All India Institute of Medical Sciences

Veerbhadra Marg, Pashulok,

Rishikesh-249203

Tender document for Planning, designing, Construction and handing over of Negative Pressure Isolation rooms at AIIMS Rishikesh

Ref. No.	:	**47/01/Isolation Room/2019/RIS/ES-664**
Publishing Date	:	**13.04.2020 at 03.00 PM**
Bid Submission Start Date	:	**13.04.2020 at 03.00 PM**
Last Date of Bid Submission	:	**23.04.2020 at 03.00 PM**
Technical Bid Opening	:	**24.04.2020 at 03.00 PM**

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Name of Work:- **Planning, designing, Construction and handing over of Negative Pressure Isolation rooms at AIIMS Rishikesh**

Certified that this bid document contains pages 1 to 116 (One to One Hundred Sixteen).

Superintending Engineer
AIIMS, Rishikesh

Tender document may be downloaded from CPPP site https://eprocure.gov.in
NIT may be downloaded from institute's website www.aiimsrishikesh.edu.in

AIIMS, Rishikesh

NOTICE INVITING TENDER

The Superintending Engineer, AIIMS Rishikesh on behalf of Director, AIIMS Rishikesh invites Item rate e-tenders from specialized agencies having experience of similar works i.e Construction of Negative pressure (Isolation Rooms) rooms for the following work: -

NIT No. : 47/01/Isolation Room/2019/RIS/ES-664

Name of Work: - Planning, designing, Construction and handing over of Negative Pressure Isolation rooms at AIIMS Rishikesh.

Estimated Cost: **Rs. 1,30,00,000.00 Earnest** money: **Rs. 2,60,000.00** & period of completion: **60 days**
Last date & time of submission of bids: 09-04-2020 upto 1500 hours

The tender forms and other details can be seen and downloaded from the website www.aiimsrishikesh.edu.in or CPPP site http://eprocure.gov.in

INFORMATION AND INSTRUCTIONS FOR CONTRACTORS FOR e-TENDERING FORMING PART OF NIT AND TO BE POSTED ON WEBSITE

The Superintending Engineer, AIIMS Rishikesh on behalf of Director, AIIMS Rishikesh invites Item rate e-tenders from specialized agencies having experience of similar works i.e Construction of Negative pressure (Isolation Rooms) rooms for the following work :-

Name of work & Location	Estimated cost put to bid	Earnest Money	Period of Completion	Last date & time of submission of bid	Time & date of opening of technical bid
Planning, designing, Construction and handing over of Negative Pressure Isolation rooms at AIIMS Rishikesh	**Rs. 1,30,00,000.00**	**Rs. 2,60,000.00**	60 Days	09-04-2020 upto 1500 Hrs	11-04-2020 at 1100 Hrs

1. The intending bidder must read the terms and conditions of CPWD-6 form carefully. He should only submit his bid if he considers himself eligible and he is in possession of all the documents required.

2. Information and Instructions for bidders posted on website shall form part of bid document.

3. The bid document consisting of plans, specifications, the schedule of quantities of various types of items to be executed and the set of terms and conditions of the contract to be complied with and other necessary documents can be seen and downloaded from website www.aiimsrishikesh.edu.in or https://eprocure.gov.in

4. But the bid can only be submitted after depositing tender fee in favour of AIIMS Rishikesh and uploading the mandatory scanned documents such as UTR number of RTGS payment towards EMD in favor of AIIMS Rishikesh in following bank account.

   a) Bank Name: - Punjab National Bank
   b) Branch Name: - PNB Pashulok
   c) Account Number: - 6189000100021125
   d) IFSC Code: - PUNB0618900

5. Those contractors not registered on the website mentioned above, are requested to get registered beforehand.

6. The intending bidder must have valid class-III digital signature to submit the bid.

7. On opening date, the contractor can login and see the bid opening process. After opening of bids he will receive the competitor bid sheets.

8. Contractor should upload documents in the form of PDF format only and scan copy of all the documents should be submitted through email before the last date of submission of Bid on following mail address.

   se@aiimsrishikesh.edu.in

9. Contractor must ensure to quote rate of each item. In addition to this, while selecting any of the cells a warning appears that if any cell is left blank the same shall be treated as "0". Therefore, if any cell is left blank and no rate is quoted by the bidder, rate of such items shall be treated as "0" (Zero).
10.The contractor should quote the rate of item including GST as per statutory rules.Bids received without Earnest Money deposit (EMD) shall stand rejected and thus shall not be considered for evaluation etc at any stage. The UTR number of EMD deposition will be uploaded by the contractor.
(ii) Earnest Money deposited with AIIMS, Rishikesh in connection with any other tender enquiry even if for same/similar material / Stores by the tenderer will not be considered against this tender.
(iii) The EMD will be forfeited if the bidder withdraws or amends its tender or impairs or derogates from the tender in any respect within the period of validity of its tender or if it comes to the notice that the information/ documents furnished in its tender is incorrect or false.

12. The bid security (EMD) without interest shall be returned to the unsuccessful bidders after finalization of contract with successful bidder.

13. The successful bidders has to execute a contract on Indian non judicial stamp paper of Rs.100/- (Rupees one hundred only) within fifteen (15) days from the date of award of this tender in his favour and also required to furnish the security deposit @ 5% against performance guarantee of contract value in the form of FD/BG/TD/CD from any Nationalized/Schedule bank duly pledged in favour of AIIMS, Rishikesh & payable at Rishikesh only. The EMD deposited by successful bidder may be adjusted towards performance guarantee as demanded above. If the successful bidder fails to furnish the full performance guarantee or difference amount between performance guarantee and EMD within 15 (fifteen) days after the issue of Letter of Award of Work, his bid security (EMD) shall be forfeited and award of tender in suppliers favour automatically stands terminated at his cost & liability, unless time extension has been granted by AIIMS, Rishikesh.

14. The bid shall be valid and open for acceptance by the competent authority of AIIMS Rishikesh for a period of 90 (Ninety) days from the published date of opening of the tenders and no request for any variation in quoted rates and / withdrawal of tender on any ground by bidders shall be entertained. The unilateral withdrawal at any stage will cause forfeiture of EMD in addition to any remedy that the purchaser may have under the law. If any bidder withdraws his bid before the said period or issue of letter of acceptance, whichever is earlier, or makes any modifications in the terms and conditions of the bid which are not acceptable to the department, **then the Government shall, without prejudice to any other right or remedy, be at liberty to forfeit 50% of the said earnest money as aforesaid. Further the bidders shall not be allowed to participate in the re-bidding process of the work.**

15. List of Documents to be scanned and uploaded within the period of bid submission:

I. UTR of RTGS payment of Tender Fee and EMD

II. Certificate of Registration for GST/ Sales Tax / VAT and acknowledgement of up to date filed return.

III . Certificate of work experience (As specified in Clause 1.2.1 of CPWD-6)

IV . Annual turnover Certificates of Past 5 Years

V. Audited Balance sheet by Chartered Accountant of Last 5 years.

CPWD - 6

Govt. of India
AIIMS, Rishikesh
Notice Inviting e-Tender

Item rate tenders are invited on behalf of Director, AIIMS Rishikesh from specialized agencies having experience of similar works i.e Construction of Negative pressure (Isolation Rooms) rooms for the work of "Planning, designing, Construction and handing over of Negative Pressure Isolation rooms at AIIMS Rishikesh.

1.1 The estimate of work is Rs. **1,30,00,000.00,** this estimated cost, however, gives merely as a rough Guide of cost of work.

1.2 Intending tenderer is eligible to submit the bid provided he has definite proof from the appropriate authority, which shall be to the satisfaction of the competent authority, of having satisfactorily completed similar works of magnitude specified below: -

Criteria of eligibility for submission of bid documents

1.2.1 Criteria of eligibility

Three similar works each of value not less than Rs. 52,00,000.00 or two similar work each of value not less than Rs.78,00,000.00 or one similar work of value not less than Rs. 1,04,00,000.00 in last 7 years ending last day of the month previous to the one in which the tenders are invited.

Similar works means: - "Construction of Negative pressure rooms (Isolation rooms) as per CDC guidelines"

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 last date of receipt of tenders.

2. Agreement shall be drawn with the successful bidders on prescribed Form No. CPWD 8, which is available as a Govt. of India Publication and available on website www.cpwd.gov.in. Bidders shall quote his rates as per various terms and conditions of the said form, which will form part of the agreement.

3. The time allowed for carrying out the work will be 60 days from the date of start as defined in schedule 'F' or from the first date of handing over of the site, whichever is later, in accordance with the phasing, if any, indicated in the bid documents.

4. The site for the work is available.

5 The tender document consisting of plans if any, specifications, the schedule of quantities of various types of items to be executed and the set of terms and conditions of the contract to be complied with and other necessary documents except Standard General Conditions Of Contract Form can be seen from website www.aiimsrishikesh.edu.in or https://eprocure.gov.in . The cost of tender is Rs.1180 (inclusive GST). Those who downloads the tender document from website should upload scan copy UTR number of RTGS payment of Rs.1180.00 (non –refundable) in favour of "AIIMS, Rishikesh", payable at Rishikesh as per following detail.

e) Bank Name: - Punjab National Bank
f) Branch Name: - PNB Pashulok
g) Account Number: - 6189000100021125
h) IFSC Code: - PUNB0618900

The required EMD shall be uploaded with the required documents otherwise tender submitted may stand

rejected.

6. After submission of the bid the contractor can re-submit revised bid any number of times but before last time and date of submission of bid as notified.

7. While submitting the revised bid, contractor can revise the rate of one or more item(s) any number of time (he need not re-enter rate of all the items) but before last time and date of submission of bid as notified.

8. The contractor whose bid is accepted will be required to furnish performance guarantee of 5% (Five Percent) of the bid amount within the period specified in Schedule F. This guarantee shall be in the form of cash (in case guarantee amount is less than Rs. 10000/-) or Deposit at Call receipt of any scheduled bank/Banker's cheque of any scheduled bank/Demand Draft of any scheduled bank/Pay order of any Scheduled Bank (in case guarantee amount is less than Rs. 1, 00,000/-) or Government Securities or Fixed Deposit Receipts or Guarantee Bonds of any Scheduled Bank or the State Bank of India in accordance with the prescribed form. In case the contractor fails to deposit the said performance guarantee within the period as indicated in Schedule 'F' including the extended period if any, the Earnest Money deposited by the contractor shall be forfeited automatically without any notice to the contractor. **The Earnest Money deposited along with tender shall be returned after receiving the aforesaid performance guarantee.**

9. Copy of certificate of work experience and other documents as specified in the press notice shall be scanned and uploaded to the e-tendering website within the period of bid submission. However, certified copy of all the scanned and uploaded documents as specified in press notice shall have to be submitted by the lowest bidder only within a week through email on se@aiimsrishikesh.edu.in

Online bid documents submitted by intending bidders shall be opened only of those bidders, whose original EMD deposited and other documents scanned and uploaded are found in order.

10. The Bid submitted shall become invalid and e-Tender Processing Fee shall not be refunded if:
   (i) The bidders is found ineligible.
   (ii) The bidder does not deposit original EMD with Superintending Engineer, AIIMS Rishikesh
   (iii) The bidders does not upload all the documents (including service tax registration/GST/ VAT registration/ Sales Tax registration) as stipulated in the bid document including the copy of receipt for deposition of original EMD.
   (iv) If any discrepancy is noticed between the documents as uploaded at the time of submission of bid and hard copies received through email by the lowest bidder in the office of tender opening authority.

10. Intending Bidders are advised to inspect and examine the site and its surroundings and satisfy themselves before submitting their tenders as to the nature of the ground and sub-soil (so far as is practicable), the form and nature of the site, the means of access to the site, the accommodation they may require and in general shall themselves obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect their bid. A bidder shall be deemed to have full knowledge of the site whether he inspects it or not and no extra charge consequent on any misunderstanding or otherwise shall be allowed. The bidders shall be responsible for arranging and maintaining at his own cost all materials, tools & plants, water, electricity access, facilities for workers and all other services required for executing the work unless otherwise specifically provided for in the contract documents. Submission of a bid by a bidder implies that he has read this notice and all other contract documents and has made himself aware of the scope and specifications of the work to be done and local conditions and other factors having a bearing on the execution of the work.

11 The competent authority does not bind itself to accept the lowest or any other bid and reserves to itself the authority to reject any or all the bids received without the assignment of any reason. All bids in which any of the prescribed condition is not fulfilled or any condition including that of conditional rebate is put forth by the tenderer shall be summarily rejected.

12 Canvassing whether directly or indirectly, in connection with bidders is strictly prohibited and the

tenders submitted by the contractors who resort to canvassing will be liable to rejection.

13 The competent authority reserves to himself the right of accepting the whole or any part of the tender and the tenderer shall be bound to perform the same at the rate quoted.

14 The contractor shall not be permitted to tender for works in AIIMS Rishikesh in which his near relative is posted as Divisional Accountant or as an officer in any capacity between the grades of Superintending Engineer, Executive Engineer and Junior Engineer (both inclusive). He shall also intimate the names of persons who are working with him in any capacity or are subsequently employed by him and who are near relatives to any gazetted officer in AIIMS Rishikesh. Any breach of this condition by the contractor would render him liable to reject his Bid submitted by him.

15. No Engineer of Gazetted rank or other Gazetted Officer employed in Engineering or Administrative duties in an Engineering Department of the Government of India is allowed to work as a contractor for a period of one year after his retirement from Government service, without the previous permission of the Government of India in writing. This contract is liable to be cancelled if either the contractor or any of his employees is found any time to be such a person who had not obtained the permission of the Government of India as aforesaid before submission of the tender or engagement in the contractor's service.

17. The bid for the works shall remain open for acceptance for a period of 90 days from the date of opening of bids/90 days from the date of opening of financial bid.. If any bidders withdraws his bid before the said period or issue of letter of acceptance, whichever is earlier, or makes any modifications in the terms and conditions of the bid which are not acceptable to the department, then the Government shall, without prejudice to any other right or remedy, be at liberty to forfeit 50% of the said earnest money as aforesaid. Further the bidders shall not be allowed to participate in the rebidding process of the work.

16. This notice inviting Bid shall form a part of the contract document. The successful bidders /contractor, on acceptance of his tender by the Accepting Authority shall within 15 days from the stipulated date of start of the work, sign the contract consisting of: -

a) The Notice Inviting Bid, all the documents including additional conditions, specifications and drawings, if any, forming part of the tender as uploaded at the time of invitation of tender.
b) Standard C.P.W.D. Form 8 or other Standard C.P.W.D. Form as applicable.

INTEGRITY PACT

To,

.....

.....

.....

Sub: 47/01/Isolation Room/2019/RIS/ES-664

Name of work :- Planning, designing, Construction and handing over of Negative Pressure Isolation rooms at AIIMS Rishikesh

Dear Sir,

It is here by declared that AIIMS Rishikesh is committed to follow the principle of transparency, equity and competitiveness in public procurement.

The subject Notice Inviting Tender (NIT) is an invitation to offer made on the condition that the Bidder will sign the integrity Agreement, which is an integral part of tender / bid documents, failing which the tenderer / bidder will stand disqualified from the tendering process and the bid of the bidder would be summarily rejected.

This declaration shall form part and parcel of the Integrity Agreement and signing of the same shall be deemed as acceptance and signing of the Integrity Agreement on behalf of the AIIMS Rishikesh.

Yours faithfully,

Superintending Engineer
AIIMS Rishikesh

To,

The Superintending Engineer,
AIIMS Rishikesh.

Sub: Submission of Tender for Planning, designing, Construction and handing over of Negative Pressure Isolation rooms at AIIMS Rishikesh

Dear Sir,

I / We acknowledge that AIIMS Rishikesh is committed to follow the principles thereof as enumerated in the Integrity Agreement enclosed with the tender/bid document.

I / We agree that the Notice Inviting Tender (NIT) is an invitation to offer made on the condition that I/We will sign the enclosed integrity Agreement, which is an integral part of tender documents, failing which I/We will stand disqualified from the tendering process. I/We acknowledge that THE MAKING OF THE BID SHALL BE REGARDED AS AN UNCONDITIONAL AND ABSOLUTE ACCEPTANCE of this condition of the NIT.

I/We confirm acceptance and compliance with the Integrity Agreement in letter and spirit and further agree that execution of the said Integrity Agreement shall be separate and distinct from the main contract, which will come into existence when tender/bid is finally accepted by AIIMS Rishikesh. I/We acknowledge and accept the duration of the Integrity Agreement, which shall be in the line with Article 1 of the enclosed Integrity Agreement.

I/We acknowledge that in the event of my/our failure to sign and accept the Integrity Agreement, while submitting the tender/bid, AIIMS Rishikesh shall have unqualified, absolute and unfettered right to disqualify the tenderer/bidder and reject the tender/bid is accordance with terms and conditions of the tender/bid.

Yours faithfully

(Duly authorized signatory of the Bidder)

To be signed by the bidder and same signatory competent / authorised to sign the relevant contract on behalf of Director AIIMS Rishikesh.

INTEGRITY AGREEMENT

This Integrity Agreement is made at..... on this.....day of.....20

BETWEEN

AIIMS Rishikesh represented through Director.....
(Name of Division)
AIIMS Rishikesh ..... (Hereinafter referred as the
(Address)
'Principal / Owner', which expression shall unless repugnant to the meaning or context hereof include its successors and permitted assigns)

AND

(Name and Address of the Individual/firm/Company)
Through..... (hereinafter referred to as the
(Details of duly authorized signatory)
"**Bidder/Contractor**" and which expression shall unless repugnant to the meaning or context hereof include its successors and permitted assigns)

Preamble

WHEREAS the Principal /Owner has floated the Tender (NIT No. .....) (hereinafter referred to as "**Tender/Bid**") and intends to award, under laid down organizational procedure, contract for

(Name of work)
Hereinafter referred to as the "**Contract**".
AND WHEREAS the Principal / Owner values full compliance with all relevant laws of the land, rules, regulations, economic use of resources and of fairness/transparency in its relation with its Bidder(s) and Contractor(s).
AND WHEREAS to meet the purpose aforesaid both the parties have agreed to enter into this Integrity Agreement (hereinafter referred to as "**Integrity Pact**" or "**Pact**"), the terms and conditions of which shall also be read as integral part and parcel of the Tender/Bid documents and Contract between the parties.

NOW, THEREFORE, in consideration of mutual covenants contained in this Pact, the parties hereby agree as follows and this Pact witnesses as under:

Article 1: Commitment of the Principal / Owner

1) The Principal/Owner commits itself to take all measures necessary to prevent corruption and to observe the following principles:

(a) No employee of the Principal/Owner, personally or through any of his/her family members, will in connection with the Tender, or the execution of the Contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.

(b) The Principal/Owner will, during the Tender process, treat all Bidder(s) with equity and reason. The Principal/Owner will, in particular, before and during the Tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential / additional information through which the Bidder(s) could obtain an advantage in relation to the Tender process or the Contract execution.

(c) The Principal / Owner shall endeavour to exclude from the Tender process any person, whose conduct in the past has been of biased nature.

2) If the Principal/Owner obtains information on the conduct of any of its employees which is a criminal offence under the Indian Penal code (IPC) / Prevention of Corruption Act, 1988 (PC Act) or is in violation of the principles herein mentioned or if there be a substantive suspicion in this regard, the Principal / Owner will inform the Chief Vigilance Officer and in addition can also initiate disciplinary actions as per its internal laid down policies and procedures.

Article 2: Commitment of the Bidder (s) / Contractor (s)

1) It is required that each Bidder / Contractor (including their respective officers, employees and agents) adhere to the highest ethical standards, and report to the Government / Department all suspected acts of **fraud or corruption or Coercion or Collusion** of which it has knowledge or becomes aware, during the tendering process and throughout the negotiation or award of a contract.

2) The Bidder(s) / Contractor(s) commit himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the Tender process and during the Contract execution:

a) The Bidder(s) / Contractor(s) will not, directly or through any other person or firm, offer, promise or give to any of the Principal / Owner's employees involved in the Tender process or execution of the Contract or to any third person any material or other benefit which he/she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the Tender process or during the execution of the Contract.

b) The Bidder(s) / Contractor (s) will not enter with other Bidder (s) into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to cartelize in the bidding process.

c) The Bidder(s) / Contractor(s) will not commit any offence under the relevant IPC/PC Act. Further the Bidder(s) / Contract(s) will not use improperly, (for the purpose of competition or personal gain), or pass on to others, any information or documents provided by the Principal/Owner as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.

d) The Bidder(s)/ Contractor(s) of foreign origin shall disclose the names and addresses of agents / representatives in India, if any. Similarly Bidder(s)/Contractor(s) of Indian Nationality shall disclose names and addresses of foreign agents/representatives, if any. Either the Indian agent on behalf of the foreign principal or the foreign principal directly could bid in a tender but not both. Further, in cases where an agent participate in a tender on behalf of one manufacturer, he shall not be allowed to quote on behalf of another manufacturer along with the first manufacturer in a subsequent/parallel tender for the same item.

d) The Bidder(s)/ Contractor(s) will, when presenting his bid, disclose (with each tender as per performa enclosed) any and all payments he has made, is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the Contract

3) The Bidder(s) / Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.

4) The Bidder(s) / Contractor(s) will not, directly or through any other person or firm indulge in fraudulent practice **means a willful misrepresentation or omission of facts or submission of fake / forged documents in order to induce public official to act in reliance thereof, with the purpose of obtaining unjust advantage by or causing damage to justified interest of others and/or to influence the procurement process to the detriment of the Government interests.**

5) The Bidder(s) / Contractor(s) will not, directly or through any other person or firm use Coercive Practices (means the act of obtaining something, compelling an action or influencing a decision through intimidation, threat or the use of force directly or indirectly, where potential or actual injury may befall upon a person, his / her reputation or property to influence their participation in the tendering process).

Article 3: Consequences of Breach

Without prejudice to any rights that may be available to the Principal/Owner under law or the Contract or its established policies and laid down procedures, the Principal / Owner shall have the following rights in case of breach of this Integrity Pact by the Bidder(s)/Contractor(s) and the Bidder / Contractor accepts and undertakes to respect and uphold the Principal / Owner's absolute right:

1) If the Bidder (s) / Contractor(s), either before award or during execution of Contract has committed a transgression through a violation of Article 2 above or in any other form, such as to put his reliability or credibility in question, the Principal/Owner after giving 14 days notice to the contractor shall have powers to disqualify the Bidder(s)/Contractor(s) from the tender process or terminate/determine the Contract, if already executed or exclude the Bidder/Contractor from future contract award processes. The imposition and duration of the exclusion will be determined by the severity of transgression and

determined by the Principal / Owner. **Such exclusion may be forever or for a limited period as decided by the Principal/Owner.**

2) **Forfeiture of EMD / Performance Guarantee / Security Deposit:**

If the Principal/Owner has disqualified the Bidder(s) from the Tender process prior to the award of the Contract or terminated/determined the Contract or has accrued the right to terminate/determine the Contract according to Article 3(1), the Principal/Owner apart from exercising any legal rights that may have accrued to the Principal/Owner, may in its considered opinion forfeit the entire amount of Earnest Money Deposit, Performance Guarantee and Security Deposit of the Bidder / Contractor.

