottom of the sash track that will ensure a nominal 25mm opening between the bottom of the sash and the floor.

D. Fume Hood Liners: TRESPA TOPLAB^{VERTICAL} or Equivalent

“6 mm Solid Grade laminate made of Composite wooden fibers with “Electron Beam Cured” surface which is free of melamine resins” and resistance to Bacteria and various chemical/Biological spillage as well as fumes. SEFA 8.0 Certified from authorized SEFA approved agency with 10 years written Product Guarantee for all properties mentioned in material property data sheet. 10 years of proven testimonials in Global and Indian reputed Government & Private Research Laboratories. Fire Rating certified by 3rd party for Fume hood application with minimum 60 minutes of Fire rating.

E. Fume Hood Baffles:

A stable, non-adjustable baffle with three fixed horizontal slots shall be provided to aid in distributing the flow of air into and through the hood. The baffle shall be spaced out 60mm from the back liner. The baffle shall be removable for cleaning

F. Fume Hood Duct Collar:

A 250mm to 300mm diameter polyethylene bell-mouthed duct collar shall be located in the top of the hood plenum chamber. PP coated steel duct collars can be accepted as an alternative. Epoxy Coated common steel duct collars are not acceptable.

G. Fume Hood Lighting:

A one-tube, energy-efficient, LED light fixture of the size given below shall be provided in the hood roof. Illumination at work surface shall be at least 500 Lux.

Hood Size, MM.	Nominal Fixture Length, MM.
1200	900
1500	1200
1800	1200
2100 /2400	900 (2 Fixtures)

The light fixtures shall be isolated from the hood interior by a 6mm thick tempered glass panel sealed from the hood cavity. Fixture shall be UL labelled.

H. Fume Hood Sash:

Combination Sash:

A combination sash shall be provided. The sash shall have horizontal sliding glass panels in a vertical rising steel frame. The bottom of the sash frame shall have a full-length metal handle.

The sash track shall be a neutral coloured polyvinyl chloride set flush with the interior liner panels to minimize turbulence. The sash shall be counterbalanced with a single weight to prevent tilting and binding during operation. The glass panels shall be 6mm laminated safety float glass mounted on metal rollers in an aluminium track.

I. Fume Hood Plumbing Services:

All Utility services shall consist of remote-control valves as selected located within the end panels, controlled by extension rods projecting through the control panels of the hood, with color coded plastic handles. All plumbing fittings shall be installed and piped upto 150mm above the Fume hood top. All the Plumbing shall be SS-304 / Hoses.

Fume hood Valves/Outlet manufacturer shall be certified to **ISO 9001 / EN 29001 / BS 5750 Part 1**, or equivalent.

The manufacturer should guarantee the availability of spare parts and replacement products for a period of minimum 10 years.

All external surfaces of the valve shall be surface treated with a chemical resistant **polyester powder coating** that shall be highly resistant to most chemicals and provides excellent light fastness. Minimum thickness of coating shall be **50µm**.

The handles of the vales must be mounted with **"zero gap"** on the spindle of the headwork. The handle should be made of polypropylene and the handle must have a clear closing/opening indication.

The valve and outlets should be delivered with an "easy-to-mount" inlet connection, where ever possible to connect hoses, Cu-, SS-, or PEX pipes directly into the inlet of the valve, depending on the applications.

Both valve and outlets should be delivered with **color and media indication in accordance with EN 13792:2002**.

Every fitting should be **leak-tested** before leaving the factory.

Fume Hood Valves for water

The valves must be supplied with a 2x360° open/close function rubber headwork for fine regulation. The sealing must be made of EPDM and the lubrication must be silicone-based. The valves should be capable of operating at **maximum operating pressure of 10 bar (145 psi)**.

Fume hood Outlets for water

The sealing of the water outlets must be made of EPDM and the lubrication must be silicone-based. The water outlets should be delivered with rear wall connection (RWC) for compact installation. **It should be possible for the outlet to be removed from outside without demounting the Fume hood panel.**

The outlets must be equipped with a hose nozzle according to DIN 12898. Depending on user requirement and preferences, the hose nozzle be made of polypropylene or powder coated brass and can be either fixed or removable type.

Fume hood valves for Cooling Water

The valves must be supplied with a 2x360° open/close function rubber headwork for fine regulation. The sealing must be made of EPDM and the lubrication must be silicone-based. The valves should be capable of operating at **maximum operating pressure of 10 bar (145 psi)**.

Configuration similar to BROEN-LAB art. Code 25997101005-40/25997101006-40: The outlets must be supplied with 1LPM flow fix for flow restriction.

Fume hood Outlets for Cooling Water

The sealing of the chilled water outlets must be made of EPDM and the lubrication must be silicone-based. The water outlets should be delivered with rear wall connection (RWC) for compact installation. **It should be possible for the outlet to be removed from outside without demounting the Fume hood panel.**

Non-burning 2.0 Gases

The valves must be supplied with a fine regulating needle headwork having 3x360 degrees open/close operation for fine regulation of media flow. The sealing must be made of FKM/FPM and the lubrication must be Perfluoropolyether based. The valves should be capable of operating at **maximum operating pressure of 16 bar (232 psi)**.

Non-Burning 2.0 Gases/Vacuum Outlets

The sealing of the outlets for non-burning 2.0 gases / vacuum must be made of FKM/FPM and the lubrication must be Perfluoropolyether based. The non-burning 2.0 gas / vacuum outlets should be delivered with rear wall connection (RWC) for compact installation. **It should be possible for the outlet to be removed from outside without demounting the Fume hood panel.**

The outlets must be equipped with a hose nozzle according to DIN 12898. Depending on user requirement and preferences, the hose nozzle be made of polypropylene or powder coated brass and can be either fixed or removable type.

J. Fume Hood Electrical Services

The hood superstructure shall be pre-wired and contain a UL label certifying acceptable wire gauge, connections, fixtures and wire colour coding. Wiring electrical services shall consist of 4 X 4 6/16 Amps Socket & Switch and a light switch. All Wiring shall terminate in one 150mm x 150mm x 100mm service junction box located on the fume hood roof. Final wiring and circuit dedication shall be by others. The control panel should be located in the front face panel of the fume hood for easy accessibility for maintenance.

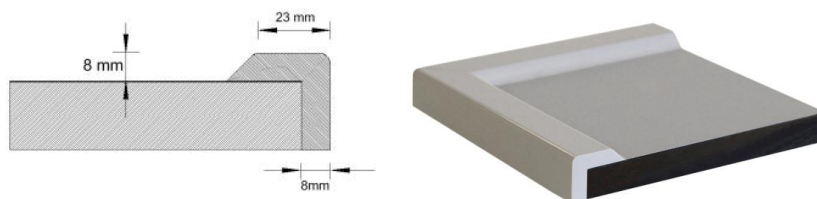
Electric Hatch – There shall be two hatches, one in each vertical front side of the fume hood near worktop level which will allow passage of the electric wires of the equipment being used in the chamber to be guided through and connected to the electric power points



K. Fume Hood work Top:

20 mm Solid Grade laminate made of Composite wooden fibers with Electron Beam Cured surface which is free of melamine resins and resistance to Bacteria and various chemical/Biological spillage as well as fumes. SEFA 3.0 Certified from authorized SEFA approved agency with 10 years written Product Guarantee for all properties mentioned in material property data sheet. 10 years of proven testimonials in Global and Indian reputed Government & Private Research Laboratories.

Epoxy Marine edges for worktops are moulded in solid epoxy resin and are fully post cured to achieve maximum chemical resistance and mechanical strength. Marine edges when fitted to a countertop will provide a raised lip of $\frac{1}{8}$ inch height. Maximum length of any single piece is 10 feet. Water absorption - 24 hours at 23°C not more than 5 -10 mg (0.06-0.068%) ISO 62 (1980). Chemical Resistance chart (Based on BS EN 438-2:1991) 24-hour spot test should be compatible for higher end Chemistry Laboratory functions. Color compatibility with selected worktop color is preferred and internationally proven testimonials are required for the same.



L. Access Opening:

The interior end liner panels shall be furnished with an opening that provides access to the service piping and valves to facilitate installation and maintenance. The openings shall be covered with a removable panel with rounded corners. Panels that require tools to remove are not acceptable. The panel shall provide an overlapping seal on all edges.

M. Fume Hood Finish:

After the component parts have been completely welded together and before finishing, they shall be given a pre-paint treatment to provide excellent adhesion of the finish system to the steel and to aid in the prevention of corrosion. Physical and chemical cleaning of the steel shall be accomplished by washing with an alkaline cleaner, followed by a spray treatment with a complex metallic phosphate solution to provide a uniform fine-grained crystalline phosphate surface that shall provide both an excellent bond for the finish and enhance the protection provided by the finish against humidity and corrosive chemicals.

After the phosphate treatment, the steel shall be dried, and all steel surfaces shall be coated with a chemical and corrosion resistant, environmentally friendly, electrostatically applied powder coat finish. All components shall be individually painted, insuring that no area be vulnerable to corrosion due to lack of paint coverage. The coating shall then be cured by baking at elevated temperatures to provide maximum properties of corrosion and wear resistance. The completed finish system in standard colors shall meet the performance test requirements specified under PERFORMANCE REQUIREMENTS

N. Fume Hood Acid Storage Cabinets:

FM approved Acid storage fume hood cabinets shall utilize the same thickness of steel and construction features as other base cabinets except they shall be completely lined with a one-piece Polyethylene corrosion resistant liner. The liner shall be 6mm thick, molded into a seamless tub, including top, sides and bottom, with a 25mm lip at the bottom front to contain spills. Each door shall have a set of louvers at the top and bottom and have a 3mm sheet polyethylene liner. Where specified, each cabinet shall be vented into the fume hood with a 40mm vent pipe. It should provide a positive airflow directly into the fume hood exhaust system. Where specified or shown on drawings, epoxy coated wire shelf supported by integral brackets shall be built into the Polyethylene liner.

O. Solvent Storage Cabinets:

FM approved Solvent storage cabinets (90minutes Fire Rating) shall be UL labelled and specifically designed for the storage for the storage of flammable and combustible liquids. Construction shall be based upon the requirements listed by UL, UFC, OSHA, and NFPA No. 30 – 1993. The bottoms, top, sides and doors shall be fabricated of 1.2mm thk steel and shall be all double panel construction with a 40mm air space between panels. All joints shall be welded, or screwed, to provide a rigid enclosure. The doors shall swing on full-length stainless-steel piano hinges and shall be fully insulated. The right-hand door shall be equipped with a three-point latching device and the left-hand door shall have a full height astragal. The doors are self-closing and synchronized so that both doors will always fully close. The right-hand door is equipped with a three-point latching system that automatically engages when the doors close. Each door is equipped with a fusible-link hold-open feature that will ensure the door closes should the temperature outside the cabinet exceed 165 degrees Fahrenheit. Units 600mm long have only one door, self-closing, and equipped with a three-point latching system and hold-open feature. A 50mm deep liquid tight pan that covers the entire bottom of the cabinet shall be furnished to contain liquid leaks and spills. A full-depth adjustable shelf is also provided. The shelf is perforated to allow air circulation within the cabinet. Two diametrically opposed vents with spark screens are provided in the back of the cabinet as well as a grounding screw. The cabinet shall have interior finish same as exterior. The cabinet shall be labeled: **“FLAMMABLE – KEEP FIRE AWAY”**.

P. Fire Suppression Inside Fume Hood:

Fire Suppression System Detection Tubing that is fitted behind the baffles and across the exhaust duct openings. These areas, by the design of the fume hood, are exactly where the heat and flames are drawn. Placing detection in each likely path of the heat and flame results

in a quick detection and suppression of the fire (many times faster than traditional detection), minimizing fire damage to the hood and lab.

The best suppression agent for the application, typically CO₂ or ABC dry chemical powder, is administered directly onto the fire, assuring quick and effective suppression.

Fire suppression systems operate automatically. The system should suppress a fire even if the sash is open and requires no electricity to activate.

PART 2: PERFORMANCE REQUIREMENTS

A. Testing Procedure:

Chemical spot tests for non-volatile chemicals shall be made by applying 5 drops of each reagent to the surface to be tested and covering with a 30mm dia. watch glass, convex side down to confine the reagent. Spot tests of volatile chemicals shall be tested by placing a cotton ball saturated with reagent on the surface to be tested and covering with an inverted 60ml wide mouth bottle to retard evaporation. All spot tests shall be conducted in such a manner that the test surface is kept wet throughout the entire test period, and at a temperature of 77° ±3° F. For both methods, leave the reagents on the panel for a period of one hour. At the end of the test period, the reagents shall be flushed from the surface with water, and the surface scrubbed with a soft bristle brush under running water, rinsed and dried. Volatile solvent test areas shall be cleaned with a cotton swab soaked in the solvent used on the test area. Immediately prior to evaluation, 16 to 24 hours after the reagents are removed, the test surface shall be scrubbed with a damp paper towel and dried with paper towels.

B. Test Evaluation:

Evaluation shall be based on the following rating system.

- Level 0 – No detectable change.
- Level 1 – Slight change in color or gloss.
- Level 2 – Slight surface etching or severe staining.
- Level 3 – Pitting, catering, swelling, or erosion of coating. Obvious and significant deterioration.

After testing, panel shall show no more than three (3) Level 3 conditions.

C. Test Reagents

Test No.	Chemical Reagent	Test Method
1.	Acetate, Amyl	Cotton ball & bottle
2.	Acetate, Ethyl	Cotton ball & bottle
3.	Acetic Acid, 98%	Watch glass
4.	Acetone	Cotton ball & bottle
5.	Acid Dichromate, 5%	Watch glass
6.	Alcohol, Butyl	Cotton ball & bottle
7.	Alcohol, Ethyl	Cotton ball & bottle
8.	Alcohol, Methyl	Cotton ball & bottle
9.	Ammonium Hydroxide, 28%	Watch glass
10.	Benzene	Cotton ball & bottle
11.	Carbon Tetrachloride	Cotton ball & bottle
12.	Chloroform	Cotton ball & bottle

13.	Chromic Acid, 60%	Watch glass
14.	Cresol	Cotton ball & bottle
15.	Dichlor Acetic Acid	Cotton ball & bottle
16.	Dimethylformamide	Cotton ball & bottle
17.	Dioxane	Cotton ball & bottle
18.	Ethyl Ether	Cotton ball & bottle
19.	Formaldehyde, 37%	Cotton ball & bottle
20.	Formic Acid, 90%	Watch glass
21.	Furfural	Cotton ball & bottle
22.	Gasoline	Cotton ball & bottle
23.	Hydrochloric Acid, 37%	Watch glass
24.	Hydrofluoric Acid, 48%	Watch glass
25.	Hydrogen Peroxide, 3%	Watch glass
26.	Iodine, Tincture of	Watch glass
27.	Methyl Ethyl Ketone	Cotton ball & bottle
28.	Methylene Chloride	Cotton ball & bottle
29.	Mono Chlorobenzene	Cotton ball & bottle
30.	Naphthalene	Cotton ball & bottle
31.	Nitric Acid, 20%	Watch glass
32.	Nitric Acid, 30%	Watch glass
33.	Nitric Acid, 70%	Watch glass
34.	Phenol, 90%	Cotton ball & bottle
35.	Phosphoric Acid, 85%	Watch glass
36.	Silver Nitrate, Saturated	Watch glass
37.	Sodium Hydroxide, 10%	Watch glass
38.	Sodium Hydroxide, 20%	Watch glass
39.	Sodium Hydroxide, 40%	Watch glass
40.	Sodium Hydroxide, Flake	Watch glass
41.	Sodium Sulfide, Saturated	Watch glass
42.	Sulfuric Acid, 33%	Watch glass
43.	Sulfuric Acid, 77%	Watch glass
44.	Sulfuric Acid, 96%	Watch glass
45.	Sulfuric Acid, 77% and Nitric Acid, 70%, equal parts	Watch glass
46.	Toluene	Cotton ball & bottle
47.	Trichloroethylene	Cotton ball & bottle
48.	Xylene	Cotton ball & bottle
49.	Zinc Chloride, Saturated	Watch glass

* Where concentrations are indicated, percentages are by weight.

D. Performance Test Results (Heat Resistance):

Hot water (190° F - 205° F) shall be allowed to trickle (with a steady stream at a rate not less than 180 per minute) on the finished surface, which shall be set at an angle of 45° from horizontal, for a period of five minutes. After cooling and wiping dry, the finish shall show no visible effect from the hot water treatment.

E. Performance Test Results (Impact Resistance):

A one-pound ball (approximately 50mm diameter) shall be dropped from a distance of 300mm onto the finished surface of steel panel supported underneath by a solid surface. There shall be no evidence of cracks or checks in the finish due to impact upon close eye-ball examination.

F. Performance Test Results (Bending Test):

An 1.2mm thk steel strip, finished as specified, when bent 180° over a 12.5mm diameter mandrel, shall show no peeling or flaking off of the finish.

G. Performance Test Results (Adhesion):

Ninety or more squares of the test sample shall remain coated after the scratch adhesion test. Two sets of eleven parallel lines 1.5mm apart shall be cut with a razor blade to intersect at right angle thus forming a grid of 100 squares. The cuts shall be made just deep enough to go through the coating, but not into the substrate. They shall then be brushed lightly with a soft brush. Examine under 100 foot-candles of illumination. Note: This test is based on ASTM D2197 68, "Standard Method of Test for Adhesion of Organic Coatings".

H. Performance Test Results (Hardness):

The test sample shall have a hardness of 4 H using the pencil hardness test. Pencils, regardless of their brand are valued in this way: 8 H is the hardest, and next in order of diminishing hardness are 7 H, 6 H, 5 H, 4 H, 3 H, 2 H, F, HB, B (soft), 2 B, 3 B, 4 B, 5 B (which is the softest).

The pencils shall be sharpened on emery paper to a wide sharp edge. Pencils of increasing hardness shall be pushed across the paint film in a chisel like manner until one is found that will cut or scratch the film. The pencil used before that one that is, the hardest pencil that will not rupture the film is then used to express or designate the hardness.

I. Liner Tests – Chemical Spot Tests – 24 Hours:

1. Chemical spot test shall be made by applying 10 drops (approximately 1/2 cc) of each reagent to the surface to be tested. Each reagent (except those marked **) shall be covered with a 38mm diameter watch glass, convex side down to confine the reagent. Spot tests of volatile solvents marked ** shall be tested as follows: A 1" or larger ball of cotton shall be saturated with the solvent and placed on the surfaces to be tested. The cotton ball shall then be covered by an inverted 60ml, wide mouth bottle to retard evaporation. All spot tests shall be conducted in such a manner that the test surface is kept wet throughout the entire 24-hour test period and at a temperature of 77 degrees F. + 3 degrees F.
2. At the end of the test period, the reagents shall be flushed from the surfaces with water and the surface scrubbed with a soft bristle brush under running water, rinsed, and dried. Volatile solvent test areas shall be cleaned with a cotton swab soaked in the solvent used on the test area. Spots where dyes have dried shall be cleaned with a cotton swab soaked in alcohol to remove the surface dye. The test panel shall then be evaluated immediately after drying.

3. Ratings/Legend:

1 –Epoxy Resin	A = No effect or slight change in gloss
2 – Glass Reinforced Polyester	B = Slight change in gloss or color
3 – Stainless Steel 304	C = Slight etching or severe staining
4 – Stainless Steel 316	D = Swelling, pitting, or severe etching

5 – Reinforced Phenolic Resin

RESULTS:	1	2	3	4	5	
1. Acetic Acid 98%		A	B	B	B	A
2. Acetone **		A	D	A	A	A
3. Acid Dichromate		A	A	A	A	A
4. Ammonium Hydroxide ** 28%		A	A	B	B	A
5. Amyl Acetate **		A	A	A	A	A
6. Benzene **	A	A	A	A	A	
7. Butyl Alcohol **		A	A	A	A	A
8. Carbon Tetrachloride **		A	A	A	A	A
9. Chloroform **		A	D	A	A	A
10. Chromic Acid 60%	B	B	C	C	A	
11. Cresol		A	A	A	A	A
12. Dichloroacetic Acid	A	D	B	A	A	
13. Dimethylformamide	A	A	A	A	A	
14. Dioxane **	A	A	A	A	A	
15. Ethyl Acetate **		A	A	A	A	A
16. Ethyl Ether **		A	A	A	A	A
17. Ethyl Alcohol **		A	A	A	A	A
18. Formaldehyde		A	A	A	A	A
19. Formic Acid 90%		A	A	A	A	A
20. Furfural **		B	B	A	A	C
21. Gasoline **	A	A	A	A	A	
22. Hydrochloric Acid 37%		A	A	B	B	A
23. Hydrofluoric Acid 48%		B	D	D	D	A
24. Hydrogen Peroxide 30%		A	A	A	A	A
25. Methyl Ethyl Ketone **		A	A	A	A	A
26. Methyl Alcohol **		A	A	A	A	A
27. Methylene Chloride **		A	D	A	A	A
28. Monochlorobenzene **		A	A	A	A	A
29. Naphthalene **		A	A	A	A	A
30. Nitric Acid 20%		B	A	B	A	A
31. Nitric Acid 30%		B	A	B	A	A
32. Nitric Acid 70%		B	D	B	A	A
33. Phenol ** 85%		A	C	A	A	A
34. Phosphoric Acid 85%	A	A	B	A	A	
35. Silver Nitrate	B	C	A	A	C	
36. Sodium Hydroxide 40%		A	D	A	A	A
37. Sodium Hydroxide 20%		A	D	A	A	A
38. Sodium Hydroxide 10%	A	D	A	A	A	
39. Sodium Hydroxide Flake		A	B	A	A	A
40. Sodium Sulfide		A	B	A	A	A
41. Sulfuric Acid 77%	A	A	C	A	A	
42. Sulfuric Acid 96%	C	D	C	A	C	
43. Sulfuric Acid 33%	A	A	C	A	A	
44. Tincture of Iodine		A	C	B	B	A
45. Toluene **	A	A	A	A	A	

46. Trichlorethylene **	A	A	A	A	A	
47. Xylene **		A	A	A	A	A
48. Zinc Chloride	A	A	B	A	A	
49. Nitric 70%/Sulfuric Acid 77%*		B	B	B	A	A

* Equal parts of Nitric Acid 70% and Sulfuric Acid 77%.

** Indicates these solvents tested with cotton and jar method

PART 3 – EXECUTION

SITE EXAMINATION

Bidder is requested to examine the site and installation work shall be taken up as per site availability and as per installation schedule approved by the Engineer in charge.

INSTALLATION

A. Preparation:

Prior to beginning installation of fume hood, check and verify that no irregularities exist that would affect quality of execution of work specified.

B. Coordination:

Coordinate the work of the Section with the schedule and other requirements of other work being performed in the area at the same time both with regard to mechanical and electrical connections to and in the fume hoods and the general construction work.

C. Performance:

Install fume hoods, plumb, level, rigid, securely anchored to building and adjacent furniture in proper location, in accordance with manufacturer's instructions and the approved shop drawings. Provide filler panels between top of hood and ceiling. Securely attach access panels but provide for easy removal and secure reattachment. Do not install any damaged units.

D. Adjust and Clean:

1. After installations are complete, adjust all moving parts for smooth operation.
2. Remove all packing materials and debris resulting from this work and turn over the fume hoods to the Owner clean and polished both inside and out.
3. Repair or remove and replace defective work, as directed by owner and/or his representative upon completion of installation.

E. Protection:

1. Provide reasonable protective measures to prevent casework and equipment from being exposed to other construction activity.
2. Advise owner and/or his representative of procedures and precautions for protection of material, installed laboratory casework and fixtures from damage by work of other trades.

F. Certification:

1. Fume Hood Manufacturer shall field test a random sample of 10% of the installed units using ANSI/ASHRAE 110-1995 to a control level of AI 0.01 ppm or better and witnessed by the consultant & IISC representative.
2. Project substantial completion shall be withheld until all required fume hood certification letters, tests, and reports have been submitted to and approved by the Consultant.

G. Integration: Fume hood exhaust need to be integrated with the supply of conditioned/fresh air required, balancing of air and testing, demonstration and commissioning complete as per site conditions and as per direction of Engineer in charge. The quoted rates as per BOQ items shall include the integration and nothing extra shall be payable for the same.

LIST OF APPROVED MAKES FOR LAB FURNITURE & FUMEHOOD

List of Makes approved by M/s. IISC Bangalore are listed below (Refer materials whichever are applicable for the scope of work). Approved equivalent materials of any other specialized firms not acceptable, in case it is established that the brands specified below are not available in the market subject to approval of the alternate brand by the M/s. IISC Bangalore.			
SL NO	MATERIALS	MANUFACTURER / SUPPLIER / MAKE	VENDOR CONFIRMATION
1	Steel	TATA Steel, JINDAL Steel, Equivalent for imported products	
2	Powder Coating	Kansai Nerolac, Berger Paints, Asian Paints, Equivalent for imported products	
3	Emergency Devices, Water Faucets and Gas Valves, Fume Hood Utility Fittings	Broen-Lab, Water saver.	
4	Switches and Sockets	Northwest/ Legrand / MK	
5	Locks	Hettich, Hafele, Ebco.	
6	Drawer Slides	Hettich, Hafele, Ebco.	
7	Sink (PP Sink)	Broen-Lab, Water Saver	
8	Fume hood liners	Trespa Toplab Vertical or Equivalent	
9	Work surface	Trespa Toplab Plus or Equivalent	

10	FUME HOOD FACE VELOCITY MONITOR	TEL, SCHNIDER ELECTRONIC	
11	LIGHT FIXTURE	CROMPTON, PHILIPS, WIPRO.	
12	REMOTE CONTROL VALVES	BROEN-LAB, WATERSAVER, BROWNALL	
13	CABLES	FINOLEX, UNIVERSAL, LAPP	
14	INTERNAL WIRING (FIRE RESISTANT LOW SMOKE WIRES(FRLS))	FINOLEX, LAPP, HAVELLS, GEMSCAB.	
15	DB'S AND MCB'S	Legrand / ABB / SCHNEIDER	
16	TERMINALS	HMI/ DOEELLS	
17	DRAIN PIPE	VULCATHENE OR APPROVED EQUIVALENT	
18	SPOT EXTRACTOR	FUMEX, ALSIDENT, NEDERMANN	
19	Chemical Cabinets / Pharmacy Cabinets / Tall Cabinets	Asecos, Duperthal, Ecosafe	
20	Eyewash / Shower	Water Saver / Broen Lab	
21	Epoxy Marine Edges	Simmons	
22	Fire Extinguisher	SAFEX / Novec	
23	Lab Chairs	Featherlite / Godrej	

ABBREVIATIONS

CRCA	Cold Rolled Cold Annealed
SEFA	Scientific Equipment and Furniture Association.
NFPA	National Fire Protection Association
UL	Underwriters Laboratories
FM	Factory Mutual
PCGI	Powder Coated Galvanized Iron
MS	Mild Steel
FDA	Food & Drug Administration
UV	Ultraviolet

SUB HEAD - 3: ELECTRICAL SPECIFICATION

1.0 ELECTRICAL DESIGN BRIEF:

1.1 SCOPE OF WORKS

Scope of work includes design, supply, installation, commissioning & handing over of following:

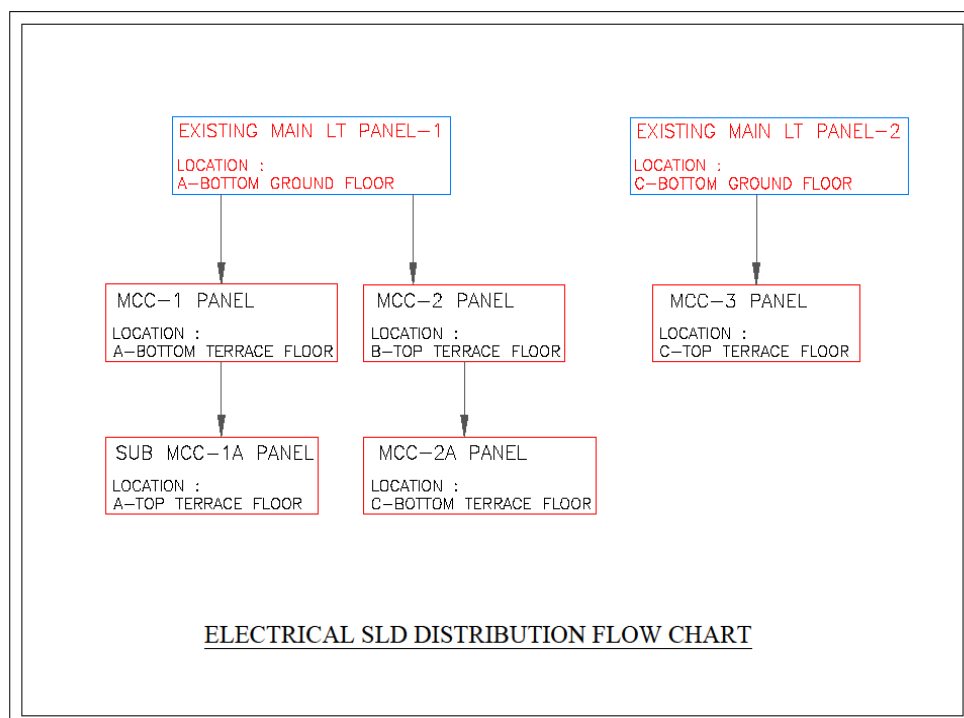
- a. Outdoor type MCC and Sub-MCC panels for Exhaust Blower & Air Compressor.
- b. Cable end terminations for blower motors and all MCC panels.
- c. Power distribution system from existing power DBs to proposed power sockets.
- d. Earth Pits and earth strips only for Exhaust Blowers MCC, Sub MCC Panels, Blower motors and air compressor.

1.2 DESIGN CRITERIA

1.2.1 Power distribution scheme: -

- a. Electrical Distribution Flow chart is as shown in the below.
- b. Incoming electrical supply for MCC-1 & MCC-2 panels shall be taken from spare feeders which are available in existing Main LT Panel-1 located at ground floor electrical room in 'A' bottom block.
- c. Incoming electrical supply for MCC-3 panel shall be taken from spare feeders which are available in existing Main LT Panel-2 located at ground floor electrical room in 'C' bottom block.
- d. MCC-1 shall be located at terrace floor in 'A' bottom block.
- e. MCC-2 shall be located at terrace floor in 'B' top block.
- f. MCC-3 shall be located at terrace floor in 'C' top block.
- g. MCC-1 panel will feed the power to Sub MCC-1A panel. The Sub MCC-1A panel shall be located at terrace floor in 'A' top block.
- h. MCC-2 panel will feed the power to Sub MCC-2A panel. The Sub MCC-2A panel shall be located at terrace floor in 'C' bottom block.
- i. Panels shall feed the power to HVAC equipment like exhaust blowers, scrubbers with recirculation pumps & utility equipment like air compressor.
- j. VFD is considered only for exhaust blowers and scrubbers. No Bypass Starters considered.
- k. Electrical Motor Starter is considered for recirculation pumps for Wet Scrubbers.
- l. Only provisions for UPS power supply for dedicated Instrument Rooms & certain Fume Hoods is considered.

- m. 1.1KV grade Multistrand XLPE Insulated PVC outer sheathed armoured cables are used for equipment power connection.
- n. 1.1KV grade Multistrand FRLS copper wires are used for Power sockets.
- o. GI Ladder type hot dip-galvanized Cable tray with considering reducers, bends, up & down frames etc. for smooth laying of the cables is considered for outdoor panel cable entry & exhaust blower on the Terrace.
- p. The cable tray should consist of 2 runs of earth bus along the length of the tray.
- q. GI powder coated raceway are provided to run the power to island benches where ever floor conduit is not provided.
- r. 6/16A modular multi pin power sockets controlled by 16A switch is considered for lab equipment and it shall be mounted on existing PVC raceway & proposed lab furniture raceway.
- s. Weather proof On/Off push buttons are considered near the blower motors.
- t. Weather proof stop push buttons are considered near the circulation pumps.
- u. Dedicated GI pipe with plate Earthing is considered with grid type for Panels, Exhaust Blowers and Utility equipment.



2.0 TECHNICAL SPECIFICATION OF PANELS & SWITCHGEARS

2.1 SPECIFICATIONS FOR PANELS & SWITCHGEARS:

- a. This specification covers the requirements for Design, Fabrication, Painting, Assembly, Testing, Packing and Supply of all types of Medium Voltage Control Panels upto 600 V AC including MCC / Distribution Boards etc.
- b. This specification shall be read in conjunction with the enclosed particular specifications (if any) which will give more details about the project/site conditions. In case of any contradictions between this and the particular specifications, the details of particular specifications shall prevail.
- c. Unless otherwise specified all control, Panels shall be suitable for continuous operation on 415 volts 3 phase 4 wire 50 Hz AC supply, suitable of withstanding fault levels & duty conditions stated in the particular specifications.

2.2 CODES AND STANDARDS:

- i. All equipment's shall generally, comply with the updated issues of:
 - a. Applicable Indian Standards.
 - b. Indian Electricity Act.
 - c. Indian Electricity Rules.
 - d. Electricity Bill 2003.
 - e. National Electrical Code by BIS.

Equipment's complying with any other authoritative / internationally recognized standards such as IEC, British, U.S.A and German etc. will also be considered that ensures performance equivalent or superior to Indian Standards. In such case the bidder shall clearly indicate the standard adopted and furnish the copy of latest English version of the same along with the bid and bring out the salient features for comparison.

All Standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as published one month prior to the date of opening the bids. A list of some of the major standards applicable is given below:

IS: 694 PVC insulated cables for working voltages upto and including 1100 V.

IS: 13947 Part-1 to Part-5 LV Switchgear and Control gear

IS: 2705 Current Transformers

IS: 3043 Code of practice for earthing

IS: 3072 Code of practice for installation and maintenance of Switchgear

IS: 3156 Voltage Transformers

IS: 3231 Electrical relays for power system protection

IS: 8623 (3 parts) Specification for factory built assemblies of Switchgear and Control gear

IEC 61439 -1 & 2 General rules, Power switchgear & control gear assemblies

IS 14763 & 14768: 2000 Conduits for Electrical Purposes - Outside Diameters of Conduits for Electrical Installation and Threads for Conduits and Fittings - Specification

IS 1709-1984 Specification for Capacitors for electric fan motor

IS 1885: Part 42: 1993 Electro technical Vocabulary: Part 42 Power capacitors

IS 1944(Pt.1&2)-1970 Code of practice for lighting

IS 2071(Pt.2)-1974 Methods of high voltage testing: Part 2

IS 2147: 1962 Degrees of protection provided by enclosures for low voltage switchgear and control gear

IS 2148-1981 Specification for Flameproof enclosures

IS 2206 (pt.1) 1984 Specification for Flameproof electric lighting fittings (well glass and bulk head type, fittings using glass tubes).

IS 3070: Part 3: 1993 Lightning Arresters for Alternating Current Systems – Specification - Part 3 : Metal Oxide Lightning Arresters Without Gaps

IS 4012: 1967 Specification for Dust-proof Electric Lighting Fittings

IS 4064: Part 2: 1978 Air-break switches, air-break disconnectors, air-break switch disconnectors and fuse-combination units for voltages not exceeding 1000V ac or 1200V dc: Part 2 Specific requirements for the direct switching of individual motors

IS 4615: 1968 Switch socket outlets (non-interlocking type)

IS 5571: 2000 Guide for Selection of Electrical Equipment for Hazardous Areas

IEC: 309 Part-3 Plugs, socket outlet, connectors and appliance inlets for use in explosive gas atmosphere

IS 5780: 2002 Electrical Apparatus for Explosive Gas Atmospheres - Intrinsic Safety "i" - Specification

IS 5831: 1984 PVC insulation and sheath of electric cables

IS: 6381 Construction and testing of electrical apparatus with type of protection 'e'.

IS 6665: 1972 Code of practice for industrial lighting

IS 7098: Part 1 : 1988 Crosslinked polyethylene insulated PVC sheathed cables: Part 1 For working voltage upto and including 1 100 V

IS 732 : 1989 Code of Practice for Electrical Wiring Installations

IS 8468 : 1977 On-load tap changers

IS 8544 : Part 1 : 1977 Motor starters for voltages not exceeding 1000 V: Part 1 Direction line ac starters & Part 2 Star-delta starters

IS 8828: Specifications for Miniature Air break circuit breakers for voltages not exceeding 1000 volts.

IS 9537: Part 1: 1980 Conduits for electrical installations: Part 1 General requirements

IS: 13346: General requirements for electrical apparatus for explosive gas atmospheres.

IS: 15652: General requirements for electrical High voltage insulating Mats.

2.3 GENERAL REQUIREMENTS:

- a) The requirements, conditions, appendices etc. in any other bid documents shall apply to and shall be considered a part of this specification as if bound together. In case of any discrepancy between conditions specified in any other volume and this volume, the requirements, specified in this volume shall prevail.
- b) The equipment offered by the Bidder shall be complete in all respects. Any material and component not specifically stated in this specification, but which is necessary for trouble free operation of the equipment and accessories specified in this specification shall be deemed to be included unless specifically excluded. All such equipment's /accessories shall be supplied without any extra cost. Also, all similar components shall be interchangeable and shall be of the same type and rating for easy maintenance and low spare inventory.
- c) All drawings, schedules and annexure appended to this specification shall form part of the specification, Specific reference in this specification and documents to any material by trade name make or catalogue number shall be construed as establishing standard of quality and performance and not as limiting competition. The bidder may offer any similar equipment provided it meets the specified standard design and performance requirements, based on client approvals only.

2.3.1 CONSTRUCTION:

- a. All panels shall be fully metal-clad, of compartmentalized dust, water proof and vermin proof of modular design with bolted design and suitable for duty application as given in the specification. Each compartment shall house all the components connected with the circuit and with feeders with multi-tier formation. And all panels / feeder must possess the LOTO facility.
- b. The design shall be aimed at ensuring total safety (to equipment and operating personnel) during Connections, Operation, Testing, Inspection, and Maintenance without any need for special precautions and without any need for disturbing the adjacent equipments or de-energization of the panel / system.
- c. All Switchboard frames and load bearing members shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness not less than 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness not less than 3 mm. doors and covers shall also be of cold-rolled sheet steel of thickness not less than 2 mm. Stiffeners shall be provided wherever necessary. The internal parts shall be of unpainted / GI parts to ensure effectively earthing connection. The construction shall be standard design which can be ordered separately as loose kits for future expansion. The gland plate thickness shall be of 3.0 mm (minimum) for hot / cold-rolled sheet steel and 4.0 mm (minimum) for non-magnetic material. The panels may be of Projection or Flush type design. All the doors should be of identical sizes and in complete alignment with each other. The door gaps shall be uniform all-

round the panel. Doors for rear side and alleys shall be of bolted type. All other doors shall be hinged type (LHS hinging preferred) using sturdy hinges.

- d. All panel edges and cover / door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members or as per type tested design. The top covers of the panels should be designed such that they do not bulge / bend by the weight of maintenance personnel on it. All cutouts shall be straight and free of burrs. Holes / round cutouts shall be punched and neatly filed / ground. All these shall be done prior to painting to avoid exposure of bare metal after painting.
- e. The complete structures shall be rigid, self-supporting, and free from flaws, twists and bends. All cutouts shall be true in shape and devoid of sharp edges.
- f. All Switchboards shall be of dust-proof, waterproof and vermin-proof construction and shall be provided with a degree of protection of IP: 52 as per IS: 13947 / IEC 60439. All cutouts shall be provided with synthetic rubber gaskets. The Switchboards which are meant for outdoor duty shall be provided with degree of protection of **IP: 55** as per IS: 13947.
- g. The Panel shall be designed for normal air-ventilated cooling without exceeding temperature limits stipulated in the Standards / Codes. Ventilation Louvers if at all necessary shall be provided with metallic screen and dust filters. The louvers shall be of uniform size and spacing.
- h. Switchboard shall be supplied with base frames made of structural steel sections, along with all necessary mounting hardware required for welding down the base frame to the foundation / steel insert plates. The base frame height shall be such that floor finishing (50 mm thick) to be done by Owner after erection of the Switchboards does not obstruct the movement of doors, covers, with drawable modules etc.
- i. The Panels shall be extensible on either side without any structural modifications. The bus bars, for this purpose, shall be brought up to the end of the Panel with fixing holes pre-drilled.
- j. The panel height shall not exceed 2100 mm and all the Panels within any particular room shall be of uniform height. The operating height shall be restricted to 1800 mm at the top and 350 mm from the bottom.
- k. The Panels shall be designed in shipping sections of width not more than 2000 mm (unless otherwise approved) and shall have lifting eye-bolts of suitable size to withstand the weight of the switchboard.
- l. Sheet steel barriers shall be provided between two adjacent vertical panels running to the full height of the switchboard, except for the horizontal busbar compartment. Form 4 segregation arrangement shall be provided in cable alley. Synthetic rubber gasket shall be provided between

the panel sections to avoid ingress of dust into panels. Each shipping section has full metal sheets at both ends for transport and storage.

All hardware used shall be non-corroding, plated and the joints secured using plated nuts / washers & spring washers. For all connections for busbars, cables, supports, high tensile steel bolts alone shall be used of specified makes only.

- m. The Panel shall be provided with doors / covers on all the four sides. All equipments / components shall be accessible from front. Rear side doors shall provide access only for cables / busbars. However, these shall also be accessible from front, particularly in cases where the Panels are installed adjoining the walls of the room.
- n. Gaskets of neoprene rubber or other similar compressible but non-ageing / non-deforming materials shall be provided for all openings.
- o. All Switchboards shall be provided into distinct vertical sections (panels). Each comprising of the following compartments:

2.3.2 BUSBAR COMPARTMENT:

- a) A completely enclosed busbar compartment shall be provided for the horizontal and vertical busbars. Bolted covers shall be provided for access to horizontal and vertical busbars and all joints for repair and maintenance, which shall be feasible without disturbing any feeder compartment. Auxiliary and power busbars shall be in separate compartments.
- b) Busbar compartments shall be provided with thick insulated shrouding sheets such that the conductors are not directly accessible even on removal of the main door.

2.3.3 SWITCHGEAR / FEEDER COMPARTMENT:

- a) All equipment's associated with an incomer or outgoing feeder shall be housed in a separate compartment of the vertical section. The compartment shall be sheet steel. Enclosed on all sides with the withdrawable units in position or removed. Insulating sheet at the rear of the compartment is also acceptable. The front of the compartment shall be provided with the hinged single leaf door with captive screws for positive closure.
- b) The internal structures on which components such as Circuit Breakers or Switches or other such heavy items are mounted shall be of 6 mm thick M.S angles. Documentary proof shall be provided during inspection of panel.
- c) Internal sheets used for mounting of components shall be of minimum 2 mm thickness and mounting of components on these sheets shall be by using rivetted nuts / self-threaded screws to have better rigidity. Sheets used as barriers or compartment partitions can be of 18 gauge CRCA sheets provided there is no other load on them and provided they do not buckle / have dents.

- d) All panels must comply with standard form- 4a/3b configuration.

2.3.4 CABLE ALLEY / CABLE COMPARTMENT:

- a) A full height vertical cable alley of minimum 300/400 mm width shall be provided for power and control cables with sufficient cable ladders / supporting arrangement. Cable alley shall have no exposed live parts and shall have no communication with busbar compartment. Cable terminations located in the cable alley shall be suitably shrouded to prevent accidental contact by falling of tools etc. For distribution boards, the partition between the feeder compartment and cable alley must be provided. For circuit breaker external cable connections, a separately enclosed cable compartment shall also be acceptable. The contractor shall furnish suitable plugs to cover the cable openings in the partition between the feeder compartment and cable alley. Cable alley shall be hinged.
- b) All the terminals shall be suitable for termination of cables as specified in the Specifications / drawings / Particular Specifications for aluminium cables / lugs. The terminals shall be finger-proof / touch-proof to avoid any accidental contact. The tentative power and control cable entries (top / bottom) required are indicated in the "Bill of Materials". However, the Owner reserves the right to alter the cable entries, if required during detailed engineering, without any additional commercial implication.
- c) Each switchboard shall be provided with undrilled, removable type gland plate which shall cover the entire cable alley. Bidder shall ensure that sufficient cable glanding space is available for all the cables coming in a particular section through gland plate. For all single core cables, gland plate shall be of non-magnetic material. The gland plate shall preferably be provided in two distinct parts for the easy and terminating addition cables in future. The gland plate of removable type shall be provided with gasket ensure enclosure protection. Recommended drilling chart of gland plate for all power and control cables in the vertical panels shall be indicated by the Contractor in the respective G.A drawings of the boards.
- d) The layout of individual feeders shall provide easy & safe accessibility to the auxiliary / control Circuits without the danger of coming in contact with the live 4 parts / busbars. Surrounding shall be provided contractor shall submit a detailed drawing for approval prior to commencement of manufacture.
- e) All Incomer / Feeder doors shall be provided with door interlocks with defeat facilities.
- f) All draw-out ACB compartments shall be provided with safety shutters.
- g) Access to auxiliary / Control terminals shall be free and safe and located such that the power terminals or any other live terminals / connections do not come in the way and any accidental contact is avoided. Terminals of different voltage classes shall be AC/DC segregated. All component terminals shall be shrouded and finger touch proof.

- h) The compartment sizes shall be standardized and in multiples of the basic size. Equipments in compartments of same size shall be interchangeable.
- i) All doors / covers shall be removable only by use of special tools / keys to prevent unauthorized access to the Panel interiors. Suitable Caution / Danger boards shall be provided on each such door / cover which leads to possibilities of coming in contact with live conductors / terminals. The Panel shall have clearly identified and marked Incoming and Outgoing terminals.
- j) All components / circuit breakers / switches shall have proper labels to identify their control points and ease in study of the drawings.
- k) The Panel shall be provided with an earth bus running throughout the panel and all switches, non-current carrying metal parts / components shall be connected to this earth bus. The earth bus shall be extended on both sides to facilitate connection of the panel to the earthing grid. All hinged doors shall be also earthed.

2.3.5 BUSBARS

- a) All Bus bar / panel shall be cut/bend using CNC machines only.
- b) Busbars shall be of high conductivity electrolytic aluminium / copper as per the Particular Specifications, supported on insulators at regular intervals of 500 mm made of non-hygroscopic, non-inflammable material i.e. epoxy / SMC / DMC / FRP such that there is no stress on the busbar / terminal. The Phase Busbars shall be of uniform current rating throughout their length and the current rating of neutral shall be at least half that of phase busbars. Maximum current density employed for busbar cross sectional area calculations shall not exceed 0.8 Amp. Per sq. mm for aluminium and 1.6 Amps per sq. mm for copper busbars.
- c) The cross-section of the busbar shall be uniform throughout the length of the switchboard and shall be adequately supported and braced to withstand the stresses due to the short circuit currents. Neutral busbar short circuit strength shall be same as main busbars.
- d) All busbar shall be adequately supported by non-hygroscopic, non-combustible, track-resistant and high strength sheet moulded compound or equivalent type polyester fibre glass moulded insulator. Separate supports shall be provided, for each phase and neutral busbar. If a common support is provided, anti-tracking barriers shall be provided between the supports. Insulators and barriers of inflammable material shall not be accepted. The busbar insulator shall be supported on the main structure.

All busbar joints shall be connected with high tensile steel bolts (8.8 grade), Belleville / spring washers and nuts, so as to ensure good contacts at the joints. Non-silver-plated busbar joints shall be thoroughly cleaned at the jointed locations and suitable contact grease shall be applied

just before making a joint. All bolts shall be tightened by the torque spanner to the recommended value.

- e) Zinc passivated, or cadmium plated high tensile strength steel bolts, nuts & washers shall be used for all busbar joints / supports. At the joints, the overlap should be equal to or greater than the width of the busbar or 10 times the bar thickness, whichever is greater. The joints shall be treated by grease to ensure the joints moisture proof and shall be smeared by petroleum jelly to increase the efficiency of the joint. Minimum clearance in air between phases shall be maintained 40 mm, phase to neutral 30 mm and neutral to earth 25 mm with panel or switch specification respectively. In the event of any difficulty in any particular section, minimum clearance of 25 mm is a must under all circumstances. Wherever it is not possible to achieve this clearance insulating barriers / sleeves shall be provided. However, for horizontal and vertical busbars the clearance specified above should be maintained even when the busbars are sleeved or insulated. All connections from the busbars upto switch / fuses shall be fully shrouded / insulated and securely bolted to minimize the risk of phase to phase and phase to earth short circuit.
- f) Busbars shall be provided with colour code PVC sleeve. Busbar have to be designed to withstand dynamic force of short circuit at 65 KA RMS, 50KA RMS and 36KA respectively according to the panel specification or SLD.
- g) The interconnections between the main busbars & individual units shall be made by using copper / aluminium busbar strips of adequate rating and shall be shrouded.
- h) All copper to aluminium joints shall be provided with suitable bimetallic washers.
- i) Whenever the busbars are painted with black matt paint, the same should be suitable for temperature encountered in the switchboard under normal operating conditions.
- j) The bidder shall furnish calculations establishing the adequacy of the busbar sizes for specified current ratings.
- k) An Earth Bus of required cross sectional area shall be provided throughout the length of the switchboard. Provision shall be made to connect the earth busbar to the Plant earthing grid at two ends. The earth bus and inter-connecting earth wire shall colour-coded in Green. All non-current carrying metal parts in the panel shall be connected to the earth bus.
- l) Vertical earth bus shall be provided in each vertical section which shall in turn be bolted / welded to main horizontal earth bus.
- m) The earth bus shall have sufficient cross section to carry the momentary short circuit and short time fault current to earth, without exceeding the allowable temperature rise.

- n) Suitable arrangement shall be provided to each end of the horizontal earth bus for bolting the Owner's earthing conductors. The horizontal earth bus shall project out of the switchboard ends and shall have predrilled holes for this connection. All joint splices to earth bus shall be made through at least two bolts and taps by proper lug and bolt connection.
- o) All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus. Electrical conductivity of the whole switchgear enclosure framework shall be maintained even after painting.

2.3.6 WIRING

Wiring for power, control signalling, protection and instrument circuit in the switchboard shall be done with PVC insulated copper conductors of 1.1 kV grade. All control wiring shall be enclosed in fire-retardant PVC/FRLS channels. A minimum 2.5 sq.mm size FRLS wire with stranded copper conductors or FRLS wire shall be used for circuit ratings of up to 6 Amps. For CT circuits 2.5 sq.mm FRLS wire shall be used. Shorting links shall be provided for all CT terminals. Each wire shall be identified at both ends by ferrules and provided with tinned copper lugs firmly crimped. Cable entry to the switchgear shall be from bottom / top as specified and supporting facilities shall be provided for clamping the cables in the cabling compartment. Inter-panel wiring within each shipping section shall be in the scope of Contractor and inter-linking using terminal blocks on adjoining shipping sections to facilitate the same along with suitable jumping wires. Internal wiring shall be taken through PVC sleeves or rubber grommets. A minimum of 10% spare terminals shall be provided on the terminal block.

2.3.7 PAINTING

The panels shall be powder coated as per specified colour. All metal surfaces shall be thoroughly cleaned and degreased to remove oil, grease and dirt. Rust and scales shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline water and drying. After phosphating, thorough rinsing shall be done with clean water followed by final rinsing with dilute dichromate solution and oven drying. The final finished thickness of paint film on steel shall not be less than 60 to 80 microns (Powder coated). Finished painted appearance of equipment shall present an aesthetically pleasing appearance free from dents and uneven surfaces. The required colour for the panels shall be as per the particular specification. Panels meant for **Outdoor locations shall have double doors** with water-tight gaskets and epoxy paint, and that for interior shall be white. All unpainted steel parts shall be plated or suitably treated to prevent rust and corrosion.

2.3.8 NAME PLATE/LABELS

Name plates shall be of anodized aluminium with white engraving on black background and shall be properly secured with fasteners. Name plate shall be provided for each feeder and equipment i.e. indicating lamps, push buttons, switches, relays, auxiliary contactors etc. mounted on the switchboard. Special warning labels shall be provided wherever necessary. A name plate with switchgear designation shall be fixed at the top of the Panel. Name plate giving feeder details shall be provided for each compartment and a separate name plate giving details of bus section shall also be provided.

