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CPWD GENERAL SPECIFICATIONS FOR MODULAR OPERATION THEATER 2022



Published under the Authority of
Director General CPWD, Nirman Bhawan, New Delhi

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भारत सरकार
Government of India

केन्द्रीय लोक निर्माण विभाग

C P W D

GENERAL SPECIFICATIONS FOR MODULAR OPERATION THEATER 2022

महानिदेशालय, के.लो.नि.वि., निर्माण भवन, नई दिल्ली 110011

DIRECTORATE GENERAL, CPWD, NIRMAN BHAWAN, NEW DELHI 110011

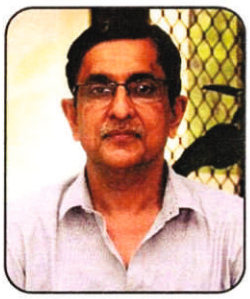
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1. **Whereas every care has been taken to ensure that all relevant and essential provisions required for execution of Construction and Maintenance Works are incorporated in this Specification in a simplified and transparent manner, all executing entities referring to are requested to bring it to the notice of the Directorate, if any conflicting provisions/ discrepancies are noticed in the Specification.**

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Shailendra Sharma
Director General

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Government of India

CPWD

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FOREWORD

CPWD has been maintaining and executing hospitals all over the country. The new hospital works right from system design to installation, commissioning are executed and also operated and maintained under our supervision. Hospital buildings and projects have become highly important all over the country due to Government's priority and commitment to provide world class health infrastructure to the citizens of India. With advancement of technology and variety of services being involved, most of the hospital buildings or projects are complex in nature, sensitive due to human life being involved and also critical due to requirement of 24x7 operation. In recent past many major hospital projects have been allotted to CPWD all over the country for constructing AIIMS, CAPFIMS hospital project, ESI projects besides others. Hence, the need for bringing out the CPWD Specifications for highly specialized services like Modular OT, MGPS, Nurse Call System and Pneumatic tube Transport system was felt.

The first CPWD General Specifications for Modular Operation Theatre have been framed and published for use by field units and others. Operation Theatre is a critical area of hospital infrastructure which involves complex design of highly specialized E&M services, Laminar Flow HVAC, Online UPS, Paneling System for Wall and Ceiling flooring, Scrub Stations, Isolation Panel System (IPS), Medical Gas Pipeline System Hermetically Sealed Doors, OT Pendants (for Anesthetist and Surgeon), Peripheral Lighting and Clean Room Luminaires, OT Light with Camera, Monitor and Recorder and PACS Monitor etc. The works have to be planned and executed in a perfect manner complying to standards with good workmanship to ensure trouble free and smooth operation of OTs keeping in mind utmost important aspect of minimizing/avoiding infections.

The existing specifications cover General Specifications for Modular Operation Theater to incorporate the latest development & technology in the field. References have been taken from the leading international standards and best practices being followed globally.

It is also to put on record my appreciation of Sh. Dharmesh Chandra Goel, ADG(Tech.), Sh. Surendra Singh, then ADG(W), Sh. Vimal kumar, CE(E) CSQ and his team, for putting in untiring efforts in preparing the specifications. It is also to acknowledge the initial contribution of Late Sh. D.K.Tulani, SE(E)TAS for giving his inputs in framing these specifications.

Any errors, omissions or suggestions for modification in this specification may be referred to CE(E) CSQ in the office of Chief Engineer, CSQ(E), CPWD, Nirman Bhawan, New Delhi-110011 on email delceecsq.cpwd@gov.in.

New Delhi
June, 2022

(SHAILENDRA SHARMA)
DIRECTOR GENERAL, CPWD



Dharmesh Chandra Goel
Addl. Director General (Tech)

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PREFACE

Various healthcare facilities & infrastructure are being dealt by CPWD for a long time on the basis of norms fixed by different statutory bodies. With changing needs and time, various modifications were proposed and inputs given from time to time by the different organizations with respect to norms & guidelines related to healthcare. Since, there is no Specifications available by BIS on the subject of Modular OT, which is a critical component in Hospital Project. Therefore a need was felt to compile CPWD specifications for Modular OTs for the use of architect as well as engineers of CPWD.

CPWD General Specifications for Modular Operation Theatre provides detailing regarding critical components of Modular OT.

Whole hearted commitment and considerable efforts has gone in to the preparation of this edition of CPWD Specifications for Modular Operation Theatre. I convey my deep appreciation and sincere thanks to Shri. Vimal Kumar, CE (E) CSQ, Sh. Saurabh Kumar, SE (E) TLQA, Shri. Rajiv Gupta, EE(E)TLQA, Shri Bhagwan Ram, AE(E) TLQA and staff of CSQ(E) unit whose names are not mentioned here for the sake of brevity for their sincere efforts made in the preparation of this document. Various individuals, firms dealing in similar type of work, field units, have immensely contributed with substantial inputs. CSQ (E) unit is indebted for their support.