3) **Criminal Liability:**

If the Principal/Owner obtains knowledge of conduct of a Bidder or Contractor, or of an employee or a representative or an associate of a Bidder or Contractor which constitutes corruption within the meaning of Indian Penal code (IPC)/Prevention of Corruption Act, or if the Principal/Owner has substantive suspicion in this regard, the Principal/Owner will inform the same to law enforcing agencies for further investigation.

Article 4: Previous Transgression

1) The Bidder declares that no previous transgressions occurred in the last 5 years with any other Company in any country confirming to the anticorruption approach or with Central Government or State Government or any other Central/State Public Sector Enterprises in India that could justify his exclusion from the Tender process.

2) If the Bidder makes incorrect statement on this subject, he can be disqualified from the Tender process or action can be taken for banning of business dealings/ holding listing of the Bidder/Contractor as deemed fit by the Principal/ Owner.

3) If the Bidder/Contractor can prove that he has resorted / recouped the damage caused by him and has installed a suitable corruption prevention system, the Principal/Owner may, at its own discretion, revoke the exclusion prematurely.

Article 5: Equal Treatment of all Bidders/Contractors/Subcontractors

1) The Bidder(s) / Contractor(s) undertake(s) to demand from all subcontractors a commitment in conformity with this Integrity Pact. The Bidder / Contractor shall be responsible for any violation(s) of the principles laid down in this agreement/Pact by any of its Sub-contractors/sub-vendors.

2) The Principal / Owner will enter into Pacts on identical terms as this one with all Bidders and Contractors.

3) The Principal / Owner will disqualify Bidders, who do not submit, the duly signed Pact between the Principal/Owner and the bidder, along with the Tender or violate its provisions at any stage of the Tender process, from the Tender process.

Article 6- Duration of the Pact

This Pact begins when both the parties have legally signed it. It expires for the Contractor / Vendor 12 months after the completion of work under the contract or till the continuation of defect liability period, whichever is more and for all other bidders, till the Contract has been awarded.

If any claim is made/lodged during the time, the same shall be binding and continue to be valid despite the lapse of this Pacts as specified above, unless it is discharged/determined by the Competent Authority, Director, AIIMS Rishikesh.

Article 7- Other Provisions

1) This Pact is subject to Indian Law, place of performance and jurisdiction is Rishikesh .

2) Changes and supplements need to be made in writing. Side agreements have not been made.

3) If the Contractor is a partnership or a consortium, this Pact must be signed by all the partners or by one or more partner holding power of attorney signed by all partners and consortium members. In case of a Company, the Pact must be signed by a representative duly authorized by board resolution.

4) Should one or several provisions of this Pact turn out to be invalid; the remainder of this Pact remains valid. In this case, the parties will strive to come to an agreement to their original intentions.

5) It is agreed term and condition that any dispute or difference arising between the parties with regard to the terms of this Integrity Agreement / Pact, any action taken by the Owner/Principal in accordance with this **Integrity Agreement/ Pact or interpretation** there of shall not be subject to arbitration.

Article 8- LEGAL AND PRIOR RIGHTS

All rights and remedies of the parties hereto shall be in addition to all the other legal rights and remedies belonging to such parties under the Contract and/or law and the same shall be deemed to be cumulative and not alternative to such legal rights and remedies aforesaid. For the sake of brevity, both the Parties agree that this Integrity Pact will have precedence over the Tender / Contract documents with regard any of the provisions covered under this Integrity Pact.

IN WITNESS WHEREOF the parties have signed and executed this Integrity Pact at the place and date first above mentioned in the presence of following witnesses:

(For and on behalf of Principal/Owner)

Superintending Engineer
AIIMS , Rishikesh,
Virbhadra Road,
Rishikesh-249203

_____

(For and on behalf of Bidder/Contractor)

WITNESSES:

1. ..... (Signature, name and address)

2. ..... (Signature, name and address)

lace: -

Dated: -

निविदा TENDER

मैंने/हमने कार्य के लिए निविदा आमंत्रण सूचना, अनुसूची क,ख,ग,घ, ड., और च, लागू विनिर्देश, नक्शे एवं डिजाइन, सामान्य नियम एवं निर्देश, ठेके के उपबंध, विशिष्ट शर्तें, दर अनुसूची एवं अन्य कागजात तथा ठेके की शर्तों में दिए गए नियम तथा निविदा कागजात में उल्लिखित अन्य बातों को पढ़ व जांच लिया है।

I/We have read and examined the notice inviting tender, schedule, A,B,C,D,E & F, specifications applicable, Drawings & Designs, General Rules and Directions, Conditions of Contract, clauses of contract, Special conditions, Schedule of Rate & other documents and Rules referred to in the conditions of contract and all other contents in the tender document for the work.

मै/हम, एतत्द्वारा अनुसूची 'च' में विनिर्दिष्ट समय के भीतर विनिर्दिष्ट कार्य, यथा–मात्राओं की अनुसूची तथा सभी संबंधित विनिर्देशों, डिजाइनों, नक्शों के अनुरूप तथा सामान्य नियमावली के नियम–1 और ठेके की शर्तों के खंड–11 में उल्लिखित लिखित अनुदेशों एवं ऐसी सामग्रियों, जो प्रदान की जाती है और उसके संबंध में, ऐसी शर्तें जो लागू हो, के अनुरूप निष्पादन हेतु निविदा देता हूं/देते हैं ।

I/We hereby tender for the execution of the work specified within the time specified in Schedule 'F', viz., schedule of quantities and in accordance in all respects with the specifications, designs, drawings and instructions in writing referred to in Rule-1 of General Rules and Directions and in Clause 11 of the Conditions of contract and with such materials as are provided for, by, and in respects in accordance with, such conditions so far as applicable.

We agree to keep the tender open for Ninety (90) days from the due date of opening of financial bid and not to make any modification in its terms and conditions.

A sum of ₹ **260000.00** is hereby forwarded as RTGS payment on account of earnest money. If I/We fail to furnish the prescribed performance guarantee within prescribed period, I/we agree that the said Director of AIIMS Rishikesh or his successors in office shall without prejudice to any other right or remedy, be at liberty to forfeit the said earnest money absolutely. Further, if I/We fail to commence work as specified, I/We agree that Director of AIIMS Rishikesh or his successors in office shall without prejudice to any other right or remedy available in law, be at liberty to forfeit the said earnest money and the performance guarantee absolutely. The said Performance Gurantee shall be guarantee to execute all the works referred to in the tender documents upon the terms and conditions contained or referred to those in excess of that limit at the rates to be determined in accordance with the provision contained in Clause 12.2 and 12.3 of the tender form. **Futher, I/we agree that in case of forfeiture of earnest money or both earnest money and performance guarantee as aforesaid, I/We shall be debarred for participation in the re-tendering process of the work.**

I/We undertake and confirm that eligible similar work(s) has / have not been got executed through another contractor on back to back basis. Further that, if such a violation comes to the notice of AIIMS Rishikesh, then I/We shall be debarred for tendering in AIIMS Rishikesh in future forever. Also, if such a violation comes to the notice of Department before date of start of work, The Engineer – in – Charge shall be free to forfeit the entire amount of Earnest Money Deposit / Performance Guarantee.

मैं/हम एतत्द्वारा घोषणा करते है कि मै/हम निविदा कागजातों, नक्शों और कार्य से संबंधित अन्य अभिलेखों को गुप्त/गोपनीय कागजात के रूप में रखेगे और उनसे प्राप्त/ली गई जानकारी किसी अन्य को, जिन्हें मैं/हम सूचित करने के लिए प्राधिकृत हो, से भिन्न किसी को,नहीं बताएगें या जानकारी को किसी ऐसे रूप में प्रयोग नही करेंगे जो राज्य की सुरक्षा के लिए प्रतिकूल हो।

I/We hereby declare that I/we shall treat the tender documents drawings and other records connected with the work as secret/confidential documents and shall not communicate information/derived therefrom to any person other than a person to whom I/We am/are authorised to communicate the same or use the information in any manner prejudicial to the safety of the State.

तारीख Dated #.....

ठेकेदार के हस्ताक्षर Signature of Contractor#

डाक का पता Postal Address#

साक्षी Witness : #
पता Address: #
उपजीविका Occupation : #

 # To be filled in by the contractor/witness as applicable

ACCEPTANCE

The above tender (as modified vide letters mentioned hereunder) is accepted by me for and on behalf of the Director, AIIMS Rishikesh for a sum of ₹. _____

(Rupees_____)

The letters referred to below shall form part of this contract Agreement:-

a)

b)

c)

For & on behalf of Director, AIIMS Rishikesh

Signature.....

तारीख Dated ....

Designation.....

अनुसूचियां SCHEDULES
[FOR MAJOR COMPONENT]

अनुसूची 'क' **SCHEDULE 'A'**
मात्राओं की अनुसूची (संलग्न)

Schedule of quantities (Enclosed) Page No. -

अनुसूची 'ख' **SCHEDULE 'B'**
ठेकेदार की निर्गत की जाने वाली सामग्रियों की अनुसूची
Schedule of materials to be issued to the contractor. NA

अनुसूची 'ग' **SCHEDULE 'C'**

ठेकेदार को भाड़े पर दिए जाने वाले औजार एवं संयत्र

Tools and plants to be hired to the contractor

क्रम सं. Sl. No.	विवरण Description	भाड़ा प्रभार प्रतिदिन Hire charges per day	निर्गत स्थान Place of Issue
1	2	3	4
		NIL	

अनुसूची ''घ' **SCHEDULE 'D'**
कार्य के लिए विशेष अपेक्षाएं/दस्तावेज, यदि कोई हों, की अतिरिक्त अनुसूची
Extra schedule for specific requirements/documents for the work, if any. Addl. Specifications attached.

अनुसूची (ड) **SCHEDULE 'E'**

ठेके की सामान्य शर्तों का संदर्भ General conditions of contract for CPWD works

1. Reference to General Conditions of contract 2016, 2019 as amended upto date and special conditions attached herewith the tender document except clause-25.

Name of work: Planning, designing, Construction and handing over of Negative Pressure Isolation rooms at AIIMS Rishikesh.

कार्य की अनुमानित लागत Estimated cost of work	:₹ **1,30,00,000.00**
(i) धरोहर राशि Earnest money	:₹ **2,60,000.00**
(ii)निष्पादन गारंटी Performance guarantee :	5% of tendered value. निविदित मूल्य का 5 प्रतिशत
(iii) प्रतिभूति निक्षेप: Security Deposit:	2.5% of tendered value plus 50% of performance guarantee for contract, involving maintenance of the building and services / other work after construction of same building and services / other work.

अनुसूची 'च' **SCHEDULE 'F'**

सामान्य नियम एवं दिशानिर्देश:

General Rules & Directions:

निविदा आमंत्रण करने वाला प्राधिकारी Officer inviting tender -	**SE, AIIMS Rishikesh**
कार्य की मदों की मात्रा के लिए अधिकतम प्रतिशत जिससे अधिक निष्पादित मदों के लिए दरों का निर्धारण खण्ड 12.2 और 12.3 के अनुसार होगा Maximum percentage for quantity of items of work to be executed beyond which rates are to be determined in accordance with Clauses 12.2 & 12.3.	निम्नानुसार see below

Definitions:

2(v)	भारसाधक इंजीनियर Engineer-in-Charge	SE , **AIIMS Rishikesh**
2(viii)	स्वीकार कर्ता प्राधिकारी Accepting Authority	**Director , AIIMS Rishikesh**
2(x)	अतिरिक्त और लाभों को पूरा करने के लिए श्रम एवं सामग्रियों की लागत पर प्रतिशतता Percentage on cost of materials and labour to cover all overheads and profits.	**15% (Fifteen per cent)**
2(xi)	Standard Schedule of Rates:	Market rates
2(xii)	Department:	AIIMS Rishikesh
9(ii)	Standard CPWD contract Form:	GCC 2016,2019 as amended up to date CPWD form 8 as modified & corrected up to date (Whether correction vide latest circulars are incorporated or not in this document) and special condition of Contract attached herewith from page no. 36 to 114.
9(ii)	मानक के.लो.नि.वि. ठेका फार्म modified Standard CPWD contract Form	CPWD form 8 (Print edition -2016) as with up to date correction slip.

खण्ड Clause 1

;पद्ध	स्वीकृति पत्र जारी होने की तारीख से निष्पादन गारंटी के प्रस्तुतीकरण के लिए अनुमत समय Time allowed for submission of performance guarantee from the date of issue of letter of acceptance	: 15 days
;पपद्ध	(उपर्युक्त प) में दी गई अवधि के पश्चात् अधिकतम अनुमेय एक्सटेंशन Maximum allowable extension with late fee @ 0.10% per day of performance guarantee amount beyond	

the period as provided in (i) above : 7 days

खण्ड Clause 2

खण्ड 2 के तहत प्रतिकार निश्चित करने वाला प्राधिकारी

Authority for fixing compensation under clause 2 — SE , AIIMS Rishikesh

खण्ड Clause 2A

क्या खण्ड 2 क लागू होगा

Whether clause 2A shall be applicable — No

खण्ड Clause 5

कार्य आरंभ की तारीख की गणना के लिए स्वीकृति पत्र के जारी होने की तारीख से दिनों की संख्या

No. of days from the date of issue of letter of acceptance for reckoning date of start — 15 days.

लक्ष्य नीचे दी गई सारणी के अनुसार

Milestone(s): - NA

कार्य निष्पादित करने के लिए अनुमत्य समय

Time allowed for execution of work — 60 Days

Authority to decide

(i) Extension of Time — SE, AIIMS Rishikesh

(ii) Rescheduling of mile stones — NA

(iii) Shifting of date of start in case of delay in handing over of site — SE, AIIMS Rishikesh

खण्ड Clause 6, 6A

खंड लागू–(6 या 6 क) Clause applicable — Clause 6

खण्ड Clause 7

अंतरिम भुगतान के लिए पात्र होने के लिए अंतिम ऐसे भुगतान के बाद कुल भुगतान एकत्रित सामग्रियों के अग्रिमों के समायोजन सहित किया जाने वाला कुल कार्य

Gross work to be done together with net payment/adjustment of advances for material collected, if any since the last such payment for being eligible to interim payment — NA

खण्ड 10 d Clause10A

कार्यस्थल प्रयोगशाला में ठेकेदार द्वारा उपलब्ध कराये जाने परीक्षण उपकरण की सूची

List of testing equipment to be provided by the contractor at site lab. — N.A.

खण्ड Clause10B(ii)

क्या खण्ड 10 ख ;पपद्ध लागू होगा

Whether clause 10B (ii) shall be applicable — No

खण्डClause10C

Component of labour expressed as Percent of value of work — NA

खण्ड Clause 10CC - NOT APPLICABLE.

~~खण्ड 10 गग उन संविदाओं पर लागू होगा जिसमें कार्य समापन की अवधि अगले कालम में दर्शाई गई अवधि से अधिक अनुबंधित है।~~
~~Clause 10CC to be applicable in c~~ DELETE
~~with sipulated period of compensation exceeding the period shown in next column~~ : ..... Months

खण्ड Clause 11

कार्य निष्पादन के लिए अनुपालन Specifications to be followed for execution of work	**Specification, standard and Guidelines of Centers for Disease Control and Prevention (CDC) and attached in Tender document.**

खण्ड Clause 12

	Type of Work	Original Work
12.2 & 12.3	विचलन सीमा जिसके परे खण्ड 12.2 तथा 12.3 भवन निर्माण कार्य के लिए लागू होंगे Deviation limit beyond which clauses 12.2 & 12.3 shall apply for building work (Other than foundation)	100 %
12.5	(i) Deviation limit beyond which clauses 12.2 & 12.3 shall apply for foundation work (except earth work)	NA

खण्ड Clause 16

घटी हुई दरे निर्धारित करने की लिए सक्षम प्राधिकारी Competent Authority for deciding reduced rates	SE, AIIMS Rishikesh or successor thereof

खण्ड Clause 18

कार्यस्थल पर ठेकेदार द्वारा लगाये जाने वाली अनिवार्य मशीनरी औजार एवं सयंत्रों की सूची :– List of mandatory machines, tools and plants to be deployed by the contractor at site.	N.A.

खण्ड Clause 42

I) क)	सीमेन्ट और बिटुमन की अनुमानमूल मात्रा निर्धारित करने के लिए अनुसूची / विवरण	
I) (a)	Schedule/statement for determining theoretical quantity of cement & bitumen	NA
II)	अनुमानमूलक मात्राओं में अनुमत्य विचलन Variations permissible on theoretical quantities.	NA
d½	सीमेन्ट जिन कार्यो के लिए निविदा में अनुमानित मूल्य रू. 5 लाख से अधिक न हो	
a)	Cement for works with estimated cost put to tender not more than Rs. 5 lakhs	NA
	जिन कार्यों के लिए निविदामें अनुमानित मूल्य रू. 5 लाख से अधिक हो	
	for works with estimated cost put to tender more than Rs. 5 lakhs	NA

ख)	बिटुमन सभी कार्यों के लिए	
b)	Bitumen for all works	NA
ग)	इस्पात प्रत्येक व्यास, कोट और श्रेणी के लिए पूनर्वलन और संरचनात्मक इस्पात काट	
c)	Steel Reinforcement and structural steel sections for each diameter, section and category.	NA
घ)	सभी अन्य सामग्रियां	
d)	All other materials	NA

AMENDMENTS TO GENERAL CONDITIONS OF CONTRACT 2014

OM No DG/SE/CM/CON/283 Dated 05-05-20158

Sujb- Payment of wages to the labour by Contractor

The Following provision of CPWD contractor laboour Regulation of GCC2014 are amended

Existing Provision	*Modified Provision*
C.P.W.D. Contractor's Labour Regulations *5. Payment of Wages* *vi) Wages due to every worker shall be paid to him direct or to other person authorized by him in this behalf.* *vii) All wages shall be paid in current coin or currency or in both.* *x) It shall be the duty of the contractor to ensure the disbursement of wages in the presence of the Junior Engineer or any other authorized representative of the Engineer-in-Charge who will be required to be present at the place and time of disbursement of wages by the contractor to workmen.* *xi) The contractor shall obtain from the Junior Engineer or any other authorized representative of the Engineer-in-Charge as the case may be, a certificate under his signature at the end of the entries in the "Register of Wages" or the "Wage cum-Muster Roll" as the case may be in the following form :-* *"Certified that the amount shown in column No .....has been paid to the workman concerned in my presence*	*C.P.W.D. Contractor's Labour Regulations* *5. Payment of Wages* *vi) Wages due to every worker shall be paid to him direct bycontractor through Bank or ECS or online transfer to his bank account.* *vii) All wages shall be paid through Bank or ECS or online transfer.* *x) It shall be the duty of the contractor to ensure the disbursement of wages through bank account of labour.* *xi) The contractor shall obtain from the Junior Engineer or any other authorized representative of the Engineer-in-Charge as the case may be, a certificate under his signature at the end of the entries in the "Register of Wages" or the "Wage cum-Muster* *Roll" as the case may be in the following form:-* *"Certified that the amount shown in column No .....has* *been paid to the workman concerned through bank account of* *labour on .....at ....."*

OM No DG/CON/285 Dated 05-06-2015

Sub: Amendment in general conditions of contractor (GCC)-2014

The following provision of GCC 2014 is modified as under

Clause 5.1 *As soon as possible after the Contact is concluded, the contractor shall submit a time and progress chart for each mile stone and get it approved by the Department. The Chart shall be prepared in direct relation to the time stated in the Contract document for completion of items of the works. It shall indicate the forecast of the dates of commencement and completion of various trades of section of the work and may be amended as necessary by agreement between the Engineer-in-Charge and the Contractor within the limitations of time imposed in the Contract documents, and further to ensure good progress during the execution of the work, the contractor shall in all cases in which the time allowed for any work, exceeds one month (save for special jobs for which a separate programme has been agreed*	*Clause 5.1* ***The contractor shall submit a programme Chart (Time and Progress) for each mile stone alongwith performanceguarantee*** *and get it approved by the Department. The Chart shallbe prepared in direct relation to the time stated in the Contract document for completion of items of the works. It shall indicate theforecast of the dates of commencement and completion of various trades of sections of the work and may be amended as necessaryby agreement between the Engineer-in-Charge and the Contractor within the limitations of time imposed in the Contract documents,and further to ensure good progress during the execution of the work, the contractor shall in all cases in which the time allowed forany work, exceeds one month (save for special jobs for which a separate programme has been agreed upon) complete the work asper mile stones given in Schedule 'F'*

upon) complete the work as per mile stones given in Schedule 'F' Clause 5.1	
Cluae 7A **No Provision**	*Clause 7A* *No Running Account Bill shall be paid for the work till the applicable labour licenses, registration with EPFO, ESIC and BOCW Welfare Board, whatever applicable are submitted by the Contractor to the Engineer-**in-Charge.***
Clause 19 *The Contractor shall obtain a valid license under the Contract Labour (R&A) Act, 1970 and the Contract Labour (Regulation and Abolition) Central Rules, 1971 before the commencement of the work, and continue to have a valid license until the completion of the work*	*Clause 19* *The Contractor shall obtain a valid license under the Contract Labour (R&A) Act, 1970 and the Contract Labour (Regulation and Abolition) Central Rules, 1971 before the commencement of the work, and continue to have a valid license until the completion of the work.* *The contractor shall also comply with provisions of the Inter –State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979.*

SPECIAL CONDITIONS

1. The work shall be carried out strictly in accordance with CPWD specifications for electrical works Part-I Internal 2013 and 1995 (external) as amended upto date and in accordance with Indian Electricity Rules, 1956, Indian Electricity Act, 1910 as amended upto date and as per instructions of the Engineer-in-Charge including as below and nothing will be paid extra. The work related to negative pressure rooms shall be carried out as per CDC guidelines.