As mentioned in GA, name must be printed; any changes in the names of the feeder shall be recorded by the panel manufacturers/consultants.

2.4 COMPONENTS

2.4.1 AIR CIRCUIT BREAKERS:

A) GENERAL:

The ACBs shall conform to IS 13947-1 / IEC 60947-1 for general rules and IS 13947-2/IEC 60947-2 for Circuit Breakers. The ACBs shall be suitable for 3 phases 415 Volts. All the breakers shall have tropicalisation as a standard feature. ACBs shall meet the following minimum parameters, ACBs must be considered with a provision to integrate with EMS System of communication models (RS 485) and all ACBs should have a provision for LOTO facility.

Rated operational Voltage	: 690V
Rated insulation Voltage	: 1000V
Rated impulse withstands Voltage	: 9 12 Kv
No. of mechanical operations	: 25,000(up to 2000A) 15,000(above 2000A, up to 4000A)
No. of electrical operations	: 10,000(up to 2000A) 5,000(above 2000A, up to 4000A)

B) CONSTRUCTION:

- i. The Breaker shall be suitable for rear and vertical mounting and line load reversibility.
- ii. The draw out type breaker shall be with service-test-isolated positions.
- iii. The Air Circuit Breaker shall be preferably single pole construction and with multiple frame sizes up to 4000A.
- iv. The ACB shall have front face with Insulation Class II ia for safety as per IEC 60947-2 allowing class II installations with breaker control from outside.
- v. The ACB shall have 100% neutral pole in case of 4 Pole breakers
- vi. All ACBs shall be with $I_{cu}=100\%I_{cs}=I_{cw}$ (1Sec)

- vii. There shall be 3 distinct and separate positions of Test/Isolated/Service on circuit breakers on cradles which are self-lockable at each position:
- viii. ACB shall have Safety Shutter as standard with provision for locking for safety.
- ix. ACB shall conform to stringent environmental directives i.e. ROHS and WEEE norms.
- x. ACB shall be provided with Arc Chute Cover and stainless-steel filters to absorb all gases which are released in the event of Short circuit which ensures better safety
- xi. All accessories like Shunt trip/Under voltage/Closing Coils shall be common for all Breakers. Shunt trip shall be continuous rated coil
- xii. All ACBs shall be provided with Ready to Close Contacts as standard feature to check in the event of Closing under the following conditions:
 - ACB is in OFF position
 - Spring Mechanism is charged
 - Opening order is not present
 - Device not completely racked in

C) CONTROL UNITS:

- i. The Control Units shall be housed in a separate enclosure and there shall be total insulation of the control unit with respect to the power unit.
- ii. The Control Unit shall be of Microprocessor type & suitable to provide short circuit, overload and earth fault protection.
- iii. The setting range of the short circuit protection shall be from 1.0 to $10 \times I_n$ (protection S) and 1.5 to $15 \times I_n$ (protection I). The overload settings shall be adjustable from 0.4 to 1.0 times the rated current.
- iv. The breaker shall provide Earth fault protection from 0.2 to 1.0 times rated current.
- v. All ACBs shall have segregated LED fault indications and Mp fault indication.
- vi. All ACBs shall be set for different protection settings using DIP switches and navigation keys.
- vii. The Control unit shall be suitable to provide Overload, Short Circuit and Earth Fault Protection the Control Unit shall not be a peak sensing device and shall measure the true RMS values to make the measurement free from the influence of harmonics. It shall have thermal memory.
- viii. ACB shall be provided with Energy Release (wherever specified) and will measure the following:
 - a. Current – Phase and Neutral
 - b. Voltage – Phase to Phase and Phase to Neutral
 - c. Power- KW, KVAR, KVARH
 - d. Energy- KWH
 - e. Power Factor

The above parameters along with the status of breaker shall be displayed on front door of the panel. Also, trip unit shall provide last 20 trip histories which include date and time stampings.

It shall be possible to upgrade the breakers with Communication feature at Site with RS485 two-way communications and further upgradable to Ethernet connectivity.

Zone Selective Interlocking shall be provided in the Breakers for logic discrimination which reduces the thermal/electrodynamic stresses in the event of Short Circuit and earth fault.

D) ACCESSORIES:

The connection for the auxiliary shall be accessible from the front.

ACB shall be provided with following accessories, in addition to the item specified in Bill of Quantities. Further these devices shall be fittable at site from the front and common for all ratings.

- Under Voltage trip coil.
- Shunt trip coil.
- Closing coil,
- 4NO + 4NC auxiliary switches.
- Fault indicator/Reset unit.

E) INTERLOCKING:

ACBs shall be provided with the following interlocking: -

- i. Pad lock to prevent unnecessary manipulations of the breaker.
- ii. Electrical interlock shall be done by using breaker aux-contacts only
- iii. All the ACBs of EDO and MDO modules must have a provision for all type of interlocking.

TYPICAL FEATURES FOR ACB		ABB	SCHNEIDER	SIEMENS
Model		E3N	NW / MVS	3WL II
Type of Release		ETU (mP)	ETU (mP)	ETU (mP)
Overload protection	40% to 100%	1) PR122PD + PR120V + HMI. 2) PR122PD for all basic releases.	Micrologic –E + FDM121 Micrologic–A for Basic Releases	1). ETU76B + HMI. 2). ETU45B for all Basic Releases
Short circuit protection	Adjustable			
Instantaneous	Adjustable			
Earth fault protection	Adjustable			
Protection option: LI/LSI/LSIG				

TYPICAL FEATURES FOR ACB		ABB	SCHNEIDER	SIEMENS
Self-diagnostics - I.e. alarm indication for abnormal temperature rise, protection release malfunction Zone Selective				
Interlocking				
I _r , I _y , I _b , I _n , I _g current display				
Neutral Settable at site - (0,50% or 100% I _n)				

* The features like COM port with RS 485 communication port, measurement functions (DLM), IDMTL settings, interrupted current values, rating plugs, etc shall be provided in the breakers as feature or in a higher release like PR122PD+PR120V+HMI - ABB, Micrologic-E of Schneider, ETU-76B of Siemens.

2.4.2 MOULDED CASE CIRCUIT BREAKER:

Moulded Case Circuit Breakers shall be current limiting type with manually operated / motorized mechanism and of breaking capacities as per the Particular Specifications. All Feeder MCCBs shall be provided with electronic or thermal-magnetic, adjustable, short circuit and overload releases. MCCBs for Motor Starter feeders shall have adjustable short circuit releases. MCCBs shall have line and load reversibility capable of being mounted in any plane (horizontal, vertical) without any deration. The MCCB terminals shall be suitable for aluminium termination. All MCCBs shall have extended type Rotary operating handle mounted on the door of the compartment and ON/OFF positions indicated. MCCBs used as Incomers in the Switchboard shall be provided with under voltage releases. And extra relay contacts shall be maintained for EMS /BMS compatibility. With also communication module as RS485 shall be provided.

The breaker shall be Double Break type to reduce the let through energy in the event of short circuits. MCCBs shall be designed according to ROHS. Especially MCCB's materials shall be of halogen free type. They shall be supplied in recyclable packing complying with European Directives. The manufacturer shall implement non-polluting production processes that do not make use of chlorofluorocarbons, chlorinated hydrocarbons, ink for cardboard markings, etc

The MCCB shall have Insulation Class II front face. No live parts shall be accessible inside the frame where accessories are fitted in the breaker to ensure safety of the operators. MCCB shall have impulse withstand voltage of 8KV.

A) BREAKING CAPACITY

Unless otherwise specified, rated service breaking capacity of the Moulded Case Circuit Breakers shall be

- Up to 200 Amps rating : 25 kA
- 250A and above : 36 kA/50kA/65/kA as per the SLD
- MCC incomer and outgoing : 36kA/25KA
- However breaking capacity of all MCCB's in the PCC Switchgear Panels (Normal Supply & Emergency Supply) shall be minimum 36kA.

Typical Features for MCCB		ABB	Schneider	Siemens
Upto 160A rating		Tmax	NSX	VL-160X
Service Breaking Capacity (KA)	As per SLD			
Type of Release		TM	TM	TM
Overload protection	Adjustable	Yes	Yes	Yes
Short circuit protection	Fixed	Yes	Yes	Yes
Instantaneous	-	-	-	-
Earth fault protection (Integrated type)	Adjustable	Yes	Yes	Yes
Upto 630A rating		Tmax Ekip	NSX	VL-200/250/400/630A (mP rel)
Service Breaking Capacity (KA)	As per SLD			
Type of Release		mP unless specified	mP unless specified	mP unless specified
Overload protection	Adjustable	Yes	Yes	Yes
Short circuit protection	Adjustable	Yes	Yes	Yes
Instantaneous	-	-	-	-
Earth fault protection (integrated type)	Adjustable	Yes	Yes	Yes
Default releases mP when adjO/, adj S/c reqd-		Yes	Yes	* mP rel has to be mentioned in case of Siemens.
* For mP release with Electromagnetic-compatibility (EMC).				
* current limiting type upto 630A				

* Icu=Ics=100%

2.4.3 MINIATURE CIRCUIT BREAKERS:

The breaking capacity of the MCBs shall be 10 kA in accordance with IS 13947 / 8828 - 1996 and with tripping characteristics to suit the type of load it is feeding. They shall be suitable for 35mm DIN rail mounting in any plane without derating. The terminals should be protected against finger contact to IP 20 degree of protection with no restriction for line and load.

2.4.4 SELECTOR SWITCHES:

All control switches shall be 16 Amps. Rated, back connected, rotary type having a cam operated contact mechanism. Type and the number of ways shall be clearly mentioned on the switches. Ammeter selector switches shall have made before break feature on its contacts. Selector switches for the motor feeders shall be lockable in OFF position.

2.4.5 CURRENT TRANSFORMERS:

Current transformers shall be resin cast/tape insulated as per the Particular Specifications. The primary and secondary terminals shall be marked indelibly. The CTs used for metering shall have accuracy of Class 0.5 and for Protection circuits shall have class 1; the CTs shall be of Class 5P10 or PS Class as required. The CTs shall have a short time withstand rating equal to that of the associated switchgear and shall be provided with test and shorting links on secondary terminals. And 10VA /15VA CTS shall have /1A accuracy.

2.4.6 PROTECTIVE RELAYS:

All protective relays used shall conform to the relevant Indian Standards and meant for the specific type of protection envisaged. Static type/microprocessor-based relays shall be preferred. The relays shall have a minimum of one NO and one NC alarm/trip contacts of rating not less than 5 amperes at 230 V AC supply. Wherever relay inputs are from current transformers, protection type CTs Class 5P10/Class PS shall be used. All relays shall be suitably calibrated / compensated for the site conditions and with variable settings adjustable at site.

2.4.7 MEASURING INSTRUMENTS:

All measuring instruments shall be of 96 sq.mm/144 sq.mm as per Particular Specification and shall be flush mounting type and complete with all auxiliary equipments such as shunts, transducers, current and voltage transformers as required. All Multi-function meter or A.C. ammeters, voltmeters, kWh meters shall be of Digital type. Ammeters for motor feeders shall have a suppressed scale at the end to indicate motor starting current. The kW meters shall be suitable to measure unbalanced loads on three phases four wire system.

2.4.8 INDICATING LAMPS AND PUSH BUTTONS:

Indicating lamps shall be of LED type and of low watt consumption, easily replaceable from the front. Lamps shall be uniformly bright and provided with translucent covers of appropriate colours. Push buttons shall have a minimum of 1 set of NO/NC contacts. As per IEC/NFPA standard Colour coding for Indicating Lamps and Push-buttons shall be as follows:

- STOP/OPEN/EMERGENCY TRIP : RED
- START/CLOSE : GREEN
- RESET/TEST/HEALTHY : YELLOW / BLACK / WHITE.
- TRIP : AMBER

2.4.9 INSPECTION & TESTING:

Routine tests as per Indian Standards shall be carried out on the panel. This shall comprise physical inspection of panel including wiring and fittings, and operational and functional tests where necessary. The routine tests to be carried will be as follows:

High Voltage Test: To test high voltage withstands capacity for power and control circuits. Test certificate to be submitted along with the panels.

Megger test: To check the insulation resistance between pole and neutral, pole and pole and all secondary wiring between phase and earth. These should be recorded and submitted.

Phase sequence test: To check phase configuration.

Bill of materials check

Functional tests

Design ambient temp: For all the switch gear shall be considered 45Deg C.

2.4.10 PARTICULAR SPECIFICATIONS FOR PANELS:

- Paint / Colour of Panels : Powder coated to shade RAL 7032.
- Busbar Material : Aluminium (minimum current density 0.8 Ampere per sq mm)
- Location of Panels / Duty : All are Indoor.
- Sheet Steel thickness : 14 SWG (2 mm) CRCA (Cold Rolled Cold Annealed) sheet Steel

Minimum thickness of FRP barriers shall be 3 mm.

Neutral Bus bars shall be rated at minimum 60% of the capacity of the Phase Busbars.

All CTs shall be of resin-cast type.

All measuring instruments shall be of digital type.

2.5 M.C.C. SPECIFICATIONS

- A. M.C.C. shall be generally of single front execution unless specified to be of double front execution.
- B. M.C.C. shall have bottom or top cable entries. Each shall have separate cable alley. Cable alleys shall be provided with suitable doors. Sheet metal barrier shall be provided between individual compartments and cable alleys. Bus tie feeders with load break SFU/MCCB will be of fixed type.
- C. All switches other than rotary switches shall be lockable in both ON & OFF positions. The switches / MCCB's shall be interlocked with compartment door to prevent opening of door when switch / MCCB is ON. A defeat mechanism for this interlock shall also be provided.
- D. The maximum height of operating handles/switches shall not exceed 1800mm and minimum height not below 300mm.
- E. The contactors shall be air break type, equipped with three main contacts and minimum 2 no. + 2no. Auxiliary contacts. The main contacts shall be rated for AC 3 Duty. The auxiliary contacts shall be rated for 5A at 240 V A.C.
- F. The coil of contactor shall be suitable for operation in 240V the drop off Voltage of contactor coil shall be between 15% to 65% of rated coil voltage.
- G. Thermal overload relays shall be of three elements, positive acting, ambient temperature compensated with adjustable range. Relays shall be of manually reset type. Relay shall be provided with minimum 1 no. + 1no having rating of 5 amps at 240 volts A.C.
- H. MCCB's shall provide with tripping device having inverse time characteristic for over load protection and instantaneous characteristic for short circuit protection. MCCB's operating handle ON & OFF position shall be clearly and handle shall be mounted on door of MCCB compartment.
- I. In case single phase preventer must be used, it shall be of current operated type and shall have provision of 2NO and 2NC contact, shall operate on the principle of sensing negative sequence component of current. SPP used shall be suitable for protection of non – reversing and reversing motors. The relay operation shall be independent of loading and rpm of the motor prior to occurrence of single phasing. And 1phase preventer must be integrated panel incomers to trip the breakers in case of phase failure.
- J. Over load relays/earth fault relays for MCC panel shall be of back connected draw out type, suitable for flush mounting and fitted with dust tight covers. The relay cases shall have provision for inserting of test plug at the front for testing and calibration. It shall be possible to test relays without disconnection of wirings. It should be provided with hand reset type build in flag indicators to reset the flag without opening of relay case.
- K. Push button used shall follow these color codes:
- L. All push buttons shall be of spring return & flush type. All push buttons shall be with minimum 1NO+1NC contacts.
- M. Emergency stop PB shall be mushroom head, stay put type with turn to release feature. All Mushroom PB shall be with minimum 2NO+2NC contacts.
- N. All illuminated PBs shall be with LED type lamps & 22.5mm dia in size with minimum 1NO+1NC contacts.

- O. Rating of all Push Button contacts shall be 10A AC 230V OR 3A 110V DC
1. Emergency Stop / stop : Red
 2. Start / Close : Green
 3. Trip : Amber
- P. Auxiliary relays / Contactors shall be used for interlocking and multiplying contacts. Their ratings must not be less than 5A for 240 Volts A.C. at PF of 0.8 to 1.0
- Q. Timers used for star delta starters 10HP & above shall be of Electronic type and shall have adjusting time of 0-60 secs.
- R. Successful bidder for LV switch boards will have to supply the following drawings for approval to the Consultant.
- a) G.A drawing
 - b) Single line diagram
 - c) Bill of quantities with makes.
 - d) Technical specification/catalogues/datasheet/specification sheet of all the used switch gear/materials.

Only on approval by the Architect/Consultant/ Electrical Consultant/Client, supplier can commence fabrication and procurement

2.5.1 SPECIFICATION FOR M.C.C.

SL No.	Designation / Name	:	MCC
1.	Rated Voltage, Phase & Frequency	:	440V AC, 3 PH, 50 HZ
2.	Maximum System Voltage	:	1.1 KV
3.	Reference Ambient Temperature	:	45° C
4.	Maximum Permissible Temp Under Continuous Operation	:	85° C
5.	Short Circuit Level	:	
	a. Short Time (1 SEC)	:	50 KA (RMS)
	b. Dynamic	:	150 KA (PEAK)
6.	Rating of bus bars	:	
7.	NO. Of Runs of Bus bars	:	a. Phase
		:	b. Neutral
8.	Single front / Double front	:	Single Front
9.	ACB 4 Pole / 3 Pole	:	Draw out Type
10.	Cable Entries	:	Top / Bottom
11.	Sheet Steel	:	14SWG (sides and door), 16 SWG (Inside Compartments)

SL No.	Designation / Name	:	MCC
12.	Cooling	:	Self
13.	Connections	:	
	a. Top Entry	:	
	b. Cable Entry Bottom	:	
14.	Rating of Bus duct / No. of Runs of Cable & size	:	
15.	Earth bus	:	50 x 6mm AL Flat Earthing Terminals 3/8bolt & nut at height of 30cm with double washers. From floor level
16.	Color	:	Light grey Enamel / Siemens grey
17.	Clearance in air (FORM 4a)	:	Phase to Phase - 40 mm
		:	Phase to neutral - 30 mm
18.	Incomer	:	ACB / MCCB / SFU / CHANGEOVER SFU
19.	Key Interlocking (PCC)	:	Yes
20.	Indicating Instruments	:	96 sqmm flush type (Outgoing), 144 sqmm flush type (incoming)
21.	Extendable on both sides if required	:	Yes
22.	Height of gland plates	:	Min. 300mm above Bottom Level of Switch Board
23.	CT	:	Measuring – Burden 15 VA
		:	Accuracy Class 0.5/1.0
		:	Protection – Burden 10/15 VA
		:	Accuracy class 1 with /1A/5A
		:	CT Ratios shall be
		:	Accordingly chosen
		:	As per rating of panel

2.5.2 PARTICULAR SPECIFICATIONS OF STARTERS

2.5.2.1 DOL STARTERS (SHOULD FOLLOW TYPE-2 COORDINATION)

A. 1HP STARTERS

- | | | |
|----------------------|---|--|
| 1. Full load current | : | 1.8 Amps |
| 2. Incomer MCCB | : | 20A TP & N |
| 3. Contractor | : | 12A 3 pole with auxiliary contacts |
| 4. Over load relay | : | 1.6 to 2.5A with single phase protection |
| 5. Push buttons | : | On and off |
| 6. Indicating lamps | : | On (Green) off (Red) & Trip (Amber) |
| 7. Terminals | : | 4Nos of 10sqmm Elmex for power, 3Nos of 2.5sqmm for Remote operation |
| 8. MCB | : | 16 A |

B. 2 HP STARTERS

- | | | |
|----------------------|---|--|
| 1. Full load current | : | 3.5 Amps |
| 2. Incomer MCCB | : | 20A TP & N |
| 3. Contractor | : | 12A 3 pole with auxiliary contacts |
| 4. Over load relay | : | 2.5 to 4A with single phase protection |
| 5. Push buttons | : | On and Off |
| 6. Indicating lamps | : | On (Green) off (Red) & Trip (Amber) |
| 7. Terminals | : | 4Nos of 10sqmm Elmex for power, 3Nos of 2.5sqmm Elmex for remote operation |
| 8. MCB | : | 16 A |

C. 3 HP STARTERS

- | | | |
|---------------------|---|--|
| ▲ Full load current | : | 4.7 Amps |
| ▲ Incomer MCCB | : | 32A TP & N |
| ▲ Contractor | : | 12A 3 pole with auxiliary contacts |
| ▲ Over load relay | : | 4.0 to 6.3A with single phase protection |
| ▲ Push buttons | : | On and Off |
| ▲ Indicating lamps | : | On (Green) off (Red) & Trip (Amber) |
| ▲ Terminals | : | 4Nos of 10sqmm Elmex for power, 3Nos of 2.5sqmm Elmex for remote operation |
| ▲ MCB | : | 16 A |

D. 5HP STARTERS

- | | | |
|----------------------|---|---|
| 1. Full load current | : | 8.2 Amps |
| 2. Incomer MCCB | : | 32A TP & N |
| 3. Contractor | : | 18A 3 pole with auxiliary contacts |
| 4. Over load relay | : | 6.3 to 10A with single phase protection |
| 5. Push buttons | : | On and Off |
| 6. Indicating lamps | : | On (Green) off (Red) & Trip (Amber) |

- | | | |
|--------------|---|--|
| 7. Terminals | : | 4Nos of 10sqmm Elmex for power, 3Nos of 2.5sqmm Elmex for remote operation |
| 8. MCB | : | 16 A |

E. 7.5 HP STARTERS

- | | | |
|----------------------|---|--|
| 1. Full load current | : | 11.1 Amps |
| 2. Incomer MCCB | : | 32A TP & N |
| 3. Contractor | : | 18A 3 pole with auxiliary contact |
| 4. Over load relay | : | 8 to 12A with single phase protection |
| 5. Push buttons | : | On and Off |
| 6. Indicating lamps | : | On (Green) off (Red) & Trip (Amber) |
| 7. Terminals | : | 4Nos of 10sqmm Elmex for power, 3Nos of 2.5sqmm Elmex for remote operation |
| 8. MCB | : | 16 A |

2.5.2.2 STAR DELTA STARTERS

A. 10 HP STARTERS

- | | | |
|---------------------|---|--|
| ⌘ Full load current | : | 14 Amps |
| ⌘ Incomer MCCB | : | 63A TP & N |
| ⌘ MCCB | : | 20A (Type-II Co-ordination full protection) |
| ⌘ Contractor | : | 2 nos 18 A & 1 no. 12 A 3 pole with auxiliary contacts
1 no Electronic timer 0-60 SEC |
| ⌘ Over load relay | : | 6 to 10A with single phase protection |
| ⌘ Push buttons | : | On and Off |
| ⌘ Indicating lamps | : | On (Green) off (Red) & Trip (Amber) |
| ⌘ Terminals | : | 8Nos of 10sqmm Elmex for power, 3Nos of 2.5sqmm Elmex for remote operation |
| ⌘ MCB | : | 16 A |

B. 12.5 & 15 HP STARTERS

- | | | |
|---------------------|---|---|
| ⌘ Full load current | : | 18 & 21 Amps respectively |
| ⌘ Incomer MCCB | : | 63A TP & N |
| ⌘ MCCB | : | 32A (Type-II Co-ordination full protection) |
| ⌘ Contractor | : | 2 nos 18A & 1no 12A 3 pole with auxiliary
contacts 1 No electronic timer |
| ⌘ Over load relay | : | 9 to 15A with single phase protection |
| ⌘ Push buttons | : | On and Off |
| ⌘ Indicating lamps | : | On (Green) off (Red) & Trip (Amber) |
| ⌘ Terminals | : | 8Nos of 10sqmm Elmex for power, 3Nos of
2.5sqmm Elmex for remote operation |
| ⌘ MCB | : | 16 A |

C. 20 HP STARTERS

⤴	Full load current	:	28 Amps
⤴	Incomer MCCB	:	125A TP & N
⤴	MCCB	:	40A (Type-II Co-ordination full protection)
⤴	Contractor	:	2 nos 25A & 1no 18An 3 pole with auxiliary contacts 1No electronic timer
⤴	Over load relay	:	14 to 23A with single phase protection
⤴	Push buttons	:	On and Off
⤴	Indicating lamps	:	On (Green) off (Red) & Trip (Amber)
⤴	Terminals	:	8 Nos of 25sqmm Elmex for power 3 Nos of 2.5sqmm Elmex for remote operation
⤴	MCB	:	16 A

D. 25 HP STARTERS

⤴	Full load current	:	35 Amps
⤴	Incomer MCCB	:	125A TP & N
⤴	MCCB	:	50A (Type-II Co-ordination full protection)
⤴	Contractor	:	2 nos 32A & 1no 25A 3 pole with auxiliary contacts 1No electronic timer
⤴	Over load relay	:	14 to 23A with single phase protection
⤴	Push buttons	:	On and Off
⤴	Indicating lamps	:	On (Green) off (Red) & Trip (Amber)
⤴	Terminals	:	8Nos of 25sqmm Elmex for power, 3Nos of 2.5sqmm Elmex for remote operation
⤴	MCB	:	16 A

E. 30 HP STARTERS

⤴	Full load current	:	40 Amps
⤴	Incomer MCCB	:	125A TP & N
⤴	MCCB	:	63A (Type-II Co-ordination full protection)
⤴	Contractor	:	2 nos 40A & 1no 25A 3pole with auxiliary contacts 1No electronic timer
⤴	Over load relay	:	20 to 33A with single phase protection
⤴	Push buttons	:	On and Off
⤴	Indicating lamps	:	On (Green) off (Red) & Trip (Amber)
⤴	Terminals	:	8Nos of 25sqmm Elmex for power, 3Nos of 2.5sqmm Elmex for remote operation
⤴	MCB	:	16 A

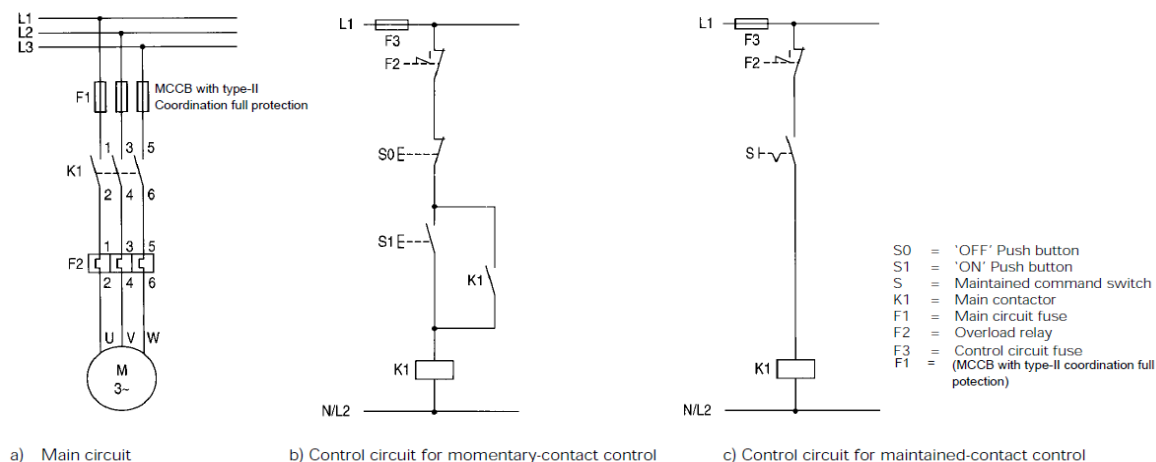
F. 40 HP STARTERS

⤴	Full load current	:	55 Amps
⤴	Incomer MCCB	:	160A TP & N
⤴	MCCB	:	63A (Type-II Co-ordination full protection)
⤴	Contractor	:	2 nos 70A & 1no 40A 3pole with auxiliary contacts
			1No electronic timer
⤴	Over load relay	:	30 to 50A with single phase protection
⤴	Push buttons	:	On and Off
⤴	Indicating lamps	:	On (Green) off (Red) & Trip (Amber)
⤴	Terminals	:	8Nos of 50sqmm Elmer for power, 3Nos of 2.5sqmm Elmex for remote operation
⤴	MCB	:	16 A

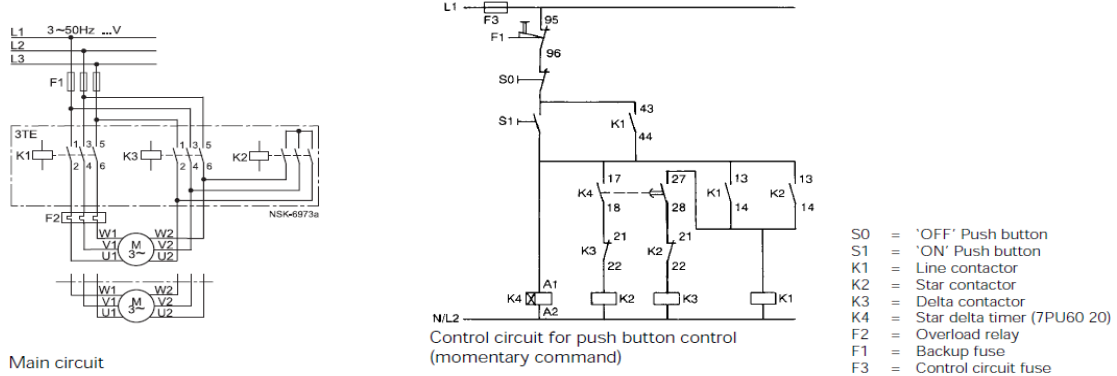
NOTE:

- Upto 7.5 HP motor rating DOL starter has to be considered.
- 10HP and above motor rating Star Delta starters has to be considered.
- Single line diagram has to be followed for detailed panel design.
- Refer Single Line diagram for incomer type, it can be either MCCB, ACB, MCB or SFDU with HRC fuses

Typical circuit diagram of Direct On Line starter



Typical circuit diagram of Star Delta starter



2.5.3 PARTICULAR SPECIFICATIONS OF VARIABLE FREQUENCY DRIVES

2.5.3.1 GENERAL

I. DESCRIPTION

- A. This specification is to cover a complete Variable Frequency Drive consisting of a pulse width modulated (PWM) inverter designed for use with IEC standard induction motor.
- B. The drive manufacturer shall supply the drive and all necessary options as herein specified. VFDs that are manufactured by a third party and "brand labeled" shall not be acceptable. All VFDs installed on this project shall be from the same manufacturer.

II. QUALITY ASSURANCE

a. Referenced Standards and Guidelines:

- IEEE 519-1992.
- UL508C
- IEC/EN 61800-3
- IEC/EN 60204-1
- IEC/EN 61000-3-12 EMC standard for limiting harmonic currents produced by equipment connected to public low-voltage systems.

b. Qualifications:

1. VFDs and options shall be UL508 listed as a complete assembly. The base VFD shall be UL listed for 100 kA SCCR without the need for external input fuses.
2. CE Mark – The base VFD shall meet product standard EN 61800-3 for the First Environment restricted level (Category C2). (RFI / EMI Filter spec).
3. The Drive manufacturing facility shall be ISO 9001:2000, ISO 14001: 2004 and certified.
4. The VFD shall be UL listed cUL Canadian UL listed, and comply with EMC Directive 89/336 EEC, Low Voltage Directive 73/23 EEC and Machinery Directive 98/37 EC in accordance with the European Union's CE directive.
5. All printed circuit boards shall be completely tested and burned-in before being assembled into the completed Drive. The Drive shall then be subjected to a preliminary functional test, minimum one (1) hour burn-in and computerized final test. The burn-in shall be at 104°F

(40°C), at full rated load, or cycled load. Drive input power shall be continuously cycled for maximum stress and thermal variation.

6. The Drive shall utilize efficient IGBT technology throughout the entire Drive manufacturer's Power and Voltage range.
7. The Drive shall utilize the same communications architecture for high-speed connectivity throughout the entire Drive manufacturer's Power range.
8. The Drive manufacturer shall have an analysis laboratory to evaluate the failure of any component. The failure analysis lab shall allow the manufacturer to perform complete electrical testing, x-ray components, and decap or delaminate components and analyze failures within the component.
9. The Drive shall utilize surface mount technology in the manufacturing of internal printed circuit boards and electronics, for maximum performance and reliability.

2.5.3.2 PRODUCTS

VARIABLE FREQUENCY DRIVES

- A. The VFD package as specified herein and defined on the VFD schedule shall be enclosed in a UL Type enclosure
 1. Environmental operating conditions: -15 to 40° C (5 to 104° F) continuous. Altitude 0 to 3300 feet above sea level, less than 95%, non-condensing All circuit boards shall be coated to protect against corrosion.
 2. The Drive shall have Protection classes of IP21 or IP54.
- B. Ratings
 1. The Drive shall be rated to operate from 3-phase power at 380VAC to 480VAC, +10% /-15%, 48Hz to 63Hz. The Drive shall employ a full wave rectifier to prevent input line notching and operate at a fundamental (displacement) input power factor of 0.98 at all speeds and nominal load. The Drive efficiency shall be 98% or better at full speed and load. An internally mounted AC line reactor or DC choke shall be provided to reduce input current harmonic content, provide protection from power line transients such as utility power factor correction capacitor switching transients and reduce RFI emissions. When a DC choke is utilized it shall be of swinging choke design to mitigate harmonics substantially more than conventional choke designs and shall provide equivalent to 5% impedance.
- C. All VFDs shall have the following standard features.
 1. All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
 2. The keypad shall include Hand-Off-Auto selections and manual speed control. There shall be fault reset and "Help" buttons on the keypad. The Help button shall include "on-line" assistance for programming and troubleshooting.

3. The VFD shall provide a programmable loss-of-load (broken belt / broken coupling) relay output. The drive shall be programmable to signal the loss-of-load condition via a keypad warning, relay output, and / or over the serial communications bus.

D. All VFDs to have the following adjustments:

1. Run permissive circuit - There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, time-clock control, or serial communications), the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD digital input and allows VFD motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop and the damper shall be commanded to close.
2. The VFD control shall include a programmable time delay for VFD start and a keypad indication that this time delay is active. A relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates
3. The VFD shall include a fireman's override input. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands), except customer defined safety run interlocks, and force the motor to run at a preset speed or in a separate PID mode.

E. Control Functions and Adjustments

1. Start-up data entries shall include motor nameplate power, speed, voltage, frequency and current.
2. A motor parameter ID function shall automatically define the motor equivalent circuit used by the sensorless vector torque controller.
3. Two independent PID speed/torque loop regulators shall be provided with an auto-tune function as well as manual adjustments.
4. A selection of eight (8) preprogrammed application macro parameter sets shall be provided to minimize the number of different parameters to be set during start-up. Macros included as standard are as follows: HVAC Default, Supply Fan, Return Fan, Cooling Tower Fan, Condenser, Booster Pump, Pump alteration, Dual setpoint PID. A selection of two (2) User Defined Parameter Sets shall also be available.
5. Carrier frequency shall be adjustable between 1 and 12 kHz up to 160kW 480V. The VFD shall automatically adjust the carrier frequency dependent upon Drive temperature and load. Increased temperatures result in automatically decreased switching frequency to ensure continuous operation of the Drive.
6. Start/Stop control functions shall include two (2) or three-(3) wire start/stop, coast/ramp stop selections.
7. The VFD shall be capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to reference without safety tripping or component damage (flying start). The

VFD shall also be capable of flux braking at start to stop a reverse spinning motor prior to ramp.

8. The VFD shall have the ability to automatically restart after an overcurrent, overvoltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.
 9. Accel/Decel control functions shall include two (2) sets of ramp time adjustments with linear and two (2) s-curve ramp selections.
 10. Speed/Torque control functions shall include:
 - a. Adjustable min./max. speed and/or torque limits
 - b. Selection of up to seven (7) preset speed settings or external speed control
 - c. Two (2) independent built-in PID controllers to control a process variable such as pressure, flow or fluid level.
 - d. Two (2) analog inputs shall be programmable to form a reference by addition, subtraction, multiplication, minimum selection or maximum selection.
 11. Output control functions shall include:
 - a. Current and torque limit adjustments to limit the maximum Drive output current and the maximum torque produced by the motor. These limits shall govern the inner loop torque regulator to provide tight conformance with the limits with minimum overshoot.
 - b. A torque regulated operating mode with adjustable torque ramp up/down and speed/torque limits.
 12. The Drive shall have programmable "Sleep" and "Wake up" functions to allow the Drive to be started and stopped from the level of a process feedback signal.
- Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.

F. Static and Dynamic Performance

1. Open loop static speed regulation shall be 0.5 % to 1% of rated motor speed. When motor speed feedback is provided from a suitable encoder, closed loop speed regulation shall be 0.1% of motor nominal speed. Dynamic speed accuracy shall be less than 1%-sec with 100% torque step open loop and 0.5%-sec closed loop with 100% torque step.
2. Torque control response time shall be less than 10 ms with nominal torque. In the torque regulating mode, torque regulating accuracy open loop shall be +/- 5%; torque regulating accuracy closed loop shall be +/- 2%;

G. Operator Control Panel (Keypad)

1. Each VFD shall be equipped with a front mounted operator control panel (keypad) consisting of a backlit, alphanumeric, graphic display and a keypad with keys for Start/Stop, Local/Remote, Up/Down and Help. Two (2) Softkeys will be provided which change functionality depending upon the position within the parameter hierarchy or state of panel.
2. All parameter names, fault messages, warnings and other information shall be displayed in complete English words or Standard English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table.

3. The Display shall have contrast adjustment provisions to optimize viewing at any angle.
4. The control panel shall provide a real time clock for time stamping events and fault conditions. The real-time clock has the following features:
 - Four daily times
 - Four weekly times
 - Timed boost function, e.g. a set constant speed which is on for a certain pre-programmed time. Activated with a digital input.
 - Timer enable with digital inputs
 - Timed constant speed selection
 - Timed relay activation
5. The control panel shall include a feature for uploading parameter settings to control panel memory and downloading from the control panel to the same Drive or to another Drive.
6. All Drives throughout the entire power range shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating.
7. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus.
8. The keypad shall be removable and insertable under Drive power, capable of remote mounting, and shall have its own non-volatile memory.
9. The standard operator panel shall provide a start-up, maintenance and diagnostic assistants that guides a new user through initial start-up and commissioning of the Drive as well as provide indications for maintenance and help to diagnose a fault. In addition, a PID assistant, Real-time Clock assistant, Serial Communications assistant, and Drive Optimizer assistant shall be included. A Drive Optimizer assistant permits the user to choose Drive set-up for low noise, drive & motor efficiency or motor control accuracy.
10. During normal operation, one (1) line of the control panel shall display the speed reference and run/stop forward/reverse and local/remote status. The remaining three (3) lines of the display shall be programmable to display the values of any three (3) operating parameters. At least twenty-six (26) selections shall be available including the following:
 - a. Speed/torque in percent (%), RPM or user-scaled units
 - b. Output frequency, voltage, current and torque
 - c. Output voltage, power and kilowatt hours
 - d. Heatsink temperature and DC bus voltage
 - e. Status of discrete inputs and outputs
 - f. Values of analog input and output signals
 - g. Values of PID controller reference, feedback and error signals.

H. I/O Capabilities

1. Six (6) digital inputs 12 to 24VDC PNP and NPN, all independently programmable with at least twenty-five (25) input function selections. Inputs shall be designed for “dry contact” inputs used with either an internal or external 24 VDC source.

2. Three (3) relay contact digital outputs, all independently programmable with at least thirty (30) output function selections. Relay contacts shall be rated to switch a maximum two (2) Amps rms continuous current at a maximum switching voltage of 30VDC or 250VAC. Function selections shall include indications that the Drive is ready, running, reversed and at set speed/torque. General and specific warning and fault indications shall be available. Adjustable supervision limit indications shall be available to indicate programmed values of operating speed, speed reference, current, torque and PID feedback. An optional relay expansion card shall be available to provide three (3) additional relay outputs. This option card shall be integrally mounted.
 3. Two (2) analog inputs, each selectable for 0VAC - 10VAC or 4mA - 20mA, and independently programmable with at least ten (10) input function selections. Analog input signal processing functions shall include scaling adjustments, adjustable filtering and signal inversion. If the input reference (4-20mA or 0-10V) is lost, the VFD shall give the user the option of the following: (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The Drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus.
 4. Two (2) analog outputs providing 0 (4) to 20mA signals. Outputs shall be independently programmable to provide signals proportional to at least twelve (12) output function selections including output speed, frequency, voltage, current and power.
- I. Serial Communications
 1. The VFD shall have an EIA-485 port as standard. The standard protocols shall be Modbus, Johnson Controls N2, Siemens Building Technologies FLN, and BACnet. The use of third party gateways and multiplexers is not acceptable. All protocols shall be "certified" by the governing authority (i.e. BTL Listing for BACnet).
 - J. EMI / RFI filters. All VFD's shall include EMI/RFI filters. The onboard filters shall allow the VFD assembly to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted level (Category C2).
 - K. DRIVE OPTIONS – Options shall be furnished and mounted by the drive manufacturer as defined on the VFD schedule. All optional features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label.

2.5.3.3 EXECUTION

I. INSTALLATION

- A. Installation shall be the responsibility of the mechanical contractor.
- B. Power wiring shall be completed by the electrical contractor, as per wiring requirements based on the VFD input current.
- C. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.
- D. Commissioning of the VFD to be carried out and commissioning report to be submitted as a part of handing over documents.

II. PRODUCT SUPPORT

Factory trained application engineering and service personnel that are thoroughly familiar with the Drive products offered shall be locally available at both the specifying and installing locations.

III. WARRANTY

Standard Warranty shall be 12 months from the date of commissioning or 18 months from the date of Invoice whichever is earlier.

3.0 TECHNICAL SPECIFICATION OF WIRING & CABLES

3.1 GENERAL

Cables shall be selected from one manufacturer who has been manufacturing such cables for at least Ten (10) Years using the Indian Standard Institution (ISI) certification produced for each cable.

3.1.1 LT CABLES:

The scope of this package covers the design, manufacture, stage inspection at works, inspection and testing of finished cables at manufacture's works, testing at independent test house, packing, transport and delivery to consignee's address of 1100V 3C/3.5C/4C Aluminium / Copper conductor, XLPE insulated PVC outer sheathed Cables as per specified construction.

I. CODES AND STANDARDS:

The Cables shall conform broadly to the latest issue of the following standards Including all addition, alternations and modifications thereof.

IS 7098(Part-I: 1988) Specification for XLPE insulated PVC Sheathed Cables for Working Voltages upto and including 1100 Volts.

IS : 8130: 1984 Specification for Conductors for Insulated Cable.

II. DESCRIPTION OF L.T. XLPE CABLE

- ❖ 1.1KV Grade Multicore stranded aluminium conductor XLPE insulated extruded PVC inner sheathed, galvanised steel strip armoured, extruded PVC outer sheathed, conforming to IS: 7098 (Part-I) read with its latest amendment and desired (as per tender BOQ specification) technical specification.
- ❖ 1.1KV Grade Single Core stranded aluminium conductor XLPE insulated, nonmagnetic material wire armoured, extruded PVC outer sheathed, conforming to IS:7098 (Part-I) read with its latest amendment and desired (as per tender BOQ specification) technical specification.

III. TEST AND TEST CERTIFICATES

All the type tests and routine tests shall be carried out in the manufacturer's works as per S:7098 (Part-I):1988 or latest amendment thereof.

The tests mentioned under 'Acceptance Tests' in the relevant IS shall be carried out as 'Acceptance Tests' In addition to above, the following tests for XLPE insulation and PVC sheath shall also be carried out as per IS:10810 during acceptance.

- a. Physical tests for insulation and sheath.
- b. Tensile strength and elongation at break.
- c. Ageing test.
- d. Shrinkage test.
- e. Hot-deformation test.
- f. Fire Resistance test.

3.1.2 STORING, LAYING, JOINTING AND TERMINATIONS.

I. STORING:

Cables shall be stored in accordance with the manufacturer's recommendations and labeled with its Manufacturing Date, Indian Standard for manufacture, cable grade, description, number of cores and cross-sectional area, and length. On receipt of cables at site the cables shall be inspected and stored in a safe place.

II. LAYING:

- a. Cables shall be laid in a manner to prevent strain and damage with no kinks or twists or stripping and be mechanically supported throughout their length. An adequate number of cable rollers, each of which shall be undamaged and completely free to rotate shall be used to support the cable during pulling in such a manner that not part of the cable can touch the ground, the trench bottom or side, or the wall of the buildings or the tray.
- b. Winches whether power driven, or hand operated, and other mechanical aids shall only be used with the prior authorization of the main contractor. Whenever a winch or similar appliance is used, an approved tension gauge shall be fitted into the haulage line between the winch and the cable. The pulling tension must at all times be within the limit advised by the cable manufacturer, which shall be communicated in writing to the main contractor before the laying is commenced.
- c. All cables shall be pulled into position in such a manner as to avoid any damage whatsoever to the cable or its sheath. Cables shall wherever possible, be pulled directly from the top of the drum, which shall be supported throughout the operation in such a manner that it is completely free to rotate. In the event of damage to the sheath or armoring of any cable, the cable shall be replaced throughout its entire length at no cost to the contract.
- d. During the course of pulling operations, the cable shall not be allowed, under any circumstances, to twist or rotate about its longitudinal axis because of excessive pulling tension or for any other reason.

III. JOINTING AND TERMINATION:

Cable jointing shall be done as per the recommendations of the cable manufacturer. Jointing shall be done by qualified & skilled cable jointers.

e. Aluminium Cable Termination Methods:

Glands shall be selected for appropriately for the environment in which the cable is to be used. Each termination shall be carried out using brass double compression glands and cable sockets. Hydraulic crimping tool shall be used for making the end terminations. Cable gland shall be bonded to the earth by using suitable size Cu/G.I. wire/tape.

The general requirements for all joints and terminations of aluminium cables shall be:

- a. To remove oxide from the conductor and prevent the oxide re-forming.
 - b. To prevent corrosion resulting from contact between dissimilar metals.
 - c. To retain contact pressure under cyclic loading conditions.
-
- For all aluminium cables, the oxide shall be removed by thoroughly wire-brushing the bare end of the cable. After brushing, a liberal coating of approved oxide-inhibiting, moisture-excluding thermally stable grease shall be applied, and the cable shall be wire-brushed again through the grease. Cable strands shall not be separated before brushing.
 - Bare aluminium lugs, ferrules and other connectors, unless factory-tinned or factory pre-filled with inhibiting grease, shall be wire-brushed and grease coated in the same way as cables.
 - Before making any joints or terminations in aluminium cables, the Contractor shall submit the proposed method for the Consultant / Main Contractor approval. Notice of at least three working days shall be given before making any joints or terminations, to enable the Consultant / Main Contractor to witness the work.

f. Acceptable Termination Methods:

Aluminium to aluminium connections shall be made by one of the following methods:

- ❖ Aluminum crimp lugs or tinned copper ferrules.
Tinned copper ferrules shall be terminated using the compression method. For compression connections on stranded cables, a hexagonal die shall be used, on solid conductor cables, indent type dies shall be used, with at least two indentations per cable connection. Lugs of ferrules shall be selected to suit the size and shape of the conductor. Compression dies shall be selected to suit the lug or ferrule. Aluminum crimp lugs shall be filled with oxide inhibiting grease.

Aluminum to copper connections shall be made by one of the following methods:

- ❖ Bi-metal connectors, or
- ❖ Tinned copper ferrules. Or
- ❖ Electro-tinned cast aluminum lugs.

Bi-metal connections shall consist of lugs or pin type connectors having a cast copper palm or pin, friction-welded to an aluminium barrel section which is subsequently factory filled with oxide-inhibiting grease. The aluminium cable shall be inserted in the barrel section and fixed using the compression method as detailed above. The copper pin or palm section shall be fixed to copper or brass connectors or bus-bars in the conventional manner. Tinned copper ferrules shall be terminated using the compression method.

Where electro-tinned aluminium lugs are used, they shall be fixed to the cable using the compression method. The palm of the lug shall be bolted to the copper bus-bar or terminal using a stainless-steel bolt and nut, with one large diameter stainless steel flat washer and two "Belleville" spring cup washers.

All nuts shall be adequately torque tightened to manufacturer's recommended levels. Identification tags for feeder designation shall be by using 'Phoenix' plastic cable markers, tied to either end of each cable.

Identification:

A permanent non-corroding securely retained identification label shall be provided at both ends of each cable identifying its cable schedule reference and at all termination points including joint boxes. An acceptable means of identification is an engraved trifoliate label fixed to the cable with plastic cable ties. Self-adhesive labels will not be accepted.

g. Road Crossings:

All cables laid below roads shall be taken through suitable underground Hume pipes / GI Pipes / trenches. The size of Hume pipes / GI pipes/ trenches shall be as per drawings.

h. Construction across Roads:

All works across roads shall be carried out as per the directions of the Project Manager. Necessary safety measures shall be taken to divert traffic. Care shall be taken not to disturb other service lines.

i. Protection of Existing Services:

All pipes, water mains, cables, etc. met with during the course of excavation shall be carefully protected and supported. In any case damage is caused, the same shall be made good at no extra cost, failing which necessary rectification will be done by Project Manager at the risk and cost of the Contractor.

Megger test and continuity test shall be conducted on the cable after carrying out the end termination.

3.1.3 GENERAL SPECIFICATIONS FOR CABLE LAYING ON CABLE TRAYS

- a. Cables used on 415V system shall be of 1.1 KV grade, aluminum/Copper stranded/single conductor, XLPE or PVC outer sheath, PVC inner sheath, upto 10Sq.mm Copper with Round Strip, from 16Sq.mm and above Aluminum Multistrand Flat Strip as per the ST2 type 7098 Part-1 Cables Standards.

- b. Cable identification tags shall be of 2 mm thick, 20mm wide aluminum strip of suitable length to contain cable identification.
- c. Cables shall be neatly arranged on trays and neatly clamped / tied to prevent sagging.
- d. Wherever cables are laid in trenches (outdoor), depth of trenches shall not be less than 750mm and width 600mm, after cable has been laid and straightened, it shall be covered with 75mm thick layer of sand. Similarly, the excavated trench should be filled upto 75mm sand prior to cable lying. Over this sand layer a course of cable protection tiles to overlap cables by 50mm on either side shall be laid. Trenches shall then be backfilled and consolidated. The suitable markers shall be provided at regular intervals to the 200mm above the ground level(MGL)
- e. Cable Trays from 600mm & above shall be supported with 50x50 Tubular Section / 50/50x6mm angle/channel fabrication.
- f. Cable Trays from 450mm shall be supported with 25x25 Tubular Section / 25/25x6mm angle/channel fabrication.
- g. 300mm & below shall be supported with down rod (12mm) & slotted angle for data & power distribution cable.
- h. At every 15mtrs length, 1no U clamp of 8mm dia hole to be provided. This is meant for internal 25X6mm GI earth strips to take tapping to vertical drop earth wires.

3.1.4 SPECIFICATION FOR WIRING / CONDUITING

- a. Wiring forms the most vital area as it is the closest point of access to all. Therefore, this shall be done with utmost skill keeping all safety aspects and aesthetics and future works in mind. The workmanship shall be of the best quality, following good engineering and safety practices and adhering to the relevant codes/ Rules / Acts / IS specification such as IS 2774/ IS 732 etc. Wherever such Codes / Rules / Acts / IS codes etc have conflicting views, the Contractor shall follow the better one and not take advantage by providing /using inferior material / practices. Code of practice for electrical wiring installations system such as IS 2774 and IS 732 must be strictly adhered to
- b. Electrical grade, non-inflammable rigid PVC/FRLS conduits and accessories shall be used throughout the installation. The thickness of the conduit shall be minimum 2 mm for 20/25/32 mm conduits and 2.5 mm for higher sizes.
- c. All conduits which are to be taken in the ceiling slab shall be laid on the prepared frame work of the ceiling slab before concrete is poured. Conduits shall be properly fixed to the bends, junction boxes and outlet boxes shall be made water tight by using sealant at ends. Before the conduits are laid, the layout shall be planned to minimize offsets and bends, and a drawing of the final layout shall be submitted for approval / records before executing the work/layout.
- d. Before conduit is embedded in the walls, cutting of all chases, grooves shall be complete. The outlet boxes point control boxes and inspection boxes shall be properly clamped and embedded and shall be so arranged that at least 12 mm plaster is used to cover it and till final finishing level.