I convey my gratitude to field offices at Delhi who rose to the occasion and provided sufficient data base to CSQ (E) office and thus enabled them to come out this publication. The team shall now be working on developing schedule of rates of various items involved for execution of Modular Operation Theatre.

This maiden effort has been to bring out this publication in the due care. However, there is possibility of inadvertent errors made. Error or omission may be brought to the notice of Chief Engineer (E) CSQ, CPWD, Room No. 229-A Wing, Nirman Bhawan, New Delhi-110011 (Tele:- 011-23061418) for strengthening these specifications further in larger public interest and in the interest of service towards healthy Bharat.

Suggestions for improvement are welcome.

Place: New Delhi
Date: June, 2022

(Dharmesh Chandra Goel)
Addl. Director General (Tech.), CPWD

REFERENCES OF AMENDMENTS

Sl.No.	Reference under which issued	Chapter No	Item No	Page

INDEX

Chapter	Description	Page No.
Chapter 1	**GENERAL**	1
1.1	Scope of Work	1
1.2	Integration & Co-Ordination Works with other Services Agencies	2
1.3	Scope of the Bidder	3
1.4	Eligibility Criteria for MOT Contractor	5
1.5	Responsibility of the Contractor	5
1.6	Responsibility of Contractor for Site Modification (Applicable only for Standalone MOT Work to be Executed in Existing Building)	7
1.7	Responsibility of Consignee/CPWD (Applicable only for Standalone MOT work to be Executed in Existing Building)	7
1.8	Related Documents	8
1.9	Terminology	8
1.10	Submission of Tenders	8
1.11	Rates	8
1.12	Taxes and Duties	9
1.13	Mobilization Advance	9
1.14	Completeness of Tender	9
1.15	Works to be arranged by the Department (In Case of Stand Alone work)	9
1.16	Works to be done by the Contractor	9
1.17	Storage and Custody of Materials	10
1.18	Power Supply, Water Supply and Drainage	10
1.19	Tools for handling and Erection	11
1.20	Payment Terms	11

1.21	Warranty and CAMC	12
1.22	Safety Codes and Labour Regulations	13
1.23	Submission of Programme, Approval of Drawings and Commencement of Work	13
1.24	Quality of Materials And Workmanship	13
1.25	Care of the Building	14
1.26	Inspection and Testing	14
Chapter 2	**PLANNING OF OPERATION THEATRE COMPLEX**	
2.1	Planning of Operation Theater	16
2.2	General Design Parameters for an OT Complex	18
2.3	Modular Operation Theatres	19
2.4	Planning of Operation Theatre Complex	20
2.5	Induction Room	21
2.6	Post Anaesthetic Care Units (PACU)	21
2.7	Staff Room	21
2.8	Sanitary Facility For Staff	21
2.9	The Anaesthesia Gas/Cylinder Manifold Room/Storage Area-	21
2.10	Offices-For Staff Nurse And Anaesthesia Staff	21
2.11	Rest Rooms	21
2.12	Laboratory	22
2.13	Lecture Theatre	22
2.14	Store Room	22
2.15	Theatre Sterile Supply Unit (TSSU)	22
2.16	Scrub Room	22
2.17	Types of OT Complexes	22

2.18	Principles to be Taken into Consideration While Planning an O.T. (Physical & Architecture):	22
2.19	Operation Rooms:	23
Chapter 3	**TECHNICAL SPECIFICATION OF MODULAR OPERATION THEATER**	
3.1	Scope of Work	24
3.2	Wall Paneling System	25
3.3	Ceiling Paneling System	26
3.4	Laminar Air Flow System	27
3.5	Internal HVAC Ducting & Exhaust System	28
3.6	PVC Flooring with Self Leveling	29
3.7	Hermetically Sealed Doors	30
3.8	Touch Screen Control Panel: 20" or More	31
3.9	Pressure Relief Dampers (PRDS)	32
3.10	Hatch Box	32
3.11	Operating List Board	33
3.12	X-Ray Film Viewer	33
3.13	Scrub Station (Minimum Size 1500mm)	33
3.14	Storage Unit	34
3.15	Pendants for Anesthetist and Surgeon	34
3.16	Peripheral Lighting and Clean Room Luminaries (LED Type)	36
3.17	Electrical Installations	37
3.18	Distribution Board	37
3.19	Isolation Panel System (IPS)	38
3.20	Online UPS	38
3.21	Medical Gas Pipe Line Installation	39
3.22	MOT Light with Camera, Monitor and Recorder	40
3.23	PACS (Picture Archiving & Communication System) Monitor: (For Non-Integrated MOT)	41