2. All materials to be used on this work by the contractor shall be got approved from the Engineer-in-Charge and deptt. Has right to inspect the material at manufacturers' place before installation at site.

3. The work shall be carried out according to approved drawings/details which shall be subsequently issued to the successful for execution of work and as per instructions of the Engineer-in-Charge who will have the right to change the layout as per requirement at site and the contractor shall not have any claim due to change in layout.

4. All damages done to the building, roads, pathways, floors, walls during execution of work shall be the responsibility of the contractor and the same will be made good immediately at his own cost to the satisfaction of the Engineer-in-Charge. Any expenditure incurred by the department in this condition shall be recovered from the contractor and decision of the Engineer-in-Charge about recovery shall be final.

5. The bad workmanship will not be accepted and defects shall be rectified at contractor's cost to the satisfaction of the Engineer-in-Charge. The programme of electrical works are to be co-ordinated in accordance with the building work and no claim for idle labour will stipulated in the tender, electrical work shall have to be completed within 60 days .

6. All the debris of the electrical works should be removed and the site should be cleared by the contractor immediately after the accruing of debris. Similarly any rejected material should be immediately cleared off from the site by the contractor.

7. Cement OPC 43 grade if required for this bonafied work is to be arranged and used by the contractor himself and nothing extra will be paid on this account.

8. The contractor or his representative is bound to sign the site order book as and when required by the Engineer-in-Charge and to comply with the remarks therein.

9. The size of conduit and wiring shall be got approved from the Engineer-in-Charge before taking upto the execution.

10. The contractor shall make his own arrangement at his own cost for electrical/general tools, plants and all material required for the work

11. Main board and main distribution board: The work shall be carried out according to the drawings/details as approved by the Engineer-in-Charge. The contractor shall have to get the samples approved before the whole lot is brought to site and it shall include all inter connections etc.

12. No Central/State sales tax/VAT/Contract tax/Excise duty etc. shall be separately paid by the department. The rates tendered should be inclusive all taxes and duties(Including GST) . Deduction of contract tax at source shall be made while releasing payment through running/final bills as applicable . A certificate specifying the rate and amount of deduction shall however be issued. No Form-D, 31/32 (Road permit) shall be issued by the department. The road permit shall be arranged by the tenderer on his own.

13. The entire installation shall be at the risk and responsibility of the contractor until these are tested and handed over to the department. However if there is any delay in construction from the department side, the installation may be taken over in parts, but the decision on the same shall rest with Engineer-in-Charge which shall be binding on the contractor. Site for this work shall be provided in parts and no claim on account of delay on this shall be entertained.

14. Not withstanding the schedule of quantities, all items of interrelated works considered necessary to make the installation complete and operative are deemed to be included shall be provided by the contractor no extra cost shall be paid on any account.

15. The connection, inter connection, earthing and inter earthing shall be done by the contractor wherever required and nothing extra shall be paid on this account

16. Some of the items of work, if already executed: on that case the successful tenderer shall have to use these items for completing the work. For wiring, the existing conduit wherever required shall be used by the contractor. The recovery will be made for these items as accepted rate of other agencies.

17. Nothing extra shall be paid for :-
    (a) Inter connections with thimbles/wires/tapes strips etc.

    (b) . All tools and tackles required for overhauling will be arranged by the party

18. It is a SITC type job hence contractor is advised to inspect the site carefuly before quoting the rates.The contractor shall be deemed to have satisfied himself to the nature & extent of work at site & no claim for extra payment/or time extension will be allowed on the ground that he was not convarsant with condition providing at the site. The rate shall be inclusive of all taxes, accessories, machining & labor, dismantling i.e. site clearance & shifting the debris from work place to specified place at site etc. The Spare list given above is tentative hence contractor may provide a comprehensive list which is suppose to be require to make full functional facility.

19. **Guarantee Period:-The contractor will be responsible for malfunctioning of Material/spares fittings/fixtures supplied by him, it might be due to poor workmanship or due to spare supplied by him, for a period of ONE year from the date of satisfactory completing the job. He has to rectify the fault arises due to above at his own cost.**

20. Jurisdiction of law of court will be at Rishikesh in case of any dispute arising out of execution / payment of this work.

21. Defective work shall be rejected out rightly. Payment shall not be made for any defective work which do not conform with standard and specifications mentioned in tender

22. No Advance payment shall be made. Payment shall be made for only completed work as per satisfaction of Engineer in charge.

Superintending Engineer,
AIIMS Rishikesh

TECHNICAL SPECIFICATIONS

1. All hardware items such as screws, thimbles, G.I. wires etc. which are essentially required for completing an item as per specifications will be deemed to be included in the item even when the same have not been specifically mentioned.
2. All hardware materials such as nuts/bolts/screws/washers etc. to be used in the work shall be of stainless steel.
3. Any conduit which is not be wired by the contractor shall be provided with GI fish wire for wiring by some other agency subsequently. Nothing extra shall be paid for the same.
4. While laying conduit, suitable junction boxes as directed by Engineer in Charge as per site requirement shall be left for pulling the wires.
5. Copper wire shall be FRLS PVC insulated multi-stranded conductor. Termination of multi-stranded conductors shall be done using crimping type thimbles at both the ends. Nothing extra shall be paid for the same.
6. The makes of material have been indicated in the list of acceptable makes. No other make will be acceptable. The material to be used in the work shall be got approved from the Engineer-in-Charge before its use at site. The Engineer-in-Charge shall reserve the right to instruct the contractor to remove the material which, in his opinion, is not as per specifications.
7. The proof of purchase in the form of Invoice/cash memo, of all the major components such as Cables, Wires, Fittings, MCB DB's, Geysers, Exhaust fans etc. shall have to be produced by the contractor at the time of final bill or as and when demanded by the deptt.
8. Test report of all the XLPE insulated PVC sheathed armoured power cables used at site of work shall have to be submitted by the contractor at the time of submission of final bill.
9. Where switches/sockets/telephone outlets are to be provided, the same shall be of only one make.
10. The MCB distribution boards shall be factory fabricated in the works of the manufacturer of the MCB's of any of the makes specified and the same shall be duly pre-wired in the works. The board shall be brought to site in ready for installation condition. The MCBs and the MCB distribution board shall be of the same make.
11. The earthing shall be carried out in the presence of the Engineer-in-Charge or his authorized representative.
12. All fittings/fans will be earthed as per specifications.

Scope of Work: Includes Design, Supply, and Installation, Testing, Commissioning (S/I/T/C) of Isolation Rooms on Turnkey Basis.

HVAC system including complete air management system for maintaining the lab environment as per the guidelines, all related internal lighting and wiring work in the Isolation Rooms.

Design strategies include:

- *Managed directional flow to ensure air always flows toward the highest area of containment*
- *Uses of with Recirculation system.*
- *Negative Pressure monitoring and control*
- *Maintenance of constant temperature of 22+/- 2 Deg C and humidity at 55+/-5 %*
- *Exhaust should always be through HEPA Filters.*
- *Audible and visual alarms to alert personnel if a system fails.*

1- Supply/Exhaust Air System:-

- All incoming air filtered by three stages Filtration in AHU and pass through HEPA.

Three stages for supply Pre- Filtration:
ASHRAE 1st stage : 30% efficiency
ASHRAE 2nd stage : 90% efficiency

Final Stage HEPA Filtration to the main Labs : 99.99% efficiency

HEPA filters for Exhaust: HEPA Filtration- 99.99% efficiency

2- Control Pressurization:

Laboratories should remain at a pressure ranging from ATM to -40 Pa in relation to the corridors/Airlocks and other spaces. The pressure gradient condition should be maintained in various areas of the negative pressure rooms based on the applications/ customer requirement.

3- Air Handling Units:

#The inner skin 20 G Plain G.I # Outer skin 22 G precoated GI

43 mm thick PUF insulation panel, with internal coving and in thermal break construction.
#Three Stage Filtration shall be in Air Handling Unit as per above mentioned ASHRAE Standards.

Fourth stage Filter should be HEPA Filter with average efficiency > 99.99% down to

0.3 micron
All filters should be UL 9000 Classified.
#. The Air Handling Unit should be complete with Fresh Air Section, 6RD CHW coil, 02 RD HW Coil, Pre & fine filters on common frame, 25 mm PUF panel sections with thermal break profile , Fresh Air, Supply Air, Return Air dampers;

4- Ducting and Insulation for Supply and Exhaust Ducts:

#Supply and Return Air Ducting should be fabricated, installed and leak test as per SMACNA standard.

#Ducting should be made out of GSS sheet.
Ducting shall be made out of minimum GSS sheet only exhaust duct from the Lab to the Exhaust BIBO Filters (Bag In Bag Out) shall be welded SS duct. And after the HEPA Filters the duct can be standard GSS.

5- Motorized Airtight Damper:
#consist of Aluminium casing with factory fitted motorised damper. Casing and attachments should be in stainless steel.

The damper blade with plastic seal when closed should comply with DIN EN 1751, CLASS 4 (Exception normal size 100 and 125, class 3) also complies with the requirement of DIN 1946, Part 4 (leakage < 10 M3/h. M2 of damper cross section with a 100 Pa Pressure differential).

6. Chiller Unit::- #The actual capacity of Chiller is selected at
50 Deg C outside temperature, CHILLING UNITS each complete with compressor, motor, insulated chiller, flow switch at chiller, fans, vibration isolators, integral refrigerant piping and wiring, accessories as required and called for, automatic and safety controls mounted in central console panel and all mounted on a steel frame complete as per specifications.

7- CONTROL PANEL:

Alarm and Monitoring Systems:

a) Pressure gauge
b) Pressure alarm visual/audio
c) Temperature/RH alarm visual/audio
d) Emergency panic button (break glass type)
- audio all rooms/control room
e) Emergency door-open" button (For interlock door)

At the Control Side – BSL2/BSL3- control software

8- Computerized Controls (DDC):

The control System, consist of DDC, should automatically adjust system airflow and maintain system as the designated negative pressure.

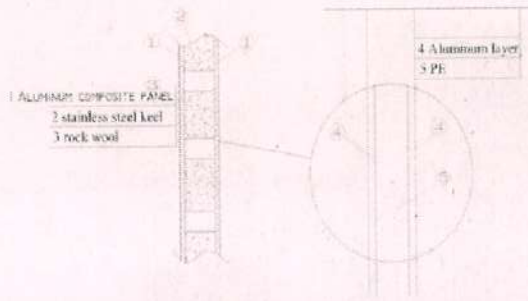
The DDC should have the following features:

- The system controller (DDC) controlled via a dedicated software program.
- Centralized Control
- Automatic air flow control.
- Pressure, Temperature & Humidity monitor and control.
- Doors interlock - controlled by DDC and display on the DDC control panel.
- HEPA filter resistance and efficiency monitoring. When the pressure of the filters reaches the setting value, the DDC has the alarm.

9- Electrical System:

The main power distribution (LT) panel and required power for the BSL-3 Laboratory shall be arranged and provided by the vendor upto the main LT Panel of the BSL-3 Laboratory. Connection of AHU/ VFD starter Panel with LT Panel. Complete Electrical wiring, switch & sockets, Lighting shall be done by us.

10- Wall And False Ceiling System:



- Internal wall panels should be pre- fabricated with GI Frame and welded to form C-channel structural frame.
- The wall skin should be of GI composite panel, sandwich with PUF material, which acts as a thermal barrier. Space in-between is sandwiched with PUF insulation and fire retardation purpose.
- The GI panel edges are sealed with Room Temperature Vulcanizing (RTV) Silicone to the structural frame and fasten on both sides to form an airtight sealed panel.

- Wall panel system should be double skin 100 mm thick skin powder coated and the thickness is 0.8 mm with PUF as the insulation.

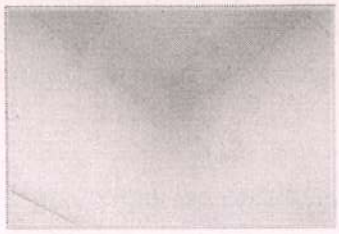
11- Flooring

- Airtight and chemical resistant PVC/ Epoxy flooring.
- All coved corner wall joints are carefully cut, formed and sealed.

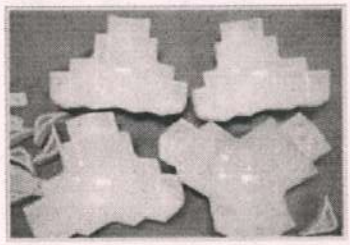
12- The Radius Coving (wall-to-wall, and wall-to-ceiling, from inside to outside corner):

Smooth radius coving should be installed at all wall-to-wall and wall-to-ceiling joints. All seams should be carefully sealed with RTV sealant. Corners at floor - coved from PVC floor sheet to the wall.

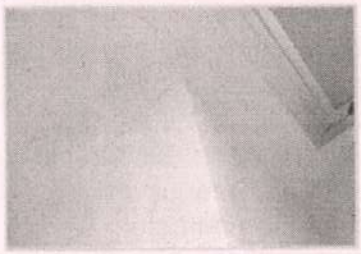
The inner corner:



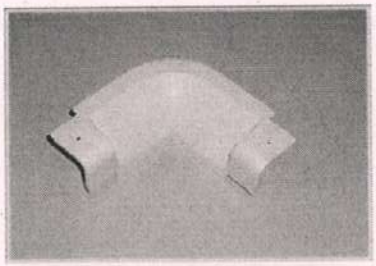
The inside corner linker:



The outer corner:

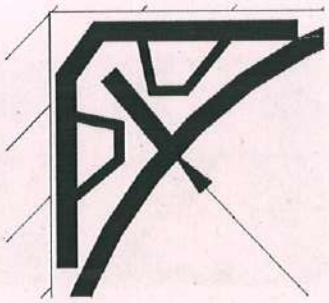


The outside corner linker:



All seams are then carefully sealed with RTV sealant. Corners at floor are coved from PVC floor sheet to the wall

see drawing for graphical illustration of wall to ceiling coving:



13- Doors

- The doors meant for entering / exit into the rooms, considered should be double skin GSS with PUF insulation of suitable thickness in between.
- Shutters should be 44mm thick.
- The Entry Air lock door, Shower door and Exit Air lock doors should be interlocked.
- Doors inside the controlled area are interlocked except the emergency exit. All doors have continuous rubber gasket around the perimeter.
- The interlock logic should be such that while entering or exiting the facility, traffic from the other side should not get access, to ensure privacy.

16- Testing and Validation: The list of test to be performed is as below:

- Containment Barrier Integrity Test
- HEPA Filter Leak Test – According to the US Federal Standard 209E
- Ducting Pre-welding leak test
- Ducting post-welding leak test
- Room Differential Pressure test
- Particle Count Test for Cleanliness
- Air Velocity/ Pattern smoke Test
- Room Air change Rate Test
- Light intensity Test
- Noise level Test
- Temperature and RH

Technical Specifications

The scope of work shall include design, complete construction and establishment of Negative pressure Isolation room facility with ante room including minor civil works, electrical works, public health engineering works etc. complete in all respect. All the fixed equipment and systems like pass box, HVAC system and its components (including A/C plant, air handling, exhaust systems, filters, controls etc.),computers, Negative pressure isolation workstations, uninterrupted power supply system, door interlocks, access control system, fire detection & alarm, system, surveillance systems CCTV with remotely placed monitor control, fire extinguishers and any other equipment/systems essentially required to meet the intent and purpose of setting up of Negative pressure Isolation room shall be provided and included in the scope of works. Architectural layout

of the lab will be provided (including of the Negative pressure Isolation room and placement of equipment and power load requirement)

The scope of works shall also include:

i. All necessary arrangements like extension of existing feeder/bus bars, laying of power cables etc. for tapping of required power shall be made by the contractor. Supply should be three phase and with proper earthing and required capacity of 440V for AHU Unit for Negative pressure Isolation room.
ii. Extension of existing water supply lines up to the Negative pressure Isolation room to meet its water supply requirements. Supply and erection of water tank 750-1000litres in case of inadequate or absence of water supply for emergency shower and eye wash stations.

The following shall be provided to the Vendor by the institution/site:

1. Three phase power supply with earthing and required capacity of 440V.
2. Water supply line nearby the site.

PRE-REQUISITES for the Site to comply

1. **Power required for the Negative pressure Isolation room** shall be tapped from the existing feeder lines (through its expansion and laying of required power cablings) or panels. Supply should be three phase and with proper earthing and required capacity of 440V for AHU Unit for Negative pressure Isolation room.
2. **Water supply to the Negative pressure Isolation room** shall be provided through the existing Water distribution network in campus.

CRITICAL CONSIDERATIONS TO BE FOLLOWED IN DESIGN:

The proposed Negative pressure Isolation room shall be constructed in accordance with CDC, WHO and RNTCP and other international guidelines as minimum (see later in document reference materials used). Some of the minimum essential critical considerations for construction of the proposed Negative pressure Isolation room shall be as under:

1. Restricted and controlled access shall be provided for entry into the laboratory.

2. The HVAC systems shall be provided to maintain the desired inside conditions in terms of temperatures, humidity conditions, air filtration requirements. Unidirectional airflow to be achieved by appropriate negative differential pressures and a minimum of 6-12 Air changes per hour to be achieved. Air from the laboratories, shall be exhausted only after appropriate filtration (HEPA filters) as per guidelines/standards. Redundant exhaust systems shall be provided for Negative pressure Isolation room room. Leak proof dampers with provision to prevent backflow of air shall be provided in supply and exhaust air systems of Negative pressure isolation rooms for isolation of rooms/zones.

3. Interiors of the Negative pressure Isolation room- The internal building finishes shall be monolithic, impervious, non-particle shredding, chemical resistant to phenol, hypochlorite, etc. cleaning and suitable to withstand chemical use during decontamination /fumigation. Modular false ceiling panels should be made for Clean Room application. Flooring inside the Negative pressure Isolation room shall be of self-levelling industrial epoxy and cleanroom compatible.

4. The door interlocks, exhaust blower of BSCs, shall be provided with online, un- interrupted power supply system with minimum 30 minutes power backup.

5. Safety measures for fire and electricity shall be provided

6. Emergency shower, Eyewash station facility will be provided to address emergency spill situations. Emergency Exit door with panic latch door from the Negative pressure Isolation room shall be provided

DETAILED SPECIFICATIONS

1. **Restricted and controlled access** shall be provided for entry into the laboratory.
   - Access control system for entry / exits should be provided. 20 numbers of card to be provided to each lab.

2. HEATING VENTILATION & AIR-CONDITIONING (HVAC) SYSTEM:

i. The entire room shall be air-conditioned. The HVAC systems shall be provided to maintain the desired inside conditions in terms of temperatures, humidity conditions, air filtration requirements, room/zone pressure requirements and air change rate.

ii. Housing/Casing of AHU unit: Air Handling Units shall be of sectionalized constructions with an under frame of extruded heavy aluminium profiles. The under frame shall be mechanically strong and shall take double skinned insulated panels. The powder coated panels shall consist of 0.8 mm galvanized iron outer skin and 0.63 mm galvanized iron inner skin with 23 mm thick injected PUF insulation in between two panels. The AHUs shall be with true thermal break. There should not be any projections inside the AHUs and the covings has to flush with the side panels. Air tight access panel with suitable neoprene gaskets shall be provided in the fan section, coil and filter section. Similar gaskets should be used at all other joints of the AHU and its ducting. Units meant for indoor locations shall be specially designed to meet the arduous and corrosive

atmosphere.

iii. Platform for AHU: In places where firm, even and concrete surface not available, the same will have to be constructed (masonry work) for the entire surface area which will be enclosed within AHU shed.

iv. There would be independent supply and exhaust system with unidirectional inward airflow and 100% exhaust.

v. **Supply Unit:**

a. Air Conditioning Plant: The Air-Conditioning plant (of suitable capacity based on requirements of the lab's AHU) shall be with Direct Extension (DX system). The condenser unit shall have multiple compressors such that at least one compressor shall be as standby. The AHU shall comprise of Cooling Coil Section with 8 row deep DX coil, necessary component, 18-gauge SS 304 drain pan with 13 mm thick closed cell self-sticking polyethylene insulation, having slope at one side, drain connection from other side. Inlet and outlet coil nipples shall be sealed against unit casing by means of neoprene gaskets. Alternately, the cold air from the existing Central Air-Conditioning plant may be taken.

b. The Negative pressure isolation rooms will be supplied with pre-conditioned (heating, cooling) fresh air by a mechanical ventilation system. Temperature inside the lab shall be maintained at 22°C±2.

c. The air will be cooled and then reheated with an electric duct coil to maintain required space conditions. This is required to maintain proper humidity conditions in the lab and humidity level should be maintained at 60±10%. To heat the air in the winter, an electrical heater unit (of adequate capacity) would be planned. This heater will be the same heater that will function as dehumidifier unit in summer.

d. Design of Supply air system: One variable speed supply fan of Gebhardt/ Krugger/ Nicotra or equivalent reputed OEM (Original Equipment Manufacturer) should be installed. Fan is designed for the whole required supply air amount (100% Redundancy). The fan shall be backward (or forward) curved centrifugal double inlet multi blade with optimized selection for low noise and high efficiency. Fans shall be statically and dynamically balanced for vibration free operation. Fans shall be enclosed in galvanized steel scroll cases and shall be driven by a variable frequency drive (VFD). The VFD should be pre-set programme for five different varying fan speed with selector switch for user operation. Fan and motor assembly shall be mounted on vibration isolators eliminating the need for external vibration isolators. Provision shall be made for belt tensioning. Motor should be of required capacity of Crompton Greaves/ Siemens/ ABB or equivalent of reputed OEM make. The fan should not exceed noise level of 75 db (A) from 1 m distance. A spare motor shall be provided in case of any burn out/breakdown for immediate repair/replacement. 5 spare fan belts shall also be provided which can be used for replacement in case of wear/tear.

e. Volume Control Dampers: The distribution of air is planned via air inlets in the Negative pressure isolation rooms. To control the air volume flow variable volume boxes in the supply air ducts are planned (at mouth of supply, after blower and after fine filter). The housing for these dampers (in fact all) will be of extruded aluminium, Low Leakage Aerofoil design. A constant volume mechanical control damper valve will be installed which will also be easily accessible for corrective purposes. The supply air needs to be constant to maintain the proper air change rate.

f. A wire mesh screen to prevent entry of rodents/birds/insects, etc. will be placed in front of the damper at the mouth of supply.

g. **Filters:**

o There will be three sets of filters- coarse filters at mouth of supply and fine filter after blower motor of supply unit and HEPA filter housing in the supply ducting at a distance of about 500mm from fine filter unit.