- e. Conduits shall be terminated into outlet boxes, with check nuts on both sides. All sharp edges etc. shall be removed before wires are drawn.
- f. Open/surface conduit shall be fully avoided. If however inevitable, they shall be fixed on to the wall surfaces, ceiling etc. with saddles, clamps and screws and neatly painted to matching colors.
- g. All wires/cables shall be of PVC insulated FRLS type of multistrand copper only. The minimum size of the wires/cables shall be 4 sq mm for power circuits.
- h. The number of wires/cables in each conduit shall be such that there shall be a minimum 50% free space in the conduit.
- i. Strands of wiring shall not be cut for connecting it to terminals.
- j. Lighting, Power, UPS wiring circuits shall be segregated and taken in separate conduits. Separate earth wire shall be run for each circuit of specific rating accordingly.
- k. Colour coding of wires/cables shall be given full importance. Phase wires shall be of red/ yellow / blue in colour. The neutral wires shall always be black in colour. Earthing wires shall be always green in colour.
- l. Earth bus / wires shall not be used as neutral conductors.
- m. The incoming / outgoing wires to Distribution boxes / sub-distribution boxes shall be taken in separate conduits and not combined with looping circuit.
- n. The number of power socket circuits, not more than 2/3 points shall be fed from one circuit, irrespective whether they are 6 Amps. or 16 Amps. Sockets. Separate circuits shall be drawn directly from the DBs for high-wattage loads.
- o. All circuits shall have positive isolation of neutral by using Double pole / four pole isolators in single phase / 3 -phase circuits respectively. If three phase supply is feeding single phase loads, the loads shall be evenly distributed amongst all the three phases.
- p. Switch boxes shall be branded and made of 16 Gauge sheet steel of minimum depth of 75 mm and shall be provided with 20/25/32 mm knockouts on all four sides, earthing studs of minimum 5 mm plated bolt/ screws, nuts and washers shall be provided in the boxes. The boxes shall be powder coated or plated. Prior to drawing of wires/ fixing of components, it shall be fully cleaned to remove all cement/plaster/dust etc.
- q. The switch boxes shall be provided with 4 mm thick acrylic covers of approved color with plated / colored / brass hardware or poly carbonate dual plates in case of Modular Switches are specified.
- r. All unused knockouts/ cutouts shall be neatly and properly plugged/ covered.
- s. The measurements given in the Specifications / Schedule of quantities are tentative. The actual measurements will be taken at the time of execution of work. Measurement of cables / wires shall be taken from entry point to entry point of panels / distribution boards/ boxes/ switch boxes etc.

4.0 TECHNICAL SPECIFICATION OF EARTHING

4.1 EARTHING SPECIFICATIONS

All earthing practice shall confirm to IS 3043

All non-current carrying metal parts of electrical installation shall be earthed as per IS 3043. All metal conduits, process equipments, motor, trunking, switch gear, DB's and all other metal parts forming part of the works shall be bonded together and connected by two separate and distinct conductors to earth electrodes.

In case of star connected systems with earthed neutrals:

The neutral point of every generator and transformer shall be earthed by not less than two separate and distinct connections with the earth having its own electrodes of ratings according to the respective technical specification.

Temporary earths are those applied at the actual location of work during construction of installations for protection of workmen and property shall be of GI rods or GI/CI pipes of size min. 50mm in dia and 2.5mt in length and shall be driven to depth of 2.5mt. By filling salt, charcoal and sand up to 2mt level from the bottom of ground.

Earth electrode resistance should not exceed 1.0 ohm.

Substation i.e., transformer (neutral + body earth) & PCC shall be earthed using plate electrodes. Deviation such as pipe electrode may be used as matter of economy. All MCC will be earthed by 50mm GI pipe electrodes / GI plate.

Plate electrodes: Plate electrode shall be made of copper plate 3.15mm thick and 600 x 600 mm size for copper plate earthing and 600 x 600 x 6 mm GI plate for GI plate earthing. Plate shall be buried vertically in ground at depth of not less than 3 mt to the top of plate. Plate shall be encased in charcoal to thickness of 15cm all around. GI pipe of size not less than 50 mm dia shall be placed vertically over the place and bolted along with double washers by GI/SS bolts and nuts. Pipe shall be terminated in a funnel at 150mm above ground. Funnel shall be covered with wire mesh. The funnel shall be enclosed in masonry chamber of 600mmx600mm. Chamber shall be provided with MS/cast iron cover. Permanent identification label shall be provided for each electrode as per drawings. And copper earth flats which is to be joined by riveting, brazing and bolting as per standards.

GI pipe size not less than 50 mm dia shall be placed vertically over the plate and bolted along with double washer by GI/SS bolts and nuts. Pipe shall be terminated in a funnel at 5 cm above ground. Funnel shall be covered with wire mesh. The funnel shall be enclosed in masonry chamber of 600mm x 600mm Chamber shall be provided.

MS/Cast iron cover. Permanent identification label shall be provided for each electrode. Refer fig. for details

All Light fixtures, fan, switch enclosures, lighting conduits shall be earthed using 16 SWG bare copper wires or 105 sqmm copper conductors PVC insulated wires.

All DB's shall be earthed using 25 x 3mm GI flat / No 8 SWG Copper wire.

All single-phase switches/points above 30 amps upto 63 amps shall be earthed using 8/10 SWG copper / GI wires.

All switch boards, DB's panels, MCC etc. Shall be earthed to earth electrodes. The number of electrodes required shall be (not less than two numbers) arrived at taking into consideration anticipated fault levels.

Earth bus shall be of size not less than 50 x 6 mm GI.

Generally Earthing for copper/GI plate electrodes shall be used for substations and pipe electrodes for MCC panels DB etc.

5.0 TECHNICAL SPECIFICATION OF LOW VOLTAGE SYSTEM

5.1 SOCKETS AND ACCESSORIES:

a. GENERAL REQUIREMENTS:

All sockets 6A/16A ratings shall be of flush mounting type (unless otherwise indicated with control switches of plate type design of the same rating as that of the sockets. All socket outlets shall be of 3 pin/multipin universal type with PVC/metal boxes.

b. METAL OUTLET, COVERS AND SWITCHES:

The switch box shall be made of modular metal boxes with suitable size modular cover plates. Modular metal box shall be made of mild steel on all sides except on the front. The metal box (other than modular type) shall be made of metal on all sides except on the front. Boxes shall be hot dip galvanized mild steel. Metal boxes up to 20 x 30 cm size M.S. box shall have wall thickness of 18 SWG and MS boxes above 20 x 30 cm size shall be of 16 SWG. The metallic boxes shall be painted with anti-corrosive paint before erection. Clear depth of the box shall not be less than 50mm. All boxes shall be covered from top with Phenolic laminated / decorative sheet of approved shade. These shall be of 3 mm thick synthetic phenolic resin bonded laminated sheet as base material and conform to grade P-I of IS: 2036-1994.

All 6/16 Amp switches shall be modular type of 240 volts A.C grade. All switches shall be fixed on modular metal boxes. All 6 Amp socket shall be 5 pin type and 16 Amp socket shall be 6 pin type (unless otherwise specified) suitable for 16/6 Amp. All modular switches, sockets, telephone, data outlets, etc. shall be in off white finish unless otherwise specified. The switches controlling the lights or fans shall be connected to the phase wire of the circuit. Switch boards shall be located at 1200 mm/ above Furniture from finished floor level unless otherwise indicated on drawings or directed by engineer in charge.

In case of computer power points, power points, telephone points etc. to be fixed on laminated partition board (furniture), same shall be fixed on laminated board (portion of laminated board meant for fixing power points) with base plate/cover plate as applicable, duly fixed with screws.

All modular switches, sockets, telephone outlets etc. shall be fixed modular metal boxes with modular base plates and modular cover plates on top.

c. INDUSTRIAL TYPE SOCKETS:

Industrial type sockets shall be provided wherever specifically called for on the drawings. Industrial sockets shall be rated as specified. Plugs and sockets shall have 3 pins for single phase applications and 5 pins for 3 phase applications. The sockets shall be provided with suitable plug top and cable entry device and shall be controlled by a suitably rated rotary switch. The sockets shall be housed in suitable PVC housings of IP 54 protection class.

d. INSTALLATION

All switch connections shall be made only after ensuring the continuity of wires and terminations. Tapping of wires shall be done only at the terminals of switches, sockets and ceiling roofs and terminal blocks. Under joining and extension of wires in pipes and conduits shall not be carried out under any circumstances.

The arrangement of switches and sockets shall be neat, systematic, and aesthetic. The Contractor shall obtain approval from the CLIENT /CONSULTANTS with regard to the proper location of switches and all outlets.

The enclosures of sockets and pin of the sockets shall be connected to the ground through a proper size insulated earth continuity wire. Metal or FRP phase barriers shall be interposed between switches located in a common enclosure, when wired on different phases.

e. LABELING

The Contractor shall provide labeling for all, industrial-type sockets, socket outlets, permanently connected devices, etc, identifying the distribution board and circuit breaker number, in an approved manner, acceptable to the Client / Consultants, to provide ready identification. Hand painted labels are not acceptable.

5.2 POWER DISTRIBUTION BOARD WITH MINIATURE CIRCUIT BREAKERS

I. SCOPE

This specification covers the design, manufacture, assembly, testing at works and supply of Distribution Boards. Complete with all accessories for efficient and trouble free operation. As per specification and makes in tender.

- a. The enclosure should be of special grade CRCA sheets or thermoplastics, in case of metal enclosures, they should be subjected to seven tank phosphating and rust retardant process final finish to be powder coated and scratch resistant.
- b. Enclosure to be of weather proof construction, IP 42 for indoor use, and IP55 for out Door use. Distribution boards to be designed to conform to IS 8623
- c. Suitable knockouts should be provided for different size of cables and cable glands.
- d. Adequate clearance to be provided between DIN rails. DIN rails to be designed for easy mounting of MCB's, RCCB's load insulators, etc.
- e. Current carrying parts should be of electrolytic grade copper.
- f. Neutral bars to be of brass with insulation and separate earth bars to be provided.

- g. MCB's should have breaking capacity of 10KA (IEC 898) and should meet the requirements of IS:8828 BS 3871, VDE 0641 and IEC: 898
- h. Circuit identification stickers or charts to be provided.

II. CONSTRUCTION

The distribution boards shall be fabricated out of 1.2 / 1.6mm thick CRCA sheet steel and shall be totally enclosed, dust and vermin proof, dead front, with hinged door with double sided hinged door type of bolted / welded construction suitable for wall mounting.

Each DB shall have individual hinged/bolted gasketed doors with cam lock. Removable gland plates shall be provided at top and bottom of the DB to facilitate drilling the holes at site to suit individual requirements or knockout shall be provided.

Protective insulated cover plate shall be provided inside the panel to shroud all the live parts. Only the operating handle of the switch and the operating knobs of the miniature circuit breakers shall be projecting outside the cover plate. The unused holes of the DB shall be suitably blanked. The incoming switch terminals should be suitably shrouded to avoid accidental contact. Each phase or way shall also be suitably shrouded with DMC / SMC. The boards shall be factory wired and assembled. Circuit identification labels shall be provided on the cover.

All Lighting distribution board shall be provided with Double Door arrangements. They shall be of Phase segregated type. All components in the Distribution boards shall be same make. All the live part of the distribution shall be suitably shrouded.

III. BUSBARS

The bus bars shall be air insulated and made of high conductivity high strength copper bus bars liberally sized with high safety factor for the required rating (both short circuit and continuous currents). The neutral bus bar shall have adequate number of terminals for all outgoing single-phase circuits. A copper earth bus of suitable size shall be provided in each DB for earthing of the power, lighting circuits and earthing of DB.

IV. MINIATURE CIRCUIT BREAKERS

The Miniature Circuit Breakers (MCB's) shall be heat resistant, moulded type, designed, manufactured and tested as per IS 8828. The MCB's shall have inverse/ clause-6-time tripping characteristic against over loads and instantaneous trip against short circuits. The MCB's shall be of fault current limiting type **Class 3**. The MCB's shall be slip on type to the busbar. The ON and OFF position of the switch handle shall be clearly marked. The MCB's shall be suitable for operating in ambient of 45°C without de rating and tripping characteristics should be calibrated at 40°C. The incoming and outgoing of the MCB's shall be accessible only after opening the front door of the DB. The MCBs shall be suitable for 415V, 3 phase, 4 wire, and 50 Hz system with the fault level of 10KA RMS symmetrical. The terminals of MCB s shall be suitable for use with eye lugs. The 4 pole, 3 pole and 2 pole MCB knobs shall be trunked with adequate strength tandem pin. B Curve for lighting, C Curve for Motor loads and D curve MCB's for UPS loads shall be used.

V. EARTH LEAKAGE CIRCUIT BREAKERS/RCCB

Incomer of the DB shall be provided with current operated Earth leakage circuit breakers with a sensitivity of 30mA for lighting, 300mA for power distribution. The ELCB shall have Trip free mechanism and shall operate even on neutral failure. ELCB shall be tested for isolation.

The ELCB shall be provided with a Test Push Button to stimulate leakage and test the ELCB. The ELCB shall operate and switch off the circuit within 30 milliseconds.

The enclosures of the ELCB shall be moulded from High quality insulating materials, which shall be fire retardant, anti-tracking, non-hygroscopic, and impact resistant and shall withstand high temperatures.

VI. GROUNDING

The DB's shall be provided with two No's brass earthing stud terminals with suitable nuts, washers etc for connection to earth bus outside the DB.

VII. PAINTING

Care shall be taken in workmanship and selection of materials to prevent the occurrence of any form of damage or corrosion due to damp or highly humid conditions. The DB shall be prepared, primed, filled and painted to the highest standards. All items shall be cleaned and de burred after fabrication and welding is complete. External surfaces shall be filled and rubbed down as necessary to obtain a perfectly flat smooth surface free from blemishes and imperfections and the entire DB shall be powder coated with epoxy paint and the shade shall be indicated later.

VIII. TESTS

All necessary routine tests shall be performed on the equipment to demonstrate satisfactory performance to owner / consultant at works without any extra cost. Equipment shall not be dispatched without obtaining approval of test certificates for type, routine and acceptance tests. Inspection of the panels / switch gear shall be done by client at the vendor premises.

IX. DRAWING & INSTRUCTION MANUALS

Along with the offer, the bidder shall submit the following documents, in Triplicate.

- a. General arrangement of DB
- b. Technical leaflets on DB, MCB, MCCB, isolator etc.
- c. Type test reports as per IS 8828
- d. Tripping characteristic curves for MCB/MCCB.

After award of the order, the contractor shall submit the following documents for approval, in six copies.

- i. General arrangement drawing showing the constructional features, dimensions, installation details etc.
- ii. Complete technical particulars of Distribution boards, miniature circuit breakers, isolators etc.
- iii. Tripping characteristic curves for MCB.

Before taking up manufacturing of the equipment the Bidder shall have to take the approval of for design and drawing. Any manufacturing done prior to approval shall be rectified by the bidder at his own cost and the equipment shall also be supplied within the stipulated period.

5.3 SPECIFICATION FOR RACEWAYS:

5.3.1 METAL RACEWAYS:

As per NEC (National Electric Code) & NEMA (National Electric Manufacturers Association) standards, raceways should be fabricated from 2 mm M.S sheet, confirming to IS: 226/1975 and if these are galvanized, Galvanizing should confirm to IS: 2629. The Race Ways should be given with Synthetic Enamel Paints confirming to IS: 3537 or IS: 168. Either one coat of Red Oxide Primer followed by two coats of Epoxy Paint has to be provided on specific demand.

5.3.2 PVC RACEWAYS:

As per NEC (National Electric Code) & NEMA (National Electric Manufacturers Association) standards, raceways should be fabricated from 2.5 mm thick PVC sheet, confirming to CE marked, to meet the EMC and LV directives. The PVC materials used are non-corrosive and not affected by sea water, mineral adds, alkalies etc. Clip on covers with optional fix & interchangeable accessories provide continuous accessibility of rewiring & maintenance.

Expansion coupler plates/ jointing strips are used to join two Race Ways. It depends on the height of edge of a Race Ways whether coupler plate is needed or a jointing strip. These has to be supplied depends on the requirement at the site.

APPROVED MAKE LIST

SL. NO.	ITEM / COMPONENT / MATERIAL	APPROVED MAKES
1.	Current Transformer	KALPA / KAPPA / VOLTAMPS / PROK DEVICE
2.	Analog / Digital Panel Meters	ELMEASURE / CONZERV / TRINITY / RISHABH / MECO / L&T / CIRCUITOR
3.	Air circuit breakers (ACBs) & Moulded Case Circuit Breakers (MCCBs)	ABB / SIEMENS / SCHNEIDER
4.	Miniature Circuit Breakers (MCBs), Earth-leakage Circuit Breakers	ABB / SCHNEIDER / LEGRAND
5.	MCB Distribution Boards	ABB / SCHNEIDER / LEGRAND

6.	Load Break Switch/Change-over Switch	ABB / LEGRAND / SCHNEIDER /SIEMENS
7.	Earth-leakage Relays	PROK DEVICES / KALPA / VOLTAMP / L&T / ABB
8.	Auxiliary relay	ABB / SCHNEIDER / L&T / SIEMENS
9.	Power Contactors	SCHNEIDER / ABB / L&T / SIEMENS
10.	Bi-Metallic Overload Relays	SCHNEIDER / ABB / LEGRAND / L&T / SIEMENS
11.	Indicating Lamps / Push button	ABB / SCHNEIDER / L&T / VAISHNO / SALZER / TEKNIC / KAYCEE
12.	Auxiliary relay	ABB / SCHNEIDER / L&T / SIEMENS
13.	VFD	ABB –ACH 550 / DANFOSS – FC-102 / ALLAN BRADLEY -POWERFLEX 525
14.	LT 1.1 KV Power Cables	POLYCAB / KEI / GEMSCAB
15.	LT 1.1 KV PVC Insulated / FR / FRLS Flexible Cables	POLYCAB / KEI / GEMSCAB
16.	PVC Insulated / FR / FRLS Copper Wires	FINOLEX / ANCHOR / GEMSCAB / KEI / POLYCAB/POWER FLEX
17.	Cable Lugs (Copper)	MULTI / BRACO/ CONNECTWELL / DOWELLS
18.	Cable Glands (Brass)	SMI / HMI / BRACO / DOWELLS
19.	PVC / MS Conduits and accessories	VIP / UNIVERSAL / AKG / BHARATH
20.	Switches / Power Sockets	NORTHWEST / LEGRAND / MK
21.	Industrial Plug & Socket	LEGRAND / NEPTUNE BALLS / CLIPSAL / BCH
22.	PVC Raceway / Metal raceway	SCHNEIDER / LEGRAND / MK / OBO
23.	Cable trays	PUSHPACK / OBO / PROFAB

24.	Isolator with Metal Enclosure	SCHNEIDER / ABB / LEGRAND / L&T
25.	ON/OFF, Emergency Push button	HENSEL / SCHNEIDER / L&T
26.	Fire Safety equipments	ALERT / MINIMAX / SAFEX
27.	Electrical Panel builder	M/s. POWER CONTROL EQUIPMENTS, M/s. SS POWER GEARS. M/s PACE SWITCHGEARS, M/s. LOTUS SWITCHGEARS &
NOTES:		
1. Please highlight the makes considered in the tender.		
2. The final choice of the actual makes to be used shall rest with the Consultant / Architect.		
3. Where no makes are specified, the Contractor shall indicate the make considered, giving complete Technical and samples if called for, for the approval of the Purchaser and / or the Consultant.		

SUB HEAD- 4: EXHAUST SYSTEM

1.0 EXHAUST SYSTEM DESIGN BRIEF:

The Exhaust system is mainly divided into three Major Sub Systems as mentioned below.

- 1.1 Fume Exhaust System for Solvent Fume Hoods.
- 1.2 Scrubber Exhaust System for Acid Fume Hoods.
- 1.3 Redundancy Exhaust Blower for each Cluster.

1.1 FUME EXHAUST SYSTEM FOR SOLVENT FUME HOODS:

- 1.1.1 A dedicated exhaust blower of suitable capacity is proposed for each cluster of solvent fume hoods, snorkel exhaust, storage cabinet exhaust, glove box & vent point exhaust.
- 1.1.2 The proposed exhaust blower shall be in the terrace floor & connected through the PP FRP exhaust ducting.
- 1.1.3 The fumes will be captured from the source of generation through the Hood / Snorkel / Cabinet & ducted through PP FRP ducting connected to the exhaust blower & then let out to atmosphere at a height of Three mtrs from the terrace level. For further details, Refer the Lab General Arrangement Drawings in tender.
- 1.1.4 For further clarity on the cluster details, Refer P & ID Drawings attached in tender.

1.2 SCRUBBER EXHAUST SYSTEM FOR ACID FUME HOODS.

- 1.2.1 A dedicated wet scrubber along with exhaust blower of suitable capacity is proposed for each cluster of acid fume hoods.
- 1.2.2 The proposed wet scrubber & exhaust blower shall be located in the terrace floor & connected through the PP FRP exhaust ducting.
- 1.2.3 The fumes will be captured from the source of generation through the acid fume hood & ducted through PP FRP ducting connected to the exhaust blower, wherein these fumes will be scrubbed in the proposed wet scrubber before letting it out to atmosphere at a height of Three mtrs from the terrace level.
- 1.2.4 For further clarity on the cluster details, Refer P & ID Drawings attached in tender.

1.3 REDUNDANCY EXHAUST BLOWER FOR EACH CLUSTER

- 1.3.1 An exhaust blower is proposed as a stand by unit for each cluster.
- 1.3.2 The blower shall be suitable for running at different capacity to match the air volume of blowers in that cluster.
- 1.3.3 In case of any break down or maintenance of the exhaust blowers, these redundancy blowers shall be in operation as a stand by unit.
- 1.3.4 Manual changeover by the dedicated service personnel is envisaged.

2.0 MODE OF OPERATION OF EXHAUST SYSTEM:

The Proposed exhaust system is to be designed for working in 2 modes of operation as mentioned below.

2.1 General Exhaust Mode.

2.2 Night Setback Mode.

2.1 GENERAL EXHAUST MODE: - The Chemical sciences labs shall be in General exhaust mode operation from morning 7.00 am to night 11.00 pm. During this period the lab shall be in full operation with faculty & students and in this mode the exhaust blower shall operate / work at full designed capacity considering all fume hoods working.

2.2 NIGHT SETBACK MODE: - The Chemical sciences labs shall be in Night setback mode operation from night 11.00 pm to morning 7.00 am. During this period no lab activity is envisaged and hence the exhaust blower shall be ramped down to the minimum exhaust set point to maintain lab under negative condition when compared to adjacent corridor area & also to save power.

The above said two modes of operation shall be programmed in the VFD control units of the respective exhaust blowers. The set point of VFD frequency shall vary from blower to blower based on its capacity, minimum exhaust requirement & fan curve limitations, the frequency set point for individual blower shall be decided at the time of system commissioning, the frequency setting shall be based on minimum requirement OR blower least working capacity.

3.0 MAIN FEATURES / CONSIDERATION OF THE PROPOSED EXHAUST SYSTEM

3.1 All proposed fume hoods are of constant air volume type.

3.2 The generic exhaust air volume considered for designing the exhaust system capacity is as under:

3.2.1	Fume hood 7" (2100 mm)	=	900 CFM
3.2.2	Fume hood 6" (1800 mm)	=	900 CFM
3.2.3	Fume hood 5" (1500 mm)	=	750 CFM
3.2.4	Fume hood 4" (1200 mm)	=	600 CFM
3.2.5	Vent point for store rooms	=	300 CFM
3.2.6	Snorkel exhaust	=	100 CFM
3.2.7	Glove box exhaust	=	150 CFM
3.2.8	Storage Cabinet exhaust	=	30 CFM

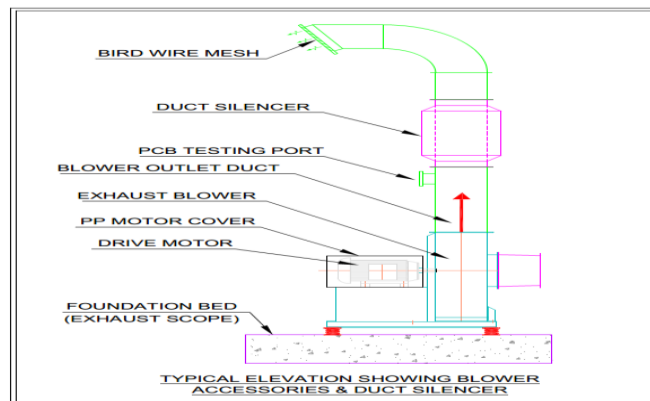
3.3 The Exhaust volume considered is for guidance purpose only. All blowers to be selected as per tender BOQ capacities.

3.4 One snorkel exhaust point is considered for each island table.

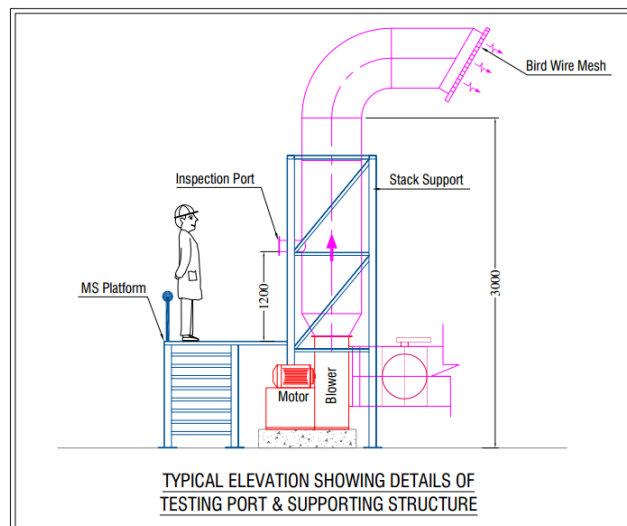
3.5 Corrosion resistant, centrifugal backward type, aerodynamically designed, statically & dynamically balanced, low noise level, imported make like Colasit / Plastifier exhaust PP blowers are proposed for this project.

3.6 The vertical blower outlet duct shall be let out at minimum three mtrs height from the terrace level.

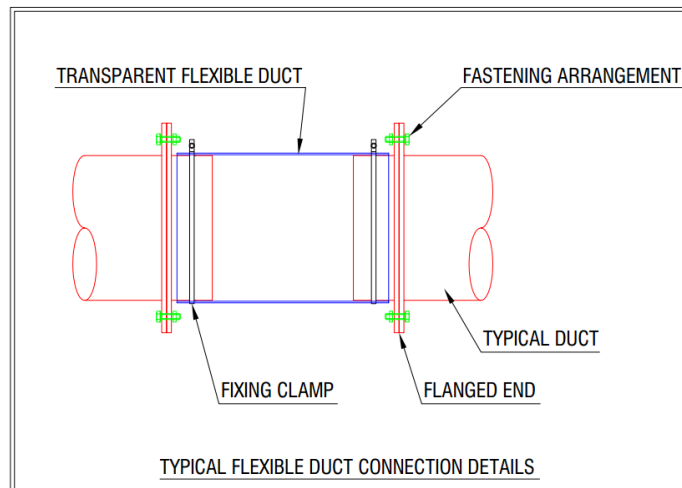
3.7 The blower outlet duct shall have a silencer to reduce the air noise, the silencer shall be made out of outer & inner layer PP FRP ducting the space between them shall be filled with Mineral wool insulation. Internal duct of the silencer shall be perforated with suitable size holes (minimum 10mm dia & pitch of 25mm) the silencer shall be with both ends flanged (For more details refer silencer specification & drawing). Mineral wool insulation shall be supplied as per tender specification.



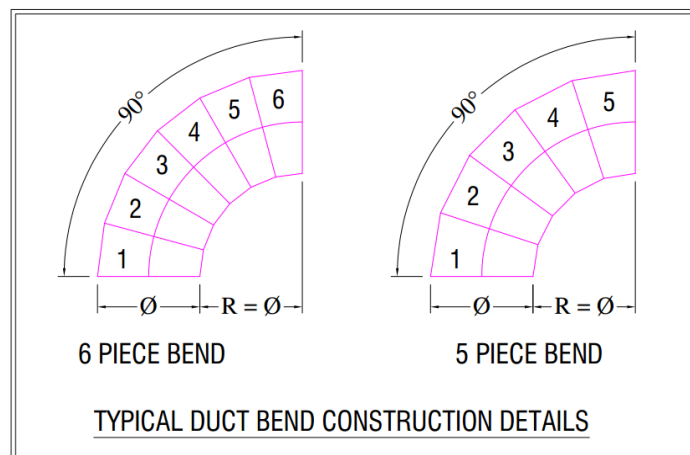
3.8 Each blower outlet duct shall have a testing port / sampling port at suitable accessible height.



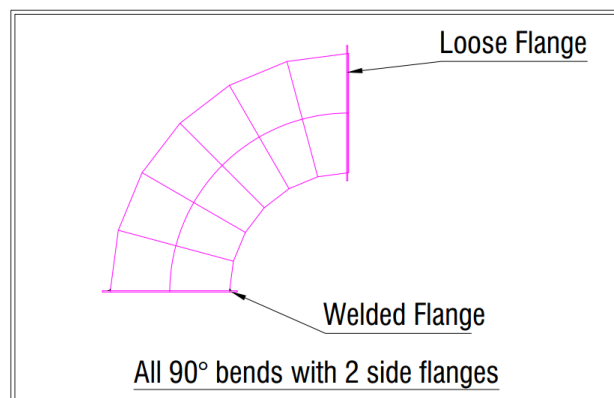
3.9 Blower Inlet & Outlet shall have Flexible connection made out of transparent PP sheet along with flanged spigot & fixing GI clamps on the both ends. The proposed arrangement shall be as shown in the figure below.



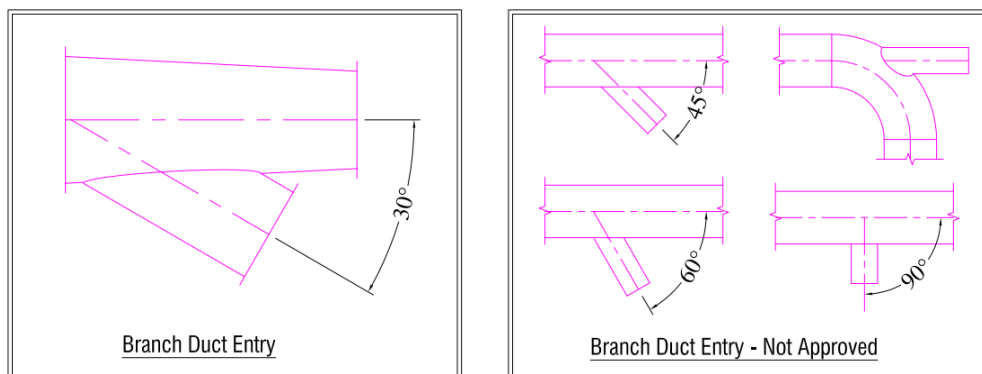
- 3.10 For emergency / maintenance purpose, a redundancy blower is proposed as a stand by unit for each cluster.
- 3.11 Water based wet scrubbers are proposed for scrubbing the acid fumes before letting it to atmosphere
- 3.12 Smooth internal PP Ducting with FRP outer lining is considered for conveying the fumes from source of generation to exhaust blower inlet.
- 3.13 Fire resistant Bisphenol resin shall be used for binding FRP over & above PP ducting.
- 3.14 5mm thk Neoprene gasket shall be used in between each flange joints.
- 3.15 All the duct bends shall be of smooth with 5 / 6 - piece construction.



- 3.16 The 90 Deg bends / ducts shall have flanges on both sides. (Minimum one side loose flange).



- 3.17 All branch duct entry shall be 30 Deg to the 'Y' piece / main duct.



- 3.18 The maximum distance between the two duct supports shall be not more than 2500mm.
- 3.19 The civil foundation required for mounting the exhaust blowers & Scrubbers shall be part of this tender, Vendor to include the necessary costing for the same in their quotations.
- 3.20 Vendor to visit site & ascertain the site condition with respect to the tender drawings, duct routing, civil roof / wall cut-outs & vendor shall include the necessary costing for any items / cut outs / closing making it leak proof, which is required for completion of this tender.
- 3.21 The Construction / Fabrication of PP exhaust duct shall be round in cross section & Elliptical duct construction is not accepted.
- 3.22 All flanges shall be made at factory only, no drilling of holes at site is acceptable.

4.0 EXHAUST SYSTEM SPECIFICATION

4.1 SPECIFICATIONS FOR PP/FRP DUCTING AND ACCESSORIES

Technical Specification for PP/FRP Ducting:

- 4.1.1 PP means PPGL: One side smooth & glossy finish and other end is mat finish.
The smooth surface should be the inner surface of the duct.
On mat side, FRP lining to be done.
- 4.1.2 FRP Lining to be done on the outer surface of PPGL I.e. on mat side.
One-layer FRP is one mm.
The final layer should be with fine mat to have smooth and good finish.
- 4.1.3 Fire resistant Bisphenol resin to be used
- 4.1.4 All the flanges should be properly ground and dressed.
- 4.1.5 Duct support distance should not be more than 2500 mm.
- 4.1.6 Any duct length should not be more than 3600 mm.
- 4.1.7 The finish paint should be admiral grey unless specified.
- 4.1.8 5 mm Thick Neoprene gasket to be used between the flanges.

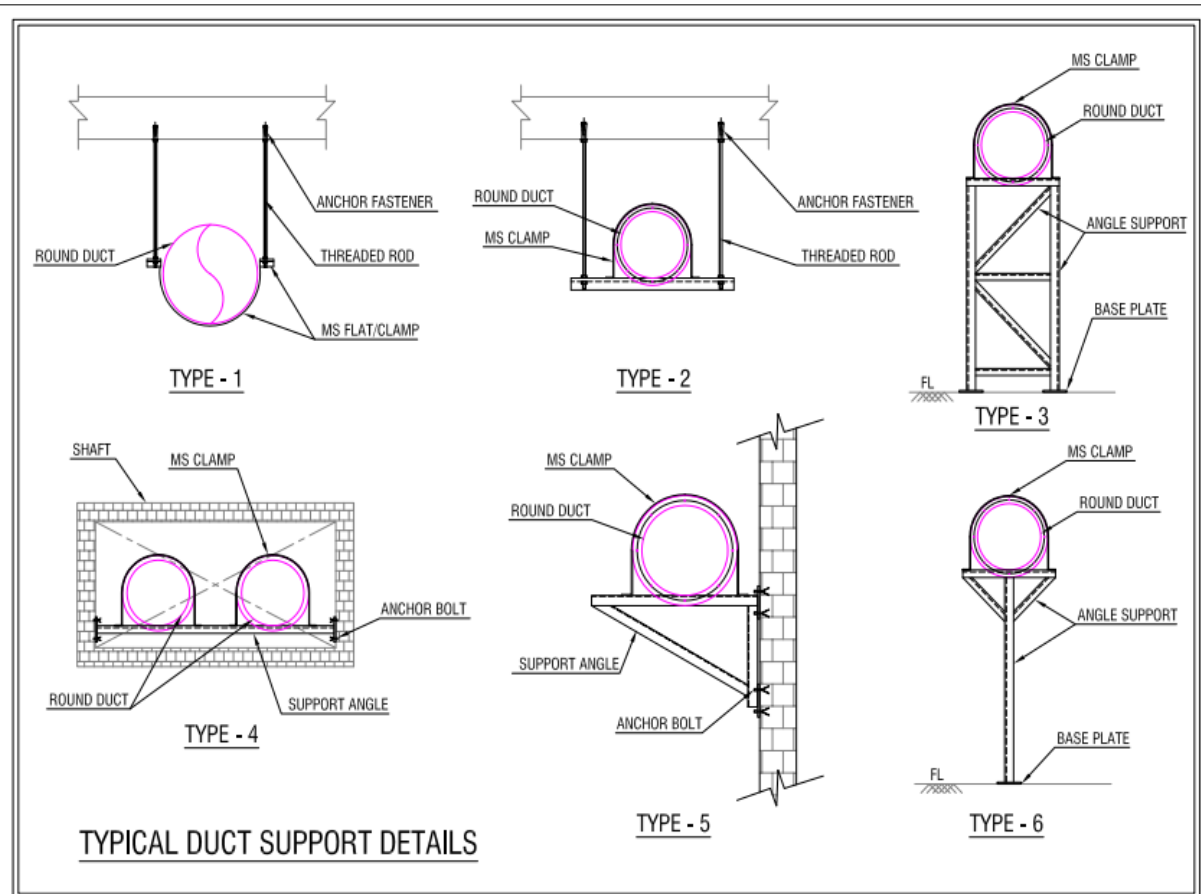
STANDARD FOR CIRCULAR DUCT FLANGE DETAILS

STANDARD FOR CIRCULAR DUCT FLANGE DETAILS						
SL NO	DUCT DIAMETER	FLANGE THICKNESS	OUTER DIA	PCD	NO OF HOLES	HOLE DIA
	D	F	OD	PCD	B	A
1.	150	30 x 8	210	186	4	8
2.	175	30 x 8	235	211	4	8
3.	200	30 x 8	260	236	4	8
4.	225	40 x 8	285	261	8	8
5.	250	40 x 8	310	286	8	8
6.	275	40 x 8	335	311	8	8
7.	300	40 x 8	360	336	8	8
8.	325	40 x 8	385	361	8	8
9.	350	50 x 8	410	380	12	10
10.	375	50 x 8	435	405	12	10
11.	400	50 x 8	460	430	12	10
12.	425	50 x 8	485	455	16	10
13.	450	50 x 8	510	480	16	10
14.	475	50 x 8	535	505	16	10
15.	500	50 x 8	560	530	16	10
16.	550	50 x 8	610	580	16	10
17.	600	50 x 8	660	630	16	10
18.	700	50 x 8	760	730	16	10

The diagram illustrates the geometry of a circular duct flange. It shows a central circular duct with diameter D . Surrounding it is a flange with thickness F and an outer diameter OD . The pitch circle diameter (PCD) is the diameter of the circle passing through the centers of the holes. The holes have a diameter A and there are B holes in total, arranged in a circle.

4.2 SUPPORT SYSTEM

- 4.2.1** All duct supports which are coming within the building shall be a part of PP FRP ducting line item, whereas the duct supports in the terrace floor area shall be considered a part of MS support BOQ line item.
- 4.2.2** A completely supporting system consisting of fully threaded rods, double L bottom brackets nuts, washers, clamps for circular ducts and anchor bolts as supplied.
- 4.2.3** To provide the required thermal brake effect, Neoprene or equivalent material of suitable thickness shall be used between duct joints.



4.3 INSTALLATION

4.3.1 TOOLS AND TACKLES FOR SITE WORK:

For duct assembly and Installation, the use of suitable tools and tackles should be used to give the required duct quality and speed of installation including.

- Drilling machine with drill bits – for drilling holes on the PP/FRP flanges.
- Hammer drill machine with drill bits – for drilling holes in building structure for anchors.
- Hoisting system – for lifting the duct assembly up to mounting heights.
- The duct pricing shall inclusive of all above facility.

4.3.2 INSTALLATION PRACTICE:

- a) All necessary allowances and provision shall be made for beams, pipes, or other obstructions in the building whether or not the same are shown on the tender drawings. Where there is interference/ fouling with other beams, structural work, plumbing and conduits, the ducts shall be modified suitably as per actual site conditions.
- b) Ducting over false ceiling shall be supported from the slab or from beams. In no case shall any duct be supported from false ceilings hangers or be permitted to rest on false ceiling. All Sheet work in dead or furred down spaces shall be erected in time to occasion no delay to other Vendor's work in the building.
- c) All ducts shall be totally free from vibration under all conditions of operation. Whenever ductwork is connected to fans that may cause vibration in the ducts, ducts shall be provided with a flexible connection, located at the unit discharge.

4.4 DAMPERS AND FLEXIBLE HOSE

GENERAL

Volume control damper sets shall be provided where specified according to the specifications in the offer BOQ. Dampers shall be double thickness heavier than the thickness of the large duct & shall be rigid in construction.

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

Construct blades of 3 mm thick PP MOC, provide heavy-duty molded self-lubricating nylon bearings, 13mm (1/2") diameter Plastic axles spaced on 225mm (9") centers. Construct frame of 300 mm diameter outer with Flange for fitting minimum 6 bolts and nuts. The outer shell body shall be a transparent material of Poly propylene.

Automatic manual volume opposed blade shall be not over 225mm wide. The dampers for fresh air inlet shall additionally provide with fly mesh screen, on the outside of 0.8mm thickness with fine mesh.

4.5 MANUALLY ADJUSTABLE DAMPER SETS

Damper sets shall be arranged in substantial supporting frames and each blade shall be mounted on a shaft, which turns in sintered bronze bearings. All damper blades shall be inter-connected by means of a suitable bar linkage for ganged operation.

All dampers shall be arranged with spindle horizontal and shall be sized to handle the air quantities shown on the drawings. Where manually adjustable damper sets are installed in ductwork or other accessible locations the operating shafts shall be extended through the duct and a lockable quadrant fitted.

4.6 BIRD SCREENS

Galvanized woven mesh or weld mesh bird screens in rigid galvanized iron frames shall be installed behind all exhaust air openings to the outside of the building.

4.7 FLEXIBLE CONNECTIONS

Provide flexible duct connections wherever ductwork connects to vibration isolated equipment and on all exhaust final connections to spot extractor and as indicated on the drawings.

Flexible connections shall be fitted to isolate fans from equipments and/or ductwork. The connections shall be arranged to permit the renewal of the connection without disturbing the duct work or the plant. The metal parts of connected equipment shall be separated by not less than six inches and installed with sufficient slack to compensate for free movement of fans or spring vibration isolators.

4.8 JOINT MEASUREMENTS

The following procedure for measurement shall be followed for the purpose of billing in case of items subject to variation in quantities.

CIRCULAR STRAIGHT DUCT
Area = $\pi D L$

RECTANGULAR TAPER DUCT
Area = $L (A+B+ab)$

CIRCULAR TAPER DUCT
Area = $1.57 L (D+d)$

RECTANGULAR BEND
90°, Area = $\pi R (A+B)$
45°, Area = $1.57 (A+B)$

CIRCULAR BEND
90° Area = 4.94 DR
60° Area = 3.28 DR
45° Area = 2.47 DR

RECTANGULAR TO CIRCULAR TRANSITION PIECE
Area = $L (1.57 D + A+B)$

RECTANGULAR STRAIGHT DUCT
Area = $2 (A+B) L$

RECTANGLE
Area = $L \times B$

TRAPEZOID
Area = $\frac{A+B}{2} \times H$

CIRCLE
Area = $\frac{\pi \times D^2}{4}$

TRIANGLE
Area = $\frac{L \times H}{2}$

SQUARE
Area = L^2

SIZE	SWG	Th	ANGLE
UP TO 750	24	0.63	25x3
751 TO 1500	22	0.80	40x3
1501 TO 2250	20	1.00	40x3
ABOVE 2251	18	1.25	40x6

SHEET			Angle	Kg/RMT
SWG	Th	Kg/Sq M		
24	0.63	4.95	ISA 25x3	1.10
22	0.80	6.30	ISA 30x3	1.40
20	1.00	7.85	ISA 40x3	1.80
18	1.25	9.80	ISA 40x6	3.50
16	1.60	12.55	ISA 50x6	4.50
14	2.00	15.70	ISA 60x6	5.40
12	2.50	19.60	ISA 65x8	7.70
10	3.15	24.75	ISA 75x8	8.90
08	4.00	31.40	ISA 75x10	11.00

PLATE		Flat	Kg/RMT
Th	Kg/Sq M		
5.00	39.25	25x3 Flat	0.60
6.00	47.10	30x3 Flat	0.70
8.00	62.80	30x6 Flat	1.40
10.00	78.50	40x6 Flat	1.90
12.00	94.20	50x6 Flat	2.40

Rod	Kg/RMT	Channel	Kg/RMT
ISRO 6	0.20	ISMC 75x40	6.80
ISRO 8	0.40	ISMC 100x50	9.20
ISRO 10	0.60	ISMC 125x65	12.70
ISRO 12	0.90	ISMC 150x75	16.40
ISRO 16	1.60	ISMC 175x75	19.10
ISRO 20	2.50	ISMC 200x75	22.10
ISRO 25	3.80		

The Pythagoras Theorem

$$C^2 = A^2 + B^2$$

$$C = \sqrt{A^2 + B^2}$$

Payment for ducting shall be on the basis of the external surface area of the ducting.

The rate per square meter of the external surface shall include flanges, gaskets for joints, bolts and nuts, duct supports and hangers, vibration isolation pads or suspenders, flexible connections, inspection doors, dampers, turning vanes, straightening vanes, and any other item which will be required to complete the duct installation except external insulation and finish thereon.

The external area shall be calculated by measuring the over-all width and depth (including the corner joints) in the centre of the duct section and over-all length of each duct section from flange face to flange face in case of duct lengths with uniform cross section.

Total area will be arrived at by adding up the areas of all duct sections.

In case of taper piece average width and depth will be worked out as follows:

W1 = Width of small cross section

W2 = Width of large cross section

D1 = Depth of small cross section

D2 = Depth of large cross section

Average Width = $(W1 + W2)/2$

Average Depth = $(D1 + D2)/2$

Width and depth in the case of taper pieces shall be measured at the edge of the collar of the flange for duct/sections. Face to face length for taper piece shall be the mean of the lengths measured face to face from the center of width and depth flanges.

For special pieces like bends, branches, and tees, etc., the same principle of area measurement as for linear lengths shall be adopted, except for bends and elbows, the length of which shall be the average of the lengths of inner and outer periphery along with curvature of angle of the piece.

Duct measurements for calculation of area shall be taken before application of insulation (if any).

Closeout Submittals such as Operation and maintenance manuals, including as-built ducting layout, final P& ID diagrams, unit location drawing and component lists, shall be provided as closeout submittals.

4.9 SCRUBBER SPECIFICATION

Vertical Flow Fume Scrubbers

WORK INCLUDED

Vertical type Single Stage Water based Scrubber System with integrated liquid tank, Material: PP/FRP, complete with pump intake connection, inlet and outlet flanged connections, single stage PP packing rings & single stage mist eliminator pads. One Sets of liquid spray system, pump & pump inlet valves. Scrubber Pump. Including all pumps enclosures, Inspection window, drain connection, makeup connection, water level indicator, Ladders & accessories.

4.9.1 The Fume scrubbers are of Single stage packed bed type to remove the bulk of the contaminant from the airstream and will be continuously wetted to prevent plugging.

4.9.2 In a scrubber, water is the media which removes pollutants from the air. When the water is re-circulated, addition of fresh water is necessary to purge contaminants and replace evaporation losses. Fresh water may be added to the recycle reservoir continuously or periodically.

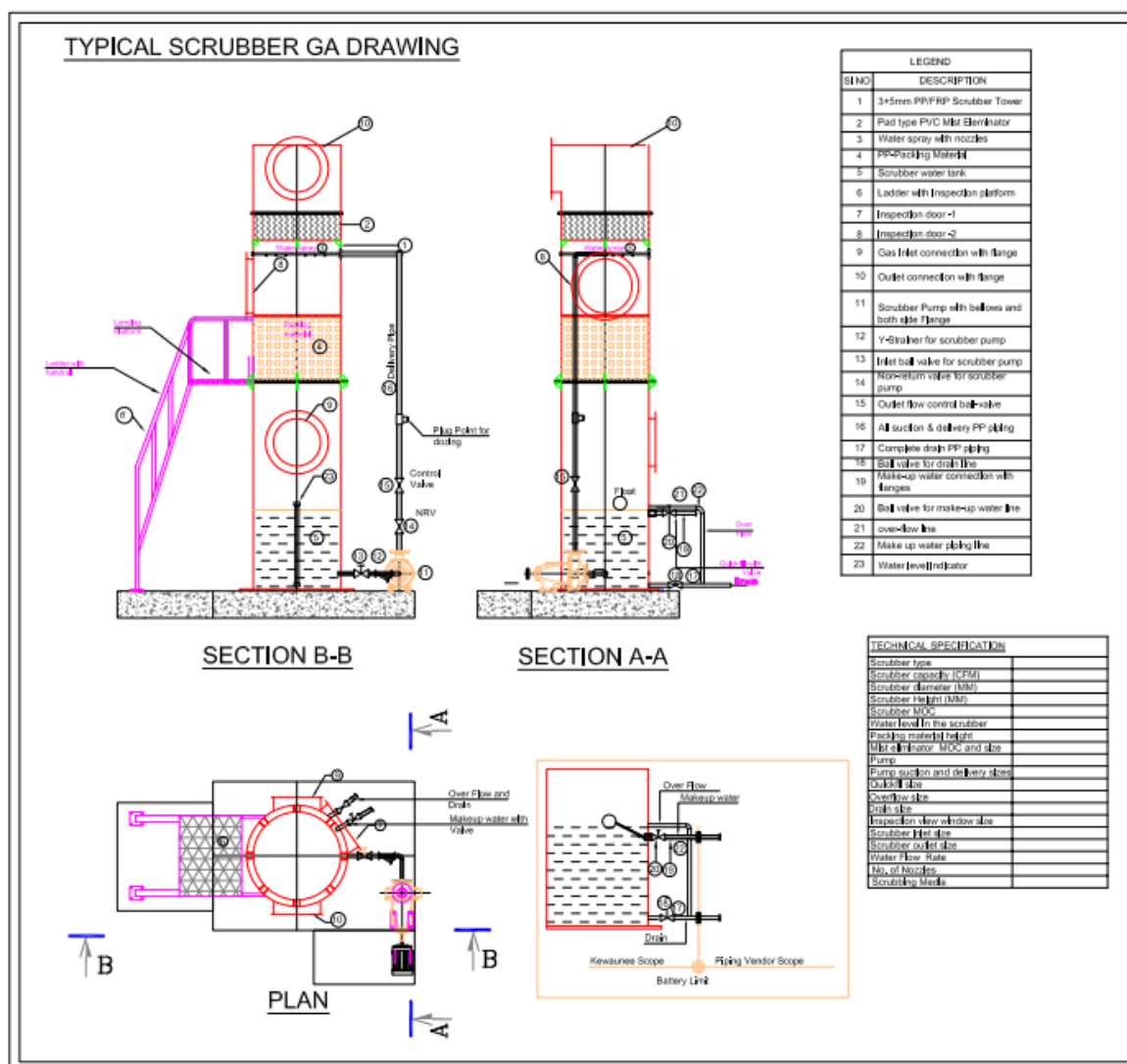
4.9.3 Scrubbers are frequently used in applications where the airstream is being treated to remove acid fumes / solvent fumes, Corrosive gasses & other odorous gas.

- 4.9.4 Fume scrubbers can be fabricated from PP-FRP with suitable thickness based on the size & volume.
- 4.9.5 The maximum temperature rating for the scrubber is 70°C. Bolted access ports are provided for inspection of the interior packing and mist eliminator elements.
- 4.9.6 All Hardware & fasteners used in the scrubber assembly shall of SS MOC only.
- 4.9.7 Single Stage Packed Bed scrubbers complete with auxiliaries and options described herein. The system shall include but is not limited to the following:
- a) All scrubber internals necessary to provide adequate process capture and to achieve the designed performance.
 - b) Mist eliminator to separate the water mist from carrying over.
 - c) Flanged connections for all external water fill, water makeup and drain, overflow piping as required.
 - d) Complete shop coating of required areas with coat or resistant paint for external surfaces.
 - e) Self-contained recirculation pumps system.

5.0 DESIGN REQUIREMENTS

- 5.1 The Scrubber's shall be manufactured using Polypropylene (PP) with FRP lining.
- 5.2 The Scrubber shall be provided with access ports / doors to allow limited access to the internals of the unit. The Scrubber shell has flanged pipe connections or female NPT connections for introducing makeup and drain water as well as recirculation liquid connections.
- 5.3 The Scrubbers are equipped with random-dumped PP rings packed with appropriate depth of the packing.
- 5.4 Material for the mist eliminator is PVC.
- 5.5 The fan and motor are designed for system static pressure per application depending on packing depth and mist eliminator selection.
- 5.6 Sound levels generated by the Vendor-furnished equipment during normal operation shall not exceed 85 dBA-weighted, slow responses, under free field condition, at a horizontal distance of 10 feet from the surface of sound generation.