3.24	Earthing	41
3.25	Air Conditioning for UPS	41
3.26	Site Modifications*	42
3.27	Make in India Policy	42
Chapter 4	**COMPREHENSIVE MAINTENANCE**	43
Chapter 5	**SAMPLE BOQ OF MOT**	46
Chapter 6	**SAMPLE COMPLIANCE SHEET OF MODULAR OT**	49
Chapter 7	**CODES & GUIDELINES FOR MEP SERVICES IN HOSPITALS**	66
Chapter 8	**LICENSES, PERMITS & STATUTORY OBLIGATIONS FOR HOSPITALS IN INDIA**	70
Chapter 9	**SKETCH OF TYPICAL MODULAR OT**	71
Chapter 10	**REVISED GUIDELINES FOR AIR CONDITIONING IN OPERATION THEATRES**	74

CHAPTER 1

GENERAL

1.1 SCOPE OF WORK

The scope of this specification cover works of SITC of Modular OT including the following on turnkey job basis:

(i) Wall paneling system
(ii) Ceiling Paneling System
(iii) Laminar Air Flow System
(iv) Internal HVAC Ducting and Exhaust System
(v) PVC Flooring
(vi) Hermetically Sealed Doors
(vii) Touch Screen Control Panel
(viii) Pressure Relief Dampers
(ix) Hatch Box
(x) Operating List Board
(xi) X-ray Film Viewer
(xii) Scrub Station
(xii) Storage Unit
(xiv) OT Pendants (Anaesthetist and Surgeon)
(xv) Peripheral Lighting and Clean Room Luminaries
(xvi) Electrical Installation
(xvii) Distribution board
(xviii) Isolation Panel System (IPS)
(xix) Online UPS
(xx) Medical Gas Lines Installations
(xxi) OT Light with Camera, Monitor and Recorder
(xxii) PACS monitor
(xxiii) Earthing
(xxiv) AC system for UPS room
(xxv) Control cabling from AHU to MOT control panel and associated sensors
(xxvi) Site modifications
(xxvii) Comprehensive maintenance of MOT installations

1.1.2 Modular Operation Theater (MOT) is the lifeline of hospital infrastructure. All major and minor procedure related to surgery are performed in OTs. Services of hospital can come to a standstill without proper planning of hospital services in the health sector.

1.1.3 The modular operation theater are highly important and sensitive in nature considering the involvement of human life and hence needs to be planned in a proper manner covering all aspects including material, workmanship, electrical installation, air filtration, ventilation, HVAC, earthing of equipment, fire, water and MGPS .The related norms for all the hospital items and standards are to be followed to meet the specific requirement of the OT.

1.1.4 In the above context, the General Specification for Modular OT lays down general guidelines to ensure safe, efficient and reliable use of operation theatre infrastructure with economical provision

1.1.5 While these Specifications serve as general guidelines, appropriate technical sanctioning authority can depart from such guidelines to meet the particular requirements of any work or for other technical reasons including requirement of hospital authority.

1.1.6 This chapter covers the general commercial and technical requirements applicable to works contract for execution of Modular OT.

1.1.7 These General Specifications are subject to revision from time to time.

1.1.8 The site modification works as required shall include all modifications to the built up space provided at the hospital site including Installation of Medical Equipment, Communication Systems, civil modifications, electrical works, plumbing works, interior decoration, air conditioning ducting inside MOT, Medical Gas Pipe Lines & interconnection with HVAC and other related works of the Operation Theatre required for the smooth and efficient functioning. These works shall comply with all relevant safety and standards guidelines. The firm shall be fully responsible for installation, testing and commissioning of all equipment mentioned in the tender complete as required.

1.2 INTEGRATION & CO-ORDINATION WORKS WITH OTHER SERVICES AGENCIES:–

1.2.1 MOT firm has to share the MOT layout drawings to OT Integration firm /other firms as required for superimposing the OT integration system components and cables, before the commencement of manufacturing of MOT walls, ceilings, pendants, etc.

1.2.2 MOT firm has to provide required cut outs for power socket/Data cables/Patch Panel/etc. wherever marked by Integration firm/other firms in approved drawings by consignee/institute.

1.2.3 MOT firm has to make provision in ceiling for installation of OT Light as per approved drawings provided by institute with dedicated electrical supply from DB to Ceiling.

1.2.4 Bidders are strongly advised to visit the site for assessment before the submission of tender offer. The layout of the OT floor area as attached with the NIT, if any is to be referred to.

1.2.5 MOT firm has to integrate the HVAC installation inside the boundary of modular OT with main HVAC contractors i.e. duct work for supply air from dedicated AHUs of OT is in the scope of main HVAC contractor and ducting work inside the modular OT including laminar flow grill, HEPA filter and return air grill including duct work up to atmosphere shall be the responsibility of MOT contractor. HVAC design load of modular OT shall be taken care of by main HVAC contractor for which consideration shall be taken at the design stage.