- Coarse filter will be in outside fresh air pre-filter section and will be G4 washable filter (50 mm deep) class having average arrestance of 85-98% for 10 microns size as per EN779 2002, after damper at mouth of supply (as mentioned in volume control damper).
- Fine filters will be F7 filter (300 mm deep) Average Efficiency 85-95% for 1 micron size as per EN 779 2002 standards and placed after coarse filter before air goes into DX system.
- F-7 filter to be provided with test port elbows (pre and post) to put in magnehelic gauges tubing for measure differential pressure across it. These test port elbows will remain sealed/closed in routine condition.
- The HEPA filter plenums (Containment Housing) shall be made in SS 304 (14 gauge) with air tight and leak proof construction. The HEPA filter plenums shall be provided Isolation dampers at Inlet and Outlet and shall have provisions and facility to carry out on site HEPA filter scanning, testing and validation, magnehelic pressure gauge to monitor pressure drop across the HEPA filter, fumigation ports to allow IN-SITU decontamination of HEPA filters and Bag-In-Bag-Out facility for change/replacement of filters. The quantity of HEPA filter should be provided on the basis of supply air room volume, length of duct.

h. Ducting: Ventilation ducting shall be made out of minimum 24 gauge GI sheet, all the ventilation ducting shall be leak proof and with thermal insulation (the colour of insulation material will not be black). This insulation is made of aluminium foil nitrile rubber (19mm) or glass wool (50mm) thick. The GI duct should be fabricated as per SMACNA standards. To prevent air leakage, all the lateral joints and flanged joints of GI ducting should be sealed using silicone sealant.

i. Ducting design will be submitted by the vendor along with details of bends, dimensions of the duct at various places from AHU to the Negative pressure Isolation room, number of inlets/outlets planned, etc. which would be suitable from the lab being upgraded. It will have to be consulted with lab design expert and the lab i/c and approved before construction is carried out.

vi. Exhaust System

a. Design of Exhaust Air System: One variable speed exhaust fan of Gebhardt/ Krugger/ Nicotra or equivalent reputed OEM (Original Equipment Manufacturer) should be installed. The fan shall be backward (or forward) curved centrifugal double inlet multi blade with optimized selection for low noise and high efficiency. Fans shall be statically and dynamically balanced for vibration free operation. Fans shall be enclosed in galvanized steel scroll cases and shall be driven by a variable frequency drive (VFD). The VFD should be pre-set programme for five different varying fan speed with selector switch for user operation. Fan and motor assembly shall be mounted on vibration isolators eliminating the need for external vibration isolators. Provision shall be made for belt tensioning. Motor should be of required capacity of Crompton Greaves/ Siemens/ ABB or equivalent of reputed OEM make. The fan should not exceed noise level of 75 db(A) from 1 m distance. A spare motor shall be provided in case of any burn out/breakdown for immediate repair/replacement which can be done by local engineer. 5 spare fan belts shall also be provided which can be replaced by local engineer in case of wear/tear.

b. Exhaust Air System will be designed such that it ensures directional air flow by differential pressure gradient across different rooms and maintains minimum 6-12- fold air change per hour in the lab area (including separate exhaust ducting for BSCs installed).

c. Ducting: Exhaust ducting (like supply) shall be made out of minimum 24 gauge GI sheet. The GI duct should be fabricated as per SMACNA standards. To prevent air leakage, all the lateral joints and flanged joints of GI ducting should be sealed using silicone sealant. All the ventilation ducting shall be leak proof and with thermal insulation (the colour of insulation material will not be black). This insulation is made of aluminium

foil nitrile rubber of thickness 13 mm or glass wool of thickness 25mm.

d. Air Filtration: The exhaust air filter handling systems shall be provided with HEPA Filters such that it protects the maintenance staff from acquiring any infections while handling/replacing the filters -Bag in Bag out system (BIBO). It is essential that the maintenance person wears PPE while doing so. The HEPA filters will be located prior to exhaust unit at a place which is easily accessible and has adequate space for BIBO to function effectively. The HEPA filter housed in BIBO should have efficiency of H13 or H14 tested as per EN1822 at MPPS (Maximum Penetrating Particle Size). The HEPA filter plenums (Containment Housing) shall be made in SS 304 (14 gauge) with air tight and leak proof construction. The HEPA filter plenums shall be provided Isolation dampers at Inlet and Outlet and shall have provisions and facility to carry out on site HEPA filter scanning, testing and validation, magnehelic pressure gauge to monitor pressure drop across the HEPA filter, fumigation ports to allow IN-SITU decontamination of HEPA filters and Bag-In-Bag-Out facility for change/replacement of filters. HEPA Filters of 99.99% efficiency would be used in all exhaust. All the HEPA filters should have 0.3µm filtration.

e. Supply Air system to be electrically interlocked (fans, dampers, electrical) with exhaust air system, to prevent sustained positive pressurization.

vii. **Appropriate negative differential pressures** (for e.g. the negative pressure room where bio safety cabinets are placed shall be -12.5 Pa (-0.05" WG) relative to the anteroom, anteroom shall be -12.5 Pa (-0.05" WG) relative to change room if planned, and the change room shall be -12.5Pa (-0.05" WG) relative to the outside atmospheric pressure. Manual differential pressure gauges shall be placed outside Change Room, Ante room and main lab. Pressure balancing system to maintain room/zone pressures within specified set limits shall be provided which should be done through manual control. Magnehelic gauges used will be of DYWER/ WAREE/ WIKA or equivalent reputed OEM (Range -50 to 0 to +50 Pascals) with supporting SS Hardware with Top plate & suitable Box SS 304 including tubing & suitable fitting & accessories in wall panel.

viii. **Fire Dampers for supply and exhaust air:** As a safety feature, fire dampers shall be provided in both supply as well as exhaust duct. In supply system it will be in between variable damper and inlet (but at an accessible point from outside). In the exhaust system it will be located in exhaust ducting coming out of the building and prior to BIBO assembly at an accessible point from outside. These dampers are curtain type made of SS interlocking blades with fusible link which melts at 74°C

ix. **Leak proof dampers** with provision to prevent backflow of air shall be provided in supply unit (after blower motor and before volume control damper) and in exhaust unit (in between blower motor and volume control damper). It is made of SS blades with neoprene gasket

x. **AHU SHED:** It will be required at sites where AHU is installed on roof/ outside the lab building. AHU shed with provision for fencing, door with lock-key arrangement.

a. Framework vertically made of M S Square Pipe frame: 2 Inches X 2 Inches, 16 Gauge

b. M S Fencing with wire mesh: ½ inch X ½ inch
c. Supporting Structure M S Angle: 50 X 5 mm
d. GI pre-coated corrugated profile roof sheet: 0.5 mm thick duly supported with J Hook.
e. 10 SWG with provision of door with lock and key

AHU Shed with fencing should be duly enamel painted and with anti-rust coating from both sides. The height covered shall be at least 8 feet. There should be no gap between roof sheet and wire mesh, if any angle creates gap, it should be covered with iron bars and wire mesh in between.

3. Electricals:

i. The electrical power requirement (power matrix) for the Negative pressure Isolation roomoratory should be calculated and provided by thelab.
ii. Supply should be three phase supply with proper earthing and required 440 V capacity to support the functioning of AHU Unit.
iii. **Earthing:** If earthing is not adequate, the vendor will do the necessary grounding work to ensure entire NEGATIVE PRESSURE ISOLATION ROOM C&DST Lab has adequate earthing. Earthing should be done as per standard for the heavy machinery equipment and the value of earthing should be less than 5 ohm and the voltage between E-N should be less than 1 V.
iv. All the required electrical panels, cabling, switchgears, surge and spike protection system and arrangements, etc. for the purpose of energizing the Negative pressure Isolation room facility shall be carried out by the contractor.
v. All the electrical fittings and fixtures in the laboratories areas on the walls shall be sealed (all conduits, outlets shall be sealed with silicon sealant), leak proof and capable to withstand chemical exposures during fumigation.
vi. Lighting should be on ceiling and surface mounted, LED of reputable manufacturer, suitable capacity (~18W) and arranged as per the layout provided. Light fixtures inside shall be with gasket or otherwise sealed with silicon.
vii. The electrical power distribution scheme shall be provided to provide back-up power supply to the critical components and equipment through a UPS (to prevent any disruption of work) and through Diesel power generator set for the entire lab.
viii. Every workbench should have at least one socket which received electrical input through UPS of Negative pressure Isolation room. Extractor fans of BSC' ducting

should also receive electrical input through this online UPS of the Negative pressure Isolation room.

ix. Power sockets with lid (15-20 in each room) should be provided for equipment (as per the layout provided). Modular type, power sockets with lid of 5A/15A are to be provided at various locations on the wall as per discretion and strategic arrangements /provisions for lab equipment. The Sockets meant for UPS should be screen printed as (UPS) for ease of operation and identification marked wires and cables used shall be copper wire of standard make (ISI Marked) and

manufacturer.

x. AHU Control panel:
   - Cabling from the panel to individual AHUs and control wiring will be in the scope of HVAC contractor. However cabling up to the electrical panel will be provided by site. Termination will be done by HVAC contractor. In case of power failure, the alternate power through Main Diesel Generator Set of the Hospital Supply to be used. The Panel is to be design accordingly.
   - Housing of the AHU panel shall be GI 16 gauge powder coated, with cable inlet and outlet going through grommet and with earthing connection arrangement.
   - Multi-function meter displaying voltage, load and power factor for electricity supply to AHU panel should be present.
   - LED indicator for ON/OFF will be provided for RBY phase, AHU supply, AHU exhaust, Standby exhaust, Condensation unit, Heating Coil of Supply Unit
   - DOL Starter Switch to be provided for AHU exhaust, AHU Supply and Condensation Unit (in the order)
   - All electrical equipment used should be high quality of reputed manufacturers like VFD may be Allen Bradley, Siemens make or equivalent, MCCB may be of Havells, Legrant, Anchor, Siemens, L&T or equivalent, wiring of Havells, Polycab or equivalent make, etc.
   - Control panel should show simple instructions for starting the AHU
   - Diagrams of electric circuit should be displayed on the backside of door of panel.
   - Control panel should have its lock and key (for controlled access)
   - SOP for lab condition for operating VFD with selector switch for manual operation of AHU

xi. MCCB panel suggesting supply and safety mechanism for different sections of the lab should be provided at adequate place near AHU control panel.

4. **Fire Safety:** Fire detection and alarm system (FDA System) and fire extinguishers of Type ABC (4kg) & inert gas system (4 Kg) shall be provided at strategic locations (Negative pressure Isolation roomRoom, Ante Room should be of inert gas system and outside at entrance of Negative pressure Isolation room and near control panel, near AHU should be of ABC type and should overall comply with fire safety guidelines). Training will be provided for its operation.

a. UNINTERRUPTED POWER SUPPLY SYSTEM (UPS): A central UPS console shall be provided to cater to the extreme essential power requirement of the laboratory. All critical components like lights, Door Interlocks, exhaust blowers of BSCs, Fire alarm sensor, CCTV camera & monitoring shall be provided with uninterrupted power supply for 30 minutes.
b. Fire and electrical safety are described in the relevant sections.

5. Interiors of the Negative pressure Isolation room:

i. Modular walls: The internal building finishes shall be monolithic, impervious, non-particle shredding, chemical resistant especially to Hypochlorite cleaning and suitable to withstand chemical use during decontamination/ fumigation. Modular wall should be made for Clean Room application, pre-engineered 60 mm thick PUF panels with GPSP Sheets with PUF insulation of minimum 38-40 kg/m^3. Both surfaces should be 0.8 mm thick GPSP sheet and has to be installed along the outer walls, partitions and false ceiling to create an impervious shell which is fully sealed. The panels on either side will be coated with Epoxy painted. These panels must have good aesthetic appeal as well and have to be easily maintainable. The height of wall shall be minimum 9 feet (to accommodate BSC with its thimble and damper).

ii. Modular false ceiling: The internal building finishes shall be monolithic, impervious, non-particle shredding, chemical resistant especially to Hypochlorite cleaning and suitable to withstand chemical use during decontamination/ fumigation. Modular false ceiling panels should be made for Clean Room application, pre-engineered 60 mm thick PUF panels with GPSP Sheets with PUF insulation of minimum 38-40 kg/m^3. Both surfaces should be

0.8 mm thick GPSP sheet and has to be installed along the ceiling, to create an impervious shell which is fully sealed. The panels on inner side will be coated with Epoxy painted and powder coated on outer side. These panels must have good aesthetic appeal as well and have to be easily maintainable. The construction of false ceiling shall be strong to allow 1 person weighing 50-60 kg to easily walk/crawl above it for necessary work. Service window will be provided for access above false ceiling preferably outside Negative pressure Isolation room.

iii. Flooring shall be of 5 mm (3 mm + 2mm) of self-levelling industrial epoxy including screed compound for adhesion, 3 mm semisolid cladding of EPOXY will be applied over a uniform cemented flooring and 2 mm semi-liquid epoxy over 3 mm hardened surface with bubble free perfect smooth finishing completed in three steps: Cementing (Uniform Flooring), Hardening (3 mm epoxy) and smoothening (2mm epoxy). Epoxy used for this application will be self-levelling and clean room compatible. Flooring outside the Negative pressure Isolation roomfacility where required for aesthetic purpose will be covered with vinyl flooring.

iv. Doors:

i. Flush Door finishes shall be 45mm thick with chemical resistant, anti- fungal and anti-bacterial properties.1.2mm thick GPSP sheet suitable to fix on 60 mm thick wall panel with provisions for double glazing glass for all door and hardware like push plates and handle on both side, lock and key, etc. PUF Panels will be with GPSP Sheets, epoxy painted on both sides and PUF insulation of minimum 38-40 kg/m3. Concealed hardware for fixing of door frames, TS-71 door closure, SS hinges, SS Door handle, SS ball

bearing butt hinges, concealed tower bolt for the double door, both sides lock and key arrangement. Suitable neoprene "Y seal" type gaskets may be used between the door jam and door stop.

ii. Door interlocking systems shall be complete with controller module, push button stations with LED indication, electromagnetic locks. To take care of malfunctioning of interlocking, alternative electrical switch to manually open the doors should be provided.

iii. Vision Glass for doors shall be fixed type vaccumised and insulated type with 6 mm toughened glass and shall be installed for natural lightening

flushed with surfaces of the door. Fixed flush to both faces of the door / wall panels to provide ease of cleaning and maintenance. No crevices / joints / sloped profiles are used for fixing the glass. This will avoid particle contamination and dust accumulation.

v. Covings: Extruded aluminium anodized R75 clip-on type (Male & Female connectors) covings for entire wall to floor, wall to wall & wall to ceiling joints. Extruded aluminium double cove integrated with top track of the partition panels. Corner internal & external cove joining pieces in aluminium anodized finish. Having similar construction and finish as the walls and properly sealed with silicon sealant with wall & ceiling. Covings used in construction shall include Wall to Wall Coving -R-75, Wall to Ceiling Coving-R-75, 90°Corner, 3-D Corner,2-D Corner

vi. All penetrations through walls, ceiling & floors will be sealed using a suitable caulking. Caulking shall be applied around pipes and conduit. The interior of electrical and cable conduit shall also be caulked.

6. **Monitoring Mechanism:** Monitoring of crucial parameters will be made available in the lab for the following:
   a. Visual display of Room Pressure, Relative humidity and temperature in the Negative pressure Isolation room
   b. Differential pressure through Magnehelic gauges in Ante-room, Change Room (where available) and outside Negative pressure Isolation room.
   c. In the Control Panel- Multi-function meter displaying voltage, load and power factor for electricity supply to AHU panel and LED indicator for ON/OFF will be provided for RBY phase, AHU supply, AHU exhaust, Standby exhaust, Condensation unit, Heating Coil of Supply Unit.
   d. CCTV footage from the various sections in the Microbiologist's room.
   e. Hooter/alarm when the emergency exit door is opened as well as when fire detection system is activated in incidence of fire.

7. Connectivity:
   a. LAN wiring for internet access inside the lab with sockets to be provided at strategic locations (near work benches) in Negative pressure Isolation room.
   b. A suitable EPABX System shall be provided for the laboratory. Telephone instrument with line will be kept in Microbiologist room, Staff room and Negative pressure Isolation room and any other place as

suggested by Site i/c. Telephone with speaker for hands free operation will be provided inside Negative pressure Isolation room.

8. SPECIALIZED NEGATIVE PRESSURE ISOLATION SUPPORT EQUIPMENTS AND SYSTEMS
   a. **CCTV Monitoring Devices:** Camera to continuously monitor the activities inside and outside the Negative pressure Isolation room by providing Central CCTV Monitor. Six Camera unit should be installed (one/two outside the Negative pressure Isolation room covering the entry and corridor area, one in ante room /Change Room and two inside Negative pressure Isolation room and one covering AHU Area). Supply, installation, testing and commissioning of the following shall be done:
      - Color Camera 1/3" CCD, IR type, dome shaped, 480 TV lines resolution which work in low light.
      - 6 Channel standalone / Network version DVR Make: DAHUA /equivalent reputed OEM
      - Hard Disk with 1 TB (TERA byte) Capacity -Make -Seagate or equivalent reputed OEM
      - 6 Channel Power Supply of reputed Make
      - Supply Laying of Co-axial Cable with necessary Accessories
      - Wall mounted monitor (at least 20 inch LED/LCD) located in Microbiologist room or as suggested by site i/c.

9. **Final performance and capacity testing and validation:** All the certification and validation parameters for Negative pressure Isolation room must be done in accordance in with NIH certification requirement. BSCs will be validated and calibrated as per NSF 49and EN 12469 standards.
   a. There will be periodic mid-term assessment of the project (after plumbing, electrical works, ducting and AHU installation, construction of interiors and dry run) by identified technical people and Site i/c to assess the timely and proper execution of the project.
   b. After completion of the construction and installations, the entire Negative pressure isolation facility, all the equipment, systems and services shall be validated by the contractor under supervision of a committee of the consultants / client or lab i/c as follows:

      i. For Negative pressure Isolation room- The installation as a whole shall be balanced, tested and validated upon completion, and all relevant information, including the following shall be submitted to the Institution
         - Pressure in each room/zone as per the design, differential pressure readings including across filters.
         - Air inflow velocity and outflow velocity test across all inlets and outlets to measure/derive air change rate per hour (minimum 6-12 ACH) and as per design
         - Smoke pattern test for directional airflow should be performed during validation including for Pass box.
         - Temperature shall be maintained at 22°C±2 and humidity level should be maintained at 60±10%
         - HEPA Filter (in BIBO) integrity test based on PAO

test and manufacturer's certifications

- Electrical current readings, in amperes on full load work, average running, and on starting, Testing of power cabling, earthling, AHU control panel, MCCB panel and LT panels
- Containment room -the walls, floors, ceilings, penetrations, and other containment barrier features have adequate integrity
- Operational performance testing for
  - HVAC including Blower motors in the Supply, exhaust including emergency, extractor of BSC ducting and condensation unit
  - Ducting for any potential leakages and insulation breakage
  - Dampers including variable control, leak proof and fire control (only verification)
  - Magnehelic Gauges
  - Temperature control sensors; pressures control sensors,
  - Passbox
  - Split ACs
  - Fire Detection system
  - EPABX System
  - Access Control System
  - CCTV System
  - UPS Back up system
  - Emergency Shower and eye wash station
  - Interlocking of supply blower motor and exhaust blower motor

c. Prior to validation, the contractor shall prepare and submit a detailed 'Validation Document' for approval.
   i. The Validation Document shall provide the detailed procedure for validation, parameters for validation, validation schemes and formats for recording the validation details.
   ii. The contractor shall arrange to do a mandatory third party validation
   iii. The contractor shall arrange for all the instruments, tools, manpower etc. required for the validation. The validation results shall be recorded and documented and shared with the site and hiring/funding agency.

d. The above validation tests shall be performed Annually during the warranty as well as maintenance period

In addition to the above validation tests, preventive maintenance servicing of all installations, operational performance testing as listed above shall be carried out on a quarterly basis during the maintenance as well as defects liability period.

10. **Training of personnel:** Institution personnel to be trained over 2 days for:
    a. Operation of HVAC Plant and all other equipment and systems.
    b. Adjustments of settings for controls and protective devices
    c. Servicing and Preventive maintenance
    d. Emergency response training.

11. **Submission of specialized systems and services layout schemes prior to**

initiation of the work: Conceptual layout plans and schematic drawings of various specialized services and utilities showing tentative locations of equipment and furniture such as to be submitted before initiating work at site for approval to hiring agency and site i/c

a. HVAC system (including Air filtration system Drawing of Supply AHU, Drawing of Exhaust AHU, Ducting drawing)
b. Pressure control system including differential pressure zones
c. Fire Detection and Alarm system
d. Air distribution System including ACH ((Heat load calculation & Design Data)
e. Electrical distribution system (including Single Line Diagram with UPS system)
f. Monitoring system including CCTV and three important parameter monitoring (pressure, temp and humidity)
g. Water supply and drainage system.
h. AHU Control Panel System with VFD controls and SOP for lab condition for operating VFD with selector switch for manual operation of AHU
i. Chart for defining the AHU fan and its speed for air quantity being delivered by supply and exhaust blower at different speed
j. Un-interrupted Power Supply system

12. Documents for final submission: The following documents are required to be submitted after Final assessment and validation of Negative pressure Isolation room for verification and approval to hiring agency and to the lab within 15 days of completion of successful validation.
    a. The drawings and layout of each final commissioned Negative pressure Isolation room should be shared with site and hiring/funding agency (both in soft and hard copy) for verification.
    b. All Test Certificates / Maintenance manuals / As Built drawings / Spare Part List should be submitted to site and hiring/funding agency after validation within one week.
    c. Detailed document on Negative pressure isolation Validation Procedures and to include as per table

BUILDING MANAGEMENT SYSTEM (BMS):

A customized Building Management System shall be designed, programmed and provided to:

i. Control and monitor the operation of HVAC system and other Negative pressure isolation operating parameters in the BSL-3 Lab rooms/zones like: Room/Area/zone pressure, temperature & RH, Ambient temperature & RH, AHU and Exhaust Blower operating status, VFD status & VCD status, OPEN/Close dampers status, Supply & exhaust air quanlity in each BSL- 3 Negative pressure isolation rooms/zone.
ii. The BMS shall be complete with PLC, Sensors, Controllers, power and control wiring, customized Software and other associated field devices, hardware and accessories complete in all respect, as per requirement and approved design.
iii. The HVAC system START and STOP sequence shall be interlocked to prevent positive pressurization of the BSL-3 laboratory, at any point of time.
iv. A dedicated desktop PC shall be provided for the BMS operation and control along with a parallel secondary display screen of 32" size at the BSL-3 laboratory entrance to show the operating parameters.

v. The BMS control panel shall be powered through UPS. Upon restoration of power after a power failure, the BMS shall start the HVAC system automatically without any human interface and restore the normal operational set points of the system.