TYPICAL SCRUBBER GA DRAWING



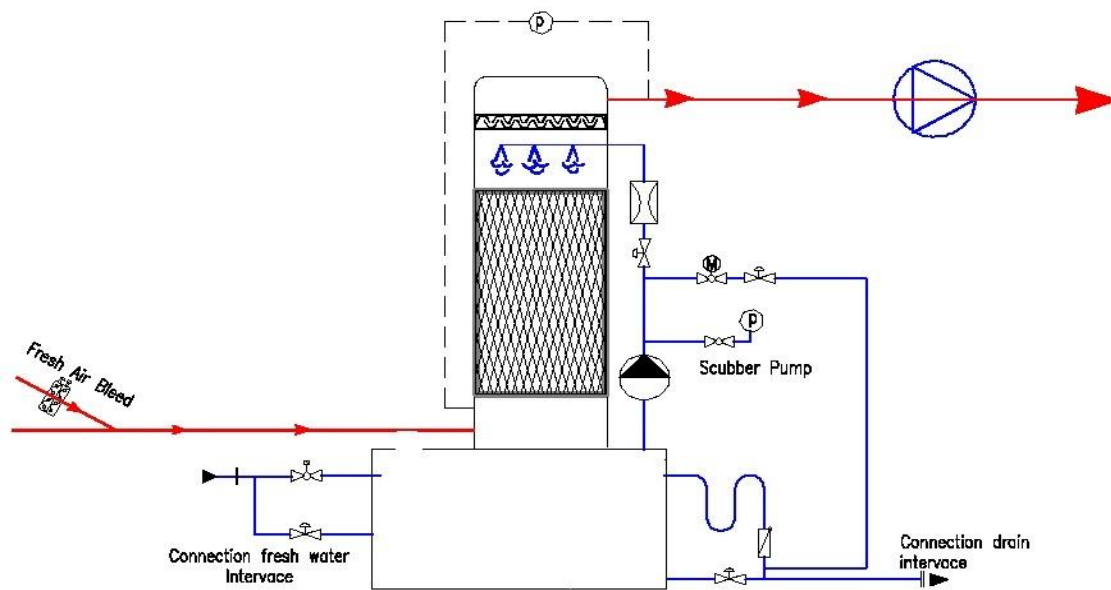
6.0 STANDARD SUPPLIED COMPONENTS

Standard components furnished on Wet Scrubbers are as follows:

- 6.1 Complete Scrubber tower including all mist eliminator, water spray nozzles, packing material, scrubber water tank and ladder.
- 6.2 Piping for recirculation water, make up fresh water & drain connection.
- 6.3 All manual valve wherever requires within scrubber.
- 6.4 Scrubber pump with pump cover & base frame.
- 6.5 Civil Foundation for scrubber & exhaust blower as per the details provided by OEM vendor.
- 6.6 Fresh water for Scrubber as per technical requirement by piping vendor (scope of utility package).
- 6.7 Required Drain connection to the Scrubber by piping vendor (scope of utility package).

Water is sprayed with high pressure through nozzles into the air flow. Water droplets are separated from the exhaust and re-circulated back to the water reservoir. Evaporated water is replaced by

fresh water and chemicals. Dust and pollution products from the process are removed periodically through the drain.



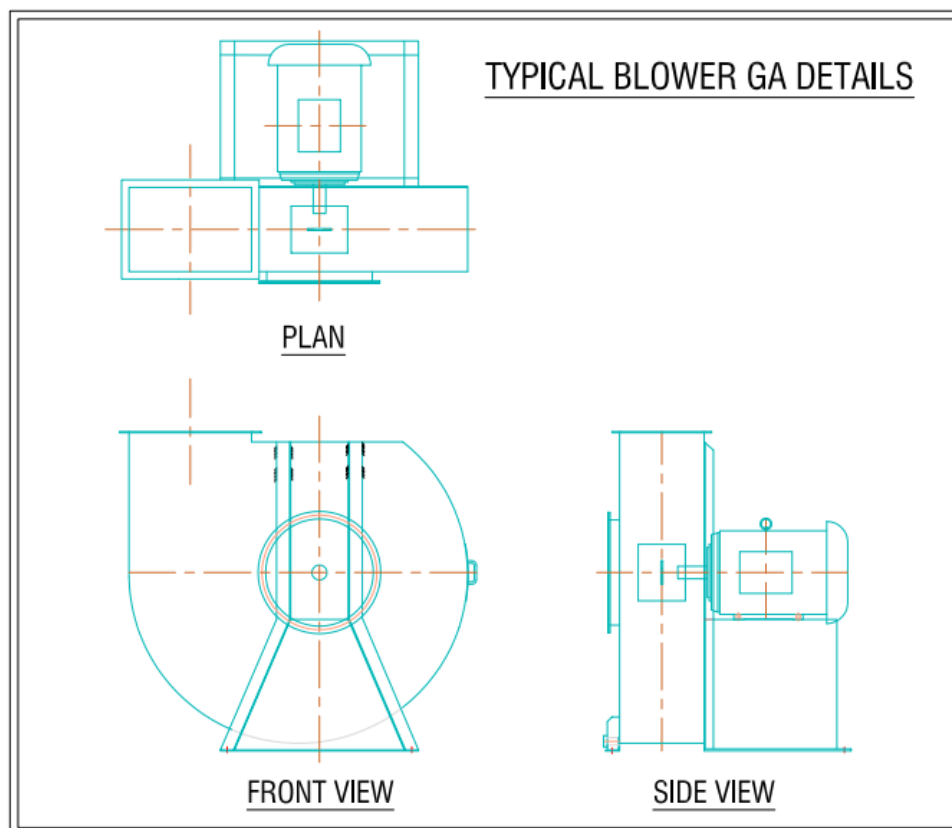
COMPLETE FUME SCRUBBING SYSTEM SCHEMATIC DIAGRAM

7.0 SPECIFICATION FOR PP EXHAUST BLOWER

- 7.1 The exhaust fans supplied and installed shall be of 'Centrifugal Corrosion Resistant' type and shall be capable of delivering the design flow rate against all duct losses. The Vendor shall submit a calculation of all losses to consultant & get it approved prior to ordering of equipment.
- 7.2 The fans shall be robust in construction and suitable for continuous duty operation. It shall be mounted with ease of maintenance and shall be installed with proper vibration isolators to minimize vibration transmission to ductwork and support structure.
- 7.3 Fans selected shall be silent and vibration free when running and suitable for outdoor use.
- 7.4 The fan speed shall not exceed 3000 rpm.
- 7.5 Aerodynamic performance of the fan shall be tested and comply with 'AMCA' and 'ISO5801' standards.
- 7.6 Sound level test shall be tested and comply with 'ISO5136.2'.
- 7.7 The casing shall be of self-supporting design, thermoformed (size 400 and below), welded by machine (automatically welded for size 400 and below). The material of construction shall be fire retardant polypropylene (PPs) for fire safety and suitable for use against corrosive 'medium' and a maximum allowable operating temperature of 70°C.
- 7.8 Impeller material shall be fire retardant polypropylene (PPs) for fan size up to 400 (polypropylene {PP} for fan size 450 and above) suitable for use against corrosive 'medium' and a maximum allowable operating temperature of 70°C. It shall consist of 20 forward curved

blades injection moulded up to size 710 (thermoformed blades, automatically welded from 800). The impeller balancing shall be tested in accordance to VDI2060, Q6.3 standards.

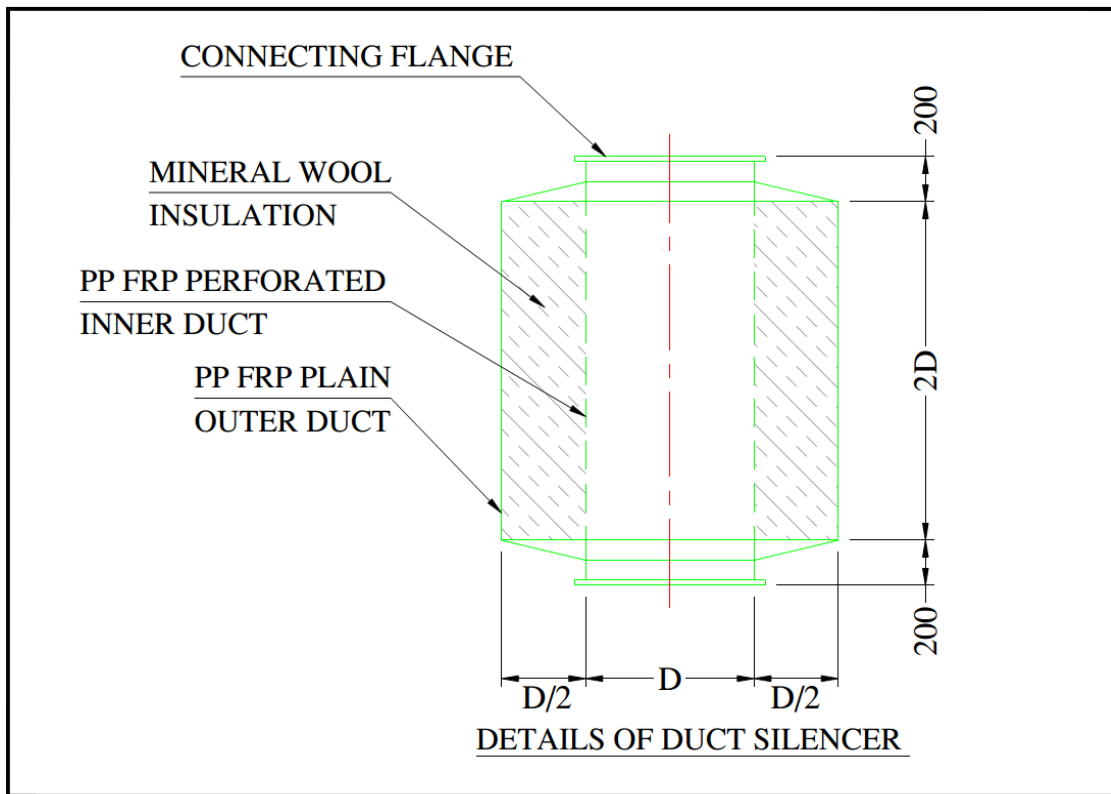
- 7.9 Each impeller above size 450 shall be tested in an over speed test stand above its nominal rate and dynamically balanced on two levels in accordance to VDI2060, Q6.3 standards.
- 7.10 Stainless steel stand shall be used to support the fan and the motor for sizes up to 400 in view of the corrosive environment. Sturdy metal galvanized steel stand shall be used from fan size 450 onwards.
- 7.11 A standard hub seal shall be incorporated onto the impeller hub to prevent corrosive 'medium' from contacting the shaft.
- 7.12 The fans have to be installed with easy access for maintenance.
- 7.13 The fans shall be from one of the approved makes only.



8.0 DUCT SILENCER

The blower outlet duct shall have a silencer to reduce the air noise, the silencer shall be made out of outer & inner layer PP FRP ducting the space between them shall be filled with Mineral wool insulation. Internal duct of the silencer shall be perforated with suitable size holes (minimum 10mm dia & pitch of 25mm) the silencer shall be with both ends flanged (For more details refer silencer specification & drawing). Mineral wool insulation shall be supplied as per tender specification.

DETAILS OF DUCT SILENCER



The above-mentioned details in the drawing is the minimum requirement for silencer, the vendor shall design the duct silencer to reduce the noise level & achieve 75 dB @ 1 mtr from the blower assembly.

9.0 TEST RUN AND COMMISSIONING:

- 9.1 Check, whether inlet and outlet are connected to ducts or protected by a protection grid.
- 9.2 Check mechanical and electrical safety devices; make sure, they are properly installed.
- 9.3 Remove foreign bodies, which still might be in the housing or ducts.
- 9.4 Check the rotation of the impeller by means of a quick switch on/off of the motor; it
- 9.5 must run in the direction as shown on the arrow. In case of wrong direction, change the connection of the wires.
- 9.6 To protect the motors against overload, the fans shall never be operated with open
- 9.7 Inlet or outlet. For test runs, the inlet has to be covered with a suitable plate.
- 9.8 The current (Amps) as indicated on the motor data plate shall never exceed. The fan has to be checked for its' smooth running.

10.0 EXHAUST SYSTEM TESTING & COMMISSIONING FORMAT – SHEET 1

BLOWER TAG NO:-						
CLUSTER NO:-						
FUME HOOD						
SI NO.	NO. OF FUME HOOD	SIZE	SASH HEIGHT (MM)	SASH AIR VELOCITY (FPM)	AIR VOLUME (CFM)	TOTAL EXHAUST (CFM)
1						
2						
3						
4						
SNORKEL						
SI NO.	NO. OF SNORKELS	---	---	AIR VELOCITY (FPM)	AIR VOLUME (CFM)	TOTAL EXHAUST (CFM)
1						
2						
SOLVENT CABINETS						
SI NO.	NO. OF CABINETS	---	---	AIR VELOCITY (FPM)	AIR VOLUME (CFM)	TOTAL EXHAUST (CFM)
1						
2						
GLOVE BOX						
SI NO.	NO. OF GLOVE BOX	---	---	AIR VELOCITY (FPM)	AIR VOLUME (CFM)	TOTAL EXHAUST (CFM)
1						
2						
VENT POINT FOR STORE ROOM						
SI NO.	NO. OF VENT POINTS	---	---	AIR VELOCITY (FPM)	AIR VOLUME (CFM)	TOTAL EXHAUST (CFM)
1						
2						

11.0 EXHAUST SYSTEM TESTING & COMMISSIONING FORMAT – SHEET 2

SI NO.	BLOWER TAG NO.	CLUSTER NO.	BLOWER WORKING MODE	FREQUENCY (Hz)	RPM	EXHAUST AIR VOLUME (CFM)
1.			GEM			
			NSM			
2.			GEM			
			NSM			
3.			GEM			
			NSM			
4.			GEM			
			NSM			
5.			GEM			
			NSM			
6.			GEM			
			NSM			
7.			GEM			
			NSM			
8.			GEM			
			NSM			
9.			GEM			
			NSM			
10.			GEM			
			NSM			
11.			GEM			
			NSM			
12.			GEM			
			NSM			
13.			GEM			
			NSM			
14.			GEM			
			NSM			
15.			GEM			
			NSM			
16.			GEM			
			NSM			
17.			GEM			
			NSM			
18.			GEM			
			NSM			

ABBREVIATION: -

GEM: GENERAL EXHAUST MODE

NSM: NIGHT SETBACK MODE

12.0 EXHAUST SYSTEM TESTING & COMMISSIONING FORMAT – SHEET 3

BLOWER COMMISSIONING FORMAT	
BLOWER TAG NO	
CLUSTER NO	
BLOWER SIZE	
STATIC PRESSURE (MM)	
FLOW VELOCITY (m/s)	
STAFHT POWER (kW)	
MOTOR CAPACITY (kW)	
MECHANICAL EFFICIENCY (%)	
OPERATING IMPELLER SPEED (RPM)	
MAXIMUM IMPELLER SPEED (RPM)	
STARTING CURRENT (AMPS)	
RUNNING CURRENT (AMPS)	
SOUND PRESSURE @ 3 MTR LEVEL (dB)	
BLOWER INLET SIZE (MM)	
BLOWER OUTLET SIZE (MM)	
STATIC WEIGHT (KG)	
DYNAMIC WEIGHT (KG)	

13.0 SUBMITTALS FOR CONSULTANT APPROVAL

- 13.1 Vendor to submit exhaust summary sheet as per their respective fume hood air volumes.
- 13.2 Vendor to submit P & ID based on the final requirement. (P & ID should be submitted in the same format as mentioned in the tender).
- 13.3 Exhaust ducting shop drawing.
- 13.4 The Vendor shall submit a calculation of all Pressure losses in the duct system, prior to ordering of Exhaust Blowers. A sample selection sheet is shown in exhibit below.
- 13.5 Provide dimensional drawings and product data on each laboratory exhaust fan assembly.
- 13.6 Provide fan curves for each fan at the specified operation point, with the flow, static pressure and horsepower clearly plotted.
- 13.7 Scrubber GA drawing.
- 13.8 Damper selection, pressure loss chart & GA drawing.
- 13.9 Supporting structure GA drawings with respective weights & quantities.
- 13.10 Civil coordination drawing showing wall / floor cut-out details, construction details of

skirting around floor opening & foundation pedestal details for exhaust blower / scrubber unit.

13.11 Vendor to coordinate with other services like Electrical, Gas & lab controls.

13.12 Commissioning report for individual blower / exhaust system.

14.0 SAMPLE PRESSURE DROP SELECTION SHEET

PROJECT : IISC, BANGALORE					CONSULTANT : MJ ASSOCIATES, BANGALORE					
SCB-14 (FUME HOOD EXHAUST)										
DUCTING PRESSURE DROP CALCULATION										
SI No.	Description	Air Vol	Duct	Duct C/s	Duct Length	Duct Leng	Velocity	Press Drop per	Actual P D	
		CFM	dia	area	in mm.	in Ft.	FPM	100 ft in inch	Drop in inch	
	Discharge Side								Ind PD	Total PD
1	Transition Piece	900	250	0.0491	1000	3.28	1704	0.56	0.018	0.018
2	St Duct	900	250	0.0491	3000	9.84	1704	0.56	0.055	0.073
3	Duct Silencer								0.100	0.173
4	Flexible Connection								0.150	0.323
5	Weather Cowl								0.250	0.573
	Suction Side									0.573
1	Flexible Connection								0.150	0.723
2	Manual Damper								0.250	0.973
3	Transition Piece	900	250	0.0491	1000	3.28	1704	0.56	0.018	0.992
4	St Duct	900	250	0.0491	1000	3.28	1704	0.56	0.018	1.010
5	90° Bend	900	250	0.0491	4267	13.99	1704	0.56	0.078	1.089
6	St Duct	900	250	0.0491	3000	9.84	1704	0.56	0.055	1.144
7	90° Bend	900	250	0.0491	4267	13.99	1704	0.56	0.078	1.222
8	90° Bend	900	250	0.0491	4267	13.99	1704	0.56	0.078	1.300
9	Wet Scrubber								3.000	4.300
10	St Duct	900	250	0.0491	1100	3.61	1704	0.56	0.020	4.320
11	90° Bend	900	250	0.0491	4267	13.99	1704	0.56	0.078	4.399
12	St Duct	900	250	0.0491	5800	19.02	1704	0.56	0.106	4.505
13	90° Bend	900	250	0.0491	4267	13.99	1704	0.56	0.078	4.584
14	St Duct	900	250	0.0491	14000	45.90	1704	0.56	0.257	4.841
15	90° Bend	900	250	0.0491	4267	13.99	1704	0.56	0.078	4.919
16	90° Bend	900	250	0.0491	4267	13.99	1704	0.56	0.078	4.997
17	St Duct	900	250	0.0491	4000	13.11	1704	0.56	0.073	5.071
18	90° Bend	900	250	0.0491	4267	13.99	1704	0.56	0.078	5.149
19	St Duct	900	250	0.0491	500	1.64	1704	0.56	0.009	5.158
20	Flexible Connection								0.200	5.358
21	Manual Damper								0.250	5.608
22	Suction Hopper								0.250	5.858
23	Fume Hood (Suc Presssure)								1.000	6.858
									Total	6.858
	CFM	900		STATIC INCH	8		Static Pressure =		6.86	
	EFFICIENCY	50	60				Dynamic Pressure =		0.18	
	BKW	2.03	1.69				Total Pressure =		7.04	
	MOTOR CAPACITY	9.30	7.50				Safety 5% =		7.39	
The exhaust blower shall be designed for 900 cfm at 8" Static Pressure										

15.0 SPECIFICATIONS FOR MOTOR AND ACCESSORIES

Use an electric motor built to IEC standards flange mounted (B5) and Foot mounted (B3), also in ex-protected or multistage versions, for the drive. The impeller hub is coated with aluminium. Power transmission from motor to impeller by means of a directly mounting the impeller on motor shaft. The impeller is fixed on to a flange bearing and the tightening adopter system guarantees secure mechanical connection.

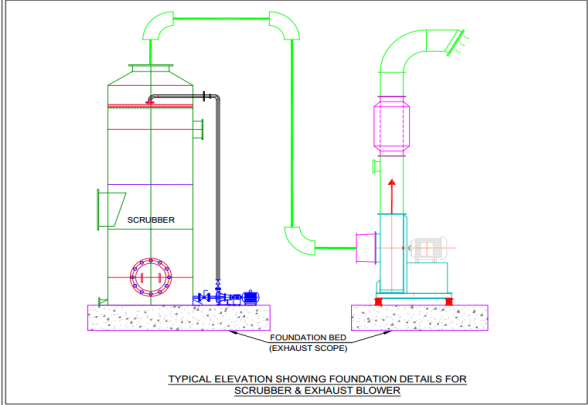
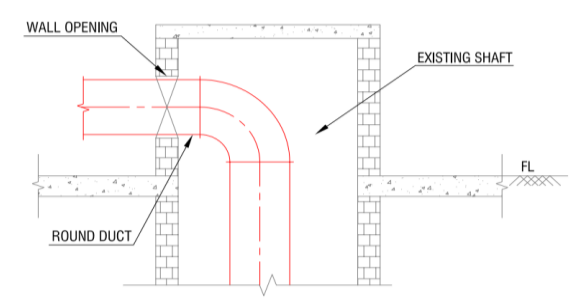
Motor Standard IEC three-phase motors in accordance with IEC. Mounting B5 and B3
Available in motor-mounted (IP55) or cabinet-mounted versions.

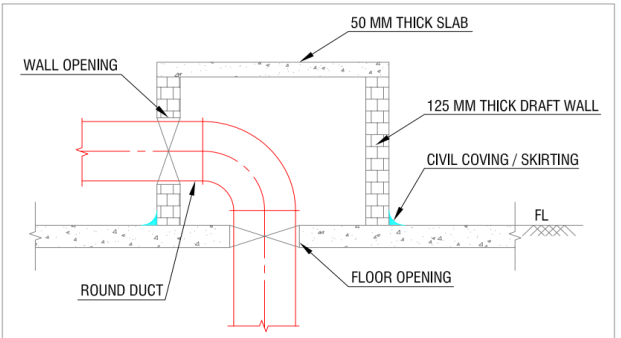
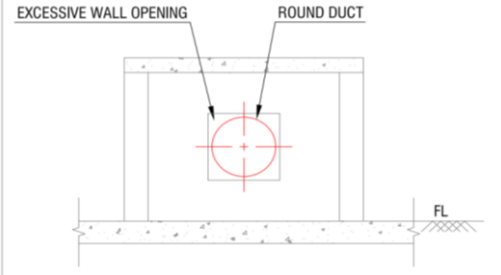
The fan shall be driven by a standard TEFC electric motor with class ‘F’ insulation and class ‘B’ temperature rise. Motor shall be suitable for outdoor installation with IP55 protection and suitable for operation with 415V/3Ph/50Hz electrical supply. Motor supplied shall be in accordance to IEC standards.

PP motor guard / cover shall be supplied along with blower & motor assembly.

16.0 CIVIL WORKS

Minor Civil works as mentioned below shall be considered along with the equipment cost & quoted accordingly.

<p>Foundation Bed for Scrubbers & Exhaust blowers.</p>	
<p>Making necessary holes for duct entry in walls.</p>	

<p>Making necessary holes for duct entry in floors, construction of draft wall around the opening & ceiling with 50 mm thick slab & making it rain / leak proof.</p>	
<p>Closing of excessive opening after erection of ducts & making it rain / leak proof.</p>	

17.0 CLOSEOUT SUBMITTALS

Closeout Submittals such as Operation and maintenance manuals, including as-built ducting layout, final P& ID diagrams, unit location drawing and component lists, shall be provided as closeout submittals.

18.0 LIST OF APPROVED MAKES FOR LAB FUME EXTRACTION & SCRUBBING SYSTEM

SI No.	DESCRIPTION	APPROVED MAKES
1.	PP MOULDED EXHAUST BLOWER	COLASIT / PLASTIFER
2.	BLOWER MOTOR	ABB / SIEMENS / CROMPTON GREAVES
3.	WET SCRUBBER WITH RECIRCULATION PUMP	CK AIRTECK / LIFE LINE / UNIVERSAL AIR CONTROL
4.	PPR / PPH PIPES	SANGIR / PRIME
5.	PP SHEETS FOR EXHAUST DUCTING	MANDHANI / DUGAR / KHANNA / SIMONA / BECK
6.	BISPHENOL RESIN	MECHEMCO / KAYSYNTH / ORSYN / SIMONA
7.	DAMPERS	CK AIRTECK / LIFE LINE/ UNIVERSAL AIR CONTROL
8.	MINERAL WOOL	UP TWIGA / LLYODS / ROCK INSUL
9.	FLEXIBLE DUCT	FINOLEX / GIBBON
10.	ANCHOR FASTENERS	HILTI / FISCHER
11.	FASTENERS & WASHERS	TVS / UNBRAKO

SUB HEAD- 5: PIPING WORKS

1.0 SCOPE OF WORK:

The scope of work shall cover supply, storage at site, transportation to the place of erection, fabrication/assembly, laying/erection, painting, testing and commissioning of the industrial tubing & piping system for GAS & UTILITIES for the project as a whole with necessary supports and supporting structures. The erection work shall be carried out as per the instructions of manufacturer and working drawings to be prepared by the Contractor and duly approved by the consultant.

1.1 GAS DISTRIBUTION SYSTEM:

The contractor should offer leak free gas controller and distribution system for laboratory gases, such as Argon, Helium, Nitrogen, Hydrogen, Zero air, Oxygen, CO₂, and Methane . The distribution system shall include all the necessary tubing's, tube fittings, cylinder connections with accessories, point of use pressure regulator, isolation valves, control valves, pressure gauges etc,. required to feed from gas bank to the laboratory work benches. All the tubing should be supported in aesthetically colored, anodized and power coated aluminum casings.

In the gas distribution system for the main piping, the tube to tube joints and branches should be joined by the way of orbital welding.

The gas distribution shall consist of:

- a. Manual Change over Gas manifold.
- b. Gas distribution lines for indicated gases with color coding.
- c. Point of use control valves with a leak free valves and precision regulators.
- d. Mounting the brackets, clamps, supports cases, etc, for aesthetically laying for the gas lines.

1.1.1 GAS TUBING:

Gas tubing shall be 1/4", 1/8" or any other sizes shall be seamless tubing, bright annealed SS316L stainless steel shall be factory cleaned for the use of high purity gas services. The tube shall have the wall thickness as mentioned in BOQ.

1.1.2 TUBE FITTINGS:

The fittings shall be compressed type & orbital weld type for all sizes. The fitting shall hold the working pressure without any leak. All the fitting end connections shall be compatible to the supplied tubing. The fittings should be nut ferrule and shall be made from SS 316L. The ¼ inch Tee

joint shall be made from SS 316L. All the fittings shall be factory cleaned suitable for laboratory high purity gas service.

1.1.3 BALL VALVES:

Ball valves of required size shall be installed at each source point of the service. The 1/4-inch size valve shall be SS316 with reinforced PTFE seat material with working pressure of 0 to 25Kg/cm².

1.1.4 PRESSURE GAUGE:

Pressure gauge shall be stainless steel pressure gauges of minimum 2inch dial size to be installed in the manual change over system and cylinder regulator. Pressure gauge shall be suitable for laboratory gas service. The material of construction shall be SS316.

1.1.5 HIGH PRESSURE MANUAL GAS CHANGE OVER SYSTEM

The Gas change over system shall be manual to the gas distribution system. The Gas change over system shall be compact and preferably enclosed model designed for easy change of gas cylinders while in operation. The Gas change over system shall have provision to clean or purge lines before adding a new cylinder. Manual change over system is for Argon, Helium, Nitrogen, Hydrogen & Zero air, Oxygen, CO₂, and Methane .

The gas changeover system shall have two diffusion resistant pressure regulators in a single body. The primary changeover regulator shall connect to an active and reserve cylinder.

The gas change over system shall be a complete unit with Vent Valve, Inlet Pressure Gauge, Inlet Valve, Outlet Pressure Gauge and Outlet Valve, etc for the intended use.

2.0 TECHNICAL SPECIFICATIONS FOR GAS TUBING WORKS:

2.1 General:

The erection of tubing's and valves & fittings shall be carried out according to the latest engineering practices and according to the working drawings, specifications, erection and instructions.

The erection shall be carried out by highly skilled workmen.

The Contractor shall take care of positioning, leveling and laying/joining of all tubing's and cylinder bank as well as supporting structures within the required accuracy and tolerance limits. It shall be deemed as a contractual obligation that the tubing's are not thrown out of alignment or lifted off during commissioning and subsequent operation.

There may be more than one contractor working in the area at the same time. As such the work has to be carried out in proper coordination and consultation with all other parties concerned with the work. The Contractor shall take due notice of the working conditions, practices and agreements prevalent in the area of the plant site and satisfy himself before quoting.

The Contractor shall be responsible for paying strict attention to statutory regulations for prevention of accidents and to other safety rules. The regulations for prevention of accidents shall be displayed at appropriate places and should be distinctly visible to all personnel working in the area.

The Contractor shall supply all required consumables, construction and erection materials, petrol, diesel oil, kerosene, solvents, sealing compounds, tapes, brazing and soldering materials, welding sets, tube bending machines, cables, clamping tools, gauges, erection bolts, nuts and packing sheets/compounds, temporary supports, wooden blocks, spacers, templates, jute and cotton wastes, sand and emery paper etc as required for satisfactory completion of work.

The Contractor shall make his own arrangement for handling the tubes & fittings at the stores and transporting it to the site of installation.

2.2 Technical specifications - Bought out Items

- 2.2.1 Tubes shall be laid using poly amide box clamps on mounting rail supports.
- 2.2.2 Bending of tubing shall be made with a tube bender. Bending radius shall be for 1" and ¾"-4D, ½" and ¼"-3D. All tube bends must be uniform with no kinks, flats, or wrinkles.
- 2.2.3 All the threaded joints shall be applied with oxygen compatible PTFE anaerobic thread sealant (Approved by fittings supplier).
- 2.2.4 Compression/ Face seal fittings shall be installed as per manufacturer's recommendations. Above ½" fittings shall be swaged with hydraulic/ pneumatic swaging machine.
- 2.2.5 Once tubing installation is completed, the system shall be flushed with nitrogen (99.999%) to remove all foreign matters from inside the tubes and in acceptance with commissioning engineer. Bypass or remove purifiers or other equipment that could be adversely affected before nitrogen flush out.
- 2.2.6 All the completed lines shall be maintained in +ve pressure with Nitrogen (99.999%) to avoid contamination.
- 2.2.7 Required gases should be arranged by the contractor.
- 2.2.8 Pipes / Tubes passing through masonry walls, beams, underground, foundations etc. Shall be taken through cut-outs. If any pipe/ tube requires embedded sleeve, the material of sleeve shall be SS-304 to avoid corrosion.
- 2.2.9 Spacing between parallel runs of tubes carrying different services should be individually clamped and aligned as per the requirements.
- 2.2.10 The clamps & supports shall be ensured to safely carry the weight of pipes.

2.3 Welding

- 2.3.1 All tubing headers shall be of seamless construction with joints welded using automatic orbital welding machine with argon gas purging.
- 2.3.2 Tube to Tube or Tube to fittings/valves welding shall be done using automatic **TIG** welding.
- 2.3.3 Isometric drawing shall be prepared before start of welding work.
- 2.3.4 Quality System of the Tubing Manufacturer shall have approval from ASME quality system certificate as material organization
- 2.3.5 Tubing shall be clearly marked with heat code, lot code, outer diameter and wall thickness as in the inspection certificate.
- 2.3.6 Tubing sizes up to 1" OD shall be bright annealed. Tubing with outside diameter larger than 1" OD shall be supplied in annealed and pickled condition.
- 2.3.7 Tubing shall have carbon content < 0.030%
- 2.3.8 All cutting and welding equipment should be cleaned of any impurities or particulates.
- 2.3.9 Clean area shall be provided for welding. The room should be maintained clean at all times.
- 2.3.10 All piping and fittings should be cleaned prior to and after welding.
- 2.3.11 Proper edge preparation before welding different tubes / fitting, while carrying out the weld joints to ensure no cutting/welding burrs, other contaminants etc enter into the tubes.
- 2.3.12 Assemblies should be bagged after welding and the bags removed just prior to making field welds.
- 2.3.13 Welding and fitting technicians should use overshoes and clean room gloves. The gloves are worn to prevent finger print oils from getting onto the pipe.
- 2.3.14 The use of a clean area and clean area procedures will protect the welds and reduce the defect incidents associated with contaminants in the welding areas.
- 2.3.15 Daily, the first and last production joint needs to go through external visual examination then cut open axially and check welding.
- 2.3.16 Each qualified welder should be formally qualified with a certificate qualifying him or her for a certain type of weld, as per welding procedure for welder qualifications mentioned in American Society of Mechanical Engineers (ASME) & American Welding Society (AWS).

2.4 Mode of Measurements Tubings:

Mode of Measurement for payment of items of tubing's shall be as follows:

2.4.1 TUBINGS & SUPPORT:

Tubings shall be inclusive of necessary specialities like bolts, nuts, washers, U-clamps, cutting, bending, welding (Orbital welding to be considered for joining tubes above false ceiling without unions), Tagging (Acrylic) etc. The rate quoted to be inclusive of necessary wall bores, cutting through walls as per tender dwg. Mode of measurement shall be in running Meters of installed tubes as per the tender BOQ.

GI rail, threaded rod, stuff clamps, expansion bolts, nuts & washers etc shall be measured in unit lengths of installed qty as per the tender BOQ. The quoted rates shall include sourcing of all such items viz. welding machine, tool and tackles, other support items etc. that are required to complete the work in all respects.

2.4.2 GUARANTEE:

The contractor shall guarantee that the materials and workmanship of the entire system are of the first class quality. All the equipment's / apparatus shall be guaranteed to yield the specified ratings of discharge and quality. Any defective equipment / material / workmanship found short of the specified quality shall be rejected. Guarantee certificate of equipment's from suppliers / manufacturers shall be handed over to IISc.

2.4.3 DEFECTS AND LIABILITY:

All the equipment's / materials and the system shall be guaranteed against defective material and workmanship for a period of 12 months from the date of commissioning to the Owners along with all relevant documentation. The contractor shall repair, rectify, and replace all the defective materials, components free of cost. In addition, normal maintenance shall be carried out periodically during the defects and liability period including replacement of spares, as required.

2.4.4 TESTING:

The entire segment of main, branch header and individual line connection piping will be flushed with Air or Nitrogen gas as specified before pressure testing is carried out. All compressed gases and compressed zero air lines that are connected with double compression joints and weld joints should be flushed with 99.99% pure compressed Nitrogen gas for ½ hrs. For all the compressed air lines, that are connected with double compression joints and weld joints should be flushed with compressed air as the media and should be flushed for ½ hrs.

While flushing keep open all the taps. By doing these the entire lengths of tubing will be flushed and will be clean with dust particles. While carrying-out the flushing operation pressure regulators, diaphragm valves etc. which are inline should be removed / bypassed.

The flushing has to be done in pressurized condition. During flushing intermittent valve opening and closing has to be done at all the final termination points.

After through flushing, the entire segment of main header, branch header and individual line connection piping will be pneumatically tested. At least 1.5 times the working pressure. (for e.g., 10 bar AWP, 15 bar ATP) .The line will be considered free of leakage only if the Pressure does not drop over a period of 24 hrs. With line locked by specific testing gas as mentioned under:

- a. For Compressed air, Zero Air, Nitrogen low pressure (normal), UHP Nitrogen, Helium, Oxygen, Argon, Carbon Dioxide and other inert gases the end connections will be double compression ferrule or threaded (NPT / BSP-P) type fittings.
- b. For Hydrogen and other flammable and toxic gases the end connections will be butt welded or face seal or threaded (NPT / BSP-P) type and the final termination will be double compression ferrule fittings.

All the butt weld joints will be carried out by means of Orbital weld technique (Automatic TIG welding with Argon 99.999% as inert gas).

Supply of compressed air / helium / nitrogen / other gases required for testing and commissioning shall be in the scope of this tender and the same will not be provided by Client / PMC. No payment shall be made to contractor on this account.

2.4.5 Regulators:

- a. Capacity of the respective regulators to be checked by varying:

Inlet pressure from 15 bars to 140 or 200 bars in case of Primary Regulators, maintaining constant pressure for range from 8 to 12 or 50 or 100 or 200 bars (as needed) on the downstream.

Inlet pressure from 8 bars to 30 bars in case of gas Secondary Regulators, maintaining constant pressure for ranges from 0 to 8 bars on the downstream.

Inlet pressure from 8 bars to 15 bars in case of air Pressure Regulators, maintaining constant pressure for ranges from 0 to 8 bars on the downstream.

- b. All tests will be carried out in the Regulator manufacturer's premises using compressed nitrogen gas, and for gases other than compressed nitrogen, the Supplier / Contractor should indicate "equivalent air / gas flow rates" to be maintained during performance testing, corresponding to the actual flow rates indicated in the BOQ and P&ID'S.
- c. The Tenderer should furnish a clear plan for the set-up and procedure that they propose to adopt for performance testing.
- d. While every Primary Regulator will be subjected to performance test, 20% of the total number of Secondary Regulators in a given category will be taken up for performance testing. This

number can be increased as may be decided by the IISc / Architect representative witnessing the tests, in case any regulator within the lot is found deviating from the specifications.

2.4.6 INSTRUCTION MANUAL / COMPLETION DRAWINGS / TRAINING:

The contractor shall furnish detailed instruction and operation manual of the system. The contractor shall also furnish detailed completion drawings inclusive of control schematics. The contractor shall train the IISC in the operation and maintenance of the system.

3.0 CODES & STANDARDS FOR GAS TUBING WORKS:

All piping works covered under this specification shall comply with currently applicable statutes, regulations and safety codes. They shall comply in all respects with the requirements of the latest editions of the codes and standards. In case of conflict between codes and standards referred to in this specification or documents enclosed with specification.

For design of the utility systems various International standards and codes, as applicable will be used. Below mentioned gives the list as applicable:

a. American Society for Testing and Materials (ASTM)

A269 Seamless and Welded Austenitic Stainless-Steel Tubing for General Service TP 316

A370 Standard Methods and Definitions for Mechanical Testing of Steel Products

A632 Seamless and Welded Austenitic Stainless-Steel Tubing (Small Diameter) for General Service

A-262 Standard Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels

ASME B31.8 Clause 841.126 Gas Safety Code

ASME G93 level C OXY Cleaning

IS-2379: 1990 (R2006), (R2007-05) Pipe Colour Code

b. American National Standards Institute (ANSI)

B31.1 Code for Pressure Piping, Chemical Plant and Petroleum Refinery Piping

B31.3 Process Piping

c. American Society of Mechanical Engineers (ASME)

Section IX Welding Qualification

d. Welding Procedure/Qualification:

ASME B 31.3/31.8, ASME Sec IX & IS: 817

e. ASME Sec IX & IS: 814:

Material Specifications, Welding rods, Electrodes & filler wire etc.

f. ANSI-B-16.5:

Pipe Flanges & Flanged Fittings:

g. ASME/ANSI-B-16.10:

Face-to-Face & End-to-End Dimensions of Valves

h. ANSI-B-18.2.1:

Square & Hex Bolts & Screw.

i. ANSI-B-18.2:

Stud & Nuts.

j. IS Standard or Equivalent:

Gauges

4.0 TECHNICAL SPECIFICATIONS FOR NB PIPING WORKS:

4.1 General:

The erection of all plant and equipment shall be carried out according to the latest engineering practices and according to the working drawings, specifications, erection and instructions of equipment manufacturers.

The erection shall be carried out by highly skilled workmen.

The Contractor shall take care of positioning, leveling and laying/joining of all tubing's and cylinder bank as well as supporting structures within the required accuracy and tolerance limits. It shall be deemed as a contractual obligation that the tubing's are not thrown out of alignment or lifted off during commissioning and subsequent operation.

There may be more than one contractor working in the area at the same time. As such the work has to be carried out in proper coordination and consultation with all other parties concerned with the work. The Contractor shall take due notice of the working conditions, practices and agreements prevalent in the area of the plant site and satisfy himself before quoting.

The Contractor shall be responsible for paying strict attention to statutory regulations for prevention of accidents and to other safety rules. The regulations for prevention of accidents shall be displayed at appropriate places and should be distinctly visible to all personnel working in the area.

The Contractor shall supply all required consumables, construction and erection materials, petrol, diesel oil, kerosene, solvents, sealing compounds, tapes, brazing and soldering materials, welding sets, tube bending machines, cables, clamping tools, gauges, erection bolts, nuts and packing sheets/compounds, temporary supports, wooden blocks, spacers, templates, jute and cotton wastes, sand and emery paper etc as required for satisfactory completion of work.

The Contractor shall make his own arrangement for handling the tubes & fittings at the stores and transporting it to the site of installation.

4.2 PIPING INSTALLATION:

Tender drawings indicate schematically the size and location of pipes. The contractor, on the award of the work, shall prepare detailed working drawings, showing the cross section, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air auto vent valves, and all pipe supports. They must keep in view the specific opening in buildings and other structures through which pipes are designed to pass.

Piping shall be properly supported on, or suspended from, stands, clamps, and hangers as specified and as required. The contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers, and be responsible for their structural sufficiency.

Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint and finished coated black. Where pipe and clamps are of dissimilar materials, a gasket shall be provided in between spacing of pipe supports shall not exceed the following:

Pipe Size	Spacing between supports
Up to 12mm	1.5meter
15 to 25 mm	2.0 meter
30 to 150 mm	2.0 meter
Over 150 mm	2.5 meter

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 by clamps or collars attached to pipe and with a 15 mm thick rubber pad or any resilient material. 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 lowest point and air vent at the highest point.

Pipe sleeves, 50 mm larger diameter than pipes, shall be provided wherever pipes pass through walls and slabs, and annular space filled with fiberglass and finished with retainer rings.

All pipes work shall be carried out in a workman like manner, causing minimum disturbance to the existing services, building, rods and structure. The entire piping work shall be organized, in

consultation with other agencies work, so that laying of pipe supports, pipe and pressure testing for each area shall be carried out in one stretch.

Cut-outs in the floor slab for installing the various pipes are indicated in the drawing. Contractor shall carefully examine the cut-outs provided and clearly point out where ever the cut- outs shown in the drawings, do not meet with the requirements.

The contractor shall make sure that the clamps, brackets, clamps saddles and hangers provided for pipe supports are adequate. Piping layout shall take due care for expansion and contraction in pipes and include expansion Loop where required.

All pipes shall be accurately cut to the required sizes in accordance with IS 554 and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reducers shall be used for the piping to drain freely. In vertical pipes, concentric reducers shall be used.

4.3 TESTING & BALANCING:

All piping shall be tested to hydrostatic test pressure of at least two and half times the maximum operating pressure, but not less than 10 kg per sq. cm gauge for a period of not less than 24 hours. All leaks and defects in joints re-welded during the testing shall be rectified and gotten approved at site.

Piping repaired subsequent to the above pressure test shall be re-tested in the same manner.

System may be tested in sections and such sections shall be securely capped, then retested for entire system.

The contractor shall give sufficient notice to all other agencies at site, of his intention to test a section or sections of piping and all testing shall be witnessed and recorded by IISC site representative.

The contractor shall provide all materials, tool, equipment, instruments, services and labor required to perform the test and to remove water resulting from cleaning and after testing.

After completion of the installation, all water system shall be adjusted and balanced to deliver the water quantities as specified, quoted or as directed, to individual scrubbers.

Complete certified balancing report shall be submitted for evaluation and approval. Upon approval, four copies of the balancing report shall be submitted with complete drawings and documents.

4.4 ERECTION OF FITTINGS

4.4.1 VALVES:

Before erection of valves, it shall be ensured that:

- i. All grit and foreign matter are removed from the inside of the valves before connecting the pipes.
- ii. All the faces are thoroughly cleaned and coated with a thin layer of mineral grease.

It shall be ensured that adequate support is provided for the pipeline and valve. The valve should never carry the weight of the pipeline. Hangers or supports placed near the valve shall be provided.

The connecting pipeline should be cleaned and flushed of sediments, sand and other foreign matter before installing the valves.

Unless it is operationally critical butterfly valves shall be mounted with the shaft horizontal and as per the direction of flow indicated on the valve.

Sluice valves shall normally be installed with the spindle vertical except on vertical pipes where the spindle shall be horizontal. On slopes, the sluice valves may preferably be kept vertical if slope is nominal and gradient can be adjusted with the help of pipes on both sides.

The valves should be tightly closed when being installed, to prevent any foreign matter from getting in between the working parts of valves.

The gasket shall be lubricated with graphite or other recommended lubricant.

It shall be ensured that the joining material sits squarely between the flanges of valves and pipelines without obstructing the waterway.

4.4.2 Laying and Jointing of Pipelines:

Pipes shall be laid to lines and levels as shown in the drawings. Laying and jointing of welded pipes shall be as per the latest revision of IS: 5822. For making welded joints, the welding shall be performed by the manual shielded metallic arc process or TIG as required.

All welding including the proposed procedure and the qualification of welders and welding operations shall be done according to power piping code ASME B 31.1 and ASME Section IX or approved equivalent. Piping for butt welded run shall be supplied with ends beveled by machining or grinding.

The ends of the pipe to pipe, pipe to fitting and fitting to fitting joints shall be aligned as accurately as is practical within the existing commercial tolerance on pipe diameters, wall thickness and out of roundness. Alignment shall provide the most favorable conditions for weld deposition of the root bead. Welds shall be full penetration, continuous without defects.

As a rule, butt-welding shall be carried out without interruption until the entire joint is welded. In any case, however, welding of butt joints must not be interrupted till at least 50% to 60% of welding thickness is completed.

If there is an unscheduled interruption in such work, it is necessary to ensure slow and uniform cooling of metal by covering it with asbestos or by other means to eliminate the possibility of sharp zonal cooling of metal. Before starting the welding again, it is necessary to heat the butt up to the required temperature and maintain this temperature till the butt welding is completed.

Besides systematic inter operational control, the quality of welded joints shall be controlled by visual inspection and mechanical tests in conformity with the provisions of applicable standard codes.

4.4.3 Above Ground Piping:

The Contractor shall supply/fabricate and install piping and fittings in strict compliance with the detailed engineering drawings. Deviations if considered necessary to suit site conditions could however, be permitted in consultation with and with prior approval of OWNER.

All openings in the piping shall be kept effectively closed until assembled in the system to avoid foreign matter entering into the system.

All piping shall follow the general arrangement shown, shall be cut accurately to measurements established for the work by the Contractor and shall be installed without strain.

All piping shall be installed with adequate clearance for lighting, bracing, doors, windows and other openings.

Piping shall be arranged in the straightest possible runs with minimum number of fittings. Flanges of the pipelines, fittings, etc., must be so mounted that top bolt holes are symmetrical about the vertical axis of the flange.

Joints should be as far as possible located at one third span from supports and must be avoided in the middle of the span.

Openings provided in the walls for pipelines must be closed with bricks or mortar with 10 to 20 mm clearance between the brick work and pipe. The clear space must be stuffed and caulked with felt or asbestos and grouted at both the ends of the wall surfaces.

The Contractor shall supply/fabricate and install as per their design drawings duly approved by CONSULTANT & IISC.

Pipe supports and all that is necessary to completely support all the piping and piping components including but not limited to beam clamps, pipe clamps, fabricated structural supports, guides and anchors, brackets, saddles, U bolts, etc.

Also supporting members required in addition to building structure shall be furnished and installed. Concrete pedestals with plate inserts on top surface for supporting the pipes as well as valves are also included in the Contractor's scope of work.

The jointing of pipes and fittings shall be made as described under underground piping.

4.4.4 Pipe hanger & bracket etc. :

Sturdy hangers, brackets and saddles of approved design shall be installed to support all pipe lengths from ceiling / masonry wall / columns / trusses. The hangers and brackets shall be fabricated from suitable M.S rolled sections for Non –Process areas and SS material for Process areas.

The hangers and brackets shall be of adjustable heights and painted with red oxide primer, clamps collars and saddles to hold pipes shall be provided with suitable gaskets / washers.

The brackets and hangers shall be designed to safely carry the weight of pipe. All pipes and fittings shall be secured near every joint and half way through every pipe length unless otherwise specified. M.S. Plates to be used in system shall conform to IS 226 ST 42 S. MS supports used are to be galvanized.

4.4.5 INTERCONNECTING PIPELINES:

Interconnecting pipelines shall consist of all the pipelines for various services from different units to the equipment and between the units of the pumping system.

The quantity of piping including valves and specials shall be as required to suit the site conditions and the approved piping layout for the plant. All the piping systems shall be designed to handle the maximum quantity of the respective fluids at the specified parameters.

All piping systems shall be provided with /as per approved drawings:

- a. Necessary isolating/Regulation & control valves
- b. Air release/ball float valves as required
- c. Drain pipes with valves
- d. Supports/trestles/thrust blocks as required
- e. Pipe fittings such as elbows, bends, reducers, tees, flanges, nipples, expansion joints, specials etc.
- f. R.C.C. encasing pipes at roads.
- g. Dismantling/flexible joints for maintenance/ replacement of header/ valves.

Piping system shall be designed with a high degree of reliability so that the system performs the duty of fluid handling without any failure under all conditions of plant operation.

Piping layout must follow good engineering practice. Proper attention shall be paid to obtain full functional requirement of the piping system with a layout which provides sufficient clearance for other equipment and operating personnel, convenient supporting points and neat appearance.

The design shall take into account the effort of internal/external pressures, thermal expansion, self-weight of piping, support reactions, surge and water hammer, earthquake and wind effects at site, corrosion and erosion etc., and any other effects dictated by good engineering practices and piping standards and codes.

Piping system shall not impose undue forces on equipment terminals/flanges.

Mild steel pipes shall be used in general for water supply facilities and special quality pipes such as GI for drinking water and PVC/MS rubber lined/HDPE pipes for corrosive fluids and S.S pipes and fittings for Potable water. For further details refer data sheet enclosed.

The pipe network shall be provided with air release valves at high points and drains valves at the lower points.

Each of the branch connections taken from the main network shall be provided with an isolation valve.

Pipelines passing under or through equipment foundations or walls of buildings or any other inaccessible structure shall be provided with steel encasing pipes for easy insertion and removal.

All the pressure pipes shall be laid with nominal slope and the gravity network with slopes for self-cleaning velocities.

Except where otherwise specified, all piping shall have butt welded connections with a minimum of flanged joints for connections to equipment. Branches shall in general be formed by welding.

Unions/nipples or flanges as required for connecting to equipment, valves, instruments, etc., shall be installed in the piping works to facilitate dismantling for maintenance.

For GI pipes, jointing shall be done by screwed and socket joints.

Provision shall be made for branches for cleaning and flushing of pipelines wherever necessary.

Provision shall be made for support of piping, which may be disconnected during maintenance work. All large pipes and all long pipes shall have at least two supports each arranged in such a way that any length of piping or valve may be removed without any additional supports being required.

Pipe supports shall be capable of supporting the pipelines under all conditions of operation.

4.4.6 WELDING:

Welders and welding procedures shall be qualified in accordance with the requirements of relevant ASME specifications, and any latest alterations, modifications thereof. This will be modified where appropriate for other materials and may be relaxed or varied by order of Consultant, provided other materials and may be relaxed or varied by order of Consultant, provided the contractor has made a reasonably comprehensive request for an alternate.

- a. All welding shall have full thickness penetration and shall be done by the following methods :
- i. Welding of SS pipes : GTAW process with Argon (Process & Utilities) purging
- b. Type of electrode to be used:

Base Metal	Root	Fill up	Cap	Purging Gas
IS 1239	E 6013	E 6013	E 6013	Nil
IS 3589	E 6013	E 6013	E 6013	Nil
SA 106 Gr. B (25 NB)	E 7018	E 7018	E 7018	Nil
SA 106 Gr. B (>25 NB & <8mm thick)	ER70S2	E 7018	E 7018	Nil
SA 333 Gr. 6	E 7018 - 1	E 7018 - 1	E 7018 -1	Nil
SA 312 TP 304	ER 308	ER 308	ER 308	Argon
SA 312 TP 304L	ER 308L	ER 308L	ER 308L	Argon
SA 312 TP 316	ER 316	ER 316	ER 316	Argon
SA 312 TP 316L	ER 316L	ER 316L	ER 316L	Argon

For stainless steel welding processes such as inert gas shielded, tungsten arc process as stipulated in the specifications, shall be employed. Special efforts should be made at all times to keep stainless steel surfaces from coming into contact with other metals. For cleaning, only clean stainless-steel wool and brushes should be used. All grinding of stainless steel should perform with aluminium oxide or silicon carbide grinding wheels bonded with resin or rubber and not previously used on other metal. Proper identification and correct marking of the types of the material should be done during fabrication and welding stage.