1.2.6 The integration of OT control panel having controls for different parameters like temperature, humidity, air flow to the HVAC system installed is highly critical and important. The cables for the inputs from various transducers of the HVAC system for these parameters has to be provided by the MOT firm. The cabling from HVAC system/ AHU till the control panel shall be in the scope of the MOT firm, which will have to be terminated in the individual connection points. The VFDs, transducers of RH, temperature control, etc in AHU shall be in the scope of the HVAC firm and rest of the items as to be installed in the MOT including differential pressure arrangement shall be in the scope of the MOT firm. All equipment like AHU, Hot water generator, heat pumps, humidifiers, dehumidifiers etc. shall be in the scope of HVAC firm.

1.2.7 Similarly for BMS integration, all the items to be installed in the MOT room shall be in the scope of the MOT firm. Any cable connection to be done from MOT to BMS system shall be done by the MOT firm.

1.2.8 MOT firm shall integrate with audio visual agency for provision of audio visual recording or live video telecast of procedures/ operations in the OT to medical students/ on the web for live telecast in class room or YouTube.

1.2.9 Planning and integration of multiple services provided in the OT is to be carried out in BIM software at the initial stage so that clashes of services can be identified and suitable decision can be taken at the planning stage.

1.3 THE FOLLOWING SHALL BE IN THE SCOPE OF THE BIDDER:-

1.3.1 Supplying, Installation, Testing and Commissioning (as applicable) of wall & ceiling paneling, Frame Structures & substructure, PVC flooring, Lighting, Touch Screen Control Panel, laminar flow, pendants, OT Light, Painting (if any), electrical work, UPS(if any) , windows (if any)and doors, and all items indicated in the NIT etc. as per technical specification as per below:

a) Wall paneling system
b) Ceiling Paneling System
c) Laminar Air Flow System
d) Internal HVAC Ducting and Exhaust System
e) PVC Flooring
f) Hermetically Sealed Doors
g) Touch Screen Control Panel
h) Pressure Relief Dampers
i) Hatch Box
j) Operating List Board
k) X-ray Film Viewer
l) Scrub Station
m) Storage Unit
n) OT Pendants (Anaesthetist and Surgeon)
o) Peripheral Lighting and Clean Room Luminaries
p) Electrical Installation
q) Distribution board
r) Isolation Panel System (IPS)
s) Online UPS
t) Medical Gas Lines Installations
u) OT Light with Camera, Monitor and Recorder
v) PACS monitor
w) Earthing
x) AC system for UPS room
y) Control cabling from AHU to MOT control panel and associated sensors in MOT room
z) Site modifications
aa) Comprehensive maintenance of MOT installations

1.3.2 All cable conduit, trenches and railings wherever required.

1.3.3 All electrical accessories like cable wire, electrical outlets, switches, Control panels, etc should be fire proof of reputed make & certified for electrical safety.

1.3.4 Testing, Installation and Commissioning of all equipment/services.

1.3.5 Any other necessary work required for satisfactory working/performance of the modular OT and not mentioned/specified.

1.4 ELIGIBILITY CRITERIA FOR MOT CONTRACTOR :-

MOT work is a specialized work as per CPWD Works Manual and the contractor shall have to fulfill the eligibility criteria or in case of composite contract engage a specialized MOT agency for complete design, construction, testing, commissioning and comprehensive maintenance of modular operation theatres.

Tender for the MOT work shall be called from following, satisfying the eligibility criteria for the work.

(a) Manufacturers / OEMs / Authorized Dealers
(b) Specialized Firms
(c) Approved and eligible CPWD composite category contractors.

The eligibility criteria shall be as per following:

The MOT firm should have successfully completed following MOT works during the last seven years ending last date of the month previous to the one in which tenders are invited:
Three similar works, each costing not less than 40% of the estimated cost put to tender,

or

Two Similar works, each costing not less than 60% of the estimated cost put to tender,

or

One Similar work costing not less than 80% of the estimated cost put to tender.

Here similar work shall mean "supplying, installation, testing and commissioning of Modular Operation Theatre (MOT) work, which may also include comprehensive maintenance of MOT installations".

Stand alone work of Comprehensive maintenance of MOT installations are not covered in similar work.

(The value of executed works shall be brought to current costing level by enhancing the actual value of work at a simple rate of 7% per annum, calculated from the date of completion to the last date of submission of bid).

1.5 RESPONSIBILITY OF THE CONTRACTOR

1.5.1 The contractor shall be primarily responsible for successful supply, installation, testing, commissioning, for arranging OEM warranty for products, defect liability and comprehensive maintenance of MOT installations for 10 (ten) years (5 years warranty and thereafter 5 years CAMC) from the date of completion of the work and handing over to the department.

1.5.2 The MOT firm shall execute complete work including submission of layout drawings, walk-through view and working drawings. If stand-alone MOT work is to be executed in an existing building, the auto-cad or PDF or hard copies of building layout drawings will be provided by the hospital / department for preparation of MOT drawings.