Alarm and Monitoring Systems:

a) Pressure gauge
b) Pressure alarm visual/audio
c) Temperature/RH alarm visual/audio
d) Emergency panic button (break glass type) - audio all rooms/control room
e) Emergency door-open" button (For interlock door)

Computerized Controls (PLC/DDC):

The control System, consist of PLC (Programmable Logic Controller) should automatically adjust system airflow and maintain system as the designated negative pressure.
The PLC/DDC should have the following features:

- The system controller (Programmable Logic controller) controlled via a dedicated software program.
- Centralized Control
- Automatic air flow control.
- Pressure, Temperature & Humidity monitor and control.
- Doors interlock - controlled by PLC/DDC and display on the PLC/ DDC control panel.
- HEPA filter resistance and efficiency monitoring. When the pressure of the filters reaches the setting value, the PLC/ DDC has the alarm.

The DDC System should be real time control on the internet and realize different control strategy separately. The DDC system should address the bubble tight position according to the negative pressure feedback signal to control the negative pressure of the Negative pressure isolation at the value which is set up. Emergency shutdown when system integrity breaches the correct sequence. In case of the normal fan failures, the stand by fan should be turned on at once to achieve the set value of negative pressure in 60 seconds. When opening the lab, first turn on the exhaust fan, then turn on the supply fan; pressure stability accomplished within 15 minutes from the start up. When turning off the lab, first turn off the supply fan, then turn off the exhaust fan.

BMS PB (Computer Specification): Supply and Installation of Main Operator Station Comprising Main P.C. with Intel i series or latest 2.5 Ghz CPU complete with accessories such as 21" LCD color monitor, 1 TB hard disk or higher, 5 GB RAM or higher, 101 Keys Key Board, Optical Mouse & Pad, DVD writer drive with A4 B/W Laser Printer including UPS with half an hour battery backup.

BMS SOFTWARE: Supply, Installation, Testing and Commissioning of the BMS System Software: Graphical Software meeting the requirements in the Given I/O Summary and technical specifications including configuration and facility to create / provide the graphic mapping for all I/O summary points, configurable password protection for Building Mgmt System as per Specifications. Software shall be able to communicate with Bacnet, Modbus devices simultaneously, with unlimited web user license capacity. Same software can be used as programming / commissioning software.

BMS PANEL: Automation stations/ Direct Digital Controller with I/O module etc. The networkable controllers shall be 32 bit, UL listed microprocessor with built in networkable (IP) type with real time clock with SD-CARD programmable memory. Minimum one networkable DDC (32 bit, UL Listed) should have inbuilt graphics display with knob operation. The networkable DDC's shall be capable of either direct sitting on IP LAN or peer to peer communication with lockable MS mounting cabinets duly powder coded connector strip, internal wiring and space to house controller & relays, connector etc. as per IO summary.

Door Interlock and Access Control System

The door interlock and access control system shall be provided with combination of proximity card based, numerical key pad lock based and push button based system. The system shall be complete with access logic controllers, door electromagnets, proximity cards and card reader/s, numerical keypad locks, door release push buttons, emergency door release buttons, PC communicator, control and power wiring and cabling and other required accessories, hardware, and software. The access control system shall be powered through UPS supply for uninterrupted operation even during mains power failure. The door Electromagnetic Lock shall be suitable for installation on doors/frames. The electromagnetic lock and armature shall be constructed and designed to provide trouble free service.

Superintending Engineer
AIIMS Rishikesh

Approved Make List

Note: Citing appropriate reasons you can also include items/parts from other companies/manufacturers not included in the list, that meet the appropriate quality standards.

Air Cooled Chilling Units	VOLTAS/BLUESTAR/CARRIER/ TRANE/YORK
Chilled Water Pump	KIRLOSKAR/ CROMPTON GREAVES/ ARMSTRONG/ GRANDFOSS/ KSB
Supply & Exhaust AHU	CITIZEN/VTS/FLAKTWOODS/SYSTEM AIR/ZECO/EQUIVALENT
Hot Water Generator	RAPIDKOOL/KHOKAR/EMERALD/EQUIVALENT
Supply & Exhaust AHU blower	NICOTRA/KRUGER/COMFRI/EQUIVALENT
Motors(for AHU)	ABB/SIEMENS/BHARAT BIJILI/CG/EQUIVALENT
VFD	SIEMENS/ABB/SCHNEIDER/DANFOSS/EQUIVALENT / OEM MAKES ACCEPTABLE
Chilled Water Piping	TATA/ JINDAL/SAIL/ HSL/RAVINDRA/EQUIVALENT
Butterfly valve	ADVANCE/ INTERVALVE/ AUDCO/C&R/CASTLE/ARROW/EQUIVALENT
Balancing Valve	ADVANCE/ INTERVALVE/ AUDCO /C&R/CASTLE/ARROW /EQUIVALENT
Gate Valve	LEADER/SANT/DIVINE/ADVANCE/CASTLE/ EQUIVALENT
NR Valve	ADVANCE/ INTERVALVE/ AUDCO/C&R/CASTLE/ARROW/EQUIVALENT
Flow Switch	JOHNSON/HONEYWELL/STAEFA/EQUIVALENT
Y strainer	SANT / EMERALD/RAPIDKOOL/EQUIVALENT
Temperature Gauges/ Pressure Gauge	WAREE/H GURU/FIEBIG/JAPSIN/FORBESMARSHALL/EQUIVALENT
Air Vents	I TAP / ANERGY/SANT/H GURU/CASTLE/EQUIVALENT
Pipe Insulation	AEROFLEX/ ARMACELL/SUPREME/PARAMOUNT/K FLEX/EQUIVALENT
Duct Insulation	AEROFLEX/ ARMACELL/SUPREME/PARAMOUNT/K FLEX/EQUIVALENT
Ducting GI Sheets 280 GSM with certificates	TATA/ JSW/ SAIL/JINDAL/EQUIVALENT
Volume Control Dampers/ Fire	CARYAIRE / AIRMASTER / AJANTHA/ SYSTEMAIR/ CONTINENTAL/

Dampers – Fusible Link	EQUIVALENT
Bag In Bag Out HEPA Filters with Module	AAF / CAMFIL/THERMADYNE/EQUIVALENT
HEPA Filter with Filter Module	AAF / CAMFIL/THERMADYNE/EQUIVALENT
Wall Panel/ Ceiling Panel/ Doors	FABTECH/I-CLEAN/GMP/SYNERGY/ NICOMAC /AIRTECH
Grills/Diffusers/Dampers	AIR MASTER/ AJANTHA/ SACHIN IMPEX / CARYAIRE /MKPRECISION/ CONTINENTAL/ SYSTEMAIR/ EQUIVALENT
Heaters	HEATCON/DASPASS/ESCORTS/UTKAL/EQUIVALENT
I BMS System/ Modulating 3 Way valves/ Thermostats/Humidistat/Sensors	HONEYWELL / SIEMENS/JOHNSON CONTROL/ROCKWELL/EQUIVALENT
Magnehelic Gauge	DWYER/EQUIVALENT
Air Circuit Breaker & Bus Couplers	L & T/SIEMENS /ABB/EQUIVALENT
MCCB	L & T/SIEMENS/SCHNEIDER/ABB/CG/EQUIVALENT
MCB's	L & T/SIEMENS/SCHNEIDER/ABB/CG/HAGER/LEGRAND/EQUIVALENT
ELCB's	L & T/SIEMENS/SCHNEIDER/ABB/CG/LEGRAND/EQUIVALENT
Power/Control Contacts, Over load Relays, Timers, etc.	L & T/SIEMENS/SCHNEIDER/ABB/EQUIVALENT
Fuses	CG/L & T/SIEMENS/EQUIVALENT
Energy Meters	L & T/CONZERVE/EQUIVALENT
Power Cables/Control Cables/Wires etc.	FINOLEX/UNIVERSAL/POLYCAB/KALINGA/HAVELLS/RR CABLES/ EQUIVALENT
CAT 5/6 Cables	AT&T/KABEL/DIGILINK/LAPP/LUCENT/EQUIVALENT
Electrical Conduits	BHARAT/GUPTA/POLYCAB/PRECISION OR EQUIVALENT MAKE WITH ISI STD.
PASS BOX	THERMADYNE/ENERTIA/EQUIVALENT.
PVC Conduit	POLYCAB/PRECISION/SUPREME/EQUIVALENT
Switches & Sockets	POLYCAB/CROMPTON/NORTHWEST/LEGRAND/WIPRO/PHILLIPS/MK/

	HAGER/LEGRAND/EQUIVALENT
LT Panel	CPRI APPROVED MANUFACTURER
Distribution Board	LEGRAND/ L&T/ABB/HAVELLS/SCHNEIDER/EQUIVALENT
Light Fixtures	POLYCAB/CROMPTON/NORTHWEST/LEGRAND/WIPRO/PHILLIPS/MK/ HAGER/LEGRAND/EQUIVALENT
Biosafety Cabinet	ESCO/NUAIRE/THERMO/BIOSAFE/EQUIVALENT
Pre-insulated Valves, strainers	CR VALVES/ AUDCO/ ADVANCE/ LEADER/SANT/CASTLE/ INTER VALVE/ KIRLOSKAR/EQUIVALENT
Epoxy Coating	APURVA/DR. BECK/FOSROK/CLEANCOATS/EQUIVALENT
Autoclave	NAT-STEEL/ MACHINFABRIC/ EQUIVALENT
CCTV Camera	CPPLUS/BOSCH/PALCO/SONY/LG/SAMSUNG/MOBOTIX/VIVOTEK/ EQUIVALENT
Fire Alarm System	HONEYWELL/BOSCH/ SIEMENS/SYSTEM SENSOR/GST/EQUIVALENT
Door Interlocking & Access control system	REALTIME/HID/LG/ESSL/EQUIVALENT

ELECTRICAL ITEMS

S. No.	Item	Name of Manufacturers
1.	FRLS PVC insulated copper conductor single core cable for wiring. (ISI marked)	Universal/Nicco/Finolex /R.R Kable/ Havells/ Batra Henlay/Anchor/Grandlay/Bonton
2.	Telephone Cables Co-exail TV cables	Delton/Kent/Finolex /Polycab
3.	CAT-6 Cables for LAN wiring & Internet Cable	D-Link/Legrand /Finolex/Avaya/Lucent/ RR Kable.
4.	MS Conduit i/c accessories (ISI marked)	AKG/BEC/NIC/Steelcraft / JPC Pipes/RMCON
5.	DWC Pipe	REX/Duraline/Gemini pipe
6.	Modular switch, socket/Telephone socket/cable TV socket/Data outlet Socket/Fan Regulator/Metal Boxes/ Occupancy sensor	Legrand-(Arteor)/ M.K.(Blenze)/ Crabtree/Anchor Woods/C&S
7.	GI Pipe	Tata/Jindal (Hissar)/Prakash Surya/Swastik
8.	Paints	ICI/Asian/Berger
9.	Terminal Blocks and connectors	Elmex/Essen/Connect Well.
10.	Compact air insulated rising main.	Legrand/Schneider/L&T/GE
11.	MCB, MCBDB, RCBO's/RCCB's	Schneider Electric/Legrand/L&T Hagger Siemens/ABB/Anchor/C&S
12.	MCCB/Timer	Schneider Electric/ Siemens/Larsen & Toubro/ Legrand/L&T Multiline/ Havells/ABB/C&S
13.	SFU, FSU, HRC Fuses, cable management	Schneider Electric/ Siemens/ Legrand/ L&T/

	system/DLP Trunking	Havells/C&S
14.	Ammeter/Voltmeter	AE/IMP/Rishabh/HPL (only digital type to be used)
15.	Selector Switch/CT's	Kayee/Siemens/Bhartiya Cutler Hammer/L&T
16.	Change over Switch	/H-Elcon/Standard/L&T/Siemens/ Havells/C&S
17.	Indicating Lamps	Teknic/Siemens/L&T/Vaishnov
18.	Panel Board/Feeder Pillar	Manufactuers having ISO 9001 certification & CPRI approved
19.	Energy Meter/Multifunctional/Intelligent Energy Meter.	/L&T/Hensel/Anchor/Siemens.
20.	Fresh Air Fan/Wall Mounted Fan/Ceiling fan/Exhaust fan. (only energy efficient fans. consuming ≤ 50 W and CMM ≥ 200 for 1200 mm & 60 W and CMM ≥ 240 for 1400 mm shall be used).	Crompton/Orienpt/Polar/Khaitan/ Ortem/ Usha
21.	Fluorescent/CFL/LED/Flood/Bulk head Fitting	Phillps/GE/Wipro/Crompton/C&S
22.	Lamps	GE/Osram/Phillips/Wipro/C&S
23.	Wall Brackets	DECON/Phillips/GE/Havells
24.	Angle Holder/Batten Holder (ISI marked)	Kinjal/Emperor/Anchor
25.	Geyser	Racold/Crompton/Jaguar./AO Smith
26.	NRV/Gate Valve	Sant/Leader/BS
27.	XLPE inslulated PVC sheathed aluminium cable upto 1.1 KV Gd	Polycab/Finolex//Nicco/KEI/Grandlay/ Gloster/Universal/Bonton/RR Kabel
28.	PVC conduit i/c accessories	Precision/Asian/Diamond/Mod./AKG/JPC Pipes
29.	Paino type Switches/Socket/TV / Telephone Outlet (ISI marked)	Anchor/Rider/Leader
30	UPS EQUIPMENTS, CABLES & RELATED ITEMS	Emerson /Schneider electric (APC)/ Numeric legrand ,

Superintending Engineer,
AIIMS Rishikesh

SCOPE OF WORK

This work includes all modifications to the built up space provided at the hospital site including installation of BOQ items or items as per site requirement , civil modifications , electrical works , plumbing works , interior decorations , air conditioning ducting and other related works for the smooth functioning of Negative pressure Isolation rooms. Bidder shall execute all required civil , electrical and peripheral lighting, plumbing, HVAC , demolition, reconstruction works as may be required for complete installation and trouble free functioning of Negative pressure isolation rooms as part of this tender.

In general the scope of works to be performed under this contract shall include but not limited to:

1. Design, engineering manufacture, inspection & testing at works, supply, transportation to site, , loading, unloading , storage, installation, testing ,commissioning and handing over of Negative pressure isolation rooms.

   Designing, engineering, providing all materials, equipment and services specified or otherwise, which are required to fulfill the intent of ensuring operability, maintainability, completeness and reliability of the total work shall be in the scope of the bidder.
   Any equipment, material, component, accessories which are not specifically mentioned in price bid and technical specifications, but necessary for satisfactory installation and trouble free operation of Negative pressure Isolation rooms adopting good engineering practice shall be in the scope of the bidder .

2. Providing complete design, engineering data, calculations, detailed drawings, schemes, commissioning procedure, O&M manuals, catalogue etc. for review/reference and records before procurement action/manufacture.

3. Supply, installation, testing & integrated commissioning of the complete system as per the approved drawings/documents.

4. All statutory approvals / license for the equipment(s) / system(s) shall be obtained by the contractor as needed including approval of relevant drawings from the electrical inspectorate of Govt. / competent authority & approval of the entire installation, after completion of work as per the approved drawings/documents.

5. Effective co-ordination with the other agencies (internal & external) to carry out the work smoothly.

6. Proper handing over of the installations in satisfactory working conditions alongwith required as built drawings, documents and items as specified in the tender.

7. INSPECTION OF SITE :

The bidder to inspect and examine the site and its surrounding and shall satisfy as to the nature of the ground and sub soil, the quantities and nature of work, materials necessary for completion of the work and their availability, means of access to site and in general to obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect his offer. No extra claim consequent on any misunderstanding or otherwise shall be allowed.

8. **PRICE :**

- Price shall be inclusive of all taxes & duties whatsoever, excise duty, sales tax, CST/VAT, GST service tax, octroi (if any), work contract tax, commissioning spares, labour, tools & plants, packing, freight/ transportation & insurance up to the site, loading, unloading, fee (s) for testing, license, inspection, documents, etc, where applicable.
- AIIMS Rishikesh does not give any confessional forms/ certificates/ permits towards any taxes, duties & other levies like sales tax, customs duty, road taxes/ permits, etc.
- Prices shall be firm throughout the contract period.

9. MAKES

- In general make of various items shall be as per the list enclosed. Wherever makes have not been indicated in the list, the items shall be of ISI marked and CDC guidelines subject to approval by AIIMS Rishikesh Engineer in Charge .

- Sample of the items or makes or the items for manufacture/ supply/ use in the work irrespective of appearing in the approved list shall be got approved from Engineer- in-charge before incorporation.

10. NEW MATERIALS:

All equipment, materials used in the work shall be brand new of BIS/ISI/UL/CE marked and free from manufacturing defects.

11. REPLACEMENT OF DEFECTIVE/ DAMAGED ITEMS

All defective/damaged items shall be replaced with the good ones without any extra cost as per guarantee clause.

12. TOOLS & TACKLES:

- All the required special tools & tackles for executing this work shall be in the scope of the vendor

13. MAN POWER:

- Authorized, experienced, competent and skilled work force shall be deployed with competent supervision.
- They should possess requisite qualifications/ valid permits/ license/ competency certificates to work on LT Electrical Installations.

14. QUALITY OF WORK & WORKMANSHIP:

The quality of work, workmanship, finishing etc should be satisfactory to the AIIMS Rishikesh. No payment shall be made for inferior quality or rejected work.

15. TESTING AND INSPECTION:

- All equipment/systems to be supplied shall conform to type tests as per the relevant standards. The bidder shall furnish the reports of all the type tests carried out.These reports should be for the tests conducted on identical/similar components/equipment/systems to those offered /proposed to be supplied under this contract. In case type test reports are not found to be meeting the specifications/relevant standard requirement then all such tests shall be conducted under this contract by the contractor free of cost to owner and reports shall be submitted for approval.

-All acceptance and routine tests as per relevant standards and specifications shall be carried out. Charges for all the tests shall be deemed to be included in the bid price. Routine test/acceptance test shall be carried out in the presence of the inspecting officer from AIIMS Rishikesh .

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All major items listed in list of approved makes for electrical items and items pertains to Negative pressure rooms shall be factory inspected. The decision to inspect/waive shall rest with the AIIMS Rishikesh .The list of approved makes enclosed is indicative, AIIMS Rishikesh . can add/delete/modify the same in the interest of organization/work from time to time considering cost, quantity, significance, completion schedules etc.

At least 15 days advance notice to be given for inspection. While inspection call is given, the actual status and details of test to be offered shall be communicated. Relevant applicable Indian standards & International standards shall be made available.

If any equipment/material fails in the tests conducted during inspection, necessary rework/replacement shall be done and equipment shall be re-offered for inspection without any cost to owner..

16. DRAWING & DOCUMENTATION TO BE SUBMITTED BY SUCCESSFUL BIDDER AFTER AWARD OF CONTRACT:

-

- Following information and documentations in addition to what has been asked for in respective equipment specification shall be furnished by the successful bidder after award of contract for approval/reference/record of the purchaser.

- Electrical layout drawing showing location of equipment, cable routing, etc.

- Single Line Diagram showing rating of components, metering, Earthing layout showing connections to equipment, structure etc.

- Drawings of all electrical equipment under the scope.

- All required drawings/documents/technical information required during various stages of works shall be submitted as and when required by the purchaser.

  All drawings submitted shall provide sufficient detail indicating type, size, general arrangement & foundation drawing, weight, the external connections, fixing arrangement required, the dimensions required for installation and interconnections with other equipment and materials, clearances and space required between various portions of equipment and any other information specifically requested.

  - All the above document shall be furnished in 3 sets to AIIMS Rishikesh .for review. One set shall be returned with comments / approval. The document shall be modified incorporating the comments given by AIIMS Rishikesh and 3 sets of corrected documents shall be submitted by contractor within 10 days time.

17. STATUTORY LAWS/RULES/APPROVALS/LICENSE:

The contractor/agency shall abide by the relevant statutory rules, laws, and guidelines and arrange for the approvals, if any required. That include adhering to labour laws, abiding local electricity rules etc.

18. SITE TESTS/ PERFORMANCE TESTS:

Necessary site tests/ performance tests i.e required negative pressure as per CDC guidelines , Air changes, leak test etc shall be conducted on the to ascertain the functional / design/ site requirements. Reports shall be prepared recording the various values, parameters, observations, settings made etc. In case of unsatisfactory results, the same shall be replaced/ rectified as per the requirement without any extra cost.

19. HANDING OVER/ CERTIFIED DATE OF COMPLETION:

Up on the satisfactory commissioning of the entire system, the system shall be observed for 15 days. After this satisfactory trial period, the work shall be handed over officially and completion date recorded by Engineer-in- charge with all the prescribed formalities for handing over.
This date shall be reckoned, as the certified date of completion and the defects liability period shall commence from this date.

Until the handing over of the installation, the responsibility lies with the vendor for safety, upkeep etc.

TRAINING/ FAMILIARIZATION ABOUT OPERATION & MAINTENANCE

The contractor to AIIMS Rishikesh staff shall give training / familiarization regarding operation & maintenance of the equipment /system at site.

20. COMPLETION PLANS

On completion of work 3 sets of following as built drawings/documents to be submitted

- General Arrangements, Layout drawings with dimensions, plans, sections etc
- Single Line diagrams
- Control & Schematic Diagrams.
- Bill of Quantities indicating makes, Technical specs, quantity etc.
- Data Sheets, Calculations
- Control logic (where applicable)
- Details of Inventory
- Equipment name plate details
- Instruction / Maintenance Manuals
- Test Certificates (Factory Tests, sites Test)
- Guarantee/ warranty Certificates (where applicable)
- Other documents/ drawings as per the instructions of Engineer-in- Charge.
- Keys, operating handles, tools etc as applicable

21. DEFECTS LIABILITY PERIOD:

- **Defects liability period shall be 5 years from the certified date of satisfactory completion & handing over of entire work to Engineer-in-charge of work.**

- During this period, the contractor shall hold himself responsible for reinstallation or replace with good ones free of cost to the AIIMS Rishikesh. in respect of any defective item/material/equipment/component supplied and installed by the contractor. Contractor shall bear all the cost involved for supply, transportation and installation etc. of such items.