- c. GAS WELDING shall NOT BE used UNLESS OTHERWISE particularly specified.
- d. In multiple pass, welding, the next layer shall be applied only when the previous layer is ensured free from slag and is clean. Any defects shall be chipped off before application of next layer.
- e. Peening shall be done, if necessary. Next run of weld should be carried out only after thorough preparation and inspection.
- f. The completed weld shall be cleaned of slag and spatter metal of all surfaces.
- g. No undercutting of pipe adjacent to the completed weld will be permitted.

- h. Finished welds shall project not less than 1.5 mm but not more than 3mm from the outer surface of the pipe.
- i. The welding electrodes used shall have suitable coating and comply with relevant standards as per IS / ASME.
- j. The electrodes used shall be stored in a damp proof enclosure. All electrodes should be dried in an oven prior to issue for welding.
- k. All metal welds shall be hammer tested and subjected to visual inspection.
- l. In case of defect, such as leakage etc., the defective area shall be marked with accepted colour code and similar system shall be employed for corrected defect areas.
- m. All consumables used by the Contractor shall be approved by the Consultant/Site Engineer.

4.5 MODE OF MEASUREMENTS:

Mode of Measurement for payment of items of piping & their insulation shall be as follows:

4.5.1 PIPING:

Shall be measured in units of length along the center line of installed pipes including all pipe fittings, flanges (with gaskets and nuts and bolts for jointing), unions, bends elbows, tees, concentric and eccentric reducers, inspection pieces, expansion loops etc. The above accessories shall be measured as part of piping length along the center line of installed pipes and no special rates for these accessories shall be permitted.

The quoted unit rates for center line linear measurements of piping shall include all wastage allowances, wooden haunches nuts and check nuts, vibration isolator suspension where specified or required, and cost of excavation, bedding, back filling and finishing as required to complete the piping installation as per the specification. None of these items will be separately measured nor paid for. However, all valves (gate/globe/butterfly/check/balancing/purge/drain etc), strainers, orifice plates, temperature gauge, pressure gauges shall be separately measured and paid as per their individual unit rates, which shall also include their insulation as per specifications, piping measurements shall be taken before application of the insulation. The cost shall also include any excavations and making masonry valve chamber with steel cover etc.

4.5.2 GUARANTEE:

The contractor shall guarantee that the materials and workmanship of the entire system are of the first class quality. All the equipment's / apparatus shall be guaranteed to yield the specified ratings of discharge and quality. Any defective equipment / material / workmanship found short of the specified quality shall be rejected. Guarantee certificate of equipment's from suppliers / manufacturers shall be handed over to the IISC.

4.5.3 DEFECTS AND LIABILITY:

All the equipment's / materials and the system shall be guaranteed against defective material and workmanship for a period of 12 months from the date of commissioning to the Owners along with all relevant documentation. The contractor shall repair, rectify, and replace all the defective materials, components free of cost. In addition, normal maintenance shall be carried out periodically during the defects and liability period including replacement of spares, as required.

4.5.4 TESTING:

The Contractor shall arrange to test the entire system as per the procedure enumerated under particular specifications, after the erection is completed. The results of the tests shall be submitted to the Owners personnel in the operation and maintenance of the system.

All pumps shall be tested at manufacturer's works in accordance with IS: 10961- 1988/IS: 5129-1977. At site free running pumps shall be carried out before commissioning the system.

All pipes with valves fittings & accessories after erection shall be hydraulically tested for a pressure of 1.5 times the maximum working pressure & duration of the test shall be minimum for 4 hours.

4.5.5 INSTRUCTION MANUAL / COMPLETION DRAWINGS / TRAINING:

The contractor shall furnish detailed instruction and operation manual of the system. The contractor shall also furnish detailed completion drawings inclusive of control schematics, in quadruplicate if any. The contractor shall train the Owners Personnel in the operation and maintenance of the system.

5.0 CODES & STANDARDS FOR NB PIPING WORKS:

All piping works covered under this specification shall comply with currently applicable statutes, regulations and safety codes. They shall comply in all respects with the requirements of the latest editions of the codes and standards. In case of conflict between codes and standards referred to in this specification or documents enclosed with specification.

5.1 STATUTORY REGULATIONS

The tenderer shall follow all statutory regulations of Government of India and Government of Karnataka currently in force such as

5.1.1 Indian Factories Act

5.1.2 Indian Electricity Rules

5.1.3 Static & mobile unfired Pressure Vessel Rules-1981

5.1.4 Central water and Air Pollution Acts

5.1.5 Karnataka Government regulations for prevention and control of water and air pollutions.

Statutory regulations with latest amendments shall be binding on the tenderer and all approval required under these regulations shall be the sole responsibility of the tenderer. Any modifications for meeting these regulations shall be carried out by the tenderer without any extra claims.

5.2 STANDARDS

The equipment and components of all equipment shall be designed, manufactured/fabricated, assembled, tested erected & commissioned in accordance with the latest standards of Bureau of Indian Standards/ International Standards.

In cases where suitable Indian Standards are not available, relevant International Standards and codes shall be followed.

In cases where the offer deviates from the specified standards, the tenderer shall indicate clearly in his offer the standards proposed to be adopted and the details thereof.

Some of the relevant standards relevant to this specification are listed below:

5.2.1 PIPES

Steel Pipes & Fittings

IS: 1239 – 1990	:	Tubes, Tubular & Part-I other wrought steel fittings.
IS: 1978 - 1982	:	Line pipes API-5L, Gr-B-1995
IS: 3589 - 2001	:	Seamless (or) electrically welded steel pipes for water, gas & sewage.
IS: 5504 - 1997	:	Spiral welded pipes.
IS: 1239 (Part-2)	:	M.S. Tubes, tubular and (1992) wrought Steel fittings.)
IS: 11428-1985	:	Wrought carbon steel butt (Part 1 to 3)
ASME	:	B 16.5- 1988 welding pipe fittings.

5.2.2 OTHERS

American Society for Testing and Materials (ASTM)

- a.** A269 Seamless and Welded Austenitic Stainless-Steel Tubing for General Service TP 304
- b.** A370 Standard Methods and Definitions for Mechanical Testing of Steel Products
- c.** A632 Seamless and Welded Austenitic Stainless-Steel Tubing (Small Diameter) for General Service
- d.** A-262 Standard Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels

American National Standards Institute (ANSI)

- a. B31.1 Code for Pressure Piping, Chemical Plant and Petroleum Refinery Piping
- b. B31.3 Process Piping
- c. American Society of Mechanical Engineers (ASME)
- d. Section IX Welding Qualification
- e. Welding Procedure/Qualification: ASME B 31.3/31.8, ASME Sec IX & IS: 817
- f. ASME Sec IX & IS: 814: Material Specifications, Welding rods, Electrodes & filler wire etc.
- g. ANSI-B-16.5: Pipe Flanges & Flanged Fittings
- h. ASME/ANSI-B-16.10: Face-to-Face & End-to-End Dimensions of Valves
- i. ANSI-B-18.2.1: Square & Hex Bolts & Screw.
- j. ANSI-B-18.2: Stud & Nuts.
- k. IS Standard or Equivalent: Gauges
- l. IS: 4038 - 198: Foot valves for water works purpose.
- m. IS: 2685 - 1971: Code of practice for selection and installation of sluice valves.
- n. IS: 2825 – 1969: Code of unfired pressure vessel.
- o. IS: 4682 – 1974: Code of Practice for lining of vessels

Vessels - 4.5 mm thick (3 x 1.5)

Piping - 3.0mm thick (2 x 1.5) shore hardness 65 + 5A.

- a. IS: 6392 – 1971: Steel pipe flanges. ASME: B 16.5- 1988
- b. IS: 1363 - 1992: Hexagon head bolts, (Part - 1 to 3) screws and nuts of product Grade-C
- c. IS: 1364 - 1983: Hexagon head bolts, screws and nuts of product Grade A & B.
- d. IS: 2062 Gr.A & B - : Steel for general structural purpose.1992
- e. IS: 5822 – 1994: Code of practice for laying of electrically welded steel pipes for water supply.
- f. IS: 10221 – 1982: Code of practice for coating and wrapping of underground M.S. pipe lines.
- g. IS: 554 – 1985:Dimensions for pipe threads.

- h. IS: 778 – 1984: Specification for copper alloy gate, globe and check valves for water works purpose.
- i. IS: 780 – 1984: Specification for sluice valves for water works purpose.
- j. IS: 781 – 1984: Specification for cast copper alloy screw down bid taps and stop valves for water services.
- k. IS: 5312: Specification for (Part-1 & 2) 1984/86 swing check reflux valves - single/multi door pattern.
- l. API – 594: Check valves: wafer, wafer-lug, and double flanged type.
- m. IS: 13095 - 1991: Butterfly valves for general purpose.
- n. IS: 1703 – 2000: Specification for copper alloy float valves for water supply fittings.
- o. IS: 9890 - 1981: General purpose ball valves.
- p. IS: 5290 - 1993: Specification for landing valves.
- q. IS: 2712 - 1998: Compressed asbestos fibre jointing.
- r. IS: 7318 - 1974: Approval tests for welders (Part-1) when welding procedure is not required.
- s. IS: 7307 - 1974: Approval tests for welding procedures.
- t. IS: 814 – 1991: Covered electrodes for manual metal arc welding.
- u. IS: 816 – 1969: Code of practice for use of metal arc welding for general construction in M.S.
- v. IS: 7810 – 1999: Approval test for welders working to approved welding procedures.
- w. IS: 5 – 1994: Colours for ready mixed paints and enamels.
- x. IS: 2379 – 1990: Colour code for identification of pipe lines.
- y. IS: 800 – 1984: Code of practice for general construction in steel.
- z. IS: 7215 – 1974 : Tolerance for fabrication of steel structure
- aa. IS: 456 – 2000: Code of practice for reinforced concrete.

6.0 DATA SHEETS & SPECIFICATIONS:

6.1 GENERAL SPECIFICATION FOR SS TUBING:

All the items shall meet the following specifications;

6.1.1 MATERIAL OF CONSTRUCTION:

1. Seamless tubing shall be made of SS material and cold drawn instrumentation type. Tubing should be dual certified as TP 316 / 316L.
2. Seamless tubing should have a minimum of 2.5% molybdenum so as to ensure high resistance to corrosion.
3. Seamless tubing should have carbon content $\leq 0.030\%$.
4. Seamless tubing hardness should be max of HRB 90.
5. Seamless tubing sizes up to 1" OD should be bright annealed. Tubing with outside diameter larger than 1" OD should be supplied in annealed and pickled condition.
6. Seamless tubing shall have Tolerance on Wall Thickness $\pm 10\%$.

6.1.2 DESIGN & MANUFACTURE:

1. Seamless tubing manufacturer should have ISO 9001/9002 certification and as well as product approvals from TUV and JIS.
2. Quality System of the Tubing Manufacturer should have approval from ASME quality system certification as material organization.
3. Tolerance for 316/316L tubing from 6 to 42mm OD as per DIN/2391/ED 10305-I & tolerance on wall thickness should be $\pm 10\%$.
4. Seamless tubes shall be certified as per NACE/ MR0175 for Hardness.
5. Tubing shall be manufactured in an integrated Mill with hot extrusion process.

6.1.3 INSPECTION & TESTING:

1. Testing of the Tubing should be in accordance with SS142353/142343, DIN 17456/58, NFA 49 – 117/217, ASTM A213, ASTM A269, ASTM A312, and EN 10216-5.
2. Tubing supplier should furnish an "INSPECTION CERTIFICATE" indicating:
 - a. Material description
 - b. Steel making process
 - c. Heat code

- d. LOT code
- e. Leak test: Eddy current test according to ASTM A-450
- f. Test result of chemical composition, tensile test, hardness test, flaring test and flattening test.

6.1.4 TEST REPORTS & CERTIFICATES:

The manufacturer should supply material compliance certificate.

6.1.5 MARKING, PACKING & SHIPMENT:

1. All tubing must be clearly marked with heat code, lot code, outer diameter and wall thickness as in the inspection certification.
2. Tubing shall be supplied with plugged ends.
3. All the items shall be suitably wrapped and packaged to withstand rough handling during ocean shipment and inland journey.
4. Items shall be wrapped and packaged in such a way that they can be preserved in original as new condition.


6.2 GENERAL SPECIFICATIONS FOR SS TUBE FITTINGS:

All the items shall meet the following specifications;

6.2.1 MATERIAL OF CONSTRUCTION

1. Fittings shall be manufactured from the following materials:-
 - a. Bar stock shall be SS 316 material as per ASTM A276/ASME SA 479, EN 1.4401 having carbon content less than 0.05% to provide increased resistance to corrosion.
 - b. Forgings shall be SS 316 material as per ASTM A182/ASME SA182 EN 1.4401.
2. The fittings end connections shall be compatible with SS tube of hardness \leq HRB 90.
3. The stainless-steel material, from which tube fitting bodies and components are made, will be restricted to a minimum chromium content of 17.0 % and a minimum nickel content of 12.0% for improved corrosion resistance and to a maximum carbon content of 0.05 %, which provides better corrosion-resistant weld ability.
4. All component parts of the fittings shall be of the same material.
5. The ferrule material shall be able to withstand an atmosphere of natural gas, oil and moisture without rusting.
6. Every Component of fitting including front and back ferrule should be etched.

Pipe for Gases:

SR NO	DESCRIPTION	SPECIFICATION	IMAGE
1	Tech. Name	Pipe (SCH.10)	
2	MOC	SS 316	
3	Ref. Standard	ASTM A 312 TP 304	
4	Size	50mm, 40mm, 25mm, 20mm & 15mm	
5	Make		
6	Origin	Indian	
7	Working Pressure	15 Bar	
8	End Connection	Plain	

6.2.2 DESIGN & MANUFACTURE

1. All fittings shall be designed in conformance with the requirements of ASME B31.3 and applicable standards. Area classification applicable for all items shall be Class-1, Division-1, Group-D as per NEC Zone-1 Group-IIA/ II-B as per IS/ IEC specification or equivalent specification. All fittings shall be designed so that all parts/ components meet the requirements for the specified area classification.
2. The tube fitting shall consist of the following precision machined parts: a) body, b) front ferrule, c) back ferrule and d) nut. The design configuration of all components shall present surface-to-surface contact, one part to another, keeping unit stresses below galling levels, for use on SS tubes conforming to ASTM A269 TP316.
3. Fittings shall be rated for at least the design pressure stipulated in the material requisition. The design of the fittings shall ensure that they shall be capable of holding full tube burst pressure after only one and a quarter turn pull up of the nut.
4. The threaded end of the fittings shall be NPT as per ASME B1.20.1, SAE AS 71051.
5. The fittings shall hold the tube with collecting action producing a firm grip on the tube without substantially reducing the tube wall thickness.
6. The fitting body shall not have any machined stop or shoulder to preclude additional tightening in subsequent make-up.
7. Fittings shall not torque the tubing during original or subsequent make-up of the connection and use geometry for inspection before and after make up the fittings shall not require disassembly for inspection before or after makeup.
8. All tube fittings shall be Gaugeable for sufficient pull up after one and quarter turn. All tube fittings shall have a gauge able shoulder and there will be no radius at the point where the shoulder meets the neck of the fitting body. A Gap Inspection Gage shall be used to check for insufficient pull-up.
9. The gap inspection gauge shall be easily insertable at finger tight position of nut. The gap inspection gauge shall not be insertable between the nut and shoulder of the fitting after completing only one and a quarter turn pull up of the nut.

10. The tube seat counter bore in the body shall be faced flat 90° to the axis of the tubing to minimize tube expansion and subsequent galling.
11. The sealing and gripping power of the fitting shall be controlled such that the action between ferrules will overcome commercial variations in tubing wall thickness, hardness, and diameter.
12. Front Ferrule
 - i. The front ferrule shall provide a long, smooth repeatable seal by contact with body.
 - ii. The front ferrule shall remain in an elastic condition to compensate for thermal stresses and to Accomplish repeated make and break.
13. Back Ferrule
 - i. The rear ferrule shall collet the tubing surface, improving the performance of the tubing in the systems of high impulse or vibration.
 - ii. The back ferrule will have a uniform surface hardening. This surface hardening will be a low-temperature carburization, avoiding carbide formation. It will follow a disclosed and auditable process procedure.
 - iii. The rear ferrule shall have a machine recess on the inside diameter and shall have complete surface hardening so as to substantially remove the required pull up torque. Both the requirements i.e. complete surface hardness and machined recess shall be met for all rear ferrules.
14. Nuts shall have silver plated threads to act as a lubricating agent to avoid galling and to reduce tightening torque.
15. Manufacturer shall be able to offer tube fittings with specially cleaned and packed to ensure compliance with product cleanliness requirements stated in ASTM G93 Level C for Oxygen.
16. All tube fittings provided by the supplier shall be NACE MR0175 certified by default.

6.2.3 INSPECTION & TESTING

The manufacturer shall submit typical type test reports for the following test carried out on random samples of two ferrule fittings:-

1. Hydrostatic Pressure Test: Fittings should undergo testing conducted to evaluate the tube gripping ability of assembled tube fittings to sustain hydraulic over pressure, attaining up to 3.5 times working pressure without hydraulic leakage and up to 4 times the working pressure without fitting material rupture or tube slippage.
2. Helium Proof / Nitrogen Re-make Test: Fittings should undergo testing conducted to evaluate the performance of tube fittings with 1.5 times the working pressure with Helium and at rated working pressure with Nitrogen after every re-make for 25 such re-makes.
3. Helium Leak Test: Fittings should undergo testing to ensure that leakage is not in excess of 1.0×10^{-9} atm-cc/sec with the test assembly evacuated to approx. 20 millitorr while maintaining a differential pressure of 1 atm between the inside and outside of the assembly.

4. Sodium Chloride Stress Test: Fittings should undergo testing conducted to evaluate the effect of an environment that promotes stress corrosion cracking (SCC); conducted as per ASTM B117-95 standards.
5. Rotary Flex Test: Fittings should undergo testing conducted to evaluate the fatigue endurance reliability of tube fittings when installed on tubing subjected to fully reverse rotary beam flexure.
6. Vibration Test: Fittings should undergo testing conducted to evaluate the amount of cantilever deflection that can be applied to a tube and fitting assembly and still pass through 10,000,000 cycles without failure.
7. Tube Burst Test: Fittings should undergo testing conducted to evaluate the grip of tube fittings on tubing at the burst pressure of the tubing.
8. Fire (Burn) Test with water quench: Fittings should undergo testing conducted to evaluate the performance when exposed to a 1,500°F burn and a water quench based on API 607 standards.
9. High Impact Shock Test: Fittings should undergo testing conducted to evaluate the performance when subjected to shock test conducted as per ASTM F1387-99 standards. Should satisfy the requirements of ASTM F1387 Standards. The above shall be witnessed and certified by the U.S Department of Navy.

6.2.4 TEST REPORTS & CERTIFICATES

1. The manufacturer should provide material compliance certificates.
2. Fittings manufacturer should have ISO 9001 certification and as well as product approvals from TUV, ASTM, ASME, BSI, DNV, GOST, Lloyds Registrar of Shipping & PED and also the most stringent fitting specification ASTM F1387, witnessed by the US Navy.

6.2.5 MARKING, PACKING & SHIPMENT

1. Heat code traceability number shall be etched on both body and nut of each fitting. All fitting shall be etched to identify manufacturer and material.
2. Replacement nuts and ferrules shall be packaged in a manner so as to allow safe and simple replacement.
3. All the items shall be suitably wrapped and packaged to withstand rough handling during ocean shipment and inland journey.
4. Items shall be wrapped and packaged in such a way that they can be preserved in original as new condition.
5. Local Stock: Manufacturer or authorized distributor shall carry significant amount of stock to the tune of 500 nos of the tube fittings each in their local stocks.

6.2.6 DOCUMENTATION

- I. All documents shall be furnished in English language only.
- II. At the time of bidding, bidder shall submit following documents:
- III. Reference list of the previous supply for similar items, giving following details:

- a. Name of the customer.
- b. Specification of the item i.e. size & pressure and temperature rating.
- c. Service
- d. Quantity
- e. Year of Supply
- f. Test procedures and typical certificates to be submitted as per clause 5.3 and 5.4 of this specification.
- g. Manufacturer Quality Control Plan and sampling plan.
- h. Copy of ISO 9000 certification for supplier/ manufacturer.
- i. The manufacturer should supply material compliance certificate.

6.2.7 WARRANTY

Manufacturer & its authorized distributors should offer a comprehensive Warranty covering the performance of the product against any defects in material or workmanship for 1 years' time of the product. A certificate to this effect must be issued on their respective Company letter head.

6.3 GENERAL SPECIFICATION FOR MANUAL CHANGEOVER REGULATORS:

All the items shall meet following specifications.

6.3.1 MATERIAL OF CONSTRUCTION

1. The Regulator body, stem & range spring shall made of SS 316.
2. Material of construction of the diaphragm shall be Alloy X-750
3. Material of construction of seat shall be either PCTFE or PEEK depending on the pressure rating of the regulator.
4. All wetted lubricants must be PTFE based.

6.3.2 DESIGN & MANUFACTURE

1. All manual changeover manifolds shall ensure continuous gas delivery by automatically switching between sources to extend gas supply.
2. Diaphragm sensing regulators enable precise pressure regulation. In order to achieve greater sensitivity and longer life, a convoluted diaphragm shall be used.
3. All manual changeover manifolds must have a Supply Pressure Effect of approx. 0.01%.
4. All manual changeover manifolds shall be supplied as a complete system with tube fittings, inlet/outlet/vent valves, pressure gauges & suitable single & double stage pressure reducing regulators mounted suitably on a SS 304 panel, except for manifolds supplied for Oxygen service. All regulators used must comply with the specifications listed below.

5. All regulators shall have a two piece design that offers linear load on the diaphragm seal when the cap ring is tightened, eliminating torque damage to the diaphragm during assembly.
6. The diaphragm of the pressure regulator shall have a convoluted, no perforated design ensuring greater sensitivity and longer life.
7. All pressure reducing regulators must include a 25µm filter that is held in the inlet port to prevent any foreign particles from entering the regulator. In addition the filter must be supported by a retainer ring to prevent it from accidentally falling out.
8. The poppet must be supported by a poppet damper to keep the poppet aligned thereby reducing vibration & resonance.
9. The diaphragm shall be supported by a braced stop plate to protect against a ruptured diaphragm.
10. All manual changeover manifolds & all components for Oxygen system shall be suitably cleaned for Oxygen service and quoted accordingly.
11. Manufacturer shall be able to Regulators with specially cleaned and packed to ensure compliance with product cleanliness requirements stated in ASTM G93 Level C for oxygen service.
12. All Regulators used must meet the technical specification listed in the earlier part of this document.

6.3.3 INSPECTION & TESTING

1. Shell testing shall be performed on all components to a requirement of no detectable leakage with a liquid detector at 80 psig (5.5 bar) nitrogen.
2. All regulators must be 100 % factory tested for changeover pressure.

6.3.4 TEST REPORTS & CERTIFICATES

1. The manufacturer shall supply material compliance certificate.
2. Regulator manufacturer should have ISO 9001 certification and as well as product approvals from TUV, ASTM, ASME, BSI, DNV, GOST, Lloyds Registrar of Shipping & PED.

6.3.5 MARKING, PACKING & SHIPMENT

1. Heat code shall be marked on Regulator body to facilitate traceability. All Regulators shall be etched to identify manufacturer and material.
2. All the items shall be suitably wrapped and packaged to withstand rough handling during ocean shipment and inland journey.
3. Each item shall be properly tagged and package separately to facilitate easy identification.
4. All items shall be wrapped and packaged in such a way that they can be preserved in original as new condition.


6.4 GENERAL SPECIFICATION FOR SS BALL VALVES:

All the items shall meet following specifications.

6.4.1 MATERIAL OF CONSTRUCTION

1. The valve shall be of Single piece design with forged / machined body made of material conforming to ASTM A479 & A276 Type SS 316.
2. Material of construction of ball stem shall confirm to ASTM A276 Type SS 316.
3. Material of construction of packing shall be Modified PTFE / D1710 type 1, Grade 1, Class B.
4. Manufacturer shall be able to provide multiple options for seat packing materials Reinforced PTFE, Alloy X-750, Carbon/glass PTFE, PEEK & UHMWPE.
5. Manufacturer shall be able to provide multiple options for stem packing materials maintenance kits and color handle kits.

6.4.2 Ball Valve:

SR NO	DESCRIPTION	SPECIFICATION	IMAGE
1	Tech. Name	Ball Valve	
2	MOC	SS 316	
3	Flow Pattern	2 Way Shut off, Straight Pattern	
4	Size	1/4" OD	
5	Make		
6	Origin	India	
7	Design Pressure	20 Bar	
8	End Connection	OD CF	

6.4.3 DESIGN & MANUFACTURE

1. Valve shall employ a live-loaded packing system that reduces need for packing adjustment improves thermal cycle performance and compensates for wear.
2. Packing shall be a single-piece design constructed of modified PTFE which reduces potential leak points and has virtually no dead space. Valve sizes above 3/8" shall have standard PTFE packing.
3. Manufacturer shall be able to offer Ball Valves with specially cleaned and packed to ensure compliance with product cleanliness requirements stated in ASTM G93 Level C for oxygen service.
4. Design pressure shall be at least twice the working pressure & Burst pressure may be almost four times the working pressure of the ball valves.

5. The back ferrule of Ball Valves' end fitting shall have a machined recess on the inside diameter and shall have complete surface hardening to substantially reduce the required pull up torque. Both the requirements i.e., complete surface hardness and machined recess shall be met for all rear ferrules of sizes ranging from ¼" to 1" OD & 6mm to 25mm OD.
6. All Ball Valves with SS Nut & Ferrule end fittings shall have a gaugeable shoulder.
7. Single piece ball Valve shall employ a balanced trunion, patent –pending design that supports packing volume, minimizing thermal effect.

6.4.4 INSPECTION & TESTING

1. The valve shall be factory tested with Nitrogen at 1000 psig (69 bar). Maximum allowable seat leakage shall be 0.1 std cc/min.

6.4.5 TEST REPORTS & CERTIFICATES

1. The manufacturer shall supply material compliance certificate.
2. For Sour Gas service - Materials for wetted components are selected in accordance with NACE Specification MR0175 for sulfide stress cracking resistant materials.
3. Valve manufacturer should have ISO 9001 certification and as well as product approvals from TUV, ASTM, ASME, BSI, DNV, GOST, Lloyds Registrar of Shipping & PED.
4. Valves are helium leak tested at a pressure of 1×10^{-4} Torr. The maximum allowable leak rate is 4×10^{-9} std cm³/s.

6.4.6 MARKING, PACKING & SHIPMENT

1. Heat code shall be marked on valve body to facilitate traceability. All valves shall be etched to identify manufacturer and material.
2. All the items shall be suitably wrapped and packaged to withstand rough handling during ocean shipment and inland journey.
3. All items shall be wrapped and packaged in such a way that they can be preserved in original as new condition.

6.5 GENERAL SPECIFICATION FOR SS NEEDLE VALVES:

All the items shall meet following specifications.

6.5.1 MATERIAL OF CONSTRUCTION

1. All 316 SS Needle valves body to conform to ASTM A182/ A479 and stem material, packing nut to conform with 316 SS/A276.
2. Material of construction of Upper and lower packing shall be PFA/D3307.
3. Manufacturer shall be able to provide multiple options for seat packing materials kits, Lockable handles and colour handles kits.
4. Manufacturer should be able to provide multiple options for stem packing materials, O-ring maintenance kits and colour handle kits.
5. Manufacturer shall be able to provide multiple options for O ring materials like Buna C, Buna N, Ethylene propylene & Karlez.
6. All Needle Valves with SS Nut & Ferrule end fittings shall have a gaugeable shoulder.

6.5.2 DESIGN & MANUFACTURE

1. Manufacturer shall be able to provide needle valves either with Integral bonnet / Union bonnet design.
2. The back ferrule of Needle Valves' end fitting shall have a machined recess on the inside diameter and shall have complete surface hardening to substantially reduce the required pull up torque. Both the requirements i.e., complete surface hardness and machined recess shall be met for all rear ferrules of sizes ranging from ¼" to 1" OD & 6mm to 25mm OD.
3. Manufacturer shall be able to offer Needle Valves with specially cleaned and packed to ensure compliance with product cleanliness requirements stated in ASTM G93 Level C for oxygen service.
4. All Needle Valves with SS Nut & Ferrule end fittings shall have a gaugeable shoulder.
5. Manufacturer shall be able to offer atleast 3 types of stem tip designs to suit for different applications parameters.

6.5.3 INSPECTION & TESTING

1. The valve shall be factory tested with Nitrogen at 1000 psig (69 bar). Maximum allowable seat leakage shall be 0.1 std cc/min.
2. Design pressure should be at least twice the working pressure & Burst pressure may be almost four times the working pressure of the Needle valves.

6.5.4 TEST REPORTS & CERTIFICATES

1. The manufacturer shall supply material compliance certificate.
2. For Sour Gas service - Materials for wetted components are selected in accordance with NACE Specification MR0175 for sulfide stress cracking resistant materials.
3. Valve manufacturer should have ISO 9001 certification and as well as product approvals from TUV, ASTM, ASME, BSI, DNV, GOST, Lloyds Registrar of Shipping & PED.

6.5.5 MARKING, PACKING & SHIPMENT

1. Heat code shall be marked on valve body to facilitate traceability. All valves shall be etched to identify manufacturer and material.
2. All the items shall be suitably wrapped and packaged to withstand rough handling during ocean shipment and inland journey.
3. Each item shall be properly tagged separately to facilitate easy identification.
4. All items shall be wrapped and packaged in such a way that they can be preserved in original as new condition.


6.6 GENERAL SPECIFICATION FOR SS CHECK VALVES:

All the items shall meet following specifications.

6.6.1 MATERIAL OF CONSTRUCTION

1. Check valve body and poppet to conform to 316 SS / A479.
2. If the check valve has an elastomer as a wetted component, a variety of sealing materials shall be made available.
3. Manufacturer shall be able to provide multiple options for Seal kits.
4. For corrosive gases If the check valve has an elastomer as a wetted component, a variety of sealing materials including Kalrez and Teflon shall be made available.
5. All Check Valves with SS Nut & Ferrule end fittings shall have a gaugeable shoulder.

Non-Return Valve /Check Valve:

SR NO	DESCRIPTION	SPECIFICATION	IMAGE
1	Tech. Name	Non-Return Valve / Check Valve	
2	MOC	SS 316	
3	Flow Pattern	1 Way Flow	
4	Size	¼"	
5	Make		
6	Working Pressure	230 Bar (As per BOQ), Cracking Pressure 0.5 Micron	
7	End Connection	NPTFxM	
8	Service	All Gases	

6.6.2 DESIGN & MANUFACTURE

The back ferrule of Check Valves' end fitting shall have a machined recess on the inside diameter and shall have complete surface hardening to substantially reduce the required pull up torque. Both the requirements i.e., complete surface hardness and machined recess shall be met for all rear ferrules of sizes ranging from ¼" to 1" OD & 6mm to 25mm OD.

1. Manufacturer shall be able offer Check Valves with specially cleaned and packed to ensure compliance with product cleanliness requirements stated in ASTM G93 Level C for oxygen service.
2. All Check Valves with SS Nut & Ferrule end fittings shall have a gaugeable shoulder.
3. Check Valve with fixed pressure, are cycled six times prior testing, every check valve is tested to ensure it seals within 5's at the appropriate seal pressure.

6.6.3 INSPECTION & TESTING

The valve shall be factory tested with Nitrogen at 1000 psig (69 bar). Maximum allowable seat leakage shall be 0.1 std cc/min. Design pressure should be at least twice the working pressure & Burst pressure may be almost four times the working pressure of the Check valves.

6.6.4 TEST REPORTS & CERTIFICATES

1. Manufacture should provide material compliance certificate.
2. Valve manufacturer should have ISO 9001 certification and as well as product approvals from TUV, ASTM, ASME, BSI, DNV, GOST, Lloyds Registrar of Shipping & PED.

6.6.5 MARKING, PACKING & SHIPMENT


1. Heat code shall be marked on valve body to facilitate traceability. All Check Valves shall be etched to identify manufacturer and material.
2. All the items shall be suitably wrapped and packaged to withstand rough handling during ocean shipment and inland journey.
3. Each item shall be properly tagged and package separately to facilitate easy identification.
4. All items shall be wrapped and packaged in such a way that they can be preserved in original as new condition.

6.7 GENERAL SPECIFICATION FOR HOSE:

All the items shall meet following specifications.

Hose:

SR NO DESCRIPTION SPECIFICATION

SR NO	DESCRIPTION	SPECIFICATION	
1	Tech. Name	Hose	
2	MOC	SS 316	
3	Ref. Standard	ASME B 16.34	
4	End Connection	1/4" NPTF x 1/4" NPTF 3/4" BSPF(LH) x 3/4" BSPM(LH) (For LPG)	
5	Service	All Gases	
6	Working Pressure	230 Bar	
7	Make		

6.7.1 MATERIAL OF CONSTRUCTION

1. Manufacturer should be able to offer Hose with 304 SS over braid.
2. Manufacturer shall provide 316L SS core & 316L SS braided hoses where permeation is undesirable.
3. All 316 SS Hoses end connections for the hose assembly can be permanent (crimped) design or reusable (compression style).

6.7.2 DESIGN & MANUFACTURE

1. Manufacturer shall be able to provide multiple cover options without changing hose technical data.
2. Manufacturer shall provide an option of carbon black filled PTFE core for applications that require static dissipation.
3. All Hoses with SS Nut & Ferrule end fittings shall have a gaugeable shoulder. There will be no radius at the point where the shoulder meets the neck of the fitting body. The gaugeable shoulder will allow a Gap Inspection Gage to be inserted between the nut and shoulder; 180 deg. flush around the neck of the fitting, to check for insufficient pull-up. The Gap Inspection Gage will not fit between the nut and shoulder of a sufficiently pulled-up fitting on the initial pull up and it must be consistently reliable.
4. All Hoses with SS Nut & Ferrule end fittings shall have a gaugeable shoulder.

6.7.3 INSPECTION & TESTING

1. Every assembly is pressure tested with water at room temperature for 30 seconds to a requirement of no detectable leakage. Testing is performed at 1000 psig (69 bar), or 225 psig (15.5 bar) if an end connection is rated below 1000 psig (69 Bar).
2. Design pressure should be at least twice the working pressure & Burst pressure may be almost four times the working pressure of the Hoses.

6.7.4 TEST REPORTS & CERTIFICATES

1. The manufacturer shall supply material compliance certificate.
2. PTFE material complies with FDA regulation 21CFR Part 177.1550, USP <88> Class VI, and 3-A.

6.7.5 MARKING, PACKING & SHIPMENT

1. Heat code shall be marked on hose to facilitate traceability. All Hoses shall be etched to identify manufacturer and material.
2. All the items shall be suitably wrapped and packaged to withstand rough handling during ocean shipment and inland journey.
3. Each item shall be properly tagged and package separately to facilitate easy identification.
4. All items shall be wrapped and packaged in such a way that they can be preserved in original as new condition.


6.8 GENERAL SPECIFICATION FOR FILTERS:

All the items shall meet following specifications.

MATERIAL OF CONSTRUCTION

1. Filter body, bonnet & bonnet nut to conform to 316 SS / A479.
2. The minimum nominal pore size of filter element shall be 0.5µm.
3. The filter element shall be of grade SS 316.
4. Maintenance kits shall be made available for field replacements.
5. All Filters with SS Nut & Ferrule end fittings shall have a gaugeable shoulder.

Inline Filter:

SR NO	DESCRIPTION	SPECIFICATION	IMAGE
1	Tech. Name	Inline Filter	
2	MOC of Contact Part	SS 316 (For Other Gases) SS 316L (For H2)	
3	End Connection	1/4" NPTF x 1/4" NPTM	
4	Make		
5	Micron	0.5 Micron	
6	Working Pressure	150 Bar	

6.8.1 DESIGN & MANUFACTURE

1. All filters with SS Nut & Ferrule end fittings shall have a gauge able shoulder. There will be no radius at the point where the shoulder meets the neck of the fitting body. The gauge able shoulder will allow a Gap Inspection Gage to be inserted between the nut and shoulder; 180 deg. flush around the neck of the fitting, to check for insufficient pull-up. The Gap Inspection Gage will not fit between the nut and shoulder of a sufficiently pulled-up fitting on the initial pull up and it must be consistently reliable.
2. The back ferrule of filter's end fitting shall have a machined recess on the inside diameter and shall have complete surface hardening to substantially reduce the required pull up torque. Both the requirements i.e., complete surface hardness and machined recess shall be met for all rear ferrules of sizes ranging from ¼" to 1" OD & 6mm to 25mm OD.
3. Manufacturer shall be able to offer Filters with specially cleaned and packed to ensure compliance with product cleanliness requirements stated in ASTM G93 Level C for oxygen service.
4. Design pressure shall be at least twice the working pressure & Burst pressure may be almost four times the working pressure of Filters.
5. All Filters with SS Nut & Ferrule end fittings shall have a gaugeable shoulder.

6.8.2 INSPECTION & TESTING

1. Every Filter shall be factory tested with Nitrogen at 1000 psig (69 Bar) to a requirement of no detectable leakage with liquid leak detector.

6.8.3 TEST REPORTS & CERTIFICATES

1. The manufacturer shall supply material compliance certificate.
2. For Sour Gas service - Materials for wetted components are selected in accordance with NACE Specification MR0175 for sulfide stress cracking resistant materials.
3. Filter manufacturer should have ISO 9001 certification and as well as product approvals from TUV, ASTM, ASME, BSI, DNV, GOST, Lloyds Registrar of Shipping & PED.

6.8.4 MARKING, PACKING & SHIPMENT

1. Heat code shall be marked on Filter to facilitate traceability. All Filters shall be etched to identify manufacturer and material.
2. All the items shall be suitably wrapped and packaged to withstand rough handling during ocean shipment and inland journey.
3. Each item shall be properly tagged separately to facilitate easy identification.
4. All items shall be wrapped and packaged in such a way that they can be preserved in original as new condition.

6.8.5 Other Mandatory Requirements

- a. The bidders must enclose a client list, contact details, relevant brochures and compliance certificate (Annexure I) with the tender.
- b. The bidders should be well established firms preferably leaders in the application stated above and must have a proven track record of completing atleast 5 Projects with product supply valued > 20L each. Firms should be in existence for atleast 2 years.
- c. Bidders to submit their reference list of Tubing, Pressure Regulators, Valves and Tube fittings and accessories as mentioned in the tender, supplied for similar services along with offer.

The reference list must include the following:

- Proven Track Record
- Process fluid type, outlet temperature rating.
- Year of supply

- Client's name & address
- Client contact details
- d. Established commitment to technical support in India, preferably Bangalore should be demonstrated.
- e. The Suppliers must have one stop shop for all Fluid components including Fittings, Valves, Tubing, Hoses, Regulators, Gauges, Manifolds, Filters and Quick Connectors etc...
- f. Products should have average leak rate close to zero as evident from Leak surveys for lower operating costs.
- g. The Supplier should have Proven track record for Excellent technical support, Help in product selection, training, Technical update etc..
- h. The authorized representative of the manufacturer shall have the ability to conduct Installation Training Program & with a past record of having conducted more than 10 such programs during the previous 1 year period.
- i. The authorized representative of the manufacturer shall have the ability to conduct Leak Audits and with a past record of having conducted more than 10 such programs during the previous 1 year period.

6.9 System Components;

6.9.1 M. S. fabricated support framework for in Cylinders and Manifolds

Construction : Arc Welding and Bolting.

Finish : One Coat of Primer & two Coates Synthetic enamel paint.

Material Used : MS. Channel /Angle/ Plate as per IS: 808/1730 / 1731


6.9.2 Cylinder Brackets with Chain

MOC : Powder coated M.S. with powder coated G.I. chain

Aesthetically designed gas cylinder brackets with powder coated chain suitable for holding the cylinder securely in upright position.

Cylinder Bracket with Chain:

SR NO	DESCRIPTION	SPECIFICATION	
1	MOC	GI	
2	Specifications	Aesthetically designed gas cylinder brackets with powder	

		coated chain suitable for holding the cylinder securely in upright position.	
3	Make		


6.9.3 Nut Bullnose

Specifications : ¼" NPTM X 5/8" BSP RH /LH nut suitable for individual gas.

MOC: Bullnose: SS 304

Nut : Barstock Brass

Nut Bullnose:

SR NO	DESCRIPTION	SPECIFICATION	
1	Tech. Name	Nut Bullnose	
2	MOC	SS 316	
3	Specification	¼" NPTM X 5/8" BSP RH /LH nut suitable for individual gas. A sintered filter of 25 micron is inbuilt in bull-nose connector to prevent entry of dust / impurities in gas handling system.	
4	Service	Suitable for all gases	
5	Working Pressure	230 BAR	
6	Make		

6.10 GENERAL SPECIFICATION FOR SS304 PIPES:

SERVICE MEDIA		CA					
DESIGN		BASE MATERIAL : STAINLESS STEEL SS -304					
CONDITIONS		RATING & FACING: 150 #.					
		CORROSION ALLOWANCE : NIL					
		MAX W.P : 5.0 KG/CM2 (G)		MAX TEMP: 50 ° C MIN.TEMP: -- 30° C			
ITEM	SIZE	TYPE	MATERIAL	DIMENSIONS	THK/ RATING	ENDS	REMARKS
	NB -						

	MM						
	FROM TO						
PIPE	15 40	ERW	A312 TP 304	ANSI B 36.19	SCH. 40S	P.E	
	50 150	ERW	A312 TP 304	ANSI B 36.19	SCH. 10S	B.E	
FLANGES	15 150	SORF	ASTM A182 F304	ANSI B 16.5	150 #	R.F	
BLIND	15 40	PLATE	ASTM A182 F304	ANSI B 16.5	150 #	R.F	
ELBOW	15 40	WELDED	A 403 GR WPW 304	ANSI B 16.9	SCH. 40S	B.E	
ELBOW	50 150	WELDED	A 403 GR WPW 304	ANSI B 16.9	SCH. 10S	B.E	
REDUCER	15 40	WELDED	A 403 GR WPW 304	ANSI B 16.9	SCH. 40S	B.E	
ECC	50 150	WELDED	A 403 GR WPW 304	ANSI B 16.9	SCH. 10S	B.E	
REDUCER	15 40	WELDED	A 403 GR WPW 304	ANSI B 16.9	SCH. 40S	B.E	
CONC	50 150	WELDED	A 403 GR WPW 304	ANSI B 16.9	SCH. 10S	B.E	
TEES	15 40	WELDED	A 403 GR WPW 304	ANSI B 16.9	SCH. 40S	B.E	
TEES	50 150	WELDED	A 403 GR WPW 304	ANSI B 16.9	SCH. 10S	B.E	
CAPS	15 40	WELDED	A 403 GR WPW 304	ANSI B 16.9	SCH. 40S	B.E	
CAPS	50 150	WELDED	A 403 GR WPW 304	ANSI B 16.9	SCH. 10S	B.E	
STUB	15 40	SMLS	A 403 GR WPW 304	ANSI B 16.9	SCH. 40S	B.E	
ENDS	50 150	SMLS	A 403 GR WPW 304	MSS.SP 43	SCH. 10S	B.E	
GASKETS	15 150	RING TYPE	PTFE	ANSI B 16.21	3 MM		
BOLTING	ALL	STUDS & HEAVY	A 193 GR B8	ANSI B 1.1	FULLY		
BOLTING	ALL	HEX NUTS	A 194 GR 8	ANSI B 18.82	THREADED		

6.11 GENERAL SPECIFICATION FOR SS304 VALVES

SL NO	TYPE	BALL VALVE(SS 304)	SL NO	INFO	
1	BODY	ASTM A182Gr F-304	17	VACUUM	PARTIAL VACUUM
2	ENDS	NB 15-25 mm SCREWED TYPE/NB ≥ 40 mm SORF	18	PACKING	PTFE
3	FLANGE HOLES	AS PER ANSI.B.16.5	19	STUDS & NUTS	SS 304/316
4	MFG. STD		20	MAX TEMP	50 °C
5	RATING	150 # RATING	21	MIN TEMP	15 °C
6	BORE	REGULAR PORT	22	MAX PRES	10 Bar g
7	BALL	SS 304	23	MIN PRES	FV
8	BODY GASKET	PTFE VIRGIN	24	MAKE	
9	TRIM	AISI 304/316-CF 8/CF8M	25	Hydro test	
10	SEATING	PTFE VIRGIN	26	BODY	30 bar g
11	LEVER	SS304	27	Hyd seat	21 bar g
12	STEM	SS304	28	Pneumatic	7 bar g
13	STEM SEAL	PTFE RENEWABLE	29	BODY TYPE	3 PIECES
14	GLAND	SS304	30	OTHERS	STEM BLOW OUT PROOF
15	HANDLE	SS 304			
16	SERVICE	PROCESS			

6.12 SPECIFICATION OF PRESSURE GAUGE:

SL NO	SPECIFICATION		DESCRIPTION
1	Model no.	:	To be specified by vendor
2	Dial size	:	4"
3	Bottom entry size	:	1/2" BSP

4	Diaphragm	:	SS 316
5	Contact parts	:	SS316/SS316 Teflon Lined/Haste alloy
6	Movement	:	SS 316
7	Block	:	SS 316
8	Design range	:	Upto 15 Kg/cm ²
9	Operating range	:	As per BOQ
10	Accuracy	:	+ / - 1 % of range span
11	Over range protection	:	125 %
12	Case & bezel	:	SS 304 with screwed Bezel of ABS plastic.
13	Mounting	:	Direct with bottom entry
14	Standard fitments	:	Micro adjustable pointer (internal) blow out disc.
15	Documentation	:	Calibration certificate traceable to National Standard.

6.13 NON-RETURN OR CHECK VALVE SPECIFICATIONS:

Sl	Descriptions		Data
1	Body	:	SS304
2	Ends	:	Spring type ASA 150 flanges
3	Flange holes	:	As per ANSI.B.16.5
4	Mfg. Std	:	API 6D/API 594
5	Rating	:	150 # RATING
6	Bore	:	Full port
7	Disc	:	CF 8
8	Hinge	:	CF 8
9	Trim	:	CF 8
10	Sealing ring	:	EPDM
11	Free open pressure	:	< 0.2 bar g
12	Spring	:	SS 316

13	Service	:	Compressed Air
14	Vacuum	:	Na
15	Studs & nuts	:	SS 304
16	Maximum temperature	:	150 °c
17	Minimum temperature	:	-20 °c
18	Maximum pressure	:	10.5 bar g
19	Minimum pressure	:	*
20	Make	:	*
21	Hydro test pressure	:	
	Body	:	30 bar g
	Seat	:	23 bar g
22	Location	:	Pressure line
23	Size	:	As per BOQ
22	OTHERS	:	Valve to be epoxy painted

6.14 GENERAL SPECIFICATION FOR CA REGULATOR:

AIR FILTER DATA SHEET			
SL	DESCRIPTIONS		DATA
1	SERVICE	:	AIR
2	TYPE	:	DIAPHRAGM, RELIEVING
3	ADJUSTING SCREW	:	REQUIRED
4	DRAIN	:	MANUAL
5	REGULATION	:	OUT LET PRESSURE VARIATION NOT MORE THAN 1% FROM SET VALUE FOR INLET PRESSURE VARIATION OF 10%
6	OVER RANGE PROTECTION	:	150 % OF INLET PRESSURE
7	OUTLET PRESSURE GAUGE	:	REQUIRED
8	GAUGE DIAL SIZE	:	50 mm
9	GAUGE COLOR DIAL/ NUMERALS	:	WHITE/BLACK
10	GAUGE ACCURACY	:	± 2%
11	CASE	:	IP54 AS PER IS 13947(P-1)
12	COLOR	:	MFG STD,EPOXY FINISH

13	MOUNTING BRACKET	:	REQUIRED
14	HOUSING(BODY) MATERIAL	:	DIE CAST ALUMINUM/BRASS (NICKEL/CHROME PLATED)
15	DIAPHRAGM MATERIAL	:	BUNA N, NYLON REINFORCED
16	INSTRUMENT VALVE	:	SS 316/SS 304
17	SPRING MATERIAL	:	SS 316/SS 304
18	INNER VALVE MATERIAL	:	SS 316/SS 304
19	TRIM MATERIAL	:	SS 316/SS 304
20	PACKING MATERIAL	:	TEFLON/BUNA N
21	GAUGE PRESSURE ELEMENT/MOVEMENT MATERIAL	:	PHOSPHOR BRONZE
22	GAUGE HOUSING MATERIAL	:	ALUMINUM/BRASS (NICKEL/CHROME PLATED)
23	GAUGE RING MATERIAL	:	ALUMINUM/BRASS (NICKEL/CHROME PLATED)
24	GAUGE GLASS	:	SHATTER PROOF/CLEAR ACRYLIC SHEET
25	INLET CONNECTION	:	1/2" /3/4" NPT(FEMALE)
26	OUTLET CONNECTION	:	1/2" /3/4" NPT(FEMALE)
27	APPLICABLE CODES AND STDS	:	1.IS-319,ANSI-B.1.20.1,ASTM-D-454
28	TESTS	:	
29	DIMENSIONAL AND THREAD CHECK	:	100 % ITEMS
30	AIR LEAK TEST	:	AT 1.25 TIMES THE DESIGN PRESSURE ON 100 % ITEMS
31	FUNCTIONAL TESTS		FOR 100 % ITEMS
	NOTE:		
1.)	VENDOR TO PROVIDE ALL MATERIAL & OTHER TEST CERTIFICATES FOR PURCHASER'S REVIEW & RECORDS		
2.)	AIR LEAK TEST & FUNCTIONAL TEST SHALL BE DONE BEFORE & AFTER SEISMIC TEST WHEN SPECIFIED		
3.)	UNDER RELIEVING OPERATION, LEAKAGE FROM PRV SHALL NOT EXCEED 5 CC / MIN.		