1.5.3 The contractor shall provide dedicated UPS power supply (if included in NIT) and dedicated earthing for MOTs as per scope of work defined in NIT. The earthing shall conform to CPWD Specifications.

1.5.4 The contractor shall carry out necessary modification in civil and electrical components, peripheral lighting, plumbing, air-conditioning system (ducting inside the MOT), demolition and other works as may be required for complete installation and trouble-free functioning of the MOTs.

1.5.5 The MOT firm shall coordinate with fire-safety (Fire Alarm & Fire Fighting) firm for installation of fire-safety sensor/instrument inside the MOT.

1.5.6 The MOT firm shall coordinate with MGPS and other firm for the successful completion of MOT.

1.5.7 The MOT firm shall cooperate for installation and commissioning of other medical equipment (like integration equipment, monitors, etc.) in coordination with hospital authorities, respective firm and the department.

1.5.8 The MOT firm shall successfully complete installation, testing and commissioning of all MOTs along with all equipment included in the scope of MOT work as per technical specifications of MOT.

1.5.9 The MOT firm shall provide ducting inside the MOT and its interconnection with outside HVAC system. Control cabling from AHU to OT control panel and associated sensors shall be provided by the MOT firm for controlling temperature and RH inside the MOT.

1.5.10 The MOT firm shall provide factory test certificates for the materials/ equipment used for the construction of modular OT.

1.5.11 The MOT firm shall supply complete set of manuals for all the systems and sub-systems.

1.5.12 The MOT firm shall arrange at his cost on-site training of consignee/user for a week by original equipment manufacturer (OEM), wherever required for operational aspects.

1.5.13 Final electrical safety test, system test, and calibration shall be done as per required standard by authorized persons using calibrated test equipment, and declaration to this effect shall be submitted by the MOT firm.

1.5.14 Outlets of the anaesthesia and surgeon pendants shall match with the existing outlet, if any, in the same building/block. These outlets shall be BIS/European CE certified with 4 digit notified body number/US FDA/ETL/UL listed/certified.

1.5.15 The MOT firm shall execute all the HVAC, electrical, and other works as per CPWD Specifications as per scope defined.

1.5.16 All queries/clarifications along with pre-installation requirements shall be submitted before pre-bid meeting.

1.5.17 The contractor shall supply only new, unused material/goods complying with the NIT specifications. The department reserves the right to accept the item satisfying the NIT conditions having improvements in design and materials in the work.

1.5.18 The contractor shall be responsible for defect liability, OEM warranty of products and comprehensive maintenance of MOT installation for 10 (ten) years from the date of completion of the work through the same MOT firm and handing over to the department. Change of firm for CAMC, if required, shall be with the approval of department/ hospital/intitute/ any other authority designated. The MOT firm shall be approved on the basis of work experience mentioned in eligibility criteria. The comprehensive maintenance of MOT installation includes complete MOT installations, labour, spares, all consumables and filters etc. In the case of MOT equipment, the comprehensive maintenance shall be done with back-to-back support from OEMs. In such cases, authorized agent of OEM shall reach the site within 24 hours of raising a service call.

A recovery of Rs. 10000/hours shall be made if complaint is not attended by the contractor within one day of lodging the complaint. The decisions of the Engineer-in-Charge shall be final and binding on the firm with respect to the imposition on overall penalty decision taking into view overall circumstances of the case.

1.6 RESPONSIBILITY OF CONTRACTOR FOR SITE MODIFICATION (APPLICABLE ONLY FOR STANDALONE MOT WORK TO BE EXECUTED IN EXISTING BUILDING)

The "Site Modification" work includes all modifications to the built-up space at the hospital site like civil works, electrical works, plumbing works, interior decoration, air conditioning ducting and other related works required for smooth and efficient functioning of the MOT. These works shall comply with all relevant safety and standards guidelines. The contractor shall be fully responsible for installation and commissioning of all equipment mentioned in the tender. Bidders are strongly advised to visit the site for assessment before the submission of tender offer.

1.7 RESPONSIBILITY OF CONSIGNEE/CPWD (APPLICABLE ONLY FOR STANDALONE MOT WORK TO BE EXECUTED IN EXISTING BUILDING)

1.7.1 The hospital/institute/CPWD will provide MOT shell structure (complete with brick works, plastering, etc.).

1.7.2 The hospital/institute/CPWD will provide hot and cold water supply with drain and 5A/15A switch sockets at each scrub location.

1.7.3 The hospital/institute/CPWD will provide electrical power supply for installation free of cost.

1.7.4 The hospital/institute/CPWD will provide one LAN cable and telephone line at each MOT. The MOT firm will provide suitable switches/routers with cables for further distribution in MOTs.

1.7.5 The hospital/institute/CPWD will provide dedicated AHU and HVAC aluminium ducts for supply and return air with suitable pre-filter upto outside of each MOT. The MOT firm will be responsible for making connection to this.