22. Bidder shall execute all required civil electrical, peripheral lighting, plumbing, demolition and any other works as required for complete installation and trouble free functioning of Negative Pressure Isolation Rooms as a part of Turnkey work.

IMPORTANT NOTE:- NEGATIVE PRESSURE ISOLATION ROOMS SHALL BE MADE AS PER CDC GUIDELINES ATTACHED IN THIS TENDER DOCUMENT. SAMPLE OF EACH ITEM INCLUDED IN THIS TENDER SHALL BE GOT APPROVED BY ENGINEER-IN-CHARGE PRIOR MANUFACTURING AND EXECUTION.

Superintending Engineer
AIIMS Rishikesh

Airborne Infection Isolation Rooms

AIRBORNE INFECTION ISOLATION ROOMS (AIIRS)

A properly designed and operating AIIR can be an effective infection control measure. Infectious airborne particles are contained within the room, and the concentration of these particles inside the room is reduced.

However, a badly designed and/or incorrectly operating AIIR can place HCWs and other patients at risk for TB infection and disease. In this situation, infectious particles may not be contained in the room, and/or their concentration inside the room may not be effectively reduced. Staff members who rely on such an AIIR may have a false sense of security.

The mechanical elements that make an AIIR effective will deteriorate over time, which may make the controls ineffective. For example, fans can break and ducts can be- come clogged with dust and lint. People who have not been trained in environmental controls may inadvertently adjust or alter the controls. An AIIR that was successfully tested after construction may not be operating correctly a month later. Hence, peri- odic and ongoing assessment of AIIRs is important.

This manual provides basic information about assessing and improving the design and operation of an AIIR. It also includes options to convert an existing patient room into an AIIR and information on guidelines and regulations covering AIIR environmen- tal controls.

TB control in high-risk settings is commonly organized in a hierarchy: administrative (or work practice) controls are the most important, followed by environmental controls, and then respiratory protection. Although this section only addresses environmental controls, all three components should be in place for an effective TB control program.

Whenever an AIIR is used, written policies and procedures should be developed and im- plemented to address the administrative aspects of the AIIR. They should include:

- criteria for initiating and discontinuing isolation
- who has authority for initiating anddiscontinuing isolation
- isolation practices
- how often and by whom the policy and procedure is evaluated

- developing and implementing a written respiratory protection program is also required.

Designing a New State-of-the-Art AIIR

This section describes the requirements and guidelines to be considered when designing a new AIIR, either during new construction or during renovation.

Planning Stage

During the planning stages of a new construction or a remodel project, users often meet with architects to discuss various design elements. This enables the users to provide in- put to the design team. These discussions usually concentrate on the physical layout of the space. The mechanical elements are often left to the mechanical engineer's discretion.

Infection control coordinators and other appropriate managers should be included in this process. The infection control aspects of the mechanical system should be addressed so that the people relying on the controls understand this system.

Architects and mechanical engineers may not be aware of some infection control require- ments. While engineers must comply with building codes to get approval for construction and occupancy, they may not be aware of CDC recommendations, or of federal or local OSHA requirements. However, architects and engineers should be familiar and comply with the most current AIA Guidelines for Design and Construction of Hospital and Health Care Facilities and ANSI/ASHRAE Standard for Ventilation for Acceptable Indoor Air Quality.

The mechanical design elements of a new hospital AIIR should, at a minimum, meet all local code requirements, as well as OSHA requirements, CDC recommendations, AIA Guidelines, and ANSI/ASHRAE Standards.

Architectural Considerations

Architecturally, an AIIR should meet all the detailed requirements for a single-patient room, including a dedicated adjacent bathroom.

Architectural design elements should also meet local code requirements. For example, California requirements include:

- Code minimum clearance around the bed
- Code minimum room area
- Windows operable only by use of tools or keys

To increase the effectiveness of negative pressure, the architectural elements should en- sure that the AIIR suite is sealed, except for a half-inch high air gap under the door. To- wards this end, the ceiling should be plaster/sheet rock rather than removable ceiling tiles, and lights should be surface-mounted. Gasketing should be provided at the sides and top of the door, and at ceiling and wall penetrations such as those around medical and electri- cal outlets.

The location of the proposed AIIR should also be considered: areas prone to strong drafts, such as those near elevator banks or doorways, should be avoided if possible.

AIIR doors should be equipped with self-closing devices.

The mechanical design elements of a new hospital AIIR should, at a minimum, meet all local code requirements, as well as OSHA requirements, CDC recommendations, AIA Guidelines,and ANSI/ASHRAE Standards.

Determining the Correct Ventilation Rate

When designing the heating, ventilating, and air-conditioning (HVAC) elements of a build- ing, the amount of air supplied to each room is usually selected on the basis of comfort concerns. Unless there are governing code requirements, the engineer will provide venti- lation air as required to keep the space comfortable. This air quantity is usually less than the amount required for effective dilution and removal of infectious particles.

For many spaces in healthcare facilities, such as AIIRs, infection control concerns may be more important than comfort concerns. Engineers should increase the airflow rate ac- cordingly. A straightforward way to increase the effectiveness of ventilation is to increase the amount of air moving through a space—in other words, to increase the ventilation rate.

A room's ventilation rate can be calculated if it has mechanical ventilation. The ventilation rate is usually expressed in air changes per hour (ACH). By calculating the ACH, the room ventilation rate can be compared to published standards, codes, and recommendations. It can also be used to estimate the length of time required to remove infectious particles.

One air change occurs in a room when a volume of air equal to the volume of the room is supplied and/or exhausted. The air change rate in ACH is the volume of air circulating every hour divided by the room volume. Appendix K (page 156) describes air change rates in more detail and demonstrates how to calculate the air change rate of a room that has mechanical ventilation and/or a HEPA filter unit.

It is recommended that AIIRs have an exhaust air ventilation rate of at least 12 ACH. This recommendation is consistent with the CDC Guidelines and meets all local requirements known to CNTC.

The ACH is the airflow per hour divided by room volume (see Appendix K). For AIIRs, the exhaust airflow should be calculated, rather than supply airflow. The ACH of the dedi- cated bathroom or anteroom, when present, should be calculated separately from that of the AIIR itself. In other words, only include exhaust air that is exhausted in the AIIR.

Variable Air Volume (VAV) Systems

Many mechanical systems do not provide a constant airflow rate. These are called vari- able air volume (VAV) systems. They are designed to continually vary the amount of cool- ing or heating air delivered to a room in response to the amount of cooling or heating re- quired. Supply air varies between a fixed minimum and a fixed maximum using a VAV box installed in the ductwork. VAV systems are generally not found in hospitals, but are com- mon in buildings that may include clinics.

The volume of air supplied to an AIIR should not vary. Therefore, if an AIIR is to be in- cluded in a building served by a VAV system, the box supplying air to the AIIR should be set to deliver constant airflow. The mechanical engineer will need to address comfort control of this room separately.

Locating Supply and Exhaust Ductwork and Outlets

The supply and exhaust location should be chosen to maximize air mixing and to optimize directional airflow from the staff member towards the patient. Exhaust should be removed near the possible contamination source.

The best arrangement is to supply air at the ceiling above the foot of the bed, and to ex- haust air on the wall near the floor at the head of the bed (where the patient's head is likely to be).

The supply diffuser should be the louvered blade type, rather than the perforated face type. The diffuser neck size and blow pattern should be selected so that air is directed to all parts of the room. Locate the diffuser where the airflow is not obstructed by items such as surface-mounted light fixtures or a suspended television set.

The bottom of the exhaust grille should be located approximately 6 inches above the floor. Because the grille does not direct air, its face pattern is not as important as that of the diffuser. The vertical exhaust duct should be installed in the AIIR wall. An enlarged wall cavity will be required and should be coordinated with the architect. To reduce noise, dampers should be located at a point in the duct far from the outlet. The area in front of the exhaust grille should be kept clear of obstructions, such as furniture and supply carts.

The individual air ducts providing supply and exhaust air for the AIIR suite should have control dampers to adjust the airflow quantity. These dampers are usually manually oper- ated, but may be automatic. To ensure access, the handles for the dampers should not be above the AIIR ceiling. They should be either accessible from above the corridor ceil- ing, or remote, tamper-proof handles should be provided in the ceiling or wall of the AIIR.

Maintaining Negative Pressure

As described previously (on page 26), negative pressure is achieved when exhaust air exceeds supply air and the room is well sealed except for a gap under the door.

The CDC Guidelines recommend a negative pressure differential of at least 0.01 inches of water gauge ("W.G.).

In practice, an offset this small can be inadequate. Negative pressure may not be consis- tently maintained if there are other external factors, such as fluctuating air currents caused by elevators, doors, or windows to the outside.

Because smoke may migrate into a room during a fire, building code officials are con- cerned with the amount of air drawn into a room under the door from a corridor. The amount of exhaust air offset from the corridor will need to comply with local codes, which may limit the maximum allowable offset. If the AIIR is equipped with an anteroom, this is- sue will not be as important.

CNTC recommends that the negative pressure differential across the AIIR door be ap- proximately 0.03" W.G. In practice, this may require that the airflow offset be adjusted to more than 100 CFM after the room is built, but before it is occupied. Engineers should allow for this possibility in their designs.

AIIR with Dedicated Bathroom

Some AIIRs have a dedicated bathroom that is part of the AIIR suite and only for use by the isolated patient. Such AIIRs are more likely to be found in hospitals than in clinics. The advantage of the bathroom is that the patient will not have to open and close the door as often to leave the suite.

To contain odors, the AIIR bathroom should be at negative pressure with respect to the AIIR, where applicable. The bathroom ventilation should comply with local requirements. For example the California Mechanical Code (CMC) mandates an air change rate of 10 ACH, negative pressure, and direct exhaust to the outdoors for bathrooms. In general, an offset of 50 CFM is sufficient between the bathroom and the AIIR.

Both the AIIR and the combined AIIR and bathroom should be at negative pressure. In other words, not only must the total exhaust for the AIIR plus bathroom exceed the total supply for AIIR plus bathroom, but the AIIR exhaust should also exceed the AIIR supply. This is illustrated in the "Case Study: Dedicated Bathroom" on page 107.

Handling AIIR Exhaust

Exhaust air removed from AIIRs is likely to contain infectious particles. Consequently, this air should be discharged directly outside the building, where the particles can be diluted by outdoor air and killed by sunlight.

While not included as a minimum recommendation by the CDC Guidelines, the optimum type of exhaust system should serve only AIIR suites, i.e., a dedicated exhaust system. Where applicable, this exhaust system should also serve the dedicated AIIR bathroom and anteroom.

Over time, dust and lint can collect at exhaust grilles and in exhaust ducts. Also, seals at duct joints break down and leak. These two effects result in diminished exhaust airflow from the AIIR. To compensate, exhaust ducts should be oversized. AIIR exhaust ducts and fan systems should be sized for the expected airflow plus an extra 50%.

Labeling

Maintenance personnel and contractors often re-route ducts to accommodate new ser- vices. To help protect these workers from potentially contaminated AIIR exhaust, the ex- haust ductwork should be permanently labeled. The label should read, "Caution— AIIR Exhaust," or similar words to that effect. The labels should be attached, at most, 20 feet apart, and at all floor and wall penetrations.

Maintenance workers may also shut down the exhaust fan without realizing this will cause a loss of negative pressure. To avoid this possibility, a permanent warning sign should be posted on the fan at the electrical disconnect and at appropriate

electrical panel breakers. The sign should read, "AIIR Exhaust Fan — Contact Infection Control Coordinator Before Turning Off Fan," or have similar wording. The sign should also include the telephone number of the infection control coordinator and the room number(s) of the AIIR(s) ex- hausted by the fan.

Exhaust Discharge

The exhaust fan discharge should be located and designed to minimize the possibility that this air is inhaled by people who are outdoors or inside the building. Exhaust air should bedirected away from occupied areas (i.e., walkways) or openings into the building (i.e., windows or outside air intakes).

To promote dilution, the fan discharge should be directed vertically upward at a speed of at least 2,000 FPM. The discharge location should be at least 25 feet away from public areas or openings into a building.

If a suitable discharge location is unavailable, then the exhaust can be disinfected using a HEPA filter (see page 42). In this case, a HEPA filter must be installed in the discharge duct upstream of the exhaust fan. This is not a desirable option, however, because it will be considerably more expensive to install, maintain, and operate than a simple exhaust fan assembly.

Installing a Permanent Room Pressure Monitor

After a new AIIR is constructed and before it is occupied, the mechanical contractor will adjust the airflow quantities as directed by the engineer to ensure that it operates as de- signed. However, mechanical systems do drift out of balance over time. It is important to regularly check that an AIIR is still operating under negative pressure; planning for this should be included in the initial mechanical design of the room. Room pressure monitors should be used as a supplement to daily visual checks when the room is in use.

The most reliable way to monitor negative pressure is to install a permanent electronic room pressure monitor as part of the construction project.

When properly selected and installed, a room pressure monitor can provide continuous qualitative and quantitative confirmation of negative pressure across a room boundary. This is in contrast to routine periodic smoke testing, which merely provides an indication of directional airflow at the moment of testing.

Continuous monitoring can provide instant notification if the pressurization fails or fluctu- ates during the day.

Most monitors consist of two main components: a wall-mounted panel and a sensor. The panel is usually mounted on the corridor wall just outside the AIIR suite and displays the pressure difference in units of " water gauge.

There are two common types of permanent pressure monitors: those that measure and display the actual air pressure difference between the AIIR and the reference space (direct type); and those that measure the velocity of air moving between the two spaces through a fixed opening and convert this to a pressure value (indirect). Both types require an elec- trical power connection at the wall panel. Either type is suitable for an AIIR, but indirect monitors generally provide a more accurate pressure reading.

Pressure differentials across room boundaries can be very small, often in the range of thousandths of an inch. For example, the CDC Guidelines recommend that negative pres- sure be at least ≥ 0.01" of water gauge. Some devices that measure differential pressure are not accurate to this level. Before specifying or purchasing a room pressure monitor, make sure that the device is capable of accurately and reliably measuring a pressure dif- ference this small.

Direct Room Pressure Monitor

To record a pressure differential directly, two readings are required: the air pressure in the room and the reference pressure in the corridor. A remote sensor to measure the room pressure is installed in the negative pressure room wall or ceiling. Another sensor mea- sures the air pressure in the corridor. The difference in these two pressure values is the relative room pressurization, which is displayed on the panel.

If there is an anteroom between the AIIR and the corridor, the pressure differential to be measured is the one between the AIIR and the anteroom. In this case, both measurement points are remote from the corridor panel. If there is no anteroom, the reference pressure can be measured right at the panel, and only one remote reading is required.

The location of the remote sensors will affect the accuracy of the measurement. They should be installed as close as possible to the AIIR door, but away from drafts.

Tubing will need to be run from the panel to the sensor(s). For new construction, this tub- ing will typically be run out of sight inside wall cavities and above the ceiling. Air tubing is usually rigid plastic, but can be made of copper.

Indirect Room Pressure Monitor

The sensing component of a velocity-reading room pressure monitor consists of an air tube with an interior velocity-sensing element. The tube is installed in the wall between the AIIR and the anteroom or corridor. An electrical device measures the air velocity and direc- tion. This signal is run back to the wall panel, where it is converted to a pressure readout.

Again, care should be taken when installing the sensor. It should be located above or next to the door, but away from the influence of drafts. To help shield the sensors, louvered cover plates are usually provided on both sides of the wall.

The signal between the sensor and the wall panel is a low voltage electrical signal instead of the air tubing used in direct pressure monitors.

Alarm(s) and Controls

In addition to providing a continuous readout of the pressure difference, the wall panel should include an audible and visual alarm to warn staff when pressurization is lost.

The alarm will sound when the measured room pressurization drifts to less than the mon- itor's reference pressure value. Reference pressure valves are programmed into the unit by an engineer or trained staff member. It will be a value between the

steady state pres- sure differential maintained by the room and zero (neutral pressure).

For example, in a room with a steady state pressure differential of minus 0.03" W.G., the alarm could be programmed to activate when the pressure differential falls to minus 0.001" W.G.. Minus 0.001" W.G. is the reference pressure value.

The wall panel should also allow staff to program a built-in time delay between loss of pres- surization and alarm activation. The time delay will allow staff a sufficient interval to routinely enter and leave the room without setting off the alarm. A typical time delay is 45 seconds.

The audible alarm is usually a beeping sound, which will stop when negative pressure is restored or when a "mute" button on the panel is pressed.

The visual alarm usually consists of a red warning light. Most wall panels also have a green "normal" or "safe" light, which indicates that the monitor is operating and negative pres-sure is within programmed parameters. Unlike the audible alarm, the visual alarm will not reset when the "mute" button is pressed. After negative pressure is restored, the lights will either automatically reset or the "reset" button must be pressed, depending on the brand of the monitor. In case no one was present, the latter option will indicate that negative pressure was temporarily lost.

Remote Alarm

In addition to the alarm included on the wall panel, most room pressure monitors include an extra identical signal that allows a "safe" or "alarm" signal to be sent from the wall panel to a remote location. Common locations for this remote alarm are the nurses' sta- tion, the engineering department, and the central switchboard.

It is usually possible to connect the alarm signals from a number of AIIR monitors to a remote alarm panel. In California, for example, the hospital building codes require that AIIRs be equipped with an alarm that annunciates at the room *and* at a nurses' station or other suitable location.

Other Optional Features

There are a number of room pressure monitors available with additional options. Exam- ples of such options include: an amber "warning" light that illuminates during the time delay when negative pressure is lost; adjustment for use in positive pressure rooms; and remote control of a fan or damper to maintain and control negative pressure.

Commissioning and Staff Training

The monitor installer's responsibilities should include verifying the operation of the sensor. A detailed checklist is included as Appendix C on page 145. The following should be com- pleted before the room is used to isolate suspected or confirmed infectious TB patients:

1. **Verify that the alarm works.** Hold the room door open. After the time delay, the audible and visual alarm should annunciate. The alarm should reset after the "mute" or "reset" button is pressed and/or the door is closed again.
2. **Verify that the monitor is correctly reading the pressure.** While the door is held open, the pressure reading should be at or near 0" water gauge.
3. **Instruct staff on monitor usage.** The floor staff that depend on the monitor for their safety should feel comfortable using it. They should receive detailed instruc- tions on how the monitor works and how it is used.

The checklist should be completed for each AIIR monitor in the facility. A copy of the completed steps in the checklist should be kept in the Policies and Procedures binder for that department.

Ongoing Monitor Checks

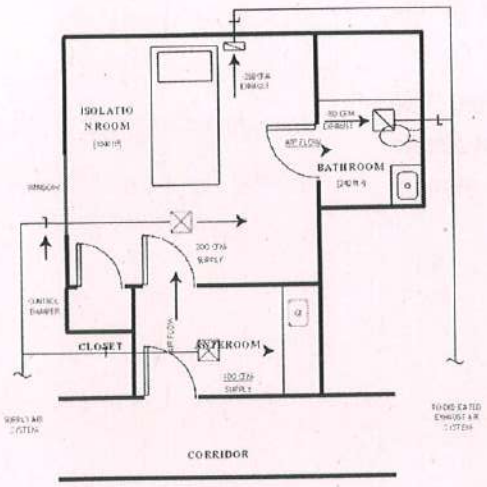
To validate the continuous pressure monitor, negative pressure should be verified month- ly with smoke tube or similar testing (see page 81). Daily verification is required when the room is in use or if there are no alarms on the pressure monitor. The results should be recorded. Space for this is included in the checklist.

Most manufacturers recommend that each monitor be recalibrated annually. The recali- bration procedure will depend on the monitor type and should be available from the man- ufacturer. CNTC recommends that the step in the new monitor checklist be completed at the same time.

To validate the continuous pressure monitor, negative pressure should be verified monthly with smoke tube or similar testing.

FIGURE 10.

AIIR with Anteroom



An anteroom should be provided between the AIIR and the corridor. This will help prevent infectious particles in the AIIR from escaping into the corridor.

When an AIIR door is open, negative pressure is immediately lost. If there is an anteroom that is negative to the corridor, then the overall integrity of the suite is maintained. The anteroom provides an "air lock" between the AIIR and the rest of the facility.

An anteroom should be at positive pressure with respect to the AIIR, and at either neutral or negative pressure with respect to the corridor. Because smoke may migrate from the corridor if there is a fire, some codes and regu- lations mandate that the anteroom be neutral to the corridor, rather than negative. However, in practice this is very difficult to accomplish. It is not easy to balance airflow to a space so that it will be positive at one door and neutral at the other. Furthermore, air pressure in the corridor will vary due to external factors such as elevators and corridor doors to the outside.

Local codes should be consulted regarding other design elements of anterooms for AIIRs. For example, California requirements include:

- Provision of a sink, cabinets, and work counter
- Provision of a view window in the door to the AIIR
- Alignment of door to corridor with door to AIIR, or provision of a second locked and gasketed entry for gurney
- Maximum of two AIIRs per anteroom.

Assessing an Existing AIIR

This section covers the steps that should be taken to evaluate the effectiveness of an existing AIIR.

Failed environmental controls in AIIRs have been identified as factors in documented hos- pital TB outbreaks. Regularly scheduled assessment of environmental controls will iden- tify and may help prevent such failures.

Items that should be checked include the exhaust and supply airflow rate, negative pres- sure, and exhaust duct termination location.

Ventilation

To determine the ACH of a space, you will need to measure the airflow and calculate the room volume. See Appendix K on page 156.

The airflow measurements and calculations should be performed by a certified testing and balancing agency or by in-house engineering staff.

Airflow Measurement

The airflow of a room is usually measured at the individual registers and diffusers using a balometer. This is a device that consists of a hood, a velocity sensor, and a micropro- cessor.

The hood is placed over a register or diffuser and should completely cover the air outlet. The top of the hood should have a foam gasket that establishes a good seal between the hood and the ceiling or wall around the outlet.

The hood directs all air entering or leaving the outlet past a velocity-sensing grid. The area of the grid is fixed. Therefore, the microprocessor can calculate and display the quantity of air being exhausted or supplied by the air outlet. Balometers usually provide an airflow reading in cubic feet of air per minute (CFM).

The standard size of a balometer hood outlet is 24" X 24", although adapters are provided to adjust the hood size. This size hood can be used to measure the airflow of any outlet equal to or smaller than this (e.g., 12" X 24" or 18" X 18" diffuser). For other size outlets, such as a 36" X 6" slot diffuser, the hood size on the balometer may need to be changed.

There may not be sufficient space in front of some outlets to place the balometer. In this case, the airflow should be measured by a pitot traverse in the duct that serves the outlet.