6.15 GENERAL SPECIFICATION FOR AIR FILTER:

AIR FILTER DATA SHEET			
SL	DESCRIPTIONS		DATA
1	SERVICE	:	PROCESS AIR
2	TYPE	:	CARTRIDGE

3	HOUSING TYPE		F-FLANGED HOUSING
4	CARTRIDGE GRADE	:	GENERAL PURPOSE PROTECTION "GP"
5	DRAIN	:	MANUAL
6	FILTER AREA	:	12 TIMES PIPE AREA
7	FILTER PERFORMANCE	:	1 MICRON DUST PARTICLES,OIL
8	AIR FLOW @ 7 bar g		*cfm
9	DIFFERENTIAL PRESSURE GAUGE	:	REQUIRED
10	MOUNTING BRACKET	:	REQUIRED
11	HOUSING(BODY) MATERIAL	:	WELDED MILD STEEL VESSELS
12	FINISH		EPOXY PAINTED
13	CONDENSATE DRAIN		AUTOMATIC
14	FILTER MATERIAL	:	MACHINE PLEATED WITH GLASS MICROFIBRE
15	PACKING MATERIAL	:	TEFLON/BUNA N
16	INLET CONNECTION	:	DN 40 FLANGE TYPE
17	OUTLET CONNECTION	:	DN 40 FLANGE TYPE
18	BOWL LIQUID LEVEL GAUGE		YES
19	APPLICABLE CODES AND STDS	:	ISO 8573.1 QUALITY 2
20	MAXIMUM OPERATING PRESSURE bar g		16 bar g
21	MAX OPERATING TEMP ° C		66° C
22	MIN OPERATING TEMP ° C		1° C
23	DIMENSIONAL AND FLANGE CHECK	:	100 % ITEMS
24	AIR FLOW AT 50 % CLOGGING	:	90 % OF RATED FLOW
25	AUTO DRAIN FUNCTION CHECK		YES
26	FUNCTIONAL TESTS		FOR 100 % ITEMS
1.)	NOTE: VENDOR TO PROVIDE ALL MATERIAL & OTHER TEST CERTIFICATES FOR PURCHASER'S REVIEW & RECORDS		
2.)	AIR FLOW TEST & FUNCTIONAL TEST SHALL BE DONE		

6.16 SPECIFICATIONS FOR CPVC PIPES, VALVES AND FITTINGS:

SLNO	PRODUCT	DESCRIPTION
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1	CPVC Pipes	:	<ol style="list-style-type: none"> 1. CPVC 4120 SDR 11/CPVC SCH 40 As per ASTM F 441 pipeline with necessary slope. 2. Manufacturer should have ISO 9001 certification and as well as product approvals. 3. Sizes range from 150mm to 15mm
2	CPVC End Caps & CPVC/Metal Clamps	:	<ol style="list-style-type: none"> 1. CPVC end caps confirming to ASTM D2846/PVC AS PER ASTM D2466 STD 2. CPVC /Metal clamps confirming to ASTM D2846/PVC AS PER ASTM D2466 STD 3. Manufacturer should have ISO 9001 certification and as well as product approvals. 4. Sizes range from 150mm to 15mm
3	CPVC Couplings/Equal Tees/Reducing Tees/90°Elbow	:	<ol style="list-style-type: none"> 1. CPVC couplings confirming to ASTM D2846/PVC AS PER ASTM D2466 STD. Sizes range from 150mm to 25mm 2. CPVC equal tee confirming to ASTM D2846/PVC AS PER ASTM D2466 STD. Sizes range from 80mm to 25mm 3. CPVC reducing tee confirming to ASTM D2846/PVC AS PER ASTM D2466 STD. Sizes range from 200mm to 25mm 4. CPVC 90°elbow confirming to ASTM D2846/PVC AS PER ASTM D2466 STD. Sizes range from 200mm to 15mm 5. Manufacturer should have ISO 9001 certification and as well as product approvals.
4	Male Adapter	:	NPT Male adapter confirming to ASTM STD.
5	CPVC Ball Valve	:	CPVC Ball valves as per ASTM STD

6.17 SPECIFICATIONS FOR HDPE PIPES, VALVES AND FITTINGS:

S/no	Product		Description
1	Service media	:	Drain piping for aqueous & non-aqueous solvents
2	Design	:	MOC- HDPE (High Density Poly Ethylene) PIPING CLASS : 150#FF
3	Pipe Rating	:	PN10,PN16, PN20

4	Max Working Pressure	:	20 kg/sqcm
5	Max Temperature	:	93°C
6	Min Temperature	:	-5°C

	OUTSIDE DIAMETER	mm	20	25	32	40	50	63	75	90	101	114	125	150	160	180	200	225	250	280	300	350	400
P	Thickness (mm / inch)		PE 100																				
I	Schedule number /	thickness	10 kg/cm ² Pr. Rating																				
P	Material		HDPE Gr. PE – 100																				
E	Ends		Plain ends																				
	Dimension standard		IS: 4984 – 1995																				
	Pipe to pipe joint		Heat & compression butt weld																				
F	Type		Sandwich flanges with steel reinforcement, SOFF																				
L	Rating		150#																				
A	Material		HDPE																				
N	Dimension standard		ANSI B 16.5																				
G																							
E	Type		Plain ends to suit pipe thickness (Fabricated)																				
L	Rating		10 kg/cm ² Pr. Rating																				
B	Material		HDPE, IS: 8008 – 95, Gr. PE – 100																				
O	Dimension standard		IS: 8360																				
W																							
S																							


FIT	Type	Plain ends injection molded HDPE
TI	Rating	10 kg/cm ² Pr. Rating
NG	Material	HDPE
GS	Dimension standard	IS 8008
ST	Type	Short length
UB	Rating	10 kg/cm ² Pr. Rating
EN	Material	HDPE
D	Dimension standard	IS 8008
GA	Type	Full face to suit pipe thickness (fabricated)
SK	Thickness / Rating	3 mm / 150#
ET	Material	Teflon / grafoil
S	Dimension standard	ANSI B16.21
BO	Stud / bolt	Fully threaded with 2 washers
LTI	Material	IS 1367 CL 4.6, GI
NG	Nuts	Hexagonal
	Dimension standard	IS 1367 CL 4.6, GI

6.18 GENERAL SPECIFICATION FOR SS316 PIPES:


SERVICE MEDIA		H2,AGRON, HELIUM, O2, CO2, METHANE, N2, Etc.							
MATERIAL		SS316							
CONDITIONS		W.P : 1100 kPa g / MAX. TEMP. 200° C :MIN TEMP. --29° C							
		CORROSION ALLOWANCE : 1.5 MM							
		MAX W.P: 15KG/CM2 (G) MAX TEMP: 170°C / MIN.TEMP: -29°C							
LINE JOINTS		≤40 mm SW, ≥65 mm BW.							
ITEM	SIZE-NB	TYPE		MATERIAL	DIM.STD	THK\RTG	ENDS	REMARKS	
	LOW	HIGH							
PIPES	15	40	ERW	A312 TP 316	ANSI B 36.9	SCH.40S	P.E		
	50	150	ERW	A312 TP 316	ANSI B 36.9	SCH.10S	B.E		
FLANGES	15	150	LAP JOINT	IS 2062	ANSI B16.5	300#	R.F	PLATE TYPE.SERR.FINISH	
BLIND FLANGES	15	40	PLATE	A240 GR.316	ANSI B16.5	300#	R.F		
	50	150	LINED	IS2062	"	"	"		
ELBOW	15	40	WELDED*	A 403 GR WPW 316	ANSI B16.9	SCH 40S	B.E		
	50	150	WELDED*	A 403 GR WPW 316	ANSI B16.9	SCH.10S	B.E	* -BUTT WELDED	
RED.ECC	15	40	WELDED*	A 403 GR WPW 316	ANSI B16.9	SCH 40S	B.E		
	50	150	WELDED*	A 403 GR WPW 316	ANSI B16.9	SCH.10S	B.E		
FITTINGS									
	RED.CONC	15	40	WELDED*	A 403 GR WPW 316	ANSI B16.9	SCH 40S	B.E	
		50	150	WELDED*	A 403 GR WPW 316	ANSI B16.9	SCH.10S	B.E	
	TEES	15	40	WELDED	A 403 GR WPW 316	ANSI B16.9	SCH 40S	B.E	
		50	150	WELDED	A 403 GR WPW 316	ANSI B16.9	SCH.10S	B.E	

	CAPS	15	40	WELDE D	A 403 GR WPW 316	ANSI B16.9	SCH 40S	B.E	
		50	150	WELDE D*	A 403 GR WPW 316	ANSI B16.9	SCH.10S	B.E	
STUB		15	40	WELDE D*	A 403 GR WPW 316L	ANSI B16.9	SCH 40S	B.E	
ENDS		50	150	WELDE D*	A 403 GR WPW 316L	ANSI B16.9	SCH.10S	B.E	
GASKET S		15	150	RING	IS 2712	ANSI B16.21	3MM	-	
				TYPE	GR.W/1				
BOLTS				STUDS &	A193 GR B7	ANSI B 1.1	FULLY		REFER NOTE - 2
		ALL	HEAVY HEX		A194 GR 2H	ANSI B 18.8.2	THREADED		WITH 2 NOS.WASHER S
				BOLTS					
NOTES:									
1	USE COLD PULLED BEND (R=5D) FOR PIPE SIZE UPTO & INCLUDING 25 NB WHENEVER POSSIBLE.								
2	BOLTS AND NUTS SHALL BE GALVANISED TO IS 1367.								


6.19 Tube Fitting:

SR NO	DESCRIPTION	SPECIFICATION	IMAGE
1	Tech. Name	Equal Tee	
2	MOC	SS 316	
3	Ref. Standard	ASTM A 269	
4	Size	½"	
5	Make		
6	Origin	Indian	
7	Design Pressure	20 Bar	
8	Service	All Gases	


6.20 End Cap:

SR NO	DESCRIPTION	SPECIFICATION	IMAGE
1	Tech. Name	End Cap	
2	MOC	SS 316	
3	Size	¼"	
4	End connection	Compression End	
5	Make		
6	Origin	Indian	
7	Design Pressure	20 Bar	
8	Service	All Gases	

6.21 Union:


SR NO	DESCRIPTION	SPECIFICATION	IMAGE
1	Tech. Name	Union	
2	MOC	SS 316	
3	Size	¼"	
4	End connection	Compression End	
5	Make		
6	Origin	Indian	
7	Design Pressure	20 Bar	

6.22 Regulator with Connector:


SR NO	DESCRIPTION	SPECIFICATION	IMAGE
1	Tech. Name	Regulator	
2	MOC	SS 316	
3	Size & Connection of Regulator	1/4" NPTF	
4	Pressure Range	Inlet Pressure 14 Bar Outlet Pressure 1 to 10 Bar	
5	Connector Size for Regulator	¼" OD CFx ¼" NPTM	
6	Flow	10-15 LPM	

7	Make		
8	Origin	Indian	
9	Services	All Gases s	


6.23 CO2 Heater

SR NO	DESCRIPTION	SPECIFICATION	IMAGE
1	Tech. Name	CO2 Heater	
2	Make	Indian	
3	Working Pressure	150 Bar	
4	Service	CO2	

6.24 Cylinder Isolation Valve:


SR NO	DESCRIPTION	SPECIFICATION	IMAGE
1	Tech. Name	Cylinder Isolation Valve	
2	MOC of Contact Part	Brass	
3	End Connection	3/4" NPTM x Bullnose Connection	
4	Make	Vanaz	
5	Origin	India	
6	Working Pressure	150 Bar	

6.25 Flash Back Arrestor

SR NO	DESCRIPTION	SPECIFICATION	IMAGE
1	Tech. Name	Flash Back Arrestor	
2	MOC	Brass (Housing)	
3	Ref Standard	EN 730-1, ISO 5175	
4	End Connection	3/8" NPTM(LH) x NPTM(RH)	
5	Make	Messer	
6	Working Pressure	10 Bar	

6.26 Tube Holding Clamp


SR NO	DESCRIPTION	SPECIFICATION	IMAGE
1	Tech. Name	Tube Holding Clamp	
2	MOC	Polypropylene	
3	Size	1/4" ID	

4	Make		
5	Origin	Indian	
6	Service	For All Tubes	

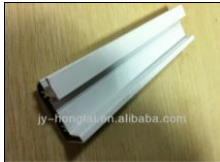
6.27 Tagging

SR NO	DESCRIPTION	SPECIFICATION
1	Tech. Name	Tagging
2	Construction	Acrylic
3	Standards	ASME 13.1- 2007
4	Make	


6.28 Manifold Block

SR NO	DESCRIPTION	SPECIFICATION	IMAGE
1	Tech. Name	Manifold Block (60mm x 60mm)	
2	MOC	SS 316	
3	Size	3/4" NPTF x 1/4" NPTF x 1/2" NB SW 1/2" NB SW x 5/8" BSPF 1/2" NB SW x 1/4" NPTF 1/2" NB SW x 3/4" NPTF 3/4" NPTF x 5/8" BSPF	
4	Make		
5	Origin	Indian	
6	Service	For All Tubes	


6.29 Aluminum Profile

SR NO	DESCRIPTION	SPECIFICATION	IMAGE
1	Tech. Name	Aluminum Profile	
2	MOC	Aluminum	
3	Size	27.5 mm	
4	Make		
5	Origin	Indian	
6	Service	For All Tubes	

6.30 Unistrut Support:

SR NO	DESCRIPTION	SPECIFICATION	
1	Tech. Name	Unistrut Support (Slotted /Without Slotted)	
2	Construction	GI Channel along with Bolting System, Size 41 x 41 x 2 mm Thk/ 41 x 41 x 1.5 mm Thk.	
3	Raw Material	GI Unistrut , L Bracket, Washer & Nut, Spring Nut & M10 GI Threaded Rod	
4	Make	Indian	

6.31 Hose:

SR NO	DESCRIPTION	SPECIFICATION	
1	Tech. Name	Hose	
2	MOC	SS 316	
3	Ref. Standard	ASME B 16.34	
4	End Connection	1/4" NPTF x 1/4" NPTF 3/4" BSPF(LH) x 3/4" BSPM(LH) (For LPG)	
5	Service	All Gases	
6	Working Pressure	230 Bar	
7	Make		

6.32 GENERAL SPECIFICATION FOR AUTO MOISTURE TRAP:

Compressor performance)*	2.5 m ³ /min
Refrigeration dryer performance)*	5 m ³ /min
Filter performance)*	25 m ³ /min
Operating pressure min/max.	0,8/16 bar (g)
Housing	fibreglass-reinforced plastic, aluminium
Material membrane	AU
Ambient temperature	+1/+60 °C
Weight	0,8 kg
Condensate inlet	G½ [optional: NPT-Adapter]
Condensate outlet (hose connection)	1 X G¼ hose connector; di = 8-10 mm
Electrical connection, standard	95...240 VAC ±10% (50...60 Hz) / 100...125 VDC ±10%
Electrical connection, option	24...48 VAC ±10% (50...60 Hz) / 18...72 VDC

Power input	P = 0,6 ... 3 VA (W)
Housing protection	IP 67
Cable cross section	0,75 ... 2,5, mm ² (AWG 14...20)
Fuse protection	recommended 0.5 A/mt

7.0 AIR COMPRESSOR SPECIFICATION:

1.0 SCOPE OF WORK

2.0 DESCRIPTION

3.0 TECHNICAL SPECIFICATION

4.0 DOCUMENTATIONS

5.0 BILL OF QUANTITY

1.0 SCOPE OF WORK:

Design, Supply, Installation, Testing & commissioning of following items.

- 1.1 Single stage rotary screw / reciprocating type air cooled Air compressors with acoustic enclosure for each block are considered.
 - a. Compressed air shall be single stage, rotary screw element with dry paper type suction air filter with silencer.
 - b. Unloader with integrated regulation valve for load/unload control system.
 - c. Three-way solenoid valve required for load/unload regulation of the compressor.
 - d. Air / oil temperature sensor to sense – Air / oil temperature at element outlet and shut down compressor in case of too high element outlet air temperature.
 - e. Air check valve at the element discharge end.
- 1.2 Air oil receiver tank consisting of;
 - a. Sight glass for oil level indication and oil filling arrangement.
 - b. Minimum pressure valve to close off the compressor from the air net when the unit
 - i. is stopped or running unloaded and to maintain required air pressure in the system
 - ii. for proper oil lubrication.
 - c. Safety valve.
 - d. Gauge for air oil receiver pressure
 - e. Oil draining arrangement.
 - f. Three stage air oil separation system.
- 1.3 Air & Oil cooled assembly.

- a. Air oil cooler are compact block coolers of aluminum for optimum heat transfer.
- b. Low pressure drop & lower weight. After cooler reduces the temperature of outlet
 - i. air to approximately 8 to 10 deg above ambient temperature.
 - ii. Oil filter mounted on air oil cooler for filtration of lubricating oil.
 - iii. Thermostatic valve to regulate oil temperature within the system.

1.4 The Vendor shall give guarantee for the material and workmanship of the complete package including filter, cooler and all the safety valves for a period of 12 months from the date of commissioning or 18 months from the date of supply whichever is earlier.

1.5 The Vendor shall give guarantee for FAD as per technical specification on continuous basis without interruption in pressure, temperature, flow and maintaining the quality of Air as specified below.

1.6 The Vendor to guarantee Noise level from Air Compressor unit shall not exceed 65 dB at a distance of 1 meter around the air compressor skid and its attachment.

1.7 The Vendor shall render all facilities free of cost for imparting onsite training for Client's technical personnel, as required for the proper assembly, installation, testing, commissioning, operation and maintenance of the equipment supplied. Installation shall include demonstration of FAD, PDP, and Efficiency of Air compressor.

2.0 DESCRIPTION:

2.1 The compressed air is required for following application:

- For Fume hoods related applications at 7.0 bar pressure of 30 cfm FAD capacity.

2.2 Distribution of Compressed Air for the above application is planned to be drawn from 30 cfm 3W FAD capacity Air Compressor @ 7.0 bar which are proposed at Terrace floor of each blocks (i.e. A, B & C). These are designed to serve Ground Floor, First floor, Second and Third Floor of each blocks.

2.3 Each compressor are interconnected at the header with an isolation valves which acts as redundancy.

3.0 TECHNICAL SPECIFICATION:

Application	:	For process(Fume hoods) related application
Type	:	Supply of Tank Mounted lubricated single stage rotary screw / reciprocating type air cooled Air compressors(30cfm) with dryer, dry paper type suction filter, unloader with integrated regulating valve, three way solenoid valve, Air / oil temperature sensor, air check valve, Air / oil receiver tank, Air / oil cooler assembly,
Model	:	Vendor to specify

Capacity	:	30 cfm FAD capacity Air Compressor @ 7.0 bar with -40deg C PDP.
Quantity	:	3 nos working
Inlet Air Condition	:	Temperature: Bangalore ambient. Relative Humidity: Bangalore ambient.
Normal Discharge Air. Temperature	:	Ambient + 5 deg C
Electric Power supply available	:	415+/-10V, 3Ph, 50HZ±3%, AC
Motor	:	3 Phase, TEFC Squirrel cage flanged, AC Induction motor, with IP55 protection and class F insulation. Motor Efficiency as per IE3 Vendor to specify the Motor make.
Type of Drive	:	Direct driven with flexible type coupling
Service Factor for Motor	:	Vendor to specify
HP / RPM & Efficiency of the motor	:	Vendor to specify under the following conditions: 1. Specific power consumption for various loads.
Control/Electrical panel	:	Microprocessor based control panel out door type for monitoring the status of compressor and automatic regulation of the unit within a pressure band for economic and efficient operation. Control Panel cable termination suitable for CU/Al cable. The system should have designed capability to reduce energy consumption. The microprocessor control should also be service friendly and user friendly with indication for Condensate drain malfunction, dew point deviation, service warning messages, error detection etc.

The following minimum parameters to be considered:

- ✓ Suitable reputed make DOL/star delta starter with contractor
- ✓ Isolator for electrical incoming.
- ✓ Dryer on/off button
- ✓ Regulator with Timer and relays
- ✓ Hour meter to indicate total hours of operation
- ✓ Start/Stop button with lamp indicating compressor operation
- ✓ Indicator for auto operation
- ✓ Dew point indicator
- ✓ Easy access for service points
- ✓ Provision for the third-party integration to the Central BMS to be included.

- Filters : Three Stage Filters at the inlet and outlet of the Air compressor:

At the inlet of the Air compressor:

1. Course filter- as per standards.

2. Fine filter- Particle size from the fine filters to be 0.1micron & 0.01 microns.

a. Interconnecting pipe lines with valves: Vendor to specify all the pipe lines including the MOC within the skid

b. Sound Level : Not more than 65 dB (A) at one meter distance around the Air compressor skid and its attachments

The following measures shall be considered for the noise free operation of the compressor:

- Compressor package to be enclosed in a powder coated acoustic canopy with sound absorbing material for limiting the noise level.
- Anti-vibration mounts support electric motor and compressor unit and isolate moving components from rest of the structure, thereby reduces sound level and avoids need for anchoring the machine on the floor

c. Operating Weight of the skid (in kgs): Vendor to specify (Civil foundation requirement to mount & grout the air compressor.

d. Floor space of the skid : Vendor to specify (GA drawing to be provided)

e. Safety measures : Discharge safety valve

Motor Overload trip, motor bearing should be greased for life.

Protection against starting on load

High air temperature trip at the element outlet

Control transformer 415V/240V for safety purpose

Note:

1. Any instrument / Items which is not specifically mentioned above and is deemed required for the successful operation of the Air Compressor is to be included and highlighted in the quote.

2. Mechanical:

- All fasteners, foundation bolts, gaskets etc. shall be in Vendor's scope.
- All manual/automated valves shall be of flanged type.

4.0 DOCUMENTATION:

The following drawings/ documents shall be submitted along with offer:

For Evaluation:

1. Technical Specification
2. Brief description of the system
3. General Arrangement drawings
4. Specific power consumptions at various loads.
5. Technical data sheet for Motors
6. Alarm list and Instrument list
7. Write-up on Control system
8. Consumption of the Utilities
9. List of performance tests to be conducted at manufacturer's facility and site.
10. Details of similar job executed with contact person for feedback to be given.
11. Energy efficiency and saving features to be mentioned.

5.0 BILL OF QUANTITY:

Sr. No.	Item description	Qty.
1.	Design, Manufacturing, Inspection, Testing, Painting, Packing, Supply, Transportation, unloading at IISC campus Bangalore site, carnage, erection, commissioning and demonstration of unit performance with guarantees of single stage rotary screw / reciprocating type air cooled Air compressors with acoustic enclosure tank mounted 30FAD(3nos) Oil Free @ 7.0 bar pressure Oil free air compressor with Dryer integrated inter and after cooler, flanged to a step up gear box with integrated oil sump, air cooled/ Radiator coolant water cooled, equipped with microprocessor control panel with accessories such as intake silencer and dry intake air Filter, air outlet silencer check valves, driers, 1no Air receiver with auto drain trap, safety relief valves, Suction & delivery valve assembly as per description given in the previous pages.	3 No Air Compressor
2.	Driers: As per spec mentioned above	3 No
3.	Other requirements to be included- <ul style="list-style-type: none">• The cost of transportation from factory to site, Unloading & leading to site, lifting & positioning on to the civil foundations.• Cost of erection and commissioning as well as GUARANTEE TEST as envisaged in the earlier paras on sustained basis for 7 consecutive days.• The Vendor shall submit the separate lists with budgetary offer for Mandatory spares, commissioning spares and recommended spares for 2 years operation.	

8.0 SHOP DRAWINGS:

The drawings enclosed herewith are for the general guidance to the Contractor. The contractor shall upon the award of the work, furnish detailed and coordinated shop drawings necessary to carry out the work at site. These shall be submitted to the Consultant & client for the approval and the work shall be commenced only after the approval of drawing by the Consultant & client.

Drawing/Information Required from Successful contractor on award of work:

1. Piping layout, Cross sectional, Isometric drawings, P & ID, MTO.
2. Hydraulic calculations for Sprinkler system & Sprinkler piping layout with Sections
3. Necessary civil scope drawing for the system.
4. Bar chart showing engineering, manufacturing and dispatch of each equipment and erection services.
5. Drawing, literature and technical data sheet of all bought out items.
6. Schedule for valves and piping material.

9.0 QUALITY PLAN:

Contractor shall furnish the quality plan for site works; Quality plan shall include Fabrication, Installation methods.

For All works, Proper storage of Items, Installation supervision. Quality plan shall be submitted to Client & PMC & approval shall be taken.

10.0 LIST OF APPROVED MAKES:

SI No	Description	Make
1	CPVC PIPES, VALVES, AND FITTINGS	ASTRAL/ASHIRVAD
2	HDPE	PRIME/SANGIR
3	SS 316 TUBING	FIT –TOK/SANDVIK/VALEX
4	SS316 WELD/COMPRESSION FITTINGS(END CAP, BEND, TEE & FEMALE/MALE CONNECTOR)	TECHMAN/ PANAM/EX-LOK
5	SS316 BALL VALVE	TECHMAN/ PANAM/EX-LOK
6	SS316 NEEDLE VALVE	TECHMAN/ PANAM/EX-LOK
7	SS316 CHECK VALVE	TECHMAN/ PANAM/EX-LOK
8	SS316 AUTOMATIC CHANGE OVER PANEL	TECHMAN/ PANAM/EX-LOK
9	SS316 LINE PRESSURE REGULATOR	TECHMAN/ PANAM/EX-LOK
10	SS316 FLEXIBLE HOSE	TECHMAN/ PANAM/EX-LOK
11	SS316 TUBINGS FILTER	TECHMAN/ PANAM/EX-LOK
12	SS316 FLASH BACK ARRESTOR	GCE/WITT/NESSER
13	SS304 PIPES	PRAKASH/HINDUSTAN INOX/ QUALITY/RATNAMANI
14	SS304 SS PIPE FITTINGS	SANDWIK/ DHV / EX-LOK
15	PRESSURE GAUGES /VACUUM GAUGES / TEMP GAUGES	H.GURU / BAUMER
16	SS304 BALL VALVES	INTERVALVE/ L & T
17	SS304 NRV	INTER VALVE/ L & T/ ADVANCE
18	GASKET MATERIAL	KLINGER / CHAMPION
19	AIR COMPRESSOR	CHICAGO PNEUMATICS/ATLAS COPCO/GARDEN- DENVER/ELGI
20	COMPRESSED AIR PRESSURE REGULATOR	SHAVO NORGREN/TECHMAN/BEKO
21	COMPRESSED AIR FILTER	DOMNICK HUNTER/PALL FILTER/BEKO
22	AUTO MOISTURE TRAP	DOMNICK HUNTER/BEKO/PARKER

23	FASTNERS	TVS / UNBRAKO
24	ANCHOR FASTNERS	HILTI/FISCHER
25	STRUCTURAL STEEL	SAIL / JINDAL / TATA
26	PP CLAMP WITH RAIL NUT	STAUFF/UNSTUT/EX-LOK
27	PAINTS	ASIAN / NEROLAC / BERGER
28	WELDING RODS	ESAB/MANGALAM
29	DRILLING MACHINES / GRINDING MACHINES	HILTI/BOSCH/HITACHI

ABSTRACT OF COST (BOQ)			
Name of work:Supply, Installation of lab furniture, fume hoods, services and lab exhaust system in Chemical Sciences Building, IISc Bengaluru.			
ITEM NO	DESCRIPTION	UNIT	QUANTITY
1	SUB HEAD 1: LAB FURNITURE		
1.1	MODULAR LAB FURNITURE WITH PLINTH MOUNTED		
	Providing, design ,supply, Installation and commissioning of best quality factory made ready built Knock down type modular steel laboratory furniture with working height 750 mm to 900mm high as per architectural drawings, all surfaces zinc phosphated/degreased and epoxy powder coated to 60 to 80 microns thickness / 80 to 100 microns Polyurethane powder coating to pass the required ASTM/ IS Codes, complete as per technical specifications given in the tender document. Rate shall be inclusive of cost of all materials and operations described in the item, drilling holes, necessary welding, required nuts and bolts for joining with the supporting members, rivets, pins including all part items complete as per approved shop drawings and directions of Engineer in charge. Laboratory furniture in general shall consists of Plinth mounted base cabinet, sink units, Laboratory bench designed for carrying a loading of 400 Kg/sqm, regent shelves, wall rails, storage cabinets etc. consisting of the following:		
	PART A- SUPPLY OF LAB FURNITURE		
	Vertical Uprights		
1.1.1	Vertical/uprights supports for adjustable regent shelves, wall rails or supports for adjustable tables/shelves, supporting frame manufactured from prime quality CRCA / GI sheet 2 mm thick high chemical resistance epoxy powder coated to 60 to 80 microns thickness / 80 to 100 microns Polyurethane powder coating with height adjustment arrangement for every 25 mm height floor mounted or connected with C frames with nuts and bolts or wall mounted with dash through fasteners of required size complete as per direction of Engineer in charge. Rate is inclusive of cost of all the materials and labour.	Rmt	1,577
	Back/End/Side/ Modesty Panels.		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
1.1.2	Providing back/end/side panels, made of 1.0mm thick CRCA / GI sheet, high chemical resistance epoxy powder coated to 60 to 80 microns thickness / 80 to 100 microns Polyurethane powder coating. All the electrical fittings, wires coming from mains to switches on service panels should be completely enclosed and all entry points of electrical/data/voice services wires/cables should pass through gland protected openings to avoid any accidental situations. All the accessories should have a very high temperature withstanding capacity and electrical insulation properties. Rate is inclusive of cost of all materials and operations described below and in general specifications. length and breadth of panel (out to out) shall be measured for working out the area in square meters for payment.	Sqm	736
	16mm Phenolic Resin work top		
1.1.3	Providing and supply of 16 mm Solid Grade laminate made of Composite wooden fibers with Electron Beam Cured surface which is free of melamine resins and resistance to Bacteria and various chemical/Biological spillage as well as fumes. SEFA 3.0 Certified from authorized SEFA approved agency with 10 years written Product Guarantee for all properties mentioned in material property data sheet. 10 years of proven testimonials in Global and Indian reputed Government & Private Research Laboratories. The bottom of the worktop should have a V-groove throughout the length of the exposed edges to protect the cabinets from coming in contact with the spillages. The overhang on the storage cabinet is 25 mm at the front side and 30 mm at the sides. The rate is inclusive of cost of all materials, labour etc. Length and breadth (out to out) of the finished top shall be measured in metres for working out the area for payment.	Sqm	1,303
	16mm Phenolic resin skirting		
1.1.4	Providing and supply of 100mm high 16mm Chemical Resistant Phenolic resin backspalsh, Trespa Toplab plus or equivalent, composed of a cellulose fiber reinforced phenolic resin core with a highly crosslinked polyurethane copolymer surface with a maximum seamless length upto 3.6m. The rate is inclusive of cost of all materials, labour etc. Exposed edges shall be finished with edge banding tape as per direction of Engineer in charge. Finished work shall be measured in running metres of payment.	m	40
	Under Bench Base Unit (Sink unit)		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
1.1.5	<p>Providing and supply of CRCA / GI sheet cabinets (high chemical resistance epoxy powder coated to 60 to 80 microns thickness / 80 to 100 microns Polyurethane powder coating) cabinet bodies with flush front construction with intersection of vertical and horizontal case members, such as end panels, top rails, bottoms and vertical posts in same plane without overlap. Exterior corners shall be spot welded with heavy back up reinforcement at exterior corners. All face joints shall be welded and ground smooth to provide a continuous flat plane.</p> <p>a) Steel used in construction of cases shall be 1.2mm thk except as follows:</p> <p>b) Case and drawer suspension channels, 2mm thk.</p> <p>c) Top and intermediate front horizontal rails, table aprons, hinge reinforcements, and reinforcement gussets, 1.6mm thk.</p> <p>d) Drawer assemblies, door assemblies, bottom, bottom back rail, toe space rail, and adjustable shelves, 1mm thk.</p> <p>e) Shelves load bearing capacity should be min 40 kg/sqm.</p> <p>f) Support frame require for positioning worktop on base cabinets costing shall be included.</p> <p>Cabinets 750mm, 900mm length, shall be provided with 2 shutters with 1 drawer, 600mm length shall be provided with 1 shutter 1 drawer.</p> <p>Rate is inclusive of cost of all materials and operations described above and in general specifications. Mode of measurement shall be in numbers as described below.</p>		
1.1.5.1	BASE UNIT 2 DOOR - 900mm(H)x560mm(D)x900mm(L)	each	54
1.1.5.2	BASE UNIT 2 DOOR - 900mm(H)x560mm(D)x1500mm(L) (Island table)	each	50
	Under Bench Unit		-

ITEM NO	DESCRIPTION	UNIT	QUANTITY
1.1.6	<p>Providing and supply of CRCA / GI sheet cabinets (high chemical resistance epoxy powder coated to 60 to 80 microns thickness / 80 to 100 microns Polyurethane powder coating) cabinet bodies with flush front construction with intersection of vertical and horizontal case members, such as end panels, top rails, bottoms and vertical posts in same plane without overlap. Exterior corners shall be spot welded with heavy back up reinforcement at exterior corners. All face joints shall be welded and ground smooth to provide a continuous flat plane.</p> <p>a) Steel used in construction of cases shall be 1.2mm thk except as follows:</p> <p>b) Case and drawer suspension channels, 2mm thk.</p> <p>c) Top and intermediate front horizontal rails, table aprons, hinge reinforcements, and reinforcement gussets, 1.6mm thk.</p> <p>d) Drawer assemblies, door assemblies, bottom, bottom back rail, toe space rail, and adjustable shelves, 1mm thk.</p> <p>e) Shelves load bearing capacity should be min 40 kg/sqm.</p> <p>f) Support frame require for positioning worktop on base cabinets costing shall be included</p> <p>Cabinets 750mm, 900mm length, shall be provided with 2 shutters with 1 drawer, 600mm length shall be provided with 1 shutter 1 drawer.</p> <p>Rate is inclusive of cost of all materials and operations described above and in general specifications. Mode of measurement shall be in numbers as described below.</p>		-
	ISLAND BENCHES		
1.1.6.1	BASE UNIT 900mm(L)x560mm(D)x900mm(H) with lock & keys	each	704
1.1.6.2	BASE UNIT 750mm(L)x560mm(D)x900mm(H) with lock & keys	each	11
1.1.6.3	BASE UNIT 600mm(L)x560mm(D)x900mm(H) with lock & keys	each	200
	WALL BENCHES		
1.1.6.4	BASE UNIT 900mm(L)x560mm(D)x750mm(H) with lock & keys	each	297
1.1.6.5	BASE UNIT 750mm(L)x560mm(D)x750mm(H) with lock & keys	each	122
1.1.6.6	BASE UNIT 600mm(L)x560mm(D)x750mm(H) with lock & keys	each	200
1.1.6.7	BASE UNIT 450mm(L)x450mm(D)x750mm(H) Corner worktop support	each	-
1.1.6.8	BASE UNIT 750mm(L)x560mm(D)x750mm(H) Knee space	each	122
1.1.6.9	BASE UNIT 900mm(L)x560mm(D)x750mm(H) Knee space	each	203
	Tall Reagent Storage		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
1.1.7	Providing and installing tall reagent storage cases with glassed(6mm thk toughened glass fixed with pvc gasket) swing door made of 1.2mm thick CRCA / GI sheet high chemical resistance epoxy powder coated to 60 to 80 microns thickness / 80 to 100 microns Polyurethane powder coating of approved colour, having double wall construction for side walls, smooth exterior and interior surfaces, cabinet sides with spar edges in the front to accommodate door hinges, sides to have holes to accommodate shelving supports or side, back wrap around body with corner posts with holes to support shelf supports. A steel plinth should be integrated into the carcass with four screw feet for height adjustments (-5/+15 mm). Plinth height 900 mm. Shelving: Adjustable Shelves shall be constructed from CRCA / GI powder coated with minimum 60 to 80 microns high chemical resistant epoxy powder /80 to 100 microns Polyurethane powder coating,steel panels (1.0 mm thickness) with all around 27mm strengthening edge; load capacity of 90 kg., height should be adjustable to optimise storage inside the cabinet. Doors should be constructed with double skin construction with sound damping technology, 270° openable 3 axis adjustable hinge or SS304 knuckle hinges with separate door catches for both doors with integrated SS D handle-160mm high, diameter 10mm. Reagent cabinet should be provided with 75mm dia, vent at the top to connect exhaust duct. Rate is inclusive of cost of all materials and operations described above and in general specifications. Mode of measurement shall be in numbers as described below.		
1.1.7.1	Size- 900w x 560d x 2150h with 5 shelves	each	1
1.1.7.2	Size- 600w x 560d x 2150h with 5 shelves	each	1
	Above bench- 2 stage reagent shelves with Phenolic Resin		
1.1.8	Providing and supply of adjustable overhead shelves made of 12mm phenolic resin (Trespa or equivalent), complete modular design consisting of 2 stage horizontal storage shelves, 500mm width. The ends and intermediate vertical supports should be 1.2mm thck of CRCA / GI steel high chemical resistance epoxy powder coated to 60 to 80 microns thickness / 80 to 100 microns Polyurethane powder coating with suitable brackets. Horizontal shelves -Each shelf should have a load carrying capacity of 50 kgs. of UDL for the length of 1000 mm. Exposed edges of board shall be provided with edge banding tape of approved size and shade. Supporting metal uprights and supporting brackets if any of reagent shelves shall be paid for seperately under BOQ item no 1.1.2 Regent shelf length and breadth (actual plan area of each shelf) shall be measured for working out the area for payment.		
1.1.8.1	12 mm thick PHENOLIC RESIN REAGENT SHELF 400mm to 500mm(D) with suitable edge bannding and fixing arrangements.	sqm	363
	Sink and Accessories		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
1.1.9	Providing and supplying of PP/Epoxy Sink with all accessories. Work includes cutting opening in granite/ trespa as per drawing and polishing edges with half round nosing, Single way Epoxy Powder Coated faucet, Make :- Broen / Water saver; PEG BOARD made up of 1mm thick SS 304/Acrylic/Epoxy, 750mm x 750mm with 33 nos. of projected polypropylene PEGS adjustable with minimum spacing of 100mm between pegs suitable to hold different sizes of glassware. PP Anti Siphon bottle trap and waste pipe up to drain outlet on the floor complete as per direction of Engineer-in-charge. Contractor shall be provided drain and water arrangement at floor level. PP sink to be fixed to granite/ trespa top with liquid glue all around with polysulphide sealant all around. Rate is inclusive of cost of all materials and operations described above and in general specifications. The rate is inclusive of cost of all material, labour involved, all taxes. Finished work shall be measured in numbers.		
1.1.9.1	PP Sink	each	104
	Providing and supply of black colour, acid and corrosion resistant PP sink with integral 50mm pipe threaded drain outlet as a one piece unit. Sink shall be injection moulded from pure polyolefins/ co-polymer material with inside corners coved, undercounter mounted. Size- 750w x 450d x 350h. Sink shall be provided with the following accessories- single way wall/ deck mounted brass water tap with swivelling gooseneck spout with epoxy powder coating with PP handle, Broen, Watersaver , as per detailed drawing and specification, anti siphon bottle trap, reducing coupler as per the outlet dia, PP pipe lengths as required to connect to drain pipe at floor. Work includes making connections in CPVC, checking connections at pressure of 4kg for 24 hours and making water tight joints. Water inlet shall be minimum 25mm dia and drain shall be minimum 50mm dia. Price to include providing and supply of PEG BOARD made up of 1mm thick SS 304 , 750mm x 750mm with 33 nos. of projected polypropylene PEGS adjustable with minimum spacing of 100mm between pegs suitable to hold different sizes of glassware. A drip channel of SS304 - 30 x 30 for full width of pegboard with drain tube shall be provided at the bottom for draining out water. Pegboards shall be fixed on wall or furniture at accessible height. Mode of measurement for sink with all accessories shall be in numbers.		
	Twin Cup Eye Wash (For all Sinks)		-
1.1.10	Providing and supply of eye shower with two angled heads, hand held, with polyarylamide handles with integrated activation mechanism that continuously flush water @ 14 litres/minute from high performance spray heads, designed and engineered for easy operation. Rate is inclusive of cost of all materials and operations described above and conforming to drawing and general specifications. Mode of measurement shall be in numbers as described below. Make :- Broen / Water saver.	each	104
	Acrylic Anti Splash Guard @ Sink Area		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
1.1.11	Providing and supply of 16mm thk.Phenolic Resin Anti Splash Guard behind Sink . Rate is inclusive of cost of all materials and operations described above and in general specifications. Mode of measurement shall be in numbers.		
1.1.11.1	400mm High x 750mm Length	each	206
1.1.11.2	400mm High x 1500mm Length	each	50
1.1.11.3	400mm High x 900mm Length	each	53
	Spot Extractor		
1.1.12	Providing and supply of spot extractors made of Poly Propylene with articulating joints having large frictional diameter and supported with ball bearings. All metal parts that come in contact with airstreams shall be made from acid resistant stainless steel (SS 316). Extraction arms shall be $\Phi 75$ mm with 360° rotation, which shall be mounted with a m.s. ceiling bracket, chemical resistance epoxy powder coated. Arms are provided with dampers, tight down to under pressure of 3500pa & air temperature of -10° to 70°C, as per drawing and detailed specification. Mode of measurement shall be in numbers.	each	65
	Service Dropper and Enclosure		
1.1.13	Providing supplying and installing of Service Dropper & Enclosure made of 1.2mm thickCRCA / GI sheet high chemical resistance epoxy powder coated to 60 to 80 microns thickness / 80 to 100 microns Polyurethane powder coating of approved colour.		
1.1.13.1	SERVICE DROPPER OF SIZE: As required---(H) X 150mm(D) X 300mm(w)	Rmt	648
	Filler Panel		
1.1.14	Providing and supply of filler panel of 1.2mm thkCRCA / GI sheet high chemical resistance epoxy powder coated to 60 to 80 microns thickness / 80 to 100 microns Polyurethane powder coating, sheet with 27mm strengthening edge, high chemical resistance epoxy powder coated to 60 to 80 microns thickness / 80 to 100 microns Polyurethane powder coating. Filler panels should be provided between wall to cabinet (front or rear) or between two cabinets as required. Mode of Measurement shall be in sqm.	sqm	485
	Base Moulding		
1.1.15	Providing and Supply of Base Moulding of pliable black vinyl, 100mm high of 1.2mm thk fixed with corner clips to conceal levelling device on base cabinets. Mode of measurement shall be in running metres.	m	2,122
1.1.16	Overhead framed glass sliding door cabinets		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Providing and installation Overhead framed glass sliding door cabinets wall storage units made of CRCA / GI sheet with high chemical resistance epoxy powder coated to 60 to 80 microns thickness / 80 to 100 microns Polyurethane powder coating of approved colour and should be 1.2mm thick, double wall construction for side walls with sound dampening technology or side and back wrap around body with corner posts with holes to support shelf supports, shelves shall be provided, constructed from 1.0mm thick CRCA steel / GI high chemical resistance epoxy powder coated to 60 to 80 microns thickness / 80 to 100 microns Polyurethane powder coating with all around 27mm strengthening edge, load capacity of 90 kg/ shelf , height should be adjustable to optimise the storage space in side the cabinet. Framed glass sliding door leaf shall be constructed from 1.2mm thick CRCA/ GI steel panels, bent to 20mm thickness all around, dampened with contact cushions with 6mm thick float glass with polished edges fixed to shutter frame with pvc gasket. A guide runner shall be provided at the bottom with plastic coated ball bearings or the shutter should be top hung, supported on a ball bearing nylon roller running in a track attached to the top of the cabinet with a guide rail at the bottom. All cabinets should have load carrying capacity of 90 kg per cabinet. All cabinets should have a magnetic label to show details about it's content. All storage cabinets should be provided with interchangeable cylinder locks. Rate is inclusive of cost of all materials and operations described above and in general specifications. Mode of measurement shall be in numbers as described below.		
1.1.16.1	Size: 750w X 400d X 900h with 2 adjustable shelves	each	110
1.1.16.2	Size: 900w X400d X 900h with 2 adjustable shelves	each	44
	Lattice Assembly		
1.1.17	Providing and supply of 12mm Dia Solid Epoxy Rod of corrosion resistant material shall be clamped to form a lattice arrangement to hold the test samples of 50 kg.	Sqm	241
	FM Approved Storage Cabinets		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
1.1.18	Providing & Supply of FM approved Self Close storages cabinets of Acid Cabinets / 90minutes Fire Rating Solvent FM Approved Self Close storages cabinets of corrosive chemicals and should be provided with a ventilation system to enable exhaust of localized fumes emanating from the chemicals stored. Because of the corrosive environment the material used is 1.2 mm thick CRCA / GI sheet high chemical resistance epoxy powder coated to 60 to 80 microns thickness / 80 to 100 microns Polyurethane powder coating, having scratch hardness of 3kg and passing 1000 hour salt spray test. It is fitted with a float glass to enable visibility inside the cabinet. It also has louvers/perforations for air supply and has a tray placed at the bottom for collecting the spillage. The rate is inclusive of the cost of all the materials and labour involved as per drawing and detailed specifications		
1.1.18.1	900 x 600 x 1800 mm (WxDxH) 90 minutes Fire Rated Solvent FM approved Storage Cabinets	Nos	20
1.1.18.2	900 x 600 x 1800 mm (WxDxH) FM Acid Storage cabinets	Nos	20
1.1.19	Lab PP Stools		
	PU lab swivel chair without handle with castor, adjustable ht 420-540MM	Nos	530
	Service Fixtures		
1.1.20	Service fittings shall be laboratory grade, and water faucets and valve bodies shall be cast red brass alloy or bronze forgings, with a minimum content of 85%. All laboratory service fixtures shall be furnished with Powder coated finish in White. Coating material shall be electrostatic ally applied to all exposed surfaces. After application, coating shall be fully baked to permit curing. The Finish coating shall have the optimum combination of Chemical Resistance, Mar & Abrasion resistance & Resistance to fading under Ultraviolet (UV) Light		
1.1.20.1	BENCH FITTING w/ 1 NEEDLE VALVE FOR ARGON	Nos	10
1.1.20.2	BENCH FITTING w/ 1 NEEDLE VALVE FOR COMPRESSED AIR	Nos	50
1.1.20.3	BENCH FITTING w/ 1 NEEDLE VALVE FOR FUTURE GAS	Nos	4
1.1.20.4	BENCH FITTING w/ 1 NEEDLE VALVE FOR NITROGEN	Nos	30
1.1.20.5	BENCH FITTING w/ 1 NEEDLE VALVE FOR H2	Nos	2
1.1.20.6	BENCH FITTING w/ 1 NEEDLE VALVE FOR ARGON	Nos	10
1.1.20.7	BENCH FITTING w/ 1 NEEDLE VALVE FOR O2	Nos	2
1.1.20.8	BENCH FITTING w/ 1 NEEDLE VALVE FOR POW	Nos	6
Note:	a) For all Gases Line 6.35mm OD Tube Connector(Double Compression fittings End) along with above valves to be included in the above pricing		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	b) For all Vacuum 12.75 mm OD Tube Connector(Double Compression fittings End) along with above valves to be included in the above pricing		
	c) For Portable Water 15 NB FNPT along with above valves to be included in the above pricing		
1.1.21	Electrical Raceway		
	Providing, Design, Supply of Metal Race ways of 1.2mm CRCA / GI high chemical resistance epoxy powder coated to 60 to 80 microns thickness / 80 to 100 microns Polyurethane powder coating for power supply distribution including provision to fix power sockets, including supply of centre reducer, left side reducer, right side reducer, 90deg bend, vertical bend, equal tees, cross tees, split clips, adjustable coupler, earth flat clamp, cable binder, fixing materials, interconnecting, brackets, clamps, screws, MS angle as required. The system shall be consisting of the following:- Standard section of Metal Race ways consisting of snap-fit lids 2 Nos and allied accessories such as cable divider, internal tees, external tees, flat tees, etc. It shall have provision to accept mounting boxes that snap fit into the profile complete as required. All raceways to be pre-treated with superior pure epoxy powder coated to 60-80 micron thk finish.		
	150(H) x 100(D) mm size Metal Race way with cable divider for power line & data line seperation	Rmt	1,234
1.1.22	ELECTRICAL POWER SOCKETS & MCBs		
	Supply and Testing of following modular / industrial type Plug sockets. The assembly shall be housed in metal / pvc Raceway / metal box / on partition / on wall. Rate shall include necessary wiring, GI back box and front face plate for sockets and necessary cabling, termination boxes, internal wiring, double compression glands, bolts, nuts etc.		
1.1.22.1	Modular Single phase 1 No 16 Amps multi pin flush type socket outlet controlled by 1 No 16 Amps flush type SP switch with indicator. The assembly shall be housed in a metal or PVC Raceway / metal box / on partition . Rate shall include necessary wiring, internal wiring GI back box and front face plate of approved make.	Nos	10
1.1.22.2	Modular Single phase 2 No 6/16 Amps multi pin flush type socket outlet controlled by 2 Nos 16 Amps flush type SP switch. The assembly shall be housed in a metal or PVC Raceway / metal box / on partition. Rate shall include necessary wiring, internal wiring GI back box and front face plate of approved make.	Nos	1,687

ITEM NO	DESCRIPTION	UNIT	QUANTITY
1.1.22.3	Modular Single phase 3 No 6/16 Amps multi pin flush type socket outlet controlled by 3 Nos 16 Amps flush type SP switch. The assembly shall be housed in a metal or PVC Raceway / metal box / on partition. Rate shall include necessary wiring, internal wiring GI back box and front face plate of approved make.	Nos	10
	PART B- INSTALLATION, TESTING & COMMISSIONING		
1.2	Installation/ fixing, testing & commissioning of all the supplied materials covered under Sh 1.1 above including the cost of nuts bolts and other accessories not covered under the supply sub head but necessary to complete the finished product, screws, scaffolding, loading unloading, storage/stacking the supplied materials, necessary protection arrangement from sun & rain, welding wherever required, making holes in floors, walls, ceilings, core cutting in RCC slabs, all equipment, machinery required for installation, cleaning the premises after installation, Removal of debris, dirt and rubbish accumulated as a result of installation/commissioning of the laboratory furniture and accessories and leaving the premises broom clean and orderly, testing commissioning as per manufacturer standards and as per contract condition and direction of University. The quoted rate shall be quoted on percentage basis (mode of measurement shall be % of total supply value at actual) and shall include the cost of all materials, labour and taxes as per bid documents.	LOT	1
1.3	PART C- MAINTENANCE		
	Maintenance charge for above items of Part A & Part B for a period of 24 months after actual date of completion of 1 year warranty period. The warranty period starts from the actual date of system commissioning & handing over whichever is later. (Rate is to be quoted as 1 lot).	LOT	1
	Refer tender specification for all the line items mentioned in this BOQ & quote accordingly.		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
Note:	<p>Installation, integration, testing, balancing, commissioning & documentation work of all the above BOQ line items & including making / preparing shop drawings, technical data sheet, co ordination with other services dwg and submission for approval, checking the design and its functionality of the whole system including the cost of all accessories, termination, connections, conduiting, nuts & bolts as per tender requirement manufacturer's requirements, all necessary supports from ceiling, walls, floors, making necessary holes for duct entry in walls / floors & making rain / leak proof, civil foundation / pedestals as required for all accessories necessary to make the whole system operational. The rate shall be inclusive of the cost of all items labour etc., The final documentation includes commissioning reports, warranty / guarantee certificates, 6 sets of as built drawing hard copies & soft copy in DVD. O&M manuals & Handling over documents to be submitted.</p> <p>All Drawings, Technical submittals & installation procedure should be as per Good engineering practices. Drawings & material approval must be obtained before fabrication.</p>		
2	SUB HEAD 2: FUMEHOOD		
	PART A- SUPPLY OF FUME HOOD		
2.1	Providing and supply of Bench Top Constant Air Volume type Fume Hood and accessories complete as per enclosed drawings and as per approved final sample consisting of:		
	Walls & Panels: Double wall construction; outer wall of 1.2mm thk CRCA / GI sheet high chemical resistance epoxy powder coated to 60 to 80 microns thickness / 80 to 100 microns Polyurethane powder coating ; inner wall lined with 6 mm Thick Reinforced Phenolic Resin Lining. A free-standing rigid frame structure of steel angle to be provided to support exterior panels and interior liner and baffle panels. To allow for maintenance and replacements, the interior liner panels shall be removable without disassembly of the frame structure and outer steel panels. Likewise, the exterior steel panels shall be removable without disassembly of the frame structure and inner liner panels.		
	Fume Hood Sash: A combination sash to be provided. The sash shall have horizontal sliding glass panels in a vertical rising steel frame. The sash shall be counterbalanced with a single weight to prevent tilting and binding during operation. The glass panels shall be 6mm laminated safety toughen glass mounted on metal rollers in an powder coated aluminium track.		
	Fume Hood Baffles: A stable, Solid Lattice assemble baffle with three fixed horizontal slots shall be provided to aid in distributing the flow of air into and through the hood. The baffle shall be spaced out minimum 50mm from the back liner. The baffle shall be removable for cleaning		
	Fume Hood Damper & Duct Collar: PP FRP 300 mm Dia Single Leaf Manual Butterfly / Sliding Damper with both sides Flanges for Fume Hood 300 mm diameter polyethylene bell-mouthed duct collar shall be located in the top of the hood plenum chamber.		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Face Velocity monitor system		
	Service Port :- 80mm Dia Circular Service Port to be provided on either side of the Fume hood Fascia panel. Emergency Stop Switch, Temperature & Magnetic Controllers		
	Fume hood worktop shall be 20 mm Solid Grade laminate made of Composite wooden fibers with Electron Beam Cured surface which is free of melamine resins and resistance to Bacteria and various chemical/Biological spillage as well as fumes. SEFA 3.0 Certified from authorized SEFA approved agency with 10 years written Product Guarantee for all properties mentioned in material property data sheet. 10 years of proven testimonials in Global and Indian reputed Government & Private Research Laboratories. Epoxy Marine edges be provided as per the technical specification		
	Note: All the Fume Hood accesseability shall be from Front side		
	Rate is inclusive of all materials and operations described above and in general specifications. Fume hood shall be manugfactured in best asthetic design and sample of the Fume hood to be got approved before taking up mass scale production. All items required to be provided in the fume hood needs to be integrated in the design, tested and commissioned. Mode of measurement shall be each fume hood.		
2.1.1	1200 W x 1000 D	Nos	2
2.1.2	1500 W x 1000 D	Nos	18
2.1.3	2100 W x 1000 D (Solvent distillation)	Nos	19
2.1.4	1800 W x 1000 D	Nos	143
	Fume Hood BASE UNITS:		
2.2	Providing and supply of FM approved self closing Acid & 90 minutes fire rating Solvent Base Cabinets with Vent Holes connected to exhaust & louvers for fresh air - Rate is inclusive of cost of all materials. Mode of measurement shall be in numbers.		
2.2.1	600 L X 550 D X 900 H with Single Door (90 minutes FM approved Solvent Storage Cabinets) for 4 feet FH	Nos	2
2.2.2	600 L X 550 D X 900 H with Single Door (Acid Cabinets) for 4 feet FH	Nos	2
2.2.3	900 L X 550 D X 900 H with Double Door (90 minutes FM approved Solvent Storage Cabinets) for 6 feet FH	Nos	46
2.2.4	900 L X 550 D X 900 H with Double Door (Acid Cabinets) for 6 feet FH	Nos	46
2.2.5	750 L X 550 D X 900 H with Double Door (90 minutes FM approved Solvent Storage Cabinets) for 5 feet FH	Nos	2
2.2.6	750 L X 550 D X 900 H with Double Door (Acid Cabinets) for 5 feet FH	Nos	2