1.7.6 The MOT firm shall execute the work in-consultation with the engineers and technicians of the Institute/hospital during installation, testing and commissioning.

1.8 RELATED DOCUMENTS

Each work has its own particular requirements. Therefore, in addition to the General Specifications, governing HTM/NFPA/IEC, I.E. Rules, Standard Contract Conditions and necessity of additional conditions/ specifications for a particular work should also be satisfied. In case of any discrepancy, such additional conditions/ specifications as mentioned in the NIT will override these General Specifications.

These General Specifications shall be read in conjunction with the General conditions of contract. These General Specifications shall also be read in conjunction with the tender specifications, schedule of work, drawings and other documents connected with the work.

1.9 TERMINOLOGY

The definition of terms shall be in accordance with HTM/NFPA/IEC, I.E. Rules which are defined in above mentioned specifications. Some of the commonly used terms are indicated in Chapter II.

1.10 SUBMISSION OF TENDERS

1.10.1 The tender shall be submitted complete with the following:-

(i) Complete tender documents as purchased/downloaded from CPWD/website duly filled in and submitted. The price part of the tender shall be indicated only on the tender schedule of work as per NIT.

(ii) Earnest Money deposit in one of the specified forms as per laid down rules issued from time to time.

(iii) Any other supplementary details required for the evaluation of the tenders such as drawings, technical literature/ catalogues, data etc.

10.2 Where two part tendering system is proposed to be adopted in any particular work, the procedure for submission and opening of tenders shall be indicated in tender documents for that work.

1.11 RATES

1.11.1 The work shall be treated as on works contract basis and the rates tendered shall be for complete items of work (except the materials, if any, stipulated for supply by the department) inclusive of all taxes (including GST etc. if any), duties, and levies etc. and all charges for items contingent to the work, such as, packing, forwarding, insurance, freight and delivery at site for the materials to be supplied by the contractor, watch and ward of all materials (including those, if any, supplied by the department) for the work at site etc.

1.11.2 Prices quoted shall be firm. Price adjustments shall however be governed by Clause 10C/ 10CC of the Conditions of Contract as given in form CPWD 7 or 8 of the tender documents, for works executed under these forms and as mention in the NIT. All relevant documents shall be produced by the contractor to the Engineer-in-charge, whenever called upon by him to do so, for working out such adjustments in rates.

1.12 TAXES AND DUTIES

1.12.1 Being an indivisible works contract, GST, or any other taxes or duties are not payable separately.

1.12.2 The works contract tax shall be deducted from the bills of the contractor as applicable in the State in which the work is carried out, at the time of payments.

1.12.3 Octroi shall not be paid separately for the materials supplied by the contractor, but the Department, on demand, can furnish octroi exemption certificate. However, the Department is not liable to reimburse the octroi duty in case the concerned authorities do not honor such exemption certificates.

1.13 MOBILIZATION ADVANCE

No mobilization advance shall be paid for the work, unless otherwise stipulated in tender papers for any individual work.

1.14 COMPLETENESS OF TENDER

All sundry fittings, assemblies, accessories, hardware items, foundation bolts, termination lugs for electrical connections as required, and all other sundry items which are useful and necessary for proper assembly and efficient working of the various components of the work shall be deemed to have been included in the tender, irrespective of the fact whether such items are specifically mentioned in the tender documents or not.

1.15 WORKS TO BE ARRANGED BY THE DEPARTMENT (IN CASE OF STAND ALONE WORK)

Unless and otherwise specified in the tender documents, the following works shall be arranged by the Department:

(i) Storage space for all equipment, components and materials for the work.

(ii) Supply of materials to the contractor as stipulated in the tender documents

(iii) Space/structure for erection of MOT structure and related equipment/services

Note: In case of EPC contracts, the firm shall be responsible for above as a whole since the complete building/structure to be built shall be within his scope and hence the above item also as per scope defined in NIT.

1.16 WORKS TO BE DONE BY THE CONTRACTOR

Unless and otherwise mentioned in the tender documents, the following works shall be

done by the contractor, and therefore their cost shall be deemed to be included in their tendered cost: -

(i) Foundations for equipment and components where required, including foundation bolts.

(ii) Cutting and making good all damages caused during installation and restoring the same to their original finish.

(iii) Sealing of all floor openings provided by him for pipes and cables, from fire safety point of view, after laying of the same.

(iv) Painting at site of all exposed metal surfaces of the installation other than pre- painted items. Damages to finished surfaces of these items while handling and erection, shall however be rectified to the satisfaction of the Engineer-in-charge.

(v) Testing and commissioning of completed installation.

1.17 STORAGE AND CUSTODY OF MATERIALS

Suitable space for storage shall be provided by the Department free of cost to the contractor but the required arrangement / set up for storage of materials in the spared space including locking arrangement shall be provided by the agency. Also, the watch and ward of the stores and their safe custody shall be responsibility of the contractor till the final taking over of the installation by the Department.