A pitot traverse is a specialized measurement that requires access above the ceiling. Air velocity is measured at a number of sample locations inside the duct. Airflow is calculated based on these velocity readings and the area of the duct cross-section. However, pitot traverses are not as accurate as balometers.

If a dedicated exhaust fan serves the AIIR suite, it may be possible to estimate the airflow at the room by measuring the airflow at this fan. Because of duct leakage, this measure- ment will not be as accurate as one taken at or near the outlet. Inadequately sealed duct joints can result in extra air being sucked into the duct between the AIIR exhaust grille and the fan, which would result in an overestimate of airflow in the room. To compensate for this, an allowance of at least 10% should be made. This allowance should be increased in the case of a long duct run.

Regularly scheduled assessment of environmental controls willidentify and may help prevent failures.

If room airflow is found to be inadequate, i.e., less than 12 ACH, it should be increased. For information on modifying existing room airflow, see "Upgrading or Converting an Ex- isting Room" on page 101.

Air Mixing and Directional Airflow

After establishing the airflow, the next step is to evaluate how effectively this air is used in the AIIR. This assessment is not as straightforward as calculating the airflow rate because there is no clearly defined numerical standard to meet.

Smoke testing can be used to visualize the direction of room air and to estimate how well air is mixing. Consequently, ventilation problems can be identified, such as undesirable directional airflow patterns and poor mixing.

Ideally, the clean supply air will be introduced near a HCW, while exhaust air will be re- moved near the patient. Good air mixing is confirmed by rapid dissipation of the test smoke in all parts of the room, which demonstrates that particles generated in the room are being diluted and removed.

If air mixing is not optimal due to short-circuiting or stagnation, the diffuser and/or register should be relocated or replaced. Either of these options will require the services of a con- sultant mechanical engineer. In the interim, a supplemental propeller-type fan can be placed in the AIIR to encourage air mixing. Such a fan is not recommended as a long-term solution because it may create uncomfortable drafts and be turned off by the patient.

Exhaust Ductwork and Discharge

The engineering department staff at the facility should trace the path taken by the exhaust air duct after it leaves the AIIR. If applicable, they should also check the exhaust duct serving the bathroom and anteroom. For the record, a set of drawings should be gener- ated (or an existing design set marked) to show the ductwork and fan.

The exhaust ductwork and fan should also be checked for optimum performance. Condi- tions that should be corrected include: excess air leakage at duct joints, damaged duct- work, incorrectly adjusted dampers, and fans in need of servicing.

Recirculating Air Systems

If air from an AIIR is returned to a recirculating ventilation system that does not include HEPA filtration, this room should no longer be used for isolation. Staff and patients in rooms served by this system may be exposed to *M. tuberculosis* from patients in isolation.

The risk of exposure from a recirculating mechanical system is affected by dilution of the return air with outside air and by the filter in the mechanical system. The risk is reduced as the percentage of outside air is increased and the efficiency of the filter is increased.

Filtration in hospital ventilation systems is usually better than in clinics because hospitals are typically covered by stricter building codes and have larger facilities and maintenance budgets.

Dedicated or Shared Exhaust System

The CDC Guidelines do not address the issue of dedicated exhaust air systems serving AIIRs. However, in some jurisdictions this is mandated by the building code for new or renovated rooms. Because most building codes are not retroactive, it is usually accept- able for an existing AIIR to combine the exhaust air with other exhaust systems, such as those serving bathrooms.

Duct and Fan Labeling

If the existing exhaust system is dedicated, make sure that the ductwork is labeled as recommended for a new AIIR ("Caution— AIIR Exhaust"). For a shared system, only the ductwork between the AIIR and the main exhaust trunk needs to be labeled.

The exhaust fan, whether dedicated or shared, should have a warning label as recom- mended for a new system ("AIIR Exhaust Fan— Contact Infection Control Coordinator Before Turning Off Fan").

See "Handling AIIR Exhaust" on page 92, for additional information on labeling of exhaust ductwork and fans.

Verifying Negative Pressure

Negative pressure is the easiest characteristic of an AIIR to check. Several methods are available to qualitatively assess negative air pressure, including smoke tube testing and tissue testing.

If the AIIR is operating as intended, there will be an air current moving into the room under the door. The existence and direction of this current should be verified.

Smoke Tube Test

Smoke tube testing helps visualize the current near a room door. In this simple procedure, smoke is released near the air gap under an AIIR door. See "Smoke Tube Testing Method for AIIRs" on page 106 for more detailed instructions.

Commercially available smoke-generating kits produce a visible cloud, which usually con- sists of water and acid. The quantity of smoke typically issued from the tube is minimal and is undetectable at short distances from the tube. Because inhalation of this smoke in concentrated form can cause irritation, care should be taken not to expose workers or patients until the smoke has been diluted. The amount of smoke used should not be ex- cessive.

There are many different types of easy-to-use smoke-generating kits available from safety supply companies. A typical design is the disposable self-contained puff bottle. Another common design is the disposable smoke tube, which attaches to a rubber bulb that acts like a bellows.

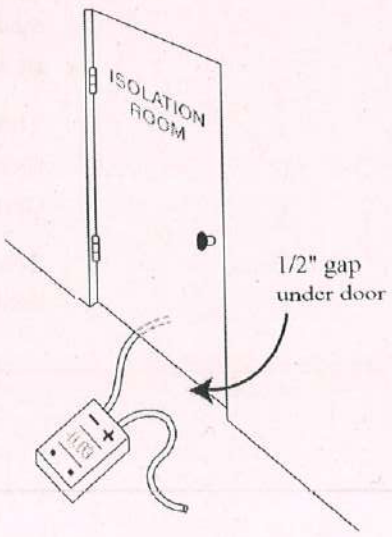
If commercial smoke-generating devices are not available, incense sticks can be used. CNTC recommends that two sticks be used side-by-side. However, incense smoke does have a strong odor, and is not as visible or controllable as commercial smoke.

Tissue Test

If smoke-generating devices are not available, or if the room is occupied by a patient who may be vulnerable to the irritant properties of smoke, a thin strip of tissue can be used to determine whether a room is at negative, neutral, or positive pressure. A thin strip of tissue should be held parallel to the gap be- tween the floor and bottom of the door. The direction of the tissue's movement will indicate the direction of air movement.

FIGURE 11.

Manometer



Manometer

Relative room pressurization can also be verified using a handheld pressure gauge or manometer, which is similar to a direct room pressure monitor, except it is portable. A length of rubber tubing is attached to each of the two ports on the manometer. The manometer displays " W.G., the pressure differ- ence between the two spaces at the termination of the tubes. If one of the tubes is threaded under the door into the AIIR and the other is in the hallway, the manometer will indicate the pressure difference between the two spaces. A negative symbol verifies that the room is at negative pressure.

Velometer

Air speed is measured by a velometer, usually in units of feet per minute (FPM). These devices can be placed near the gap under the AIIR door to measure the speed of the airstream. Velometers are available in a number of different configurations. Many only in- dicate air speed regardless of air direction. For instance, some velometers indicate how fast the air is moving, but not whether the air is entering or leaving the room. However, there are models available that can also be used to determine airflow direction.

Repeat Test

All of these tests to verify negative pressure should be conducted at least three times until the results are consistent.

Validate Existing Monitor

If the existing room is equipped with a permanent room pressure monitor, one of the above tests should be performed to confirm negative pressure and to validate the moni- tor. Also, the AIIR Pressure Monitor Checklist (Appendix C on page 145) should be com- pleted for the monitor.

Measuring Negative Pressure

After negative pressure has been verified, it should be measured. Table 10 summarizes three ways to quantify negative pressure. The corresponding units of measurement and the measuring device for each method are also shown.

TABLE 10 .

How to Quantify Negative Pressure

PARAMETER	UNITS OF MEASUREMENT	MEASURING DEVICE
pressure difference	inches of water gauge (" W.G.)	manometer
speed of air under the door	feet per minute (FPM)	velometer
exhaust air offset	cubic feet per minute (CFM)	balometer

Upgrading or Converting an Existing Room

This section covers methods of improving the ventilation characteristics of an existing room to make it more effective for AII.

Previous sections have outlined recommendations for a new state-of-the-art AIIR and have shown how to assess an existing room to see how it compares with these recommenda- tions. This section describes how to correct deficiencies found during the assessment.

The methods outlined below could also be used to convert an existing patient room into an AIIR.

- **Disconnect Recirculating Air System**

  The first step is to ensure that air from the room is not inadequately filtered and re- circulated to other areas. The air removed from the room must either be exhausted outdoors to a safe location or HEPA-filtered. If room exhaust is currently connected to a recirculating air system that does not include a HEPA filter, it should be discon- nected from this system.

- **Install HEPA Filter in Existing Return Air System**

  Theoretically, another safe option for correcting a recirculating system is to replace the existing filter with a HEPA filter. However, CNTC does not recommend this. A HEPA filter is a specialized piece of equipment that should only be used in a ventila- tion system specifically designed to accommodate it. HEPA filters are physically larger than most filters and require larger fans to overcome increased resistance to airflow.

- **Two Upgrade/Conversion Options**

  There are two basic approaches to upgrading or creating an AIIR. The preferred op- tion is to adjust the building ventilation system to create a permanent AIIR. A tem- porary solution is to add a recirculating HEPA filter unit to supplement, or even re- place, the building ventilation system.

  Regardless of the upgrade option selected, steps must be taken to reduce un- wanted air leakage from the room, i.e., the room must be sealed.

- **Negative Pressure**

  As explained previously, the negative pressure value will depend on two factors: how much more air is exhausted than supplied (i.e., the offset); and how well the room is sealed. In general, when converting or upgrading a room, the negative pres- sure value will not be as high as that attainable for new construction because there is less control over the architectural elements.

  CNTC recommends that the negative pressure value should be at least minus 0.006" W.G. for upgraded or converted AIIRs.

  This is more stringent than the CDC Guidelines, which recommend $\geq$ 0.01" of water gauge as a minimum negative pressure value.

Sealing the Room

A room in which exhaust exceeds supply will not necessarily be at negative pressure with respect to the corridor; it is not unusual to have such a room at positive pressure.

For example, a room could have exhaust air from the central system exceeding supply by 100 CFM. Assume this room has leaky windows and some holes in the ceiling tiles. If it is windy outdoors, 75 CFM could enter through the leaks around the windows, and another 75 CFM could enter through the ceiling. Now the air being introduced to the room ex- ceeds exhaust by 50 CFM. Smoke testing at the door would probably indicate positive pressurization.

When upgrading an existing AIIR or converting an existing room to operate at negative pressure, it is important to make the best use of the excess exhaust by sealing the room as tightly as possible. For a given exhaust air offset, the better the room is sealed, the greater the amount of air that will flow into the room under the door and the greater the negative pressure.

The following are some examples of steps that can be taken to improve a room's air- tightness:

- Apply gasketing at sides and top of room door
- Caulk around windowpanes and around window frames
- Apply gasketing at the connection of the ceiling and the walls
- Apply gasketing around electrical boxes
- Replace acoustic ceiling tiles with non-porous vinyl tiles and apply gasketing at tile connection to ceiling grid
- Replace recessed light fixtures with surface-mounted fixtures

Adjusting the Ventilation System

If the room is not currently connected to an exhaust system, it should be either connected to an existing exhaust system or a new system should be installed. Consult with the build- ing facilities department staff, which will probably hire a mechanical engineering consul- tant to design this work and oversee the construction.

Connect to Existing Exhaust System or Add New One

If there is an accessible exhaust air system nearby, such as a toilet exhaust system, with sufficient capacity, it may be possible to make a new exhaust connection to the existing return register. Otherwise, a new exhaust air fan and ductwork system should be installed.

New exhaust ducts, and new or existing exhaust fans serving AIIRs, should have the same warning labels used for new AIIRs.

Rebalance Existing Mechanical System

To increase room airflow and/or create, or increase, negative pressure, the existing venti- lation system needs to be adjusted to exhaust more air. The supply air quantity may also need to be increased. Airflow is varied using dampers.

Adjust Dampers

Dampers are devices that control the flow of air in ducts, similar to the way valves control the flow of fluids in pipes. Dampers, usually located above the ceiling, should only be adjusted by a facility engineer or certified air balance contractor. To increase airflow, the dampers in the ducts serving the room should be opened wider. It usually takes an air balancer two or three adjustments to obtain the desired airflow.

The exhaust airflow rate should be at least 12 ACH. For existing rooms, this recommen- dation is more restrictive than the CDC Guidelines, which accept an air change rate of 6 ACH. However, 6 ACH will not satisfy some local regulatory agencies, including Cal/OSHA and the Office of Statewide Health Planning and Development (OSHPD) in California. Twelve (12) ACH, which meets all local requirements known to CNTC, is readily achiev- able using HEPA filter units.

The supply should be approximately 100 CFM less than exhaust. Depending on how well the room is sealed, more air may need to be exhausted in order to achieve a larger pres- sure differential.

Most rooms do not have a dedicated ventilation system. They are connected to a fan system that serves other rooms in the building. Before and after adjusting the AIIR airflow, the air balancer should measure the airflow in some of these other spaces to make sure that the AIIR adjustments do not have an adverse effect on ventilation elsewhere.

Adding a Recirculating HEPA Filter Unit

It may not be possible or practical to connect to an existing exhaust air system, or to in- stall a new one. It is possible to create a temporary and less expensive AIIR. This can be done using a recirculating HEPA filter unit. There are two basic ways to use these units in AIIRs. They can be used to increase only the ventilation rate of a room without affecting room pressurization. Or they can be used to simultaneously:

- Increase the ventilation rate,
- Create or increase negative pressure, and
- Replace the need for additional exhaust.

HEPA Filter Units

HEPA filter units are readily available electrical devices that consist primarily of a fan, a HEPA filter, and a prefilter. They also include controls, such as a three-speed switch, and possibly an indicator light to indicate when the filter needs to be changed.

HEPA filter units are available in a number of different physical configurations, including wall- and ceiling-mounted types. The most popular configuration is the floor-standing, portable type.

Wall- or ceiling-mounted units are less obtrusive and do not take up floor space. They are also less likely to be tampered with by staff and patients. However, floor-mounted units are more portable and are easier to service. Regulatory bodies,

such as OSHPD in Cali- fornia, may require that a structural engineer oversee the design and construction of the support system for a wall-mounted or ceiling-mounted HEPA filter unit.

Increase Ventilation Rate

If negative pressure in the AIIR is satisfactory, but the ventilation rate is low, a HEPA filter can be used to supplement the room airflow rate. The effective ventilation rate of the room is the sum of the central system airflow and the HEPA filter unit airflow.

Sizing HEPA Filter Units

The size of the unit selected should be based on the additional airflow (in CFM) required to achieve the desired ACH in your room. To determine the additional airflow:

- Measure the actual CFM exhausted from the room, and
- Calculate the CFM required to achieve the desired ACH. The HEPA filter unit should be sized to make up the difference.

Most HEPA filter units allow staff to adjust the amount of air delivered by means of a switch. Common examples of switches include those with three fixed settings and those that allow any setting between the maximum and minimum. Manufacturers' catalogs generally list a CFM delivered by the unit at each of the three speeds, or at the high and low setting.

In practice, people usually turn down the HEPA filter unit switch and operate the units at or near the low setting. This is because the units can be very noisy and/or drafty when the fan is at, or near, full speed.

CNTC recommends that HEPA filter units be selected based on the airflow at or near the low speed.

These units may deliver less than the manufacturers' listed airflow, and output of the units may decrease as the filters load up. To compensate for this, it is recommended that the unit selected have a listed capacity that is 25% more than required. The marginal cost of selecting a unit with more capacity is usually not significant, compared to the initial cost of the unit.

To summarize, it is recommended that a unit is selected that can deliver 25% more CFM than required at or near the low speed fan setting.

For example, if 150 CFM is measured, and 220 CFM is required to achieve 12 ACH, then the required additional airflow is 70 CFM. If a HEPA filter unit is used to increase airflow, then 25% should be added to 70 CFM for a total of approximately 90 CFM. Therefore, a unit with a listed capacity of at least 90 CFM at or near the low fan speed setting should be selected.

Increase Ventilation Rate and Create or Increase Negative Pressure

If a sufficient portion of the discharge from a HEPA filter unit is ducted somewhere outside of the room, then the HEPA filter unit can create negative pressure and replace the need for any extra exhaust.

A HEPA filter unit supplements ventilation as follows:

- The effective exhaust air quantity is increased by an amount equal to the airflow of the HEPA filter unit (because this air is now being removed and droplet nuclei are removed by the filter)
- The effective supply is increased by an amount equal to the returned air quantity (HEPA unit airflow minus the amount discharged outside the room)
- The effective negative pressure offset is increased by an amount equal to the HEPA unit airflow discharged outside the room.

Theoretically, the technique described above could also be used to create negative pres- sure in a room that had no ventilation system. However, this is not recommended be- cause the room would then have no outside air at all, only recirculated, HEPA-filtered air. Building codes mandate that fresh outdoor air be supplied to all occupied spaces that do not have an operable window.

Monitoring the Environmental Controls

Once the AIIR upgrade has been completed, procedures to monitor the environmental controls must be implemented. This is essential to ensure that staff will be alerted if the controls fail.

The two items that need to be monitored are the airflow rates and the room pressurization.

Airflow Rate Monitoring

The airflow rates are monitored by measuring with a balometer to ensure that the rates have not deviated more than about 5% from the initial values.

Airflow rates should be measured and air change rates calculated at least once a year.

Room Pressurization Monitoring

Room pressurization should be continuously monitored to ensure that the room remains under negative pressure.

The CDC Guidelines recommend that room pressurization be confirmed daily while the room is occupied by a suspected or known infectious TB patient, and at least once a month at other times.

These tests can be done with smoke or a telltale device, such as a tissue. However, it is recommended that each AIIR be equipped with a permanent room pressure monitor.

Documentation

Records should be kept of all AIIR environmental control tests and measurements. Local regulatory agencies may require that these records be kept for a number of years. For example, Cal/OSHA requires that records be kept for a minimum of five years.

Smoke Trail (or Smoke Tube) Testing Method for Negative Pressure AIIRs

Smoke from a smoke tube can be used to observe airflow between areas or airflow pat- terns within an area. Smoke tube testing must be performed outside the room with the door closed.

To check the negative pressure in a room, hold the smoke tube near the bottom of the door and approximately 2 inches in front of the door, or at the face of a grille or other door opening. Generate a small amount of smoke by gently squeezing the bulb

The smoke tube should be held parallel to the door, and the smoke should be issued slowly from the tube to ensure that the velocity of the smoke does not overpower the air velocity. The smoke will travel in the direction of airflow.

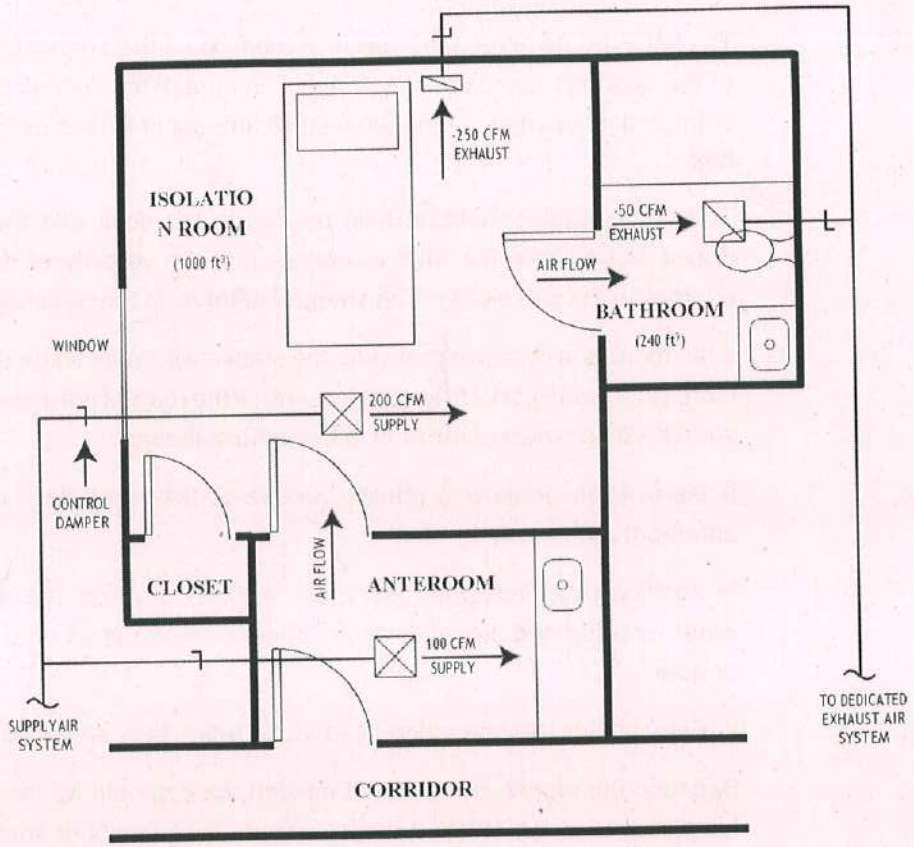
If the room is at negative pressure, the smoke will travel under the door and into the room (e.g., from higher to lower pressure). If the room is not at negative pressure, the smoke will be blown outward or will remain stationary.

If there is an anteroom, release smoke at the inner door undercut, with both anteroom doors shut.

In addition to a pedestrian entry, some AIIRs or areas are accessed through a wider wheeled-bed stretcher door. Release smoke at all door entrances to AIIRs or areas.

If room air cleaners are being used in the room, they should be running during the test.

Because the smoke is irritating if inhaled, care should be taken to prevent direct inhalation from the smoke tube. However, the quantity of smoke issued from the tube is minimal and is not detectable at short distances from the tube.



Dedicated Bathroom

Background

The setting is an AIIR with a dedicated bathroom. Supply air to the AIIR is 200 CFM.

The Options

The AIIR volume is approximately 1,000 cubic feet, so the supply air change rate is 12 ACH.

You are installing a new exhaust fan with a capacity of 300 CFM that will serve only the AIIR suite. Local codes mandate a minimum of 10 ACH in bathrooms. The bathroom volume is approximately 240 cubic feet, so a minimum of 40 CFM exhaust is required.

How should the 300 CFM of exhaust air be split up between the bathroom and the AIIR?

Should 250 CFM be exhausted in the AIIR and 50 CFM in the bathroom?

Or should 200 CFM be exhausted in the AIIR and the remaining 100 CFM in the bathroom?