ITEM NO	DESCRIPTION	UNIT	QUANTITY
2.3	<p>Providing and supply of base units CRCA / GI sheet cabinets (high chemical resistance epoxy powder coated to 60 to 80 microns thickness / 80 to 100 microns Polyurethane powder coating) cabinet bodies with flush front construction with intersection of vertical and horizontal case members, such as end panels, top rails, bottoms and vertical posts in same plane without overlap. Exterior corners shall be spot welded with heavy back up reinforcement at exterior corners. All face joints shall be welded and ground smooth to provide a continuous flat plane.</p> <p>a) Steel used in construction of cases shall be 1.2mm thk except as follows:</p> <p>b) Case and drawer suspension channels, 2mm thk.</p> <p>c) Top and intermediate front horizontal rails, table aprons, hinge reinforcements, and reinforcement gussets, 1.6mm thk.</p> <p>d) Drawer assemblies, door assemblies, bottom, bottom back rail, toe space rail, and adjustable shelves, 1mm thk.</p> <p>e) Shelves load bearing capacity should be min 40 kg/sqm.</p> <p>f) Support frame require for positioning worktop on base cabinets costing shall be included.</p> <p>Cabinets 750mm, 900mm length, shall be provided with 2 shutters with 1 drawer, 600mm length shall be provided with 1 shutter 1 drawer.</p> <p>Rate is inclusive of cost of all materials and operations described above and in general specifications. Mode of measurement shall be in numbers as described below.</p>		
2.3.2	600(L)mmx560(D)mmx900mm(H) for storing vacuum pump (Include Power supply for vacuum pump within the Fume Hood circuit, Drain from Vacuum to be connected to Fume Hood drain connection, Hot Air generated from Vacuum pump to be exhausted through fume hood exhaust connections	Nos	44
2.3.2	900(L)mmx560(D)mmx900mm(H) for storing vacuum pump (Include Power supply for vacuum pump within the Fume Hood circuit, Drain from Vacuum to be connected to Fume Hood drain connection, Hot Air generated from Vacuum pump to be exhausted through fume hood exhaust connections	Nos	44
2.3.1	600(L)mmx560(D)mmx900mm(H)	Nos	106
2.3.3	750(L)mmx560(D)mmx900mm(H)	Nos	-
2.3.4	900(L)mmx560(D)mmx900mm(H)	Nos	80
2.3.5	600 L X 550 D X 450 H with Double Door for Solvent Distillation Fume Hoods for 7 feet FH	Nos	38
2.3.6	900 L X 550 D X 450 H with Double Door for Solvent Distillation Fume Hoods for 7 feet FH	Nos	19

ITEM NO	DESCRIPTION	UNIT	QUANTITY
2.4	FUMEHOOD CONTROL VALVE:		
	Providing and supply of gas and utility control valves, located in the end panels, controlled by extension rods and colour coated plastic handles. Mode of measurement shall be in numbers as described below.		
2.4.1	FH Front Control Valve for N2	Nos	362
2.4.2	FH Front Control Valve for CA	Nos	362
2.4.3	FH Front Control Valve for Portable water	Nos	362
24.4	FH Flow Fix Control Valve	Nos	182
2.4.5	FH Front Control Valve for Condensate Water Drain Valve	Nos	182
2.4.6	FH Front Control Valve for H2	Nos	27
2.4.7	FH Front Control Valve for Ar	Nos	8
2.4.8	FH Front Control Valve for O2	Nos	8
2.4.9	FH Front Control Valve for Methane	Nos	4
2.4.10	FH Front Control Valve for CO2	Nos	4
Note:	a) For all Gases including Compressed Air, N2 6.35mm OD Tube Connector(Double Compression fittings End) along with above valves to be included in the above pricing		
	b) For Portable Water 15 NB FNPT along with above valves to be included in the above pricing		
	AUTOMATIC MODULAR FIRE EXTINGUISHER (FOR H2, METHANE, ACTELYENE GASES PIPE LINE TERMINATED TO FUME HOODS):		
2.5	Providing and supply of 5kg SAFEX Automatic Clean agent gas fire extinguisher consist of MIG (Metal Insert Gas) welding MS body 2 mm thick CRCA sheet upper part of which is fitted with adapter or flange for fixing on ceiling wall & below part fixed automatic release nozzle based sprinkler. Sprinkler -Brass Crom plated, release temperature 68degc, Pressure Gauge - Imported. Fire ExtMode of measurement shall be in numbers as described below.	Nos	23
	FUMEHOOD INTERNAL PIPING & DRAIN:		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
2.6	Providing and supply of internal all Utility services piping in fume hoods, consisting SS 304 / Hoses of required dia and length, all pipes extended up to 150mm above the Fume hood top including making connections with control valves etc complete internal piping work. Control valve shall be paid separately. Fume Hood along with Cup Sink HDPE & Condensate drain pipe shall be connected to nearest floor trap. Rate is inclusive of cost of all materials, labour and operations. refer technical specification Mode of measurement shall be per each fume hood.	Nos	182
	Note: 110 & 75mm OD HDPE Popup is provided behind the sinks & Fume Hoods by Piping Vendor. Fume Hood Vendor shall connect & seal the drain piping to nearest points (approximately 3 rmtrs) . Based on the Site Condition may vary the outlet drain points		
	FUMEHOOD INTERNAL ELECTRICAL SYSTEM:		
2.7	Providing and supply of fume hood internal electrical supply system, consisting of - 6/16A sockets 4+4 nos, with 16A Tiny Trip MCB; DB on Top or at suitable location of the fume hood with MCB's for each circuit along with 20A DP RCCB isolator; FRLS wiring with 4 sqmm wires for power sockets; with Two rapid start, approved LED light fixtures on Fume Hood internal ceiling. Light switches on Fume hood Fasica, 32 amp 4 pole MCB for main incomer, wiring should be done by using proper raceway/conduit. Socket should be provided with proper earthing with 4 sqmm FRLS wire. Rate is inclusive of cost of all materials, mode of measurement shall be each fume hood. (Note the control box of fume hood should be placed in the front panel of fume hood for easy maintenance. Proto type sample to be got approved from the University before mass production.)	Nos	182
	FUMEHOOD CEILING ENCLOSURES:		
2.8	Providing and supply of vertical side panels, made of 1.2mm thick CRCA / GI sheet, epoxy powder coated to 60 to 80 microns thickness / 80 to 100 microns Polyurethane powder coating -Ceiling Enclosures to fill the space between the top of the hood and the ceiling to get a finished appearance. False ceiling height to be considered up to 3.0 Meter Height from FFL. The Ceiling Panel to be provided with an Access Panel in the front for easy access to the light fixture, Electrical Junction Box, CAV Dampers etc. Rate to include cost of all materials and operations. Mode of measurement shall be perimeter outer boxing panel and height of panel shall be measured for working out the area in Sqm for payment.	Nos	182
	PART B- INSTALLATION, TESTING & COMMISSIONING		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
2.9	Installation/ fixing, testing & commissioning of all the supplied materials covered under Sh 2 above including the cost of nuts bolts and other accessories not covered under the supply sub head but necessary to complete the finished product, screws, scaffolding, loading unloading, storage/stacking the supplied materials, necessary protection arrangement from sun & rain, welding wherever required, making holes in floors, walls, ceilings, core cutting in RCC slabs, all equipment, machinery required for installation, cleaning the premises after installation, Removal of debris, dirt and rubbish accumulated as a result of installation/commissioning of the laboratory furniture and accessories and leaving the premises broom clean and orderly, testing commissioning as per manufacturer standards and as per contract condition and direction of University. The quoted rate shall be quoted on percentage basis (mode of measurement shall be % of total supply value at actual) and shall include the cost of all materials, labour and taxes as per bid documents.	LOT	1
	PART C- MAINTENANCE		
	Maintenance charge for above items of Part A & Part B for a period of 24 months after actual date of completion of 1 year warranty period. The warranty period starts from the actual date of system commissioning & handing over whichever is later. (Rate is to be quoted as 1 lot).	LOT	1
	Refer tender specification for all the line items mentioned in this BOQ & quote accordingly.		
Note:	Installation, integration, testing, balancing, commissioning & documentation work of all the above BOQ line items & including making / preparing shop drawings, technical data sheet, co ordination with other services dwg and submission for approval, checking the design and its functionality of the whole system including the cost of all accessories, termination, connections, conduiting, nuts & bolts as per tender requirement manufacturer's requirements, all necessary supports from ceiling, walls, floors, making necessary holes for duct entry in walls / floors & making rain / leak proof, civil foundation / pedestals as required for all accessories necessary to make the whole system operational. The rate shall be inclusive of the cost of all items labour etc., The final documentation includes commissioning reports, warranty / guarantee certificates, 6 sets of as built drawing hard copies & soft copy in DVD. O&M manuals & Handling over documents to be submitted. All Drawings, Technical submittals & installation procedure should be as per Good engineering practices. Drawings & material approval must be obtained before fabrication.		
3	SUB HEAD 3: ELECTRICAL WORKS		
	Scope:		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Following documents also need to be provided:		
	Asbuilt drawings		
	LT panels test reports and test certificates		
	Cable test certificates and catalogues		
	All electrical items technical submittals		
	Power sockets test result and voltage recording sheet		
	Earth resistance test report		
	ELECTRICAL LAB WORKS		
	PVC CONDUIT & ACCESSORIES		
3.1	OPEN CONDUIT SYSTEM		
3.1.1	Supplying and laying of heavy gauge PVC conduit pipe following dia and thickness confirming to IS 2509 with suitable size bends, junction boxes, adhesive paste etc. and fixing using inverted wood plugs in case of RCC ceiling and RCC wall/stone structure or rawl plugs in case of brick walls and cement plastering the damage portion using heavy gauge saddles at an interval of 700mm using NF screws.		
3.1.1.1	32 mm dia 2.5mm thick	meter	400
3.2	WIRES & CABLES		
3.2.1	Supply & Wiring for lighting/power circuits using one of FRLS PVC insulated 1100V grade, Multistrand copper with low conductor resistance single core wire in open or concealed system of wiring with specified IS – 694 : 1990 & confirming to GTP of Group – A.		
3.2.1.1	2 X 2.5 sq. mm + 1 X 2.5 sq. mm earth wire	meter	RO
3.2.1.2	2 X 4 sq. mm + 1 X 4 sq. mm earth wire	meter	20000
3.2.1.3	4 X 4 sq. mm + 2 X 4 sq. mm earth wire	meter	RO
3.2.1.4	4 X 6 sq. mm + 2 X 6 sq. mm earth wire	meter	3000
3.2.2	1 C 6sqmm Multistrand PVC CU wire with copper lugs crimped on both the ends and bolts & nuts. Rate shall include necessary cable ties to tie it to the supports.	meter	RO
3.2.3	Supplying and drawing following sizes of FRLS PVC insulated copper conductor, flexible cable in the existing surface/ recessed steel/ PVC conduit as required.		
3.2.3.1	3 x 4 sq. mm	meter	RO

ITEM NO	DESCRIPTION	UNIT	QUANTITY
3.2.3.2	3 x 6 sq. mm	meter	RO
3.3	SWITCHES, SOCKETS & ACCESSORIES		
3.3.1	Supplying and fixing 32 A, 415 V, TPN Industrial type socket outlet, with 4 pole and earth, metal enclosed plug top along with 32 A, "C" curve, TPMCB, in sheet steel enclosure, on surface or in recess, with chained metal cover for the socket out let and complete with connections, internal wiring, testing and commissioning etc. as required.	Each	120
3.3.2	Supplying and fixing of modular switch / sockets /stepped electronic fan regulator / dimmer /telephone socket etc. and rate shall be include all internal wiring, loop to loop wiring using copper wire on existing modular switch plate as per IS 3854 & IS 1293		
	GROUP B		
3.3.2.1	16 A oneway switch	Each	250
3.3.2.2	16 A Tiny Trip MCB	Each	RO
3.3.2.3	6/16 A universal socket	Each	250
3.3.3	Supplying and fixing modular blanking plate on the existing modular plate & switch box excluding modular plate as required.	Each	200
3.3.4	Supplying and flush mounting powder coated / galvanized metal box suitable for mounting modular switch plates. The box should be firmly flush mounted after due groove cutting in brick / stone / C.C wall		
3.3.4.1	1-3 Way	Each	10
3.3.4.2	6 Way	Each	125
3.3.4.3	8 Way	Each	RO
3.3.5	Supply and fixing superior quality modular switch mounting polycarbonate plate with necessary supporting back plate with required numbers of machine screws, bolts, nuts etc. complete on the existing metal / PVC box.		
3.3.5.1	1 or 2 Module	Each	10
3.3.5.2	3 Module	Each	RO
3.3.5.3	4 Module	Each	RO
3.3.5.4	6 Module	Each	125

ITEM NO	DESCRIPTION	UNIT	QUANTITY
3.3.5.5	8 Module	Each	RO
3.4	CONTROL SWITCHGEARS AND ACCESSORIES		
3.4.1	Supply and fixing miniature circuit breakers on existing MCB distribution boards using necessary fixing materials and C type curve, indicator ON/OFF, energy cross -3 with short circuit breaking capacity of 10K and complete wiring as required confirming to IEC 60898. with connections, testing and commissioning etc. as required.		
3.4.1.1	5-32Amps Single pole	Each	400
3.4.1.2	5-32Amps Double pole	Each	25
3.4.1.3	5-32Amps Triple pole	Each	60
3.4.2	Supply and fixing regular MCB distribution boards on wall(concealed) / wood board / flush mounting using required clamps, bolts, nuts and wall chipping, drilling and plastering etc. with provision for fixing suitable type capacity MCBs single phase/ three phase/single door with powder coated painting, made out of 14 SWG MS enclosure with with tinned copper bus bar, neutral bus bar, earth bar, din bar, interconnections.		
3.4.2.1	8 way SP & N, Double door	Each	RO
3.4.2.2	12way SP & N, Double door	Each	18
3.4.2.3	4way TP & N, Double door	Each	27
3.5	RACEWAYS		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Supply, transport , unloading , shifting & installation in horizontal & vertical formation of raceway of different widths and delivered in standard lengths along with Coupler plates and requisite number of hardwires at different levels along pipe rack, open area , ready made cable trenches, cable cellar, etc and The Contractor's scope is inclusive of lifting & placing of raceways on supports at different levels, aligning, joining of raceways with couplers, clamping/ fastening to the support of the vertical portions and wherever required as per specs/ drawings. All the necessary bends (horizontal/ vertical), tees, cross, elbows, reducers, etc, as shown in the drawing and as per the site condition/ requirement are to be fabricated out of standard length of trays and as per standard & good engineering practice, gas cutting of raceway at site is not permitted. If any welding is to be done on raceway applying of two coats of zinc rich primer and one coat of Silver paint at the modified / repaired area/ portions and erection of the same. The running rate shall include bends , T section and couplers. Raceway supports shall be paid extra under the head of Structural steel. All the necessary modifications, addition, removal of supports, brackets, cleats, etc., minor civil works for grouting and entries are to be carried out as and where required as a part of this item work but the measurement and payment will be made against similar item appearing elsewhere in this BOQ. Without limiting to the above, the work is to be completed in all respects end to end of each route as per the specs, drawings and the direction of the Engineer-In-Charge. Installation of Factory fabricated GI powder coated type raceway made out of 14swg sheet steel and supporting angle frame at every 1.2 mtr, bottom angles, anchor fasteners, bolts and nuts etc. The tray shall be suspended from ceiling using anchor bolt and angle iron supports or threaded rods. The rate shall include for all accessories like bends, elbows, tees, coupler plates, joints and fixing accessories etc., which will be measured as linear measurement.		
3.5.1	150(H)x100(D) metal raceway with cover for fixing the industrial power sockets, power sockets and laying of power cables. cover, body, finishing accessories such as end cap, flat angle, junctions, joints, etc.	Mtrs	RO
3.5.2	150(H)x50(D) PVC raceway with separation partition for power & lan cables, cover, body, finishing accessories such as end cap, flat angle, junctions, joints, etc.	Mtrs	250
3.5.3	150(H)x50(D) size powder coated GI raceway with cover and separation partition for power & lan cables, including its accessories like Tees, Lbows. Rate shall be included for drilling, chipping,tiles cutting, plastering, complete civil work.	Mtrs	350
3.5.4	Fabricated Underfloor junction boxes with,baseplate & SS cover for installing with all required accessories to mount it. size 200x200x58mm. Rate shall be included for drilling, chipping,tiles cutting, plastering, complete civil work.	Mtrs	RO

ITEM NO	DESCRIPTION	UNIT	QUANTITY
3.6	EARTHING		
3.6.1	supplying and running of 8 SWG dia G.I. wire for grounding and (along with other wires in conduit system of wiring) using necessary suitable size clamps, nails, guttas/spacers etc. for loop earthing as required.	meter	110
3.6.2	Supplying & running of GI/Copper strips for grounding connections using necessary fixing material and strip at 0.50 meter below ground level for conductor earth electrode, including connection/ termination with GI thimble etc. as required.		
3.6.2.1	Providing and fixing 25 mm X 6 mm G.I. strip on surface or in recess for connections etc. as required.	meter	300
3.7	LT UG CABLES - CABLE LAYING		
3.7.1	Labour charges for laying of 1.1kv class U G cable (XLPE armoured) in existing trench GI pipe/Stoneware pipe / on wall / on poles / cable tray as required.		
3.7.1.1	6sqmm to 16 sq. mm	meter	1130
3.7.2	Supply and fixing of heavy duty double compression, weather proof cable glands of brass metal suitable for UG cable(XLPE armoured) of 1.1kv class.with brass washer, rubber ring complete erected with cable and lead connection, PVC insulating tape, identification ferrules at each core end and other consumables, etc		
3.7.2.1	19/20mm	each	190
3.7.2.2	25mm dia	each	80
3.7.3	Supplying tinned copper lugs and crimping and wiring to terminal point for wire and terminals to be covered using PVC insulating tape, identification ferrules at each core end and other consumables, of following sizes		
3.7.3.1	1.5 sq. mm	Each	850
3.7.3.2	3 C 6 sq. mm	Each	160
3.7.3.3	10 sq. mm	Each	275
3.7.4	LT UG CABLES - CABLE SUPPLY		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
3.7.4.1	Supply,testing and commissioning of 1100V grade, XLPE insulated armoured / unarmoured Aluminium / Copper conductor cable as per specifications. The cable shall be laid in trenches / cable trays as required. The cable shall be clamped at regular intervals to the supports in trench or on cable trays or brick wall using MS clamps, cable ties and fasteners. upto 6sqmm cable shall be round strips and 10sqmm and above cables shall be flat strips to be considered.		
3.7.4.1.1	3 C 6 Sqmm LT XLPE insulated copper conductor pvc outer sheathed Armoured cable	meter	1000
3.7.4.1.2	4 C 10 Sqmm LT XLPE insulated copper conductor pvc outer sheathed Armoured cable	meter	150
3.8	MISCELLANEOUS		
3.8.1	Providing and doing with civil wall cutout, wall chipping, drilling, external wall plaster in single layers , with C.M 1:4, with approved water proofing compound with sponge finish including the cost all leads, lifts, scaffolding, staging hacking the concrete surface , curing etc. , complete. Note: considered for the reworking finished civil walls.	SqMtr	30
3.8.2	Removing & Refixing of raceways and wiring, with necessary dressing.	meter	200
3.8.3	Relocation of Existing Electrical DBs. Rate shall be include removable and refixing of DBs with necessary circuit wirings and also civil works like chipping, plastering and final finishing.	Nos.	20
	TERRACE FLOOR EXHAUST BLOWER WORKS		
3.9	EARTHING		
3.9.1	Supplying, fixing, wiring, Earth electrode for grounding using 40mm dia thick 2.5 mtr long GI pipe and GI plate of 600x600x3mm with GI funnel with mesh and suitable size reducer fixed on the top of the earth electrode. The funnel should be enclosed in a CC chamber of 400mmx400x400mm with a cast iron cover. The earth electrode shall have staggered holes of 12mm dia and the electrode should be covered 150mm all-round with alternate layers of salt and charcoal from the bottom of the CC chamber. The connection from the electrode is to be established through GI strip using GI bolts and nuts.	set	12
3.9.2	Supply, Installation & Testing of copper Plate (600mm x 600mm x3.15mm) earth station as per IS 3043 complete with salt, charcoal, 2 Nos of 50mmx6mm cu strip/conductor up to test link, 50mm dia GI watering pipe with funnel, test link. the earthing chamber of 600mmx600mm size, CI cover size shall be 450mmx450mm etc. with required civil works complete. Rate shall include excavation concrete breaking & backfilling charges as per the site condition. The identification number shall be provided both inside and outside of equipment.	set	RO

ITEM NO	DESCRIPTION	UNIT	QUANTITY
3.9.3	Supplying & running of GI/Copper strips for grounding connections using necessary fixing material and strip at 0.50 meter below ground level for conductor earth electrode, including connection/ termination with GI thimble etc. as required.		
3.9.3.1	Providing and fixing 25 mm X 6 mm G.I. strip on surface or in recess for connections etc. and strip at 0.50 meter below ground level for conductor earth electrode, including connection/ termination with GI thimble etc. as required.	meter	3000
3.9.3.2	Providing and fixing 50 mm X 6 mm Aluminium strip on surface for connections etc. and strip at 0.50 meter below ground level for conductor earth electrode, including connection/ termination with GI thimble etc. as required.	meter	1000
3.9.3.3	Providing and fixing 25 mm X 6 mm copper strip on surface or in recess for connections etc. and strip at 0.50 meter below ground level for conductor earth electrode, including connection/ termination with GI thimble etc. as required.	meter	RO
3.10	CABLE SUPPLY		
3.10.1	Supply,testing and commissioning of 1100V grade, XLPE insulated armoured / unarmoured Aluminium / Copper conductor cable as per specifications. The cable shall be laid in trenches / cable trays as required. The cable shall be clamped at regular intervals to the supports in trench or on cable trays or brick wall using MS clamps, cable ties and fasteners. upto 6sqmm cable shall be round strips and 10sqmm and above cables shall be flat strips to be considered.		
3.10.1.1	3 C 1.5 Sqmm LT XLPE insulated copper conductor pvc outer sheathed Armoured cable	meter	710
3.10.1.2	3 C 2.5 Sqmm LT XLPE insulated copper conductor pvc outer sheathed Armoured cable	meter	722
3.10.1.3	3 C 4 Sqmm LT XLPE insulated copper conductor pvc outer sheathed Armoured cable	meter	230
3.10.1.4	3 C 6 Sqmm LT XLPE insulated copper conductor pvc outer sheathed Armoured cable	meter	828
3.10.1.5	3 C 10 Sqmm LT XLPE insulated copper conductor pvc outer sheathed Armoured cable	meter	RO
3.10.1.6	3 C 16 Sqmm LT XLPE insulated copper conductor pvc outer sheathed Armoured cable	meter	RO
3.10.1.7	4 C 10 Sqmm LT XLPE insulated copper conductor pvc outer sheathed Armoured cable	meter	100
3.10.1.8	4 C 6 Sqmm LT XLPE insulated copper conductor pvc outer sheathed Armoured cable	meter	20
3.10.1.9	3 C 16 Sqmm LT XLPE insulated Aluminium conductor pvc outer sheathed Armoured cable	meter	340
3.10.1.10	3.5 C 25 Sqmm LT XLPE insulated Aluminium conductor pvc outer sheathed Armoured cable	meter	240
3.10.1.11	3.5 C 70 Sqmm LT XLPE insulated Aluminium conductor pvc outer sheathed Armoured cable	meter	312
3.10.1.12	3.5 C 95 Sqmm LT XLPE insulated Aluminium conductor pvc outer sheathed Armoured cable	meter	204
3.10.1.13	3.5 C 150 Sqmm LT XLPE insulated Aluminium conductor pvc outer sheathed Armoured cable	meter	RO

ITEM NO	DESCRIPTION	UNIT	QUANTITY
3.10.1.14	3.5 C 185 Sqmm LT XLPE insulated Aluminium conductor pvc outer sheathed Armoured cable	meter	RO
3.10.1.15	3.5 C 300 Sqmm LT XLPE insulated Aluminium conductor pvc outer sheathed Armoured cable	meter	480
3.10.1.16	3.5 C 400 Sqmm LT XLPE insulated Aluminium conductor pvc outer sheathed Armoured cable	meter	RO
3.10.1.17	5 C 1.5 Sqmm LT XLPE insulated copper conductor pvc outer sheathed Armoured cable	meter	1816
3.10.2	LT UG CABLES - CABLE LAYING		
3.10.2.1	Labour charges for laying of 1.1kv class U G cable (XLPE armoured) in existing trench GI pipe/Stoneware pipe / on wall / on poles / cable tray as required.		
3.10.2.1.1	1.5sqmm to 4 sq. mm	meter	3478
3.10.2.1.2	6sqmm to 16 sq. mm	meter	1288
3.10.2.1.3	25sqmm to 75 sq. mm	meter	552
3.10.2.1.4	95sqmm to 150 sq. mm	meter	204
3.10.2.1.5	300sqmm to 400 sq. mm	meter	480
3.10.3	Supply and fixing of heavy duty double compression, weather proof cable glands of brass metal suitable for UG cable(XLPE armoured) of 1.1kv class.with brass washer, rubber ring complete erected with cable and lead connection, PVC insulating tape, identification ferrules at each core end and other consumables, etc		
3.10.3.1	19/20mm	Each	336
3.10.3.2	25mm dia	Each	RO
3.10.3.3	32mm dia	Each	16.8
3.10.3.4	50mm dia	Each	14.4
3.10.3.5	63mm dia	Each	12
3.10.3.6	75mm dia	Each	RO
3.10.4	Supplying tinned copper lugs with Bimetallic paste for Aluminium cable and crimping and wiring to terminal point for wire and terminals to be covered using PVC insulating tape, identification ferrules at each core end and other consumables, of following sizes		
3.10.4.1	1.5 sq. mm	Each	775
3.10.4.2	2.5 sq. mm	Each	166
3.10.4.3	4 sq. mm	Each	43
3.10.4.4	6 sq. mm	Each	175
3.10.4.5	10 sq. mm	Each	19

ITEM NO	DESCRIPTION	UNIT	QUANTITY
3.10.4.6	16 sq. mm	Each	96
3.10.4.7	25 sq. mm Long Barrel	Each	50
3.10.4.8	35 sq. mm Long Barrel	Each	10
3.10.4.9	50 sq. mm Long Barrel	Each	5
3.10.4.10	70 sq. mm Long Barrel	Each	29
3.10.4.11	95 sq. mm Long Barrel	Each	14
3.10.4.12	120 sq. mm Long Barrel	Each	RO
3.10.4.13	150 sq. mm Long Barrel	Each	10
3.10.4.14	185 sq. mm Long Barrel	Each	RO
3.10.4.15	240 sq. mm Long Barrel	Each	RO
3.10.4.16	300 sq. mm Long Barrel	Each	29
3.10.4.17	400 sq. mm Long Barrel	Each	RO
3.10.5	Supplying and running of G.I./copper conductor for grounding and (along with other wires in conduit system of wiring) using necessary suitable size clamps, nails, guttas/spacers etc. for loop earthing as required.		
3.10.5.1	8 SWG GI wire	meter	250
3.10.5.2	8 SWG Copper wire	meter	200
3.11	CABLE TRAYS		
3.11.1	Hot Dipped Galvanized Iron Cable Tray		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	<p>Supply, transport , unloading , shifting & installation in horizontal & vertical formation of prefabricated perforated type, galvanised sheet steel cable trays & cable tray cover of different widths and delivered in standard lengths along with Coupler plates and requisite number of hardwires at different levels along pipe rack, open area , ready made cable trenches, cable cellar, etc and The Contractor's scope is inclusive of lifting & placing of trays on supports at different levels, aligning, joining of trays with couplers, clamping/ fastening to the support of the vertical portions and wherever required as per specs/ drawings. All the necessary bends (horizontal/ vertical), tees, cross, elbows, reducers, etc., as shown in the drawing and as per the site condition/ requirement are to be fabricated out of standard length of trays and as per standard & good engineering practice, gas cutting of cable trays at site is not permitted. If any welding is to be done on cable trays applying of two coats of zinc rich primer and one coat of Silver paint at the modified/ repaired area/ portions and erection of the same. The running rate shall include bends , T section and couplers. Cable tray supports shall be paid extra under the head of Structural steel. All the necessary modifications, addition, removal of supports, brackets, cleats, etc., minor civil works for grouting and entries are to be carried out as and where required as a part of this item work but the measurement and payment will be made against similar item appearing elsewhere in this BOQ. Without limiting to the above, the work is to be completed in all respects end to end of each route as per the specs, drawings and the direction of the Engineer-In-Charge. Installation of Factory fabricated GI Ladder type cable tray made out of 14swg sheet steel, side channel size 75mmx15 mm and rung size 30mmx6mm, spaced at 250mm interval and factory fabricated GI perforated type cable tray made out of 14swg sheet steel,supporting angle frame at every 1.2 mtr, bottom angles, anchor fasteners, bolts and nuts etc. The tray shall be suspended from ceiling using anchor bolt and angle iron supports or threaded rods. The rate shall include for all accessories like bends, elbows, tees, coupler plates, joints and fixing accessories etc., which will be measured as linear measurement.</p>		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Open area cable tray shall be hot dipped galvanized with cover and minimum thickness of coating is 70 to 90 Microns and inside the area pregalvanized cable tray with coating is 90GSM. Thickness of perforated cable tray sheet steel for 50 mm to 300 mm cable tray = 2.0 mm thick and minimum height of the perforated cable Tray is 50 mm. Thickness of perforated cable tray sheet steel for 450 mm to 900 mm cable tray = 2.5 mm thick and inside / covered area, Factory fabricated GI Ladder type cable tray made out of 14swg sheet steel, minimum Height of the perforated cable tray is 50mm. Thickness of Ladder cable tray sheet steel cable tray = 2.5 mm thick and minimum Height of the ladder type cable tray is 50 mm. Cable tray shall be in different widths and shall be in standard length 2500 mm long and suitable to couple two cable trays with coupler. Thickness of cable tray cover for all width of cable tray is 1.6 mm		
3.11.1.1	100 mm (W) X 50 mm (H) wide Hot dip galvanised perforated type cable tray	Each	200
3.11.1.2	150 mm (W) X 50 mm (H) wide Hot dip galvanised perforated type cable tray	Each	75
3.11.1.3	300 mm (W) X 50 mm (H) wide Hot dip galvanised perforated type cable tray	meter	200
3.11.1.4	450 mm (W) X 50 mm (H) wide Hot dip galvanised ladder type cable tray	meter	220
3.11.1.5	600 mm (W) X 75 mm (H) wide Hot dip galvanised ladder type cable tray	meter	150
3.11.1.6	750 mm (W) X 75 mm (H) wide Hot dip galvanised ladder type cable tray	meter	RO
3.11.1.7	900 mm (W) X 75 mm (H) wide Hot dip galvanised ladder type cable tray	meter	RO
3.11.1.8	100mm (W) cable tray Hot dip galvanized cover	meter	200
3.11.1.9	150mm (W) cable tray Hot dip galvanized cover	meter	75
3.11.1.10	300mm (W) cable tray Hot dip galvanized cover	meter	200
3.11.1.11	450mm (W) cable tray Hot dip galvanized cover	meter	220
3.11.1.12	600mm (W) cable tray Hot dip galvanized cover	meter	150
3.12	MISCELLANEOUS		
3.12.1	Supplying & installation of weather proof(IP65) emergency stop mushroom type Push button station with key lockable type fixed on wall or on required MS angle support with all its accessories as per specifications. Rate shall include Back box & accessories to fix it of approved make.	Each	55
3.12.2	Supplying & installation of ON & OFF Push button station with front plate & key lockable type fixed on wall or on required MS angle support with all its accessories as per specifications. Rate shall include Back box & accessories to fix it of approved make.	Each	23

ITEM NO	DESCRIPTION	UNIT	QUANTITY
3.11.3	Supply, Fabrication, Grouting & Installation of structural steel in form of MS angles/tees/channels/flats etc. for supporting various items of equipments such as various cable trays, push button station, junction boxes,DBs, Plug sockets etc. including drilling, welding, grouting, chipping, bolting with supply of required hardware. Fabricated and installed structural steel shall be suitably painted with 2 coats of enamel paint after applying 2 coats of red oxide primer. Colour shade of supports shall be same as that of main shade of support structure or will be as per the site engineer approval.	KG	5000
3.11.4	Supply and laying of Rubber mat of size 1000mmx2000mmx2.5mm thick of 11K V grade as per IS 15652.	Nos	30
3.11.5	CORE CUTTING TO SLAB - UPTO 250MM THK		
3.11.5.1	Providing core cutting and carting away the debris outside the construction premises (stock yard shown by client) as directed. Mode of measurement : shall be payable for the pipe outside diameter only.		
3.11.5.2	a) 50mm		10
3.11.5.3	b) 100mm		10
3.11.5.4	c) 150mm		10
3.11.6	GROUTING		
3.11.6.1	Providing Packing the core cut hole to make it water leakage tight using fosroc chemicals like GP-2 / Micro concrete. Mode of measurement : shall be payable for the pipe outside diameter only.		
3.11.6.2	a) 50mm		10
3.11.6.3	b) 100mm		10
3.11.6.4	c) 150mm		10
	TERRACE FLOOR ELECTRICAL PANEL WORKS		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Design, fabrication, assembly, wiring , Supply, loading, transportation, unloading at site, storages at site,shifting from storage place to site, Installation, Testing & Commissioning of following 3 Phase, 4 wire, 415 V, 50 Hz totally enclosed cubicle type compartmentalized, outdoor mounting, Double door, with canopy , free standing, floor mounted on painted ISMC MS channels of suitable size or suitable size MS stands wherever required, front operated, weather proof, water proof, dust and vermin proof, (Ingress protection IP 55) panels . The fabrication shall be made with cold rolled cold annealed sheet with Machine pressing. The surface shall be rigorously treated for derusting in 7 tank process with dephosphating and with powder coating on both sides of the panel. The panel shall be totally enclosed with double gasketing with rubber / resin lining.The panel shall be mounted on existing trench/ MS Stand/Floor mounted and shall have cable entry provision from the bottom with suitable alley as the case may be. The panel builder must have approved CPRI type test certificate certifying 50 kA short circuit withstand capacity for 1 Sec. for the bus bars.(The Single Line Diagram and Technical specifications shall be closely followed).		
	Notes:-		
	The Panel shall be designed fully as per the technical specifications of the tender, indicative SLD and requirement of Engineer-in-charge.		
	General Arrangement drawing, SLD & Schematic drawings of the designed Panel must be submitted for approval of the consultant before taking up the production of Panels. In addition to this, internal bus-bar layout including vertical droppers and termination arrangement drawing, Bill of material with Make, Model and Cat No. of switchgears & accessories are required to be submitted to the Engineer -in-charge for approval of the consultant before taking up the production of Panels		
	Cubicle Details : Material of construction: Frames:- 3 mm Thick CRCA MS Sheet Gland Plates:- 3mm Thick CRCA MS Sheet Non load bearing parts load bearing parts:-2 mm Thick CRCA MS Sheet. IP Protection - IP - 55 outdoor cubicle type free standing & floor mounting, Front/Rear panels - Hinged and lockable type doors/ Removable type, weather proof, dust & vermin proof		
	Base frame shall be with each panel. The size shall be same for all the sections & panels.		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Any panel if more than 1.5m width should be made in parts, each part not exceeding 1.5 metre Width of the Panel should be decided as per the site conditions and taken care while approving the GA drawings.		
	All doors to have double rubber gasket with shutter assembly & door seating frame.		
	All Switchboard front mounted equipment as well as equipment mounted inside shall be provided with individual nameplate with equipment designation engraved.		
	The panel shall be having control directory pasted inside the panel.		
	TP means three pole		
	TP & N means 3 pole breaker with neutral link		
	4P means Four Pole breaker with 100% neutral		
	Unless specified as 3.5 pole breaker, 4 pole means 4 pole ONLY.		
	All breakers to have breaker manufacturer's factory made phase barriers and Spreaders links.		
	Circuit Breakers shall confirm IS 13947-2/IEC 947-2		
	All breakers release shall be as mentioned in BOQ of each feeder and as per Tender electrical single line diagrams.		
	All Breakers both Incoming & Outgoing shall have LED 'ON / OFF / TRIP' indications without fail.		
	In any case Aluminium or copper bus bars should not be connected directly to the breaker without spreader links.		
	Irrespective of the Ampacity of the breakers, connection to all the breakers from the Bus bars shall be using suitable size of Bus bars matching the prescribed CD. Cables of any make or type will not be accepted for interconnection.		
	The current density for Aluminium bus bars shall be 0.8 Amps./ Sq.mm.		
	The current density for Copper bus bars shall be 1.3 Amps./ Sq.mm.		
	All vertical bus bars in bus bar alley shall have bottom supports.		
	Bi-metallic tape/washers to be used where ever Cu. & Al are joined.		
	Auxiliary contactor to be provided along with auto-manual switch for all the starters		
	CTs shall be with single ratio and cast resin type only.		
	MCB's shall be considered for the protection of controls circuit.		
	The control wiring shall be neatly bunched, adequately supported and properly routed to allow easy access and maintenance		
	Earthing of the Panel should be with fully tinned copper Bus Bar of size 25mm x 5mm. The Earthing Bus Bar should be provided through out the length of panel.		
	Panel earthing strip should come out vertically on top of the panel.		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Door earthing shall be provided for all the doors.		
	All metallic covers of relays, instruments and other panel mounted equipment shall be connected to the earth bus by means of PVC insulated copper wire of not less than 2.5 Sq.mm.		
	Cable entry details : Incoming - All cables are from bottom Outgoings - All outgoings by cables from bottom		
	All test certificates must be provided immediately after testing and commissioning.		
	NOTE:		
1)	VFD vendor team should attend the site during commissioning of VFD for timer set-up.		
2)	Commissioning report to be submitted as a part of handing over documents.		
	MCC Panels as under:-		
3.12	MCC-1 PANEL- OUTDOOR TYPE (A-BOTTOM)		
	Supply, Installation, Testing & Commissioning of MCC PANEL-1 as per standard fabrication details mentioned above		
3.12.1	INCOMING:		
	MCCB:		
	Rating - 630Amps, 36KA		
	Quantity -1 No.		
	No. of poles - 4Pole		
	MCCB Operation - Manual Fixed type Standard Extended Rotary Handle		
	Protection Releases in MCCB - Microprocessor based releases for short circuit, over current, Earth fault & Shunt trip.		
	Indication - RYB / ON/OFF/TRIP		
	Current Transformer's -1 set of 3 Nos. for each Breaker.		
	Class I - 15VA burden.		
	Type - Cast resin.		
	Ratio - 630 / 5A		
	METERS: Multi Function Meter - MFM with RS 485 Serial communication port.		
	BUS BAR: 800A Phase, 400A Neutral, TPN, 415V, 3Phase, 50Hz, Aluminium Bus Bar.		
	Bus Bar Supports -Fire retardant DMC/SMC.		
	Bus bar sleeves - Heat shrinkable - colour coded.		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Internal & control wiring -Circuit Wire for the CTs: 2.5 Sq.mm and for control circuits: 2.5 Sq.mm FRLSH, 1100V grade PVC insulated single core,multistrand copper flexible as per approved make. To be with ferrules		
3.12.2	OUTGOINGS:		
3.12.2.1	MCCB:		
	Rating - 250Amps, 36KA		
	Quantity - 1 Nos.		
	No. of poles - TPN		
	MCCB Operation - Manual Fixed type Standard Extended Rotary Handle		
	Protection Releases in MCCB -Thermalmagnetic based releases for short circuit, over current .		
	Indications - OFF/ON/TRIP. With control MCB		
	Other features - All standard accessories mentioned in the technical specifications like Spreader links,phase barrier,trip alarm contact,etc		
3.12.2.2	MCCB:		
	Rating - 63Amps, 25KA		
	Quantity - 3 Nos.		
	No. of poles - TPN		
	MCCB Operation - Manual Fixed type Standard Extended Rotary Handle		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP. With control MCB		
	Other features - All standard accessories mentioned in the technical specifications like Spreader links,phase barrier,trip alarm contact,etc		
3.12.2.3	VFD WITH MCCB:		
	MCCB Rating - 63Amps, 25KA		
	Quantity - 2 Nos.		
	No. of poles - TPN		
	Operation - 11.2kw VFD with inbuilt choke,ventilation fan, internal wiring with disply,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch.		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 2 Nos.		
	SP MCB Rating - 6 Amps.		
3.12.2.4	VFD WITH MCCB:		
	MCCB Rating - 63Amps, 25KA		
	Quantity - 3 Nos.		
	No. of poles - TPN		
	Operation - 7.5kw VFD with inbuilt choke,ventilation fan, internal wiring with display,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 3 Nos.		
	SP MCB Rating - 6 Amps.		
3.12.2.5	VFD WITH MCCB:		
	MCCB Rating - 32Amps, 25KA		
	Quantity - 3 Nos.		
	No. of poles - TPN		
	Operation - 5.5kw VFD with inbuilt choke,ventilation fan, internal wiring with disply,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 3 Nos.		
	SP MCB Rating - 6 Amps.		
3.12.2.6	VFD WITH MCCB:		
	MCCB Rating - 20Amps, 25KA		
	Quantity - 1 Nos.		
	No. of poles - TPN		
	Operation - 2.2kw VFD with inbuilt choke,ventilation fan, internal wiring with disply,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 1 Nos.		
	SP MCB Rating - 6 Amps.		
3.12.1.7	DOL STARTER:		
	MCCB Rating - 20Amps, 25KA		
	Quantity - 3 Nos.		
	No. of poles - TPN		
	MCCB Operation - 1.5KW DOL starter with contactor, overload relay,single phase preventor. 2 pole 2 way rotary selector switch for auto/manual switch		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 3 Nos.		
	SP MCB Rating - 6 Amps.		
	MS stand for panel mounting height is 500mm and length as per the panel.		
	Complete set	set	1.00
3.13	MCC-2 PANEL- OUTDOOR TYPE (C- BOTTOM)		
	Supply, Installation, Testing & Commissioning of MCC PANEL-2 as per standard fabrication details mentioned above		
3.13.1	INCOMING:		
	MCCB:		
	Rating - 630Amps, 36KA		
	Quantity -1 No.		
	No. of poles - 4Pole		
	MCCB Operation - Manual Fixed type Standard Extended Rotary Handle		
	Protection Releases in MCCB - Microprocessor based releases for short circuit, over current, Earth fault & Shunt trip.		
	Indication - RYB / ON/OFF/TRIP		
	Current Transformer's -1 set of 3 Nos. for each Breaker.		
	Class I - 15VA burden.		
	Type - Cast resin.		
	Ratio - 630 / 5A		
	METERS: Multi Function Meter - MFM with RS 485 Serial communication port.		
	BUS BAR: 800A Phase, 400A Neutral, TPN, 415V, 3Phase, 50Hz, Aluminium Bus Bar.		
	Bus Bar Supports -Fire retardant DMC/SMC.		
	Bus bar sleeves - Heat shrinkable - colour coded.		
	Internal & control wiring -Circuit Wire for the CTs: 2.5 Sq.mm and for control circuits: 2.5 Sq.mm FRLSH, 1100V grade PVC insulated single core,multistrand copper flexible as per approved make. To be with ferrules		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
3.13.2	OUTGOINGS:		
	MCCB:		
	Rating - 320Amps, 36KA		
	Quantity - 1 Nos.		
	No. of poles - TPN		
	MCCB Operation - Manual Fixed type Standard Extended Rotary Handle		
	Protection Releases in MCCB -Thermalmagnetic based releases for short circuit, over current .		
	Indications - OFF/ON/TRIP. With control MCB		
	Other features - All standard accessories mentioned in the technical specifications like Spreader links,phase barrier,trip alarm contact,etc		
3.13.2.1	MCCB:		
	Rating - 250Amps, 36KA		
	Quantity - 1 Nos.		
	No. of poles - TPN		
	MCCB Operation - Manual Fixed type Standard Extended Rotary Handle		
	Protection Releases in MCCB -Thermalmagnetic based releases for short circuit, over current .		
	Indications - OFF/ON/TRIP. With control MCB		
	Other features - All standard accessories mentioned in the technical specifications like Spreader links,phase barrier,trip alarm contact,etc		
3.13.2.2	MCCB:		
	Rating - 63Amps, 25KA		
	Quantity - 3 Nos.		
	No. of poles - TPN		
	MCCB Operation - Manual Fixed type Standard Extended Rotary Handle		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP. With control MCB		
	Other features - All standard accessories mentioned in the technical specifications like Spreader links,phase barrier,trip alarm contact,etc		
3.13.2.3	VFD WITH MCCB:		
	MCCB Rating - 63Amps, 25KA		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Quantity - 3 Nos.		
	No. of poles - TPN		
	Operation - 11.2kw VFD with inbuilt choke,ventilation fan, internal wiring with disply,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch.		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 3 Nos.		
	SP MCB Rating - 6 Amps.		
3.13.2.4	VFD WITH MCCB:		
	MCCB Rating - 63Amps, 25KA		
	Quantity - 4 Nos.		
	No. of poles - TPN		
	Operation - 7.5kw VFD with inbuilt choke,ventilation fan, internal wiring with disply,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch.		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 4 Nos.		
	SP MCB Rating - 6 Amps.		
3.13.2.5	VFD WITH MCCB:		
	MCCB Rating - 32Amps, 25KA		
	Quantity - 1 Nos.		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	No. of poles - TPN		
	Operation - 5.5kw VFD with inbuilt choke,ventilation fan, internal wiring with disply,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 1 Nos.		
	SP MCB Rating - 6 Amps.		
3.13.2.6	VFD WITH MCCB:		
	MCCB Rating - 32Amps, 25KA		
	Quantity - 1 Nos.		
	No. of poles - TPN		
	Operation - 3.7kw VFD with inbuilt choke,ventilation fan, internal wiring with disply,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 1 Nos.		
	SP MCB Rating - 6 Amps.		
3.13.2.7	VFD WITH MCCB:		
	MCCB Rating - 20Amps, 25KA		
	Quantity - 1 Nos.		
	No. of poles - TPN		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Operation - 2.2kw VFD with inbuilt choke,ventilation fan, internal wiring with disply,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch.		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 1 Nos.		
	SP MCB Rating - 6 Amps.		
3.13.2.8	DOL STARTER:		
	MCCB Rating - 20Amps, 25KA		
	Quantity - 4 Nos.		
	No. of poles - TPN		
	MCCB Operation - 1.5KW DOL starter with contactor, overload relay,single phase preventor. 2 pole 2 way rotary selector switch for auto/manual switch		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 4 Nos.		
	SP MCB Rating - 6 Amps.		
	MS stand for panel mounting height is 500mm and length as per the panel.		
	Complete set	set	1.00
3.14	SUB MCC-1(a) PANEL- OUTDOOR TYPE (A- TOP)		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Supply, Installation, Testing & Commissioning of SUB-MCC-1(a) PANEL as per standard fabrication details mentioned above		
3.14.1	INCOMING:		
	MCCB:		
	Rating - 250Amps, 36KA		
	Quantity -1 No.		
	No. of poles - 4Pole		
	MCCB Operation - Manual Fixed type Standard Extended Rotary Handle		
	Protection Releases in MCCB - Microprocessor based releases for short circuit, over current, Earth fault & Shunt trip.		
	Indication - RYB / ON/OFF/TRIP		
	Current Transformer's -1 set of 3 Nos. for each Breaker.		
	Class I - 15VA burden.		
	Type - Cast resin.		
	Ratio - 250 / 5A		
	METERS: Multi Function Meter - MFM with RS 485 Serial communication port.		
	BUS BAR: 320A Phase, 200A Neutral, TPN, 415V, 3Phase, 50Hz, Aluminium Bus Bar.		
	Bus Bar Supports -Fire retardant DMC/SMC.		
	Bus bar sleeves - Heat shrinkable - colour coded.		
	Internal & control wiring -Circuit Wire for the CTs: 2.5 Sq.mm and for control circuits: 2.5 Sq.mm FRLSH, 1100V grade PVC insulated single core,multistrand copper flexible as per approved make. To be with ferrules		
3.14.2	OUTGOINGS:		
	MCCB:		
	Rating - 63Amps, 25KA		
	Quantity - 4 Nos.		
	No. of poles - TPN		
	MCCB Operation - Manual Fixed type Standard Extended Rotary Handle		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP. With control MCB		
	Other features - All standard accessories mentioned in the technical specifications like Spreader links,phase barrier,trip alarm contact,etc		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
3.14.2.1	VFD WITH MCCB:		
	MCCB Rating - 80Amps, 25KA		
	Quantity - 2 Nos.		
	No. of poles - TPN		
	Operation - 22kw VFD with inbuilt choke,ventilation fan, internal wiring with disply,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch.		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 2 Nos.		
	SP MCB Rating - 6 Amps.		
3.14.2.2	VFD WITH MCCB:		
	MCCB Rating - 63Amps, 25KA		
	Quantity - 4 Nos.		
	No. of poles - TPN		
	Operation - 15kw VFD with inbuilt choke,ventilation fan, internal wiring with disply,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch.		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 4 Nos.		
	SP MCB Rating - 6 Amps.		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
3.14.2.3	VFD WITH MCCB:		
	MCCB Rating - 63Amps, 25KA		
	Quantity - 1 Nos.		
	No. of poles - TPN		
	Operation - 11.2kw VFD with inbuilt choke,ventilation fan, internal wiring with disply,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch.		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 1 Nos.		
	SP MCB Rating - 6 Amps.		
3.14.2.4	VFD WITH MCCB:		
	MCCB Rating - 63Amps, 25KA		
	Quantity - 2Nos.		
	No. of poles - TPN		
	Operation - 7.5kw VFD with inbuilt choke,ventilation fan, internal wiring with disply,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch.		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 2 Nos.		
	SP MCB Rating - 6 Amps.		
3.14.2.5	VFD WITH MCCB:		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	MCCB Rating - 32Amps, 25KA		
	Quantity - 1Nos.		
	No. of poles - TPN		
	Operation - 5.5kw VFD with inbuilt choke,ventilation fan, internal wiring with disply,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch.		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 1 Nos.		
	SP MCB Rating - 6 Amps.		
3.14.2.6	DOL STARTER:		
	MCCB Rating - 20Amps, 25KA		
	Quantity - 4 Nos.		
	No. of poles - TPN		
	MCCB Operation - 1.5KW DOL starter with contactor, overload relay,single phase preventor. 2 pole 2 way rotary selector switch for auto/manual switch		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 4 Nos.		
	SP MCB Rating - 6 Amps.		
	MS stand for panel mounting height is 500mm and length as per the panel.		
	Complete set	set	1.00