Note: Item no. 1.17 shall not be applicable in case of EPC contract. It shall be the responsibility of EPC contractor only.

1.18 POWER SUPPLY, WATER SUPPLY AND DRAINAGE

1.18.1 Power Supply

(i) Unless otherwise specified, 3 phase, 415 Volts, 50 Hz power supply shall be provided by the department free of charge to the contractor at one point for installation at site. Termination switchgear however, shall be provided by the contractor. Further extension if required shall be done by the contractor.

(ii) The power supply for testing and commissioning of the complete installation shall be made available by the Department free of charge to the contractor. For this purpose, the power supply shall be given at the main incomer unit of the main electrical panel (provided by the contractor) through U.G. cable, or bus-trunking arrangement. The termination of this feeder in the main incomer unit shall be the responsibility of the contractor and nothing extra shall be paid on this account.

(iii) Unless otherwise specified in the contract, further power distribution to the various equipment shall be done by the contractor.

(iv) Where the power supply has to be arranged by the Department at more than one point as per the terms of the contract, the termination of all such power feeders in the incomer of respective control panels (provided by the contactor) shall be the responsibility of the contractor.

(v) The contractor shall not use the power supply for any other purpose than that for which it is intended for. No major fabrication work shall be done at site. Power shall be used only for welding/ cutting works. The power supply shall be disconnected in case of such default and the contractor shall then have to arrange the required power supply at his cost.

(vi) Contractor may have to install their DG Set for construction activity. The department do not guarantee for continuous power supply for the work to be carried out.

Note: In case of EPC contracts, the firm shall be responsible for above as a whole since the complete building/structure to be built shall be within his scope and hence the above item also as per scope defined in NIT

1.18.2 WATER SUPPLY

(i) Water supply shall be made available to the contractor by the Department free of charge at only one point for installation. Further extension if required shall be done by the contractor.

Note: In case of EPC contracts, the firm shall be responsible for above as a whole since the complete building/structure to be built shall be within his scope and hence the above item also as per scope defined in NIT.

1.18.3 DRAINAGE

(i) Drain traps in Modular OT shall be arranged by the department.

(ii) All drainage arrangements from the drain traps etc. to the drain line shall be arranged by the Department as required.

(iii) Piping Connections from the equipment to the drain trap including providing valves at the drain points shall be done by the contractor. These items of work shall be separately measured and paid as per contract.

Note: In case of EPC contracts, the firm shall be responsible for above as a whole since the complete building/structure to be built shall be within his scope and hence the above item also as per scope defined in NIT

1.19 TOOLS FOR HANDLING AND ERECTION

All tools and tackles required for handling of equipment and materials at site of work as well as for their assembly and erection and also necessary test instruments shall be the responsibility of the contractor.

1.20 PAYMENT TERMS

Payment shall be made in Indian Rupees as specified in the contract through electronic transfer in NEFT/RTGS subject to recoveries, if any, by way of liquidated damages or any other charges as per terms & conditions of contract in the following manner:

a. On delivery: 70% payment of the contract price on pro rata basis shall be paid on receipt of goods in good condition and upon the submission of the following documents:

Original copies of supplier's invoice showing contract number, goods description, quantity, packing list, unit price and total amount.

b. On installation: 20% payment of the contracts would be made against successful installation of the item at site, as per NIT requirements.

c. On Testing, commissioning and completion: Balance 10% payment would be made against Testing , commissioning and completion, subject to recoveries, if any, either on account of non-rectification of defects/deficiencies not attended by the firm or otherwise. "Final Installation, Testing, Commissioning and Acceptance Certificate" need to be issued by the department after successful installation, commissioning, testing and successful trial run in coordination with hospital authorities.

d. Payment of Civil/Electrical Works at site: The payment related to Civil/Electrical Works at site will be made as indicated in the contract.

Payment for Comprehensive Annual Maintenance Contract Charges: The payment of CAMC will be made on six monthly basis after satisfactory completion of said period, duly certified by the department in coordination with client department, on receipt of bank guarantee for an amount equivalent to 2.5% of the cost of the equipment as per contract in the prescribed format valid till 3 months after expiry of entire CAMC period. The firm will associate the supplier/authorised channel partner of OEM of the equipment for CAMC for the required period and submit coy of agreement to the department.

1.21 WARRANTY AND CAMC

1.21.1 Comprehensively all the goods supplied under the contract shall be new, unused and incorporate all recent improvements in design and materials unless prescribed otherwise in the contract. The supplier further warrants that the goods supplied under the contract shall have no defect arising from design, materials (except when the design adopted and/or the material used are as per the Purchaser's/Consignee's specifications) or workmanship or from any act or omission of the supplier, that may develop under normal use of the supplied goods under the conditions prevailing in India.