The Best Option

The preferred arrangement is to exhaust 250 CFM at the AIIR and 50 CFM at the bathroom (as shown in the above diagram), rather than 200 CFM at the AIIR and 100 CFM at the bathroom.

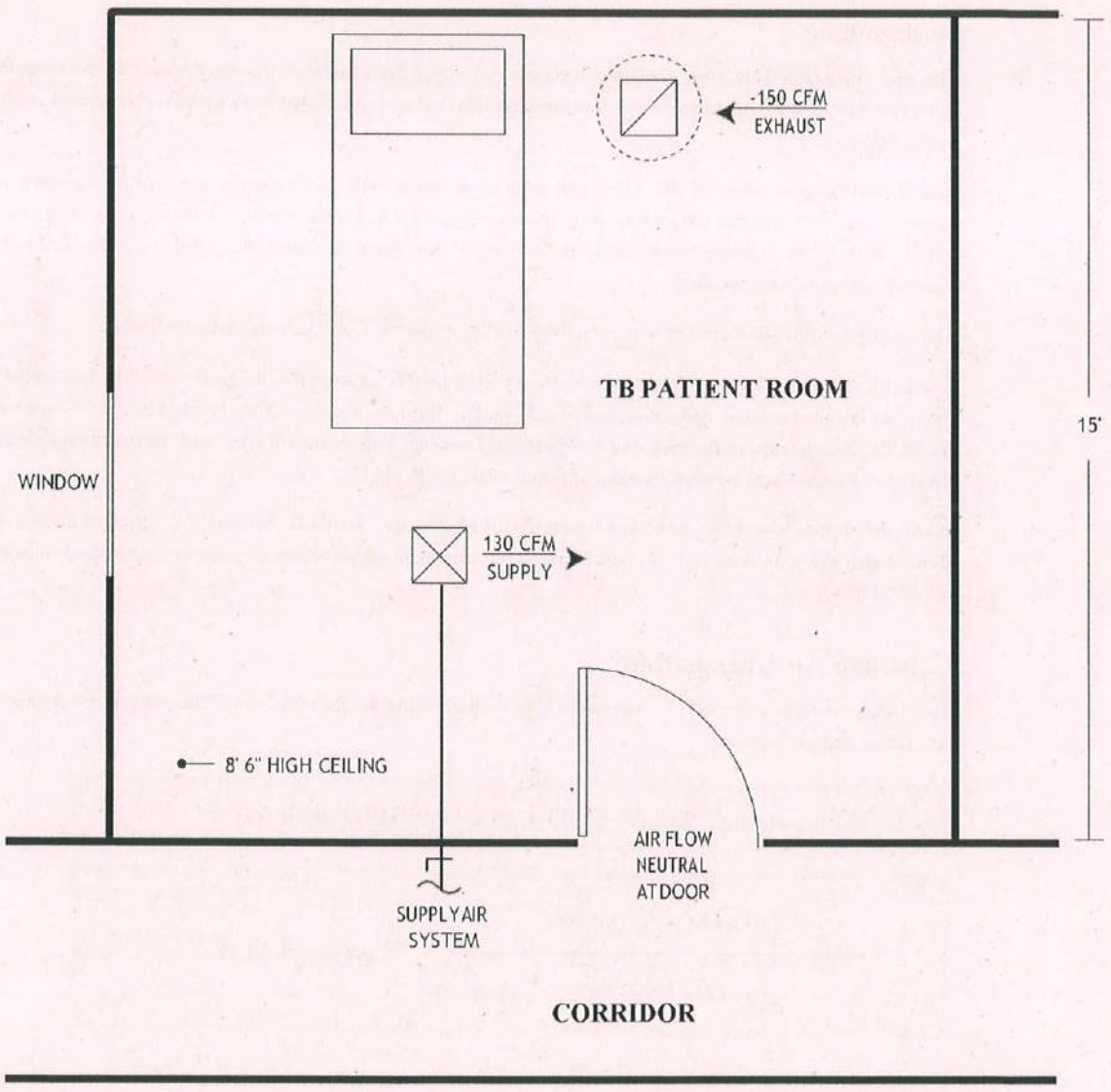
The Reason

Each arrangement will result in both a 100 CFM off- set across the AIIR door and an equal volume of air moving through the AIIR. But only the preferred op- tion provides more exhaust than supply in the AIIR itself, resulting in negative pressure, and increases airflow towards the head of the bed.

Also, code officials may require that direct exhaust from the AIIR exceed direct supply air. The latter op- tion would result in a room with supply equal to ex- haust.

CASE STUDY


TB CLINIC HOUR


-150 CFM
EXHAUST
TB PATIENT ROOM
15'
WINDOW
130 CFM
SUPPLY
8' 6" HIGH CEILING
AIR FLOW
NEUTRAL
AT DOOR
SUPPLY AIR
SYSTEM
CORRIDOR

AIIR: Part One

Background

Routine annual tuberculin skin testing revealed that two employees in a small, single-story county clinic converted their TSTs over the last year. Both employees were clerks in the billing department; neither had patient contact.

Assessment

The clinic manager, Janet, was concerned because the billing department shares a corridor with the room used to isolate TB patients. *M. tuberculosis* transmission may have occurred due to failed envi- ronmental controls in the AIIR.

Janet tested pressurization of the AIIR with a piece of tissue. The room clearly had positive pressure with respect to the corridor. She felt airflow from the supply grille. Even after wiping off the consider- able amount of dust on the exhaust grille, there was no air movement. A tissue held against the grille was not pulled toward the grille as would be expected.

The county facilities department sent out a maintenance engineer, Cynthia, to investigate further.

Cynthia remembered converting this room into an AIIR for TB patients about 2 years ago. She had sealed the room and installed a small, dedicated rooftop exhaust fan. But now she found that dust and lint had accumulated on the fan motor, causing the motor to overheat and burn out. She cleaned the fan and ductwork and replaced the motor. Exhaust was now measured and found to be 150 CFM.

Room air supply was 130 CFM, which was 20 CFM less than exhaust. However, a series of smoke tests showed that the room was now at neutral pressure rather than negative pressure. Room air leakage exceeded the 20 CFM offset.

Calculate Air Change Rate

The room was square-shaped (15 feet each side), with a ceiling height of 8.5 feet. The exhaust air change rate was calculated as follows:

$$\text{Room Volume} = 15 \times 15 \times 8.5 = \textbf{1913 cubic feet}$$

$$\frac{150 \text{ CFM} \times 60 \text{ minutes}}{1913 \text{ cubic feet}} = \text{approx. } \textbf{5 ACH}$$

Therefore, even with the exhaust fan fixed, the room was unsuitable for isolation because it was at neutral pressure with a low air change rate.

Clearly, something had to be done. See "AIIR: Part 2" for conclusion.

What steps should be taken to achieve negative pressure in the AIIR?

CASE STUDY

AIIR: Part Two

Calculate Additional Airflow

Although Janet, the clinic manager, wanted to bring the AIIR into compliance with CDC environmen- tal control recommendations, she thought her budget was too limited to accomplish this.

Cynthia, the engineer, suggested a portable HEPA filter unit as an affordable upgrade option. A HEPA filter unit would provide additional airflow. If a portion of the discharge were ducted outside, it would also create negative pressure.

The first step was to calculate the additional airflow required:

$$\text{Airflow required for 12 ACH} = \frac{1913 \text{ cubic feet} \times 12 \text{ ACH}}{60 \text{ minutes}} = \text{approx. } \mathbf{400\ CFM}$$

$$\text{Additional airflow required} = 400 \text{ CFM} - 150 \text{ CFM} = \mathbf{250\ CFM}$$

Sizing and Installing a Portable HEPA Filter Unit

A HEPA filter unit that produced at least 250 CFM airflow was required. Cynthia contacted a me- chanical equipment supplier. Two units were available: a small unit rated for 150 to 300 CFM; and a large unit rated for 250 to 750 CFM. Each unit had a variable speed switch and an optional connec- tion that could be used to duct some of the discharge air outdoors.

Janet suggested buying the small unit to save money. If run at high speed, it would provide more than enough airflow. However, Cynthia explained that most people turn down the fan speed switch be- cause the units can be noisy. The units may also produce less airflow than the catalog claims. She suggested adding a 25% safety factor, then buying a unit listed for this airflow at low or medium speed.

$$\text{Additional airflow} + \text{safety factor} = 250 \text{ CFM} + 25\% = \text{approx. } \mathbf{310\ CFM}$$

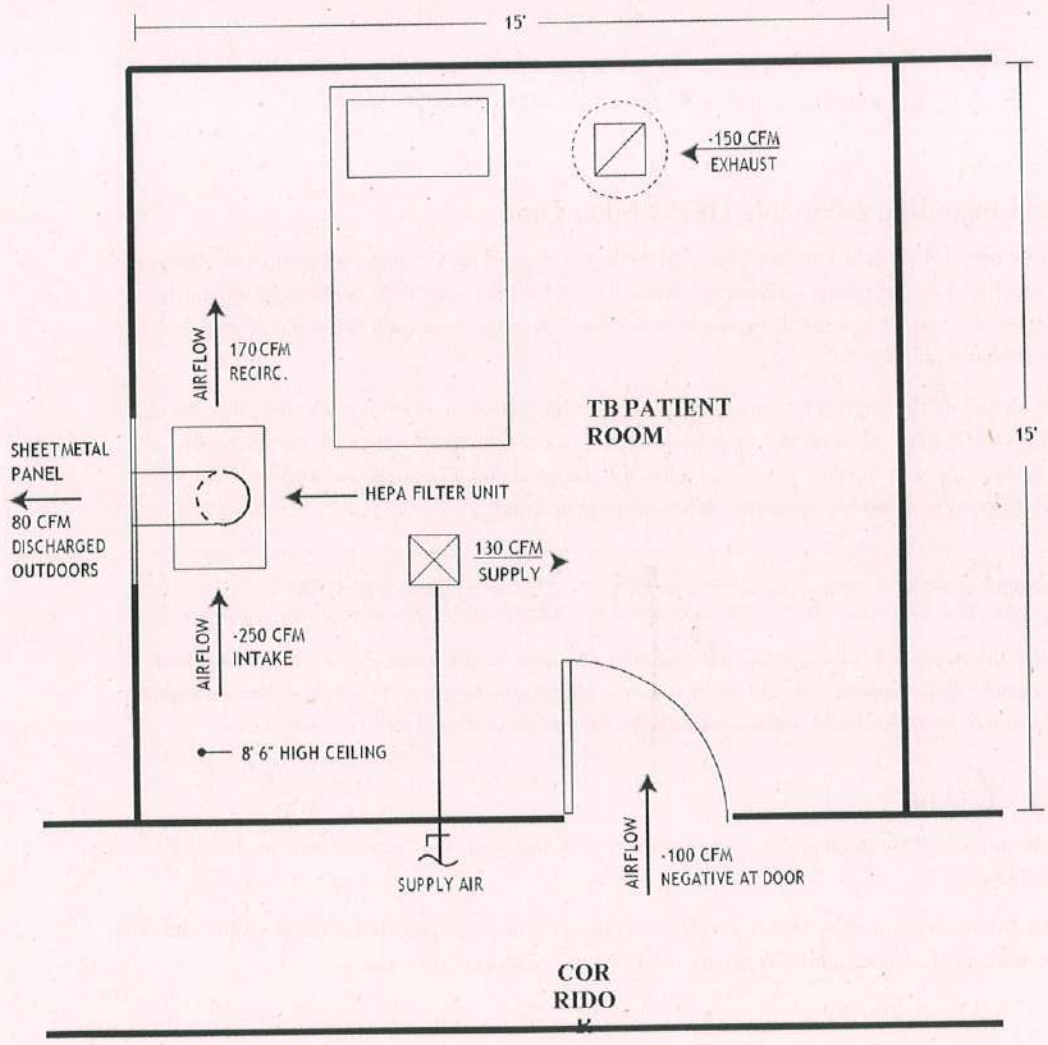
Based on this, the larger unit was selected and placed in the room. Cynthia replaced a windowpane with a sheet metal panel. She connected a flexible duct from the HEPA unit discharge to a hole in the sheet metal panel, set the unit to about 300 CFM, and diverted about a third of the discharge air to the outdoors.

The Happy Ending

The room was now clearly at negative pressure, the airflow was improved, and the noise from the HEPA filter unit was acceptable.

Cynthia's final measurements showed that the HEPA filter was returning approximately 250 CFM, with 80 CFM of this discharged outside and the remaining 170 CFM recirculating in the room.

Effective supply	= 130 CFM + 170 CFM	=	**300 CFM**
Effective exhaust	= 150 CFM + 250 CFM	=	**400 CFM**
Effective supply	= 400 CFM - 300 CFM	=	**100 CFM**



How often should the negative pressure be verified for this AIIR?

				Unit Rate	Amount
1	**SH: CIVIL Clean Room shall be prepared with following arrangements** **Clean Room Wall Panels PPGI/PPGI** , Providing and fixing 50 mm thick double skin modular wall panel system made of 0.8 mm thick PPGI sheets on both sides with PUF as infill of density 40 +/- 2 kg/m3, Profiles for reinforcement along the periphery & Extruded Aluminium Connector. Cost includes Floor Track, Frame work, Hardware as required at site.	550	sqm		
2	**Ceiling Panels** Providing and fixing 50mm thick Double skin totally flush walkable false ceiling panels made with 0.8mm thick PCGI sheet on both sides with PUF as infill of density 40±2Kg/m3, with suitable ceiling grid and necessary hardware for supporting the ceiling panels. Joints shall be sealed with suitable silicon sealant.	200	sqm		
3	**Clean Room Scientfic Doors** Providing and fixing Clean Room Doors of required size (1100mmx2100 mm or as approved size by Engineer in charge) with 46mm thick PUF insulation 0.8 mm thk PCGI Shutters. Door frame of 1.2 mm thk PCGI . Double glazed View glass with 5 mm Float glass, Twin side SS 'D' type handles, SS Hinges, SS Push plates, SS Kick plates, Door closer and dropseal . Both side key operated locking arrangement, SS 304 ball bearing hinges 2BB 4x3x3 , Door closer make -dorset-DCCOMS for self door closing , SS D -handle back to back (250mmx19mm)	12	Nos		
4	**Clear Vision Panels** Providing and Fixing Powder Coated Double Glazed View Panel of required size within the Wall panels flush design with 6 mm thick float glass fixed with Tapes & Sealed with RTV Silicon Sealant for WALL PANELS of 50mm Thk including all necessary fittings & accessories.	250	sqft		
5	**Riser panels** Providing and fixing Double skin with PCGI/PPGIheet, PUF in filled with min. 40 +/- 2 Kg density, Clean room wall panels 50mm thick with Air Riser , including necessary utility cut-outs duly concealed, as per specification	150	sqm		
6	Providing and fixing Flooring shall be of 5 mm (3 mm + 2mm) of self-levelling industrial epoxy including screed compound for adhesion, 3 mm semisolid cladding of EPOXY will be applied over a uniform cemented flooring and 2 mm semi-liquid epoxy over 3 mm hardened surface with bubble free perfect smooth finishing completed in three steps: Cementing (Uniform Flooring), Hardening (3 mm epoxy) and smoothening (2mm	200	sqm		

	epoxy). Epoxy used for this application will be self-levelling and clean room compatible.				
7	**Radius Coving & Corners** Providing and fixing Coving Wall to Wall & Ceiling R-45 PVC progressive ceiling to wall coving suitable for wall & ceiling finish	600	RM		
8	**Radius Coving & Corners** Providing and fixing 3D Corners	96	Nos		
9	Providing and fixing Cutout for Lighting ,Supply and Exhaust System in ceiling / walls	60	Nos		
10	**SH:- ELECTRICAL Electrical Installations shall be provided with following arrangements** Supply Installation Testing and commissioing of Cleanroom Led Light 1ft*1ft light fixture 28 watt	60	Nos		
11	Supply installation testing and commissioing Modular Single phase 16/32 Amps multi pin flush type socket outlet controlled by 2 No 16 Amps flush type SP switch with indicator. The assembly shall be housed in a Raceway / metal box / on partition .	72	Nos		
12	Supply installation testing and commissioing Modular Single phase 1 No 6/16 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 Raceway / metal box / on partition .	36	Nos		
13	Supply installation testing and commissioing Electrical panel for the MCB Housing of suitable ratings along with Neutral connector and GI plating for Earthing.Individual MCBS for 6 isolation rooms	1	job		
14	Supply installation testing and commissioing of electrical wirings of suitable thickness from the main incomer to the electrical panel and for parallel routing of all the subsystems inside the lab along with conduits and junction boxes for 6 isolation rooms	1	lot		
15	Supply & Laying of 25mm dia heavy duty PVC conduit with conduit accessories.	450	RM		
16	Supply installation testing and commissioing AHU Panel with suitable rating MCCB and outgoings , drawing shall be approved by Engineer in charge	1	Lot		
17	Supply installation testing and commissioing of Variable Frequency Drive (VFD)	4	set		
18	Providing and fixing Wiring for AHU room, AHU panel of approved make . Cable from electrical room to main panel will be in scope of vendor	1	job		
19	Supply installation testing and commissioing UPS (5KVA)Un-interrupted power supply for Access control, CCTV system, lights and computer system	1	set		

20	SH:- HVAC system shall be provided with following Supply , installation , testing & commissioning of following Air cooled outdoor condensing units (with suitable replacement of R407A Refrigerant gas in future without compromising required capacities) with Compressors, Copper refrigerant piping of suitable size as per capacities to be approved prior installation and duly insulated along with refrigerant piping acessories like drier, sight glass, isolating valves and Refrigerant gas, Temperature Sensor & RH Sensor, HP/ LP cut off's, Single phase preventor, Phase reversal protection and suitable Electronic expansion valve, for the following ratings Copper refrigerant pipe shall be adequately supported. The rate should include all piping, ms support system and cabling & cable tray works, Refrigerants, supports, etc. The Capacities in TR is the actual capacities required at AHU DX Cooling Coils. Note : The condensing unit shall be capable for outside ambient temperature of 50 Deg C and all necessary safety devices shall be provied for safe operation of system. Condensing Units 11 TR for 6 isolation rooms (Two with working AHU & Two with standby AHU)arrangements	4	nos		
21	**Air Handling Units (1W + 1 S)** Supply , installation , testing & commissioning of Modular Outdoor type Double skin Air Handling Units of 43+/-2 mm thick PUF injected panels with 24 gauge GI inner skin and pre-coated GI outer skin all as per specification including fan with TEFC motor. AHU shall have Air intake louver combined with pre filter (EU-4), Fine Filter section (EU-5), HEPA Filter section (EU-13), coil section with Dx 8 Row coil blower section with DIDW centrifugal fan having static pressure of 140 mm/Wg - With Duct Heater. Supply , installation , testing & commissioning AHU - 1 : Once Thru AHU with supply air quantity 2160 cfm at 140 mmWG Static pressure for Isolation Rooms 1 to 6	2	Nos		

22	**Exhaust AHU (1W + 1S)** Supply , installation , testing & commissioning Double skin (PUF panel thickness shall not be less than 25 mm) ventilation Exhaust unit (in single Decker construction) with inner skin of 0.8 mm plain GI & Outer skin of 0.6 mm precoated GI Sheets with 25 mm thick Puf Insulated panels density 40+2 Kg/M3 .All VUS's shall be with thermal break profile constructed with internal coving.The blowers shall be backward curved Centrifugal DIDW type with blet diven motor (IE2) with minimum IP55 protection(ABB/SIEMENS/CG).The unit are with Aluminium constructed aerofoil Volume control dampers suitable for manual operation .The units are with Return plenum with Prefilter(EU-4) and HEPA filter (H-13) section and Exhaust damper. Cushy foot mountings, Fire proof double canvass connections (Fungal resistant and Lint free), inspection lamp, door limitswitch, control cables with tray/conduits and standard accessories. All the nylon & PVC components should be tested as per IS846. . - 2400CFM or higher - 120mm WG Static Pressure, for Isolation Rooms 1 to 10.	2	Nos		
23	Supply , installation , testing & commissioning BIBO 2000 CFM with HEPA filters	1	Nos		
24	**Air Distribution System:-** Providing and fixing GI Ducting complete with MS painted flanges, all joints sealed with RTD silicon sealant with Zinc deposition 120gms/sqm. GSS-24 Swg ducting including accessories and Support arrangement	350	sqm		
25	Providing and fixing Aluminium Gear Operated volume control dampers for AHU, ducting and exhaust fans	10	sqm		
26	Providing and fixing Duct Insulation with 19 mm thick for Supply	200	sqm		
27	Providing and fixing Duct Insulation with 13 mm thick for Exhaust	100	sqm		
28	Fuseable link type Fire dampers at AHUs & EAUs (Supply air and Exhaust air unit)	4	Nos		
29	Providing and fixing Extruded aluminium powder coated Supply/ Exhaust Air Diffusers with Black Matt Finish VCD	6	sqm		
30	**SH: Miscellaneous** Providing and fixing Sink Cabinet 2 Door without locks	6	nos		
31	Providing and fixing Storage Cabinet 2 Door & 1 Drawer with locks	24	nos		
32	Providing and fixing Polypropylene Sink, 550Lx450Dx290H	6	nos		
33	Providing and fixing Ceramic Sink with necessary fittings (Toilet)	6	nos		
34	Providing and fixing Standout Single Tap	12	nos		
35	Providing and fixing Bottle trap with connection pipe	12	nos		
36	Providing and fixing Single removable eye washer	6	nos		
37	Providing and fixing Granite work top	180	sqft		
38	Providing and fixing Granite skirting H=100mm	60	RM		

39	Providing and fixing Rooms Labelling and sign boards	1	job		
40	Validation, Testing and Documentation of Facility	1	job		
41	Providing and fixing Chamber Pot Toilet	6	Nos		
42	Supply , installation , testing & commissioning CCTV for the facility with HDD	1	Job		
43	All Plumbing work including new fittings and fixtures of approved make	1	job		
44	Supply , installation , testing & commissioning Fire detection and alarm system with fire extinguishers	1	job		
45	Supply , installation , testing & commissioning Access Control	1	job		
46	AHU Shed	1	Ls Job		
47	Supply , installation , testing & commissioning Temperature and pressure digital Monitor with alarm	6	nos		
48	Supply , installation , testing & commissioning Duct Heater	6	nos		
49	Installation and commissioning Charges	1	Job		
50	Supply , installation , testing & commissioning Audio and Visual system for communication between doctor and patients from doctors room to isolation room	1	Job		
51	Supply , installation , testing & commissioning BMS	1	job		

TOTAL .....