ITEM NO	DESCRIPTION	UNIT	QUANTITY
3.15	SUB MCC-2(a) PANEL- OUTDOOR TYPE (B-TOP)		
	Supply, Installation, Testing & Commissioning of SUB MCC-2(a) PANEL as per standard fabrication details mentioned above		
3.15.1	INCOMING:		
	MCCB:		
	Rating - 250Amps, 36KA		
	Quantity -1 No.		
	No. of poles - 4Pole		
	MCCB Operation - Manual Fixed type Standard Extended Rotary Handle		
	Protection Releases in MCCB - Microprocessor based releases for short circuit, over current, Earth fault & Shunt trip.		
	Indication - RYB / ON/OFF/TRIP		
	Current Transformer's -1 set of 3 Nos. for each Breaker.		
	Class I - 15VA burden.		
	Type - Cast resin.		
	Ratio - 250 / 5A		
	METERS: Multi Function Meter - MFM with RS 485 Serial communication port.		
	BUS BAR: 320A Phase, 200A Neutral, TPN, 415V, 3Phase, 50Hz, Aluminium Bus Bar.		
	Bus Bar Supports -Fire retardant DMC/SMC.		
	Bus bar sleeves - Heat shrinkable - colour coded.		
	Internal & control wiring -Circuit Wire for the CTs: 2.5 Sq.mm and for control circuits: 2.5 Sq.mm FRLSH, 1100V grade PVC insulated single core,multistrand copper flexible as per approved make. To be with ferrules		
3.15.2	OUTGOINGS:		
	MCCB:		
	Rating - 63Amps, 25KA		
	Quantity - 4 Nos.		
	No. of poles - TPN		
	MCCB Operation - Manual Fixed type Standard Extended Rotary Handle		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP. With control MCB		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Other features - All standard accessories mentioned in the technical specifications like Spreader links,phase barrier,trip alarm contact,etc		
3.15.2.1	VFD WITH MCCB:		
	MCCB Rating - 80Amps, 25KA		
	Quantity - 2 Nos.		
	No. of poles - TPN		
	Operation - 22kw VFD with inbuilt choke,ventilation fan, internal wiring with dispaly,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch.		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 2 Nos.		
	SP MCB Rating - 6 Amps.		
3.15.2.2	VFD WITH MCCB:		
	MCCB Rating - 63Amps, 25KA		
	Quantity - 4 Nos.		
	No. of poles - TPN		
	Operation - 15kw VFD with inbuilt choke,ventilation fan, internal wiring with dispaly,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch.		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 4 Nos.		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	SP MCB Rating - 6 Amps.		
3.15.2.3	VFD WITH MCCB:		
	MCCB Rating - 63Amps, 25KA		
	Quantity - 3 Nos.		
	No. of poles - TPN		
	Operation - 11.2kw VFD with inbuilt choke,ventilation fan, internal wiring with disply,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch.		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 3 Nos.		
	SP MCB Rating - 6 Amps.		
3.15.2.4	VFD WITH MCCB:		
	MCCB Rating - 63Amps, 25KA		
	Quantity - 1 Nos.		
	No. of poles - TPN		
	Operation - 7.5kw VFD with inbuilt choke,ventilation fan, internal wiring with disply,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch.		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 1 Nos.		
	SP MCB Rating - 6 Amps.		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
3.15.2.5	DOL STARTER:		
	MCCB Rating - 20Amps, 25KA		
	Quantity - 4 Nos.		
	No. of poles - TPN		
	MCCB Operation - 1.5KW DOL starter with contactor, overload relay,single phase preventor. 2 pole 2 way rotary selector switch for auto/manual switch		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 4 Nos.		
	SP MCB Rating - 6 Amps.		
	MS stand for panel mounting height is 500mm and length as per the panel.		
	Complete set	set	1.00
3.16	SUB MCC-2(b) PANEL- OUTDOOR TYPE (C- TOP)		
	Supply, Installation, Testing & Commissioning of SUB MCC-2(b) PANEL as per standard fabrication details mentioned above		
3.16.1	INCOMING:		
	MCCB:		
	Rating - 320Amps, 36KA		
	Quantity -1 No.		
	No. of poles - 4Pole		
	MCCB Operation - Manual Fixed type Standard Extended Rotary Handle		
	Protection Releases in MCCB - Microprocessor based releases for short circuit, over current, Earth fault & Shunt trip.		
	Indication - RYB / ON/OFF/TRIP		
	Current Transformer's -1 set of 3 Nos. for each Breaker.		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Class I - 15VA burden.		
	Type - Cast resin.		
	Ratio - 320 / 5A		
	METERS: Multi Function Meter - MFM with RS 485 Serial communication port.		
	BUS BAR: 400A Phase, 200A Neutral, TPN, 415V, 3Phase, 50Hz, Aluminium Bus Bar.		
	Bus Bar Supports -Fire retardant DMC/SMC.		
	Bus bar sleeves - Heat shrinkable - colour coded.		
	Internal & control wiring -Circuit Wire for the CTs: 2.5 Sq.mm and for control circuits: 2.5 Sq.mm FRLSH, 1100V grade PVC insulated single core,multistrand copper flexible as per approved make. To be with ferrules		
3.16.2	OUTGOINGS:		
3.16.2.1	MCCB:		
	Rating - 63Amps, 25KA		
	Quantity - 4 Nos.		
	No. of poles - TPN		
	MCCB Operation - Manual Fixed type Standard Extended Rotary Handle		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP. With control MCB		
	Other features - All standard accessories mentioned in the technical specifications like Spreader links,phase barrier,trip alarm contact,etc		
3.16.2.2	VFD WITH MCCB:		
	MCCB Rating - 80Amps, 25KA		
	Quantity - 4 Nos.		
	No. of poles - TPN		
	Operation - 22kw VFD with inbuilt choke,ventilation fan, internal wiring with disply,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch.		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 4 Nos.		
	SP MCB Rating - 6 Amps.		
3.16.2.3	VFD WITH MCCB:		
	MCCB Rating - 80Amps, 25KA		
	Quantity - 2 Nos.		
	No. of poles - TPN		
	Operation - 18.5kw VFD with inbuilt choke,ventilation fan, internal wiring with disply,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch.		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 2 Nos.		
	SP MCB Rating - 6 Amps.		
3.16.2.4	VFD WITH MCCB:		
	MCCB Rating - 63Amps, 25KA		
	Quantity - 4 Nos.		
	No. of poles - TPN		
	Operation - 11.2kw VFD with inbuilt choke,ventilation fan, internal wiring with disply,single phase preventor, ON/OFF indicating lamp,2 pole 2 way rotary selector switch for auto/manual switch.		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 4 Nos.		
	SP MCB Rating - 6 Amps.		
3.16.2.5	DOL STARTER:		
	MCCB Rating - 20Amps, 25KA		
	Quantity - 4 Nos.		
	No. of poles - TPN		
	MCCB Operation - 1.5KW DOL starter with contactor, overload relay,single phase preventor. 2 pole 2 way rotary selector switch for auto/manual switch		
	Protection Releases in MCCB - In Built Thermal Magnetic, Adjustable Over current and Short circuit		
	Indications - OFF/ON/TRIP.		
	Push button - ON/OFF.		
	Other features - Electrical interlocking as per the SLD with contactors & timer.		
	Auxiliary Contactors:		
	Potential free contactor - 4sets For Auto/ Manual selector switch status, Run status, Trip status, MCC power status & ON/OFF command.		
	Quantity - 4 Nos.		
	SP MCB Rating - 6 Amps.		
	MS stand for panel mounting height is 500mm and length as per the panel.		
	Complete set	set	1.00
	PART B- INSTALLATION, TESTING & COMMISSIONING		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Installation/ fixing, testing & commissioning of all the supplied materials covered under Sh 2 above including the cost of nuts bolts and other accessories not covered under the supply sub head but necessary to complete the finished product, screws, scaffolding, loading unloading, storage/stacking the supplied materials, necessary protection arrangement from sun & rain, welding wherever required, making holes in floors, walls, ceilings, core cutting in RCC slabs, all equipment, machinery required for installation, cleaning the premises after installation, Removal of debris, dirt and rubbish accumulated as a result of installation/commissioning of the laboratory furniture and accessories and leaving the premises broom clean and orderly, testing commissioning as per manufacturer standards and as per contract condition and direction of University. The quoted rate shall be quoted on percentage basis (mode of measurement shall be % of total supply value at actual) and shall include the cost of all materials, labour and taxes as per bid documents.		
	PART- C- MAINTAINENCE		
3.17	Maintenance charge for above items of Part A & Part B for a period of 24 months after actual date of completion of 1 year warranty period. The warranty period starts from the actual date of system commissioning & handing over whichever is later. (Rate is to be quoted in percentage over the amount of supply & installation items as above in Part-A & Part-B).	Lums	1.00
	Refer tender specification for all the line items mentioned in this BOQ & quote accordingly.		
	Installation, integration, testing, balancing, commissioning & documentation work of all the above BOQ line items & including making / preparing shop drawings, technical data sheet, co ordination with other services dwg and submission for approval, checking the design and its functionality of the whole system including the cost of all accessories, termination, connections, conduiting, nuts & bolts as per tender requirement manufacturer's requirements, all necessary supports from ceiling, walls, floors, making necessary holes for duct entry in walls / floors & making rain / leak proof, civil foundation / pedestals as required for all accessories necessary to make the whole system operational. The rate shall be inclusive of the cost of all items labour Removal of debris, dirt and rubbish accumulated as a result of installation/commissioning of the electrical and accessories and leaving the premises broom clean and orderly etc., The final documentation inculdes commissioning reports, warranty / guarantee certificates, 6 sets of as built drawing hard copies & soft copy in DVD. O&M manuals & Handling over documents to be submitted. All Drawings, Technical submittals & installation procedure should be as per Good engineering practices. Drawings & material approval must be obtained before fabrication.		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	SUB HEAD 4: FUME HOOD EXHAUST SYSTEM		
	SCOPE:		
	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for Fume Exhaust System Comprising of Exhaust Blower, Scrubber, Ducting & all other Accessories as mentioned in the BOQ below & tender specification.		
4.0	CENTRIFUGAL BLOWER & ACCESSORIES		
4.1	<p>Design, Supply, Installation, Testing, Balancing, Commissioning and preparation of handing over documents of Single Inlet Single Width (SISW) IMPORTED PP Exhaust Blowers direct driven by IE 2 Motor for Fume Hood Exhaust System (Solvent) with the following capacity. Drive Motor shall be suitably rated & VFD compatible, TEFC Foot mounted, 3 phase, 50 Hz, 415 Volts, IP 55, Protection Class F & Class B Temperature rise. The blower & motor assembly shall be suitable for outdoor application with neccessary anti vibration cushy foot mounting, Inlet & outlet transparent flexible hose with clamps on both ends, suitable clamp adapter, Electro galvanized pedestal motor stand and fasteners like bolts, nuts and washers, base frame, motor protection guard & accessories.</p> <p>Quoted Rate shall include for design & providing civil pedestals as per the blower foundations requirement.</p> <p>Details to be read as blower tag number, blower capacity in CFM, blower static pressure in inch, approximate drive motor capacity.</p> <p>Please note the blower drive motor capacity has to be arrived on bases of actual SP loss calculation after the ducting layout is approved. The data provided is indicative & for the purpose of tender only.</p>		
	BLOWER TAG NO, CAPACITY (CFM), STATIC PRESSURE IN INCH, DRIVE MOTOR (kW)		
4.1.1	EAB-1 -11910 CFM - 5 INCH -18.5 kW	No.	1
4.1.2	EAB-2 -8800 CFM- 5 INCH -15 kW	No.	1
4.1.3	EAB-3-9680 CFM- 5 INCH -15 kW	No.	1
4.1.4	EAB-4-8350 CFM- 5 INCH -15 kW	No.	1
4.1.5	EAB-5-9300 CFM- 5 INCH -15 kW	No.	1
4.1.6	EAB-6-9360 CFM- 5 INCH -15 kW	No.	1
4.1.7	EAB-7-9630 CFM- 5 INCH -15 kW	No.	1
4.1.8	EAB-8-11780 CFM- 5 INCH -22 kW	No.	1
4.1.9	EAB-9-11780 CFM - 5 INCH -22 kW	No.	1
4.1.10	EAB-10-12200 CFM- 5 INCH -22kW	No.	1
4.1.11	EAB-11-11650 CFM- 5 INCH -22 kW	No.	1

ITEM NO	DESCRIPTION	UNIT	QUANTITY
4.1.12	EAB-12-12600 CFM- 5 INCH -22 kW	No.	1
4.1.13	EAB-13-4590 CFM- 5 INCH -11 kW	No.	1
4.1.14	EAB-14-1030 CFM- 5 INCH -2.2 kW	No.	1
4.1.15	EAB-15-2500 CFM- 5 INCH -5.5 kW	No.	1
4.1.16	EAB-16-5710 CFM- 5 INCH -9.3 kW	No.	1
4.1.17	EAB-17-7920 CFM- 5 INCH -15 kW	No.	1
4.1.18	EAB-18-4720 CFM- 5 INCH -7.5 kW	No.	1
4.1.19	EAB-19-760 CFM- 5 INCH -2.2 kW	No.	1
4.1.20	EAB-20-5000 CFM- 5 INCH -7.5 kW	No.	1
4.2	<p>Design, Supply, Installation, Testing, Balancing, Commissioning and preparation of handing over documents of Single Inlet Single Width (SISW) IMPORTED PP Exhaust Blowers direct driven by IE 2 Motor for Fume Hood Exhaust System (Acid) with the following capacity. Drive Motor shall be suitably rated & VFD compatible, TEFC Foot mounted, 3 phase, 50 Hz, 415 Volts, IP 55, Protection Class F & Class B Temperature rise. The blower & motor assembly shall be suitable for outdoor application with necessary anti vibration cushy foot mounting, Inlet & outlet transparent flexible hose with clamps on both ends, suitable clamp adapter, Electro galvanized pedestal motor stand and fasteners like bolts, nuts and washers, base frame, motor protection guard & accessories. Quoted Rate shall include for design & providing civil pedestals as per the blower foundations requirement. Details to be read as blower tag number, blower capacity in CFM, blower static pressure in inch, approximate drive motor capacity.</p> <p>Please note the blower drive motor capacity has to be arrived on bases of actual SP loss calculation after the ducting layout is approved. The data provided is indicative & for the purpose of tender only.</p>		
	BLOWER TAG NO, CAPACITY (CFM), STATIC PRESSURE IN INCH, DRIVE MOTOR (kW)		
4.2.1	SCB-1-3600 CFM- 8 INCH -9.3 kW	No.	1
4.2.2	SCB-2 -2700 CFM- 8 INCH -7.5 kW	No.	1
4.2.3	SCB-3-3450 CFM- 8 INCH -9.3 kW	No.	1
4.2.4	SCB-4-1800 CFM- 8 INCH -5.5 kW	No.	1
4.2.5	SCB-5-3600 CFM- 8 INCH -9.3 kW	No.	1
4.2.6	SCB-6-3300 CFM- 8 INCH -9.3 kW	No.	1
4.2.7	SCB-7-3600 CFM- 8 INCH -9.3 kW	No.	1
4.2.8	SCB-8-3600 CFM- 8 INCH -9.3 kW	No.	1
4.2.9	SCB-9-3600 CFM- 8 INCH -9.3 kW	No.	1

ITEM NO	DESCRIPTION	UNIT	QUANTITY
4.2.10	SCB-10-3600 CFM- 8 INCH -9.3 kW	No.	1
4.2.11	SCB-11-3600 CFM- 8 INCH -9.3 kW	No.	1
4.2.12	SCB-12-3600 CFM- 8 INCH -9.3 kW	No.	1
4.2.13	SCB-13-2550 CFM- 8 INCH -7.5 kW	No.	1
4.2.14	SCB-14-900 CFM- 8 INCH -3.7 kW	No.	1
4.2.15	SCB-15-1800 CFM- 8 INCH -5.5 kW	No.	1
4.2.16	SCB-16-2700 CFM- 8 INCH -7.5 kW	No.	1
4.2.17	SCB-17-4500 CFM- 8 INCH -11.0kW	No.	1
4.2.18	SCB-18-900 CFM- 8 INCH -3.7 kW	No.	1
4.2.19	SCB-19-1800 CFM- 8 INCH -5.5 kW	No.	1
4.3	<p>Design, Supply, Installation, Testing, Balancing, Commissioning and preparation of handing over documents of Single Inlet Single Width (SISW) IMPORTED PP Exhaust Blowers direct driven by IE 2 Motor for Redundancy Blower with the following capacity. Drive Motor shall be suitably rated & VFD compatible, TEFC Foot mounted, 3 phase, 50 Hz, 415 Volts, IP 55, Protection Class F & Class B Temperature rise. The blower & motor assembly shall be suitable for outdoor application with necessary anti vibration cushy foot mounting, Inlet & outlet transparent flexible hose with clamps on both ends, suitable clamp adapter, Electro galvanized pedestal motor stand and fasteners like bolts, nuts and washers, base frame, motor protection guard & accessories. Quoted Rate shall include for design & providing civil pedestals as per the blower foundations requirement. Details to be read as blower tag number, blower capacity in CFM, blower static pressure in inch, approximate drive motor capacity. Please note the blower drive motor capacity has to be arrived on bases of actual SP loss calculation after the ducting layout is approved. The data provided is indicative & for the purpose of tender only.</p>		
	BLOWER TAG NO, CAPACITY (CFM), STATIC PRESSURE IN INCH, DRIVE MOTOR (kW)		
4.3.1	R EAB-1-11910 CFM- 5 INCH -18.5 kW	No.	1
4.3.2	R EAB-2-9680 CFM- 5 INCH -15.0 kW	No.	1
4.3.3	R EAB-3-9360 CFM- 5 INCH -15.0 kW	No.	1
4.3.4	R EAB-4-11780 CFM- 5 INCH -22.0 kW	No.	1
4.3.5	R EAB-5-1220 CFM- 5 INCH -22.0 kW	No.	1
4.3.6	R EAB-6-12600 CFM- 5 INCH -22.0 kW	No.	1
4.3.7	R EAB-7-4590 CFM- 5 INCH -11.0 kW	No.	1
4.3.8	R EAB-8-5710 CFM- 5 INCH -9.3 kW	No.	1

ITEM NO	DESCRIPTION	UNIT	QUANTITY
4.3.9	R EAB-9-7920 CFM- 5 INCH -15.0 kW	No.	1
4.3.10	R EAB-10-5000 CFM- 5 INCH -7.5 kW	No.	1
4.4	WET SCRUBBER SYSTEM WITH ACCESSORIES FOR ACID FUMEHOOD EXHAUST SYSTEM		
4.4.0	Design, Supply, Installation, Testing, Balancing, Commissioning and preparation of handing over documents of Wet Scrubber System , Scrubber Type: Vertical with integrated liquid tank, Material: PP/FRP, Airflow: as mentioned below, Temperature: 70 deg C (max.), Pressure drop: 100 mm wg (approx.), Scrubber Sink consisting of PP Tank of suitable Dia & Height not less than 1200mm, complete with makeup water connection with control valve, water level indicator, drain with control valve, over flow pipe, scrubber recirculation pump with mechanical seal, inlet flange connection with 'Y' Strainer, outlet flanged connections with non return valve (NRV), Ball valve with gaskets & bolt nuts, single stage PP packing rings (minimum depth of 900 mm) & single stage PVC mist eliminator pad (minimum depth of 200 mm), one set of liquid spray nozzle system, including dosing plug with valve, mounting bolt & nuts with anti vibration pads, recirculation pump of ~1 HP, 3 phase, 50 Hz, 415 Volts. Rate shall be Including all pumps cover, ladders, inspection point with platform, complete with necessary MS support & safety railing, maintenance door, painting of entire scrubber after erection & any other accessories. Rate to include for the cost of civil foundation required as per scrubber dimension.		
	SCRUBBER TAG NO, CFM		
4.4.1	SC-1-2700 CFM	No.	1
4.4.2	SC-2-2700 CFM	No.	1
4.4.3	SC-3-3450 CFM	No.	1
4.4.4	SC-4-1800 CFM	No.	1
4.4.5	SC-5-3600 CFM	No.	1
4.4.6	SC-6-3300 CFM	No.	1
4.4.7	SC-7-3600 CFM	No.	1
4.4.8	SC-8-3600 CFM	No.	1
4.4.9	SC-9-3600 CFM	No.	1
4.4.10	SC-10-3600 CFM	No.	1
4.4.11	SC-11-3600 CFM	No.	1
4.4.12	SC-12-3600 CFM	No.	1
4.4.13	SC-13-2550 CFM	No.	1
4.4.14	SC-14-900 CFM	No.	1

ITEM NO	DESCRIPTION	UNIT	QUANTITY
4.4.15	SC-15-1800 CFM	No.	1
4.4.16	SC-16-2700 CFM	No.	1
4.4.17	SC-17-4500 CFM	No.	1
4.4.18	SC-18-900 CFM	No.	1
4.4.19	SC-19-1800 CFM	No.	1
4.5	PP-FRP DUCTING WITH ACCESSORIES		
4.5.0	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents of PP-FRP ducting with glass lined (GL) finish. FRP lining shall be of fire resistant Bisphenol resin. Duct pricing shall be inclusive of all necessary accessories like - flanges, bends, entry branches, tapers, inspection door, gaskets for flanges, GI bolt & nuts, washers, support angle, hanger threaded rods with anchor bolts for fixing in roof / wall. Rate shall be inclusive of 2 coats of enamel painting for duct surface. Mode of measurement shall be in sq mtr, measured as circumference of duct outer surface x running length. Extra will not be paid for accessories such as flanges, bends, elbows, Y piece, branch off, reducer, entry doors, inspection doors, gaskets etc.		
4.5.1	Ducting upto 500 mm Dia - wall thickness shall be 3 mm PP and 3 mm FRP	Sq mtr	2,400
4.5.2	Ducting above 501 mm Dia - wall thickness shall be 4 mm PP and 4 mm FRP	Sq mtr	2,200
Note:	Refer civil works column in tender specification. The ducting rate quoted shall be inclusive of minor civil works for duct entry in the existing service shaft & terrace floor.		
4.6	VOLUME CONTROL DAMPER (Manual operation with lock & graduation arrangement)		
4.6.1	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents of PP FRP circular Volume control damper shall be as follows outer casing 3mmPP + 3mmFRP, flanges with 6mmPP + 3mmFRP, Disc of 5mmPP, center shaft of 20mm Dia PP with brass bush, lock & graduation arrangement with SS wing nut & blots for circular ducts. (Mode of Measurement = Cross sectional Area OR Internal face area of the damper).	Sqmtr	50
4.7	SUPPORTING STRUCTURE FOR PP-FRP DUCTS AT TERRACE FLOOR & BLOWER OUTLET DUCT SUPPORTING STACK FOR ALL LABS		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
4.7.1	Design, Supply, Installation / Erection, Fabrication, Testing, Balancing, Commissioning and preparation of handing over documents of Blower Outlet duct support / Stack support works (at terrace only) consisting of base plates, angles, rods, pipes, ISMC etc. in Testing platform, Ladder, Safety railings etc. The rate shall be inclusive of design, supply, fabrication to required size and shape, Welding, Cutting, Erection, Grouting, Anchor Bolts, Base plate, Gusset plates, brazing, GI Fasteners with washers, providing and applying of one coat of steel primer and two coats of epoxy paint of approved shade etc. Weight of steel fixed at site shall be measured for payment. Rate to include cost of civil foundation, as required.	Kgs	25,000
4.8	PVC FLEXIBLE HOSE		
4.8.0	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents of PVC Braided Flexible connecting hose with Necessary Hose Clamps on both the ends. (Each Flexible length Not exceeding 1M Length)		
4.8.1	100 mm OD	Mtr	50
4.8.2	125 mm OD	Mtr	90
4.8.3	175 mm OD	Mtr	20
4.8.4	275 mm OD	Mtr	200
4.8.5	300 mm OD	Mtr	5
4.8.6	325 mm OD	Mtr	5
4.9	Design, Supply, Installation / Erection, Filling & Testing of min 100 mm thick Mineral wool / Rock wool insulation material of 96 Kg/M3 density , sandwiched between the external Plain PP sheet & internal Perforated PP sheets. Insulation shall be spread equal across the silencer to avoid any air pocket.	Sqmtr	1,000
	PART B- MAINTENANCE		
4.10.1	Maintenance charge for above items of Part A & Part B for a period of 24 months after actual date of completion of 1 year warranty period. The warranty period starts from the actual date of system commissioning & handing over whichever is later. (Rate is to be quoted as 1 lot).	LOT	1
	NOTE:		
	Refer tender specification for all the line items mentioned in this BOQ & quote accordingly.		
	All Electrical works including VFD & Local Push Buttons shall be a part of Electrical Tender.		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
	Installation, integration, testing, balancing, commissioning & documentation work of all the above BOQ line items & including making / preparing shop drawings, technical data sheet, co ordination with other services dwg and submission for approval, checking the design and its functionality of the whole system including the cost of all accessories, termination, connections, conduiting, nuts & bolts as per tender requirement manufacturer's requirements, all necessary supports from ceiling, walls, floors, making necessary holes for duct entry in walls / floors & making rain / leak proof, civil foundation / pedestals as required for all accessories necessary to make the whole system operational. The rate shall be inclusive of the cost of all items labour Removal of debris, dirt and rubbish accumulated as a result of installation/commissioning of the exhaust system and accessories and leaving the premises broom clean and orderlyetc.,		
	The final documentation inculdes commissioning reports, warranty / guarantee certificates, 6 sets of as built drawing hard copies & soft copy in DVD. O&M manuals & Handling over documents to be submitted.		
	The vendor shall design the duct silencer to reduce the noise level & achieve 75 dB @ 1 mtr from the blower assembly.		
	Support clamps for flexible hose to be provided at all user points.		
	All Drawings, Technical submittals & installation procedure should be as per Good engineering practices. Drawings & material approval must be obtained before fabrication.		
5	SUB HEAD 5: GAS DISTRIBUTION SYSTEM		
	PART- A DESIGN, SUPPLY, INSTALLATION TESTING & COMMISSIONING		
	SS tubes, fittings & accessories		
5.1	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for SS316 tube with 120 grit & Ra value of 1.2 to 2 μ , as per attached specification with necessary specialities like bolts, nuts, washers, U-clamps, cutting,bending , welding (Orbital welding to be considered for joining tubes above false ceiling without unions), Tagging (Acrylic) etc. The rate quoted to be inclusive of necessary wall bores, cutting through walls as per dwg. Mode of measurement shall be in running Meters as described below.		
5.1.1	3/8" OD X 1.65 mm WT	Mtrs	
5.1.2	1/4"OD X 1.65 mm WT	Mtrs	3,438
5.1.3	1/8"O.D X 1.65mm WT	Mtrs	-

ITEM NO	DESCRIPTION	UNIT	QUANTITY
5.2	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for SS316 Double Compression fittings End caps , as per attached specification. Mode of measurement shall be in numbers as described below.		
5.2.1	3/8" OD	Nos	-
5.2.2	1/4"OD	Nos	92
5.3	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for SS316 Double Compression fittings Ferule end unions , as per attached specification. Mode of measurement shall be in numbers as described below.		
5.3.1	3/8" OD	Nos	-
5.3.2	1/4"OD	No's	572
5.3.3	1/8"OD	No's	-
5.4	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for SS316 Double Compression fittings Ferule end reducers , as per attached specification. Mode of measurement shall be in numbers as described below.		
5.4.1	1/4" OD X 1/8"OD	No's	-
5.5	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for SS316 tee , as per attached specification. Mode of measurement shall be in numbers as described below.		
5.5.1	3/8" OD X 3/8"OD-Orbital Weld	Nos	-
5.5.2	3/8" OD X 1/4"OD-Orbital Weld	Nos	-
5.5.3	1/4"OD X 1/4"OD- Double Compression fittings	No's	484
5.5.4	1/4"OD X 1/4"OD-Orbital Weld	No's	-
5.5.5	1/8"OD X 1/8"OD- Double Compression fittings	No's	-
5.6	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for Manual Change Over Panel for N2 , 1x1 Cylinders, Total flow 1660LPM, MOC=SS316L/SS316,Consisting of High Pressure Changeover Regulator, inlet=230bar/3300psi, Outlet =14 Bar/200PSI,Diaphragm=Hastelloy/ Alloy X-750/SS316, With 2 numbers of Inlet Shut-Off Diaphragm Valves & outlet valve,With 2 Numbers of Internal Purge Diaphragm Valves, With Safety Relief Valve, With Inlet & Outlet Normal Gauges,With Inlet = 1/4 FNPT , Outlet Ports =1/4" FNPT	Set	30

ITEM NO	DESCRIPTION	UNIT	QUANTITY
5.7	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for Manual Change Over Panel for H2 , 1X1 Cylinders, Total flow 40LPM, MOC=SS316L/SS316,Consisting of High Pressure Changeover Regulator, inlet=230bar/3300psi, Outlet =14 Bar/200PSI,Diaphragm=Hastelloy/ Alloy X-750/SS316, With 2 numbers of Inlet Shut-Off Diaphragm Valves & outlet valve,With 2 Numbers of Internal Purge Diaphragm Valves, With Safety Relief Valve, With Inlet & Outlet Normal Gauges,With Inlet = 1/4 FNPT , Outlet Ports =1/4" FNPT	Set	3
5.8	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for Manual Change Over Panel for ARG , 1X1 Cylinders, Total flow 5X5 LPM, MOC=SS316L/SS316,Consisting of High Pressure Changeover Regulator, inlet=230bar/3300psi, Outlet =14 Bar/200PSI,Diaphragm=Hastelloy/ Alloy X-750/SS316, With 2 numbers of Inlet Shut-Off Diaphragm Valves & outlet valve,With 2 Numbers of Internal Purge Diaphragm Valves, With Safety Relief Valve, With Inlet & Outlet Normal Gauges,With Inlet = 1/4 FNPT , Outlet Ports =1/4" FNPT	Set	2
5.9	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for Manual Change Over Panel for O2 , 1X1 Cylinders, Total flow 100LPM, MOC=SS316L/SS316,Consisting of High Pressure Changeover Regulator, inlet=230bar/3300psi, Outlet =14 Bar/200PSI,Diaphragm=Hastelloy/ Alloy X-750/SS316, With 2 numbers of Inlet Shut-Off Diaphragm Valves & outlet valve,With 2 Numbers of Internal Purge Diaphragm Valves, With Safety Relief Valve, With Inlet & Outlet Normal Gauges,With Inlet = 1/4 FNPT , Outlet Ports =1/4" FNPT	Set	2
5.10	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for Manual Change Over Panel for Methane , 1X1 Cylinders, Total flow 60 LPM, MOC=SS316L/SS316,Consisting of High Pressure Changeover Regulator, inlet=230bar/3300psi, Outlet =14 Bar/200PSI,Diaphragm=Hastelloy/ Alloy X-750/SS316, With 2 numbers of Inlet Shut-Off Diaphragm Valves & outlet valve,With 2 Numbers of Internal Purge Diaphragm Valves, With Safety Relief Valve, With Inlet & Outlet Normal Gauges,With Inlet = 1/4 FNPT , Outlet Ports =1/4" FNPT	Set	1
5.11	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for Manual Change Over Panel for CO2 , 1X1 Cylinders, Total flow 40 LPM, MOC=SS316L/SS316,Consisting of High Pressure Changeover Regulator, inlet=230bar/3300psi, Outlet =14 Bar/200PSI,Diaphragm=Hastelloy/ Alloy X-750/SS316, With 2 numbers of Inlet Shut-Off Diaphragm Valves & outlet valve,With 2 Numbers of Internal Purge Diaphragm Valves, With Safety Relief Valve, With Inlet & Outlet Normal Gauges,With Inlet = 1/4 FNPT , Outlet Ports =1/4" FNPT	Set	1

ITEM NO	DESCRIPTION	UNIT	QUANTITY
5.12	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for Manual Change Over Panel for ACE , 1X1 Cylinders, Total flow 10 LPM, MOC=SS316L/SS316,Consisting of High Pressure Changeover Regulator, inlet=230bar/3300psi, Outlet =14 Bar/200PSI,Diaphragm=Hastelloy/ Alloy X-750/SS316, With 2 numbers of Inlet Shut-Off Diaphragm Valves & outlet valve,With 2 Numbers of Internal Purge Diaphragm Valves, With Safety Relief Valve, With Inlet & Outlet Normal Gauges,With Inlet = 1/4 FNPT , Outlet Ports =1/4" FNPT	Set	1
5.13	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for FUTURE GAS , 1X1 Cylinders, Total flow 40 LPM, MOC=SS316L/SS316,Consisting of High Pressure Changeover Regulator, inlet=230bar/3300psi, Outlet =14 Bar/200PSI,Diaphragm=Hastelloy/ Alloy X-750/SS316, With 2 numbers of Inlet Shut-Off Diaphragm Valves & outlet valve,With 2 Numbers of Internal Purge Diaphragm Valves, With Safety Relief Valve, With Inlet & Outlet Normal Gauges,With Inlet = 1/4 FNPT , Outlet Ports =1/4" FNPT	Set	27
5.14	Supply, Installation, testing and commissioning of Manual Change Over Panel for Argon+H2 GAS , 1X1 Cylinders, Total flow 40 LPM, MOC=SS316L/SS316,Consisting of High Pressure Changeover Regulator, inlet=230bar/3300psi, Outlet =14 Bar/200PSI,Diaphragm=Hastelloy/ Alloy X-750/SS316, With 2 numbers of Inlet Shut-Off Diaphragm Valves & outlet valve,With 2 Numbers of Internal Purge Diaphragm Valves, With Safety Relief Valve, With Inlet & Outlet Normal Gauges,With Inlet = 1/4 FNPT , Outlet Ports =1/4" FNPT	Set	2
5.14.1	1/4" OD SS Flexible Hose(Internal SS) with Safety Wire, 1.0 Meter length for Hose ends= Tube end fittings	Nos	138
5.14.2	1/4" OD SS Check Valves, Cracking pressure-1 PSIG & Tube end fittings. MOC: SS	Nos	145
5.14.3	1/4" OD SS 0.5 micron filter , Ends= Tube end fittings	Nos	138
5.14.4	Cylinder connection bullnose.	Nos	138
5.14.5	1/4" OD SS316 Double Compression fitting X 1/4" MNPT connector.	Nos	210
5.16	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for SS316 BALL VALVE with tube fitting end connections, as per attached specification. Mode of measurement shall be in numbers as described below.		
5.16.1	1/4" OD	Nos	366
5.16.2	3/8" OD	Nos	-
			-
5.16.3	1/4" OD X 1/4" hose nipple PU quick connector	Nos	22

ITEM NO	DESCRIPTION	UNIT	QUANTITY
5.17	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for SS316 Integral Bonnet Angle-Pattern Needle Valve with SS support for mounting and drilling in table to include in costing ,with tube fitting end connections, as per attached specification. Mode of measurement shall be in numbers as described below.		
5.17.1	1/8" OD	Nos	-
5.17.2	1/4" OD	Nos	-
5.18	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for Line pressure Regulator for N2,H2, O2,ARG,MET & CO2 Wall Mounting, MOC:SS316L/SS316 , Total flow 10 -15LPM, Inlet Pressure= 14 Bar, Outlet Pressure= 1 to 10 Bar, With Hastelloy/ Alloy X-750 Diaphragm/SS316, With Inlet & Outlet Pressure Gauge.With Inlet/Outlet Ports =1/4" FNPT.	Nos	86
5.18.1	1/4" OD SS316 Double Compression fitting X 1/4" MNPT connector.	Nos	172
5.19	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for SS316 Flash Back Arrestor with tube fitting end connections, as per attached specification. Mode of measurement shall be in numbers as described below.	Nos	8
5.19.1	1/4" OD		
5.20	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for Gas Pre Heater for CO2 , Power Supply, 230V, 50 Hz, 150/200W, 2Meter Cable, With Inlet Port = 1/4" OD & Outlet Ports=1/4" OD.	Nos	3
5.21	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for cylinder stand for 2nos cylinder (Bracket with chain) , as per attached specification. Mode of measurement shall be in numbers as described below.	Nos	69
	COMPRESSED AIR DISTRIBUTION SYSTEM SUPPLY		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
5.22	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for Stainless Steel ERW pipes , material to SS304(ASTM A 312 TP 304), dimensions to ANSI B 36.19 pipes with necessary slopes and specials items like flanges, gaskets, bolts, nuts, washers, U-clamps, Tagging(Acrylic), elbows, tees, unions, reducers, threading, cutting,bending welding, cutting etc. Complete Every two lengths of pipe shall be with flanged ends. The rate quoted shall include for necessary wall bores, cutting through walls, column, Metal supports (ISMC, ISA) etc., Painting with two coats of enamel paint as per relevant IS codes etc., to be considered for all sizes as per attached specification and drawing.		
	Note: Mode of Pipe measurement will be centreline measurement without any additional measurement for bends, Tee, reducers and fittings, supports etc.		
5.22.1	50 mm Sch 10S	Mts.	-
5.22.2	40 mm Sch 40S	Mts.	24
5.22.3	25 mm Sch 40S	Mts.	710
5.22.4	20 mm Sch 40S	Mts.	942
5.22.5	15 mm Sch 40S	Mts.	1,130
5.23	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for SS304 Ball valves of approved make as per detailed specification.		
5.23.1	50 mm dia	Nos.	-
5.23.2	40 mm dia	Nos.	10
5.23.3	25 mm dia	Nos.	15
5.23.4	20 mm dia	Nos.	55
5.23.5	15 mm dia	Nos.	257
5.24	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for SS304 Non Return Valve (NRV) of approved make.		
5.24.1	40 mm dia	Nos.	3
5.24.2	25 mm dia	Nos.	-
5.24.3	20 mm dia	Nos.	1
5.24.4	15 mm dia	Nos.	-

ITEM NO	DESCRIPTION	UNIT	QUANTITY
5.25	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for Pressure gauge Bourdon type with SS syphon and cock, Dial Size: 4", Bottom entry size: 3/8" BSP, Diaphragm: SS316 Coated with teflon, Contact parts: SS316, Movement: SS 316, Block: SS 316, Range 0 to 7 kg/cm2, Accuracy : +/- 1% of range span, Over range protection: 125%, Case & Bezel: SS 304 with screwed Bezel of ABS plastic, Mounting: Direct with bottom entry, Standard Fitments: Micro adjustable pointer (internal) blow out disc.	Sets	6
5.26	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for Flanged End Micron Filter . Housing: Welded SS304, End: Flanged end Manual drain, The rate quoted shall include for supply & providing jointing materials like Teflon tape, bolts, nuts, gaskets, washers as applicable.(as per attached specification)		
5.26.1	3 micron filter,40NB	Nos.	2
5.26.2	0.2 micron filter,40NB	Nos.	2
5.26.3	3 micron filter,25NB	Nos.	1
5.26.4	0.2 micron filter,25NB	Nos.	1
5.27	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for AUTO MOISTURE TRAP (automatic condensate drain with float).		
5.27.1	25 mm dia	Nos.	12
5.27.2	20 mm dia	Nos.	50
5.28	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for Line pressure Regulator for CA, MOC:Brass/Al, Inlet Pressure= 10 Bar, Outlet Pressure=0 to 8 Bar, with Coloured Identification, With Outlet Pressure Gauge.With Inlet/Outlet Ports =40 NB NPTM .	Nos.	2
5.29	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for Line pressure Regulator for CA, MOC:Brass/Al, Inlet Pressure= 10 Bar, Outlet Pressure=0 to 8 Bar, with Coloured Identification, With Outlet Pressure Gauge.With Inlet/Outlet Ports =25 NB NPTM .	Nos.	11

ITEM NO	DESCRIPTION	UNIT	QUANTITY
5.30	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for Line pressure Regulator for CA, MOC:Brass/Al, Inlet Pressure= 10 Bar, Outlet Pressure=0 to 8 Bar, with Coloured Identification, With Outlet Pressure Gauge.With Inlet/Outlet Ports =20 NB NPTM .	Nos.	31
5.31	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for Line pressure Regulator for CA, MOC:Brass/Al, Inlet Pressure= 10 Bar, Outlet Pressure=0 to 8 Bar, with Coloured Identification, With Outlet Pressure Gauge.With Inlet/Outlet Ports =15 NB NPTM .	Nos.	-
5.32	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for Tank Mounted lubricated single stage rotary screw / reciprocating type air cooled Air compressors(30cfm) with dryer, dry paper type suction filter, unloader with integrated regulating valve, three way solenoid valve, Air / oil temperature senson, air check valve, Air / oil reciever tank, Air / oil cooler assembly, power - 7 kw 2 pole motor, with TEFC IP 55 enclosure, class F insulation, suitable for 45 deg ambient temperature & 415+/- 10% volts, 3ph, 50+/- 3% Hz supply.	Nos.	3
	Note: Supply of Air compressor with civil structure & anchoring support with weather proof support shall be done by Air compressor vendor.		
5.33	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for SS316 tube , as per attached specification with necessary specialities like bolts, nuts, washers, U-clamps, cutting, bending , welding(Orbital) etc. The rate quoted to be inclusive of necessary wall bores, cutting through walls as per dwg. Mode of measurement shall be in running Meters as described below.		
5.33.1	1/2" OD X 1.65 mm WT	Mtrs	-
5.33.2	1/4"OD X 1.65mm WT	Mtrs	270
5.34	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for SS316 Double Compression fittings End caps , as per attached specification. Mode of measurement shall be in numbers as described below.		
5.34.1	1/2" OD	Nos.	-
5.34.2	1/4" OD	Nos.	-
5.35	Supply, Installation, testing and commissioning of SS316 Double Compression fittings Ferule end unions , as per attached specification. Mode of measurement shall be in numbers as described below.		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
5.35.1	1/2" OD	Nos.	-
5.35.2	1/4" OD	Nos.	-
5.36	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for SS316 tee , as per attached specification. Mode of measurement shall be in numbers as described below.		
5.36.1	1/4" OD X 1/4" OD Double compression fittings	Nos.	182
	POTABLE WATER DISTRIBUTION SYSTEM SUPPLY		
5.37	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for CPVC 4120 SDR 11/SCH40 plastic pipe as per ASTM D-2846/ASTM F 441 pipeline with necessary slope. The rate quoted shall include for (All fittings shall be heavy duty type SCH80 as per ASTM F439) necessary U-Trap, Unions, Reducer, Coupling, Tee, Reducer tee, Elbow, Male adapter, Female adapter, End cap, Brass couplings, Flange, Gaskets, clamps, Adhesives solution (ASTM F-493), threading, Wall bores cutting through walls, Metal supports (Clamps, ISMC, ISA), etc. as per dwg to be considered for all sizes of every 1.5 mts distance. Note: Mode of Pipe measurement will be centreline measurement without any additional measurement for bends, Tee, reducers and fittings, supports etc.		
5.37.1	40 mm Dia	Mts.	-
5.37.2	25 mm Dia	Mts.	180
5.37.3	20 mm Dia	Mts.	396
5.37.4	15 mm Dia	Mts.	-
5.38	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for CPVC Union type ball valves of approved make as per detailed specification. The rate quoted shall include for necessary fittings & Adhesives solution (ASTM F-493) etc.,.		
5.38.1	40 mm Dia	Nos.	-
5.38.2	25 mm Dia	Nos.	19
5.38.3	20 mm Dia	Nos.	96
5.38.4	15 mm Dia	Nos.	182

ITEM NO	DESCRIPTION	UNIT	QUANTITY
5.39	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for CPVC Nipples of approved make as per detailed specification. The rate quoted shall include for necessary fittings & Adhesives solution (ASTM F-493) etc.,		
5.39.1	20 mm dia	Nos.	182
5.40	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for CPVC Tee of approved make as per detailed specification. The rate quoted shall include for necessary fittings & Adhesives solution confirming ASTM D2846.		
5.40.1	15 mm NB to 15mm NB	Nos.	182
	COOLING WATER DISTRIBUTION SYSTEM SUPPLY		
5.41	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for CPVC 4120 SDR 11/SCH40 plastic pipe as per ASTM D-2846/ASTM F 441 pipeline with necessary slope. The rate quoted shall include for (All fittings shall be heavy duty type SCH80 as per ASTM F439) necessary U-Trap, Unions, Reducer, Coupling, Tee, Reducer tee, Elbow, Male adapter, Female adapter, End cap, Brass couplings, Flange, Gaskets, clamps, Adhesives solution (ASTM F-493), threading, Wall bores cutting through walls, Metal supports (Clamps, ISMC, ISA), etc. as per dwg to be considered for all sizes of every 1.5 mts distance. Note: Mode of Pipe measurement will be centreline measurement without any additional measurement for bends, Tee, reducers and fittings, supports etc.		
5.41.1	40 mm Dia	Mts.	-
5.41.2	25 mm Dia	Mts.	-
5.41.3	20 mm Dia	Mts.	-
5.41.4	15 mm Dia	Mts.	182
5.42	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for CPVC Union type ball valves of approved make as per detailed specification. The rate quoted shall include for necessary fittings & Adhesives solution (ASTM F-493) etc.,		
5.42.1	40 mm Dia	Nos.	-
5.42.2	25 mm Dia	Nos.	-
5.42.3	20 mm Dia	Nos.	-
5.42.4	15 mm Dia	Nos.	182

ITEM NO	DESCRIPTION	UNIT	QUANTITY
5.43	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for CPVC Nipples of approved make as per detailed specification. The rate quoted shall include for necessary fittings & Adhesives solution (ASTM F-493) etc.,		
5.43.1	15 mm dia	Nos.	182
5.44	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for CPVC Tee of approved make as per detailed specification. The rate quoted shall include for necessary fittings & Adhesives solution confirming ASTM D2846.		
5.44.1	15 mm NB to 15mm NB	Nos.	182
	PROCESS & CONDENSATE DRAIN PIPING		
5.45	Design, Supply, Installation / Erection, Testing, Balancing, Commissioning and preparation of handing over documents for PN10 HDPE pipes confirming to IS:4984 complete with necessary slope and fittings specials like flanges, P-Trap , end cap, bends, collar, Equal Tee, Reducing Tee, Y-type Tee, gaskets, bolts, nuts, washers, unions, heat welding, cutting, bending, etc. The rate quoted shall include for necessary wall bores cutting through walls, column, pipe clamps & MS supports (including required size of anchor fasteners type, Channels, Threaded Rods, " U " Clamp & Universal GI clamps with necessary bolts, washer and nuts, suspended in ceiling and Roof slabs etc.) to be considered for all sizes of every 1 mts distance, etc.- (Excluding earth excavation) Note: Mode of Pipe measurement will be centreline measurement without any additional measurement for bends, Tee, reducers and fittings P-Trap, MS Supports, Clamps & bolts etc.		
	Note: Mode of Pipe measurement will be centreline measurement without any additional measurement for bends, Tee, reducers and fittings P-Trap, MS Supports, Clamps & bolts etc.		
5.45.1	200 mm OD - PN 10 HDPE pipes	Rmt.	-
5.45.2	160 mm OD - PN 10 HDPE pipes	Rmt.	-
5.45.3	110 mm OD - PN 10 HDPE pipes	Rmt.	12
5.45.4	90 mm OD - PN 10 HDPE pipes	Rmt.	-
5.45.5	75 mm OD - Pn 10 HDPE pipes	Rmt.	126
5.45.6	40 mm OD - Pn 10 HDPE pipes	Rmt.	204
5.45.7	25 mm OD - Pn 10 HDPE pipes	Rmt.	204

ITEM NO	DESCRIPTION	UNIT	QUANTITY
5.46	Excavating trenches of required width for pipes etc including excavation for sockets and dressing of ramming of bottom depth upto 1 to 1.5 mtrs including getting out the excavated soil and then returning the soil as required in layers not exceeding 20 cms indepth in luding consolidating each deposited layer by ramming , watering, etc., and disposing of surplus excavated soil as directed within a lead of 150 mtrs (pipe not exceeding 200mm) In ordinary Soil.	Mts.	-
5.47	Supplying & Drilling/Core Cutting of required dia outlets using low vibration mechanical means.		
	RCC deck slabs (115 to 200 mm Thick)		
5.47.1	Core holes for 175mm dia pipes	Nos.	-
5.47.2	Core holes for 100 mm dia pipes	Nos.	-
5.47.3	Core holes for 80 mm dia pipes	Nos.	72
	SUPPORTS		
5.48	Supply and Installation of GI & STAUFF Clamp UNISTRUT Slotted Channel 41 X 41 X 2.5MM Thick/41 X 21 X 2.5MM Thick, PP Clamp With Rail Nut(For all size of tubes as per BOQ), Unistrut Channel PP End Caps, M10 GI Threaded Rod, M10 GI Plane Washer & nut, M10 GI Anchor Bolt For Threaded Rod,Tagging(Acrylic), Clean room wall support works (For tubes & hole covering plates in clean room, such as self-tapping screw SS & 40 X 6 MM THK SS FLAT With M6 Tapped Holes including welding, cutting etc.), including drilling, wall bores, cutting through walls, fixing support, welding, cutting etc. The rate quoted shall include for all above mentioned items & accessories.	Mts.	1,000
5.49	Supply and Installation of of Mild Steel miscellaneous & piping structural supports consisting of plates, Anchored Plate MS(IS 2062 steel), M12 Bolts, Nuts & Expansion Bolts (High tension HILTI) , rods, angles, Square Hollow Sections, Channels, GI & STAUFF Clamp UNISTRUT Slotted Channel, beams, pipes fabricated to required design and shape as per site requirements, cage works for gas bank & equipment frame works etc. including welding, cutting, clamps, bolts, nuts, fixed with dash through fasteners, concrete supports/ foundation bolts etc. complete. The rate shall be inclusive of cost of all the materials, labour and painting with two or more coats with epoxy paint of approved make over and including priming coat of steel primer. Mode of measurement shall be in kgs of Mild steel fixed at site.	Kgs.	1,500
	PART- B- MAINTAINENCE		

ITEM NO	DESCRIPTION	UNIT	QUANTITY
5.50	Maintenance charge for above items of Part A & Part B for a period of 24 months after actual date of completion of 1 year warranty period. The warranty period starts from the actual date of system commissioning & handing over whichever is later. (Rate is to be quoted as 1 lot).	LOT	1
	Refer tender specification for all the line items mentioned in this BOQ & quote accordingly.		
	NOTE :		
	1) All above Works should be as per Good engineering practices.		
	2) All Material supplied should comply to technical specifications.		
	3) All Mechanical works installation should comply to technical specifications.		
	4) Insulation to be considered per running along with pipe, fittings & accessories		
	5) All test certificates & As built drawing should be submitted at the end of the project.		
	6) Quantity for final billing shall be considered based on installed quantity, not as per supply.		
	7) Installation, integration, testing, balancing, commissioning & documentation work of all the above BOQ line items & including making / preparing shop drawings, technical data sheet, co ordination with other services dwg and submission for approval, checking the design and its functionality of the whole system including the cost of all accessories, termination, connections, conduiting, nuts & bolts as per tender requirement manufacturer's requirements, all necessary supports from ceiling, walls, floors, making necessary holes for pipes entry in walls / floors & making rain / leak proof, civil foundation / pedestals as required for all accessories necessary to make the whole system operational. The rate shall be inclusive of the cost of all items labour Removal of debris, dirt and rubbish accumulated as a result of installation/commissioning of the utility & gas piping and accessories and leaving the premises broom clean and orderly etc.,		
	8) The final documentation includes commissioning reports, warranty / guarantee certificates, 6 sets of as built drawing hard copies & soft copy in DVD. O&M manuals & Handling over documents to be submitted.		
	9) Necessary Chequered plates to be considered for shafts.		
	GRAND TOTAL		