1.21.2 The warranty shall include all spares, labour and preventive maintenance from the date of completion of the satisfactory installation and acceptance till warranty period.

1.21.3 The Comprehensive Annual Maintenance Contract shall include all spares, labour and preventive maintenance from the date of completion of the satisfactory installation and acceptance till warranty period.

1.21.4 Warranty as well as Comprehensive Annual Maintenance Contract will be inclusive of all accessories and turnkey work and it will also cover the following, wherever executed in the contract:-

(i) All kinds of wall panel door , scrubs. OT Light, MGPS line & terminal in MOT area gauges, surgeon control panels, pendents, anaesthetic equipment, UPS and UPS battery electrical installation, isolation panel, audio visual equipment camera and monitor etc.

(ii) Plastic & Glass Parts against any manufacturing defects.

(iii) All kinds of sensors.

(iv) All kind of laminar flow, Motor etc.

Note: HEPA & other filters shall be covered as an additional item payable based on actual replacement done at site, being a consumable item. Suitable item should be kept in the NIT for the same by the NIT calling authority.

1.22. SAFETY CODES AND LABOUR REGULATIONS

(i) All the safety procedures outlined in the safety codes applicable for the works shall be complied with.

(ii) In respect of all labour employed directly or indirectly on the work for the performance of air conditioning contractor's part of work, the contractor at his own expense, will arrange for the safety provisions as per the statutory provisions, B.I.S. recommendations, factory act, workman's compensation act, CPWD code and instructions issued from time to time. Failure to provide such safety requirements would make the tenderer liable for penalty as provided in the labour laws/GCC for each violation. In addition the Engineer-in-charge, shall be at liberty to make arrangements and provide facilities as aforesaid and recover the cost from the contractor.

(iii) The contractor shall provide necessary barriers, warning signals and other safety measures while laying pipelines, duct cable etc. or wherever necessary so as to avoid accident. He shall also indemnify CPWD against claims for compensation arising out of negligence in this respect. Contractor shall be liable, in accordance with the Indian Law and Regulations for any accident occurring due to any cause. The department shall not be responsible for any accident occurred or damage occurred or claims arising there from during the execution of work. The contractor shall also provide all insurance including third party issuance as may be necessary to cover the risk. No extra payment would be made to the contractor due to the above provisions thereof.

1.23 SUBMISSION OF PROGRAMME, APPROVAL OF DRAWINGS AND COMMENCEMENT OF WORK

1.23.1 SUBMISSION OF PROGRAMME

As per the time stipulated in the NIT from the date of receipt of the letter acceptance, the successful tender shall submit a programme indicating submission of drawings, supply of equipment, installation, testing, commissioning and handing over of the installation to the Engineer-in- Charge . This programme shall be framed keeping in view the milestones

stipulated in the contract, wherein the building progress shall be given priority. In case of EPC contract, in which this is one of the work, the complete programme for the project will include MOT work also with detailing, matching the over all completion target for the project as stipulated in the clause of GCC.

1.23.2 SUBMISSION OF DRAWINGS AND COMPLIANCE SHEET

The contractor shall submit the drawings and compliance sheet to the Engineer-in-charge for approval before start of work.

1.23.3 COMMENCEMENT OF WORK

The contractor shall commence work as soon as the drawings and compliance sheet submitted by him are approved.

1.24. QUALITY OF MATERIALS AND WORKMANSHIP

1.24.1 The components of the installation shall be of such design so as to satisfactorily function under all conditions of operation.

1.24.2 The entire work of manufacture/ fabrication, assembly and installation shall conform to sound engineering practice. The entire installation shall be such as to cause minimum transmission of noise and vibration to the building structure.

1.24.3 All equipment and materials to be used in work shall be manufactured in factories of good reputation having excellent track record of quality manufacturing, performance and proper after sales service.

1.24.4 None of the equipment/ machines supplied shall be more than six months old from date of supply at site. Copy of GST Gate Pass/ Invoice/ Shipment / Custom Clearance certificate/ details (in case of imported equipment) shall be submitted to prove the date of manufacture & genuineness of the equipment/ machines supplied.

1.25 CARE OF THE BUILDING

Care shall be taken by the contractor during execution of the work to avoid damage to the building. He shall be responsible for repairing all such damages and restoring the same to the original finish at his cost. He shall also remove all unwanted and waste materials arising out of the installation from the site of work from time to time.

1.26 INSPECTION AND TESTING

1.26.1 Initial inspection of materials & equipment at manufacturer's work as per details given will be done by the engineer-in-charge or his representative. For item/ equipment requiring initial inspection at manufacturer's works, the contractor will intimate the date of testing of equipment as applicable at the manufacturer's works before dispatch. The Contractor shall give sufficient advance notice regarding the dates proposed for such tests to the department's representative(s) to facilitate his presence during testing. The Engineer-in-charge at his discretion may witness such testing. Equipment will be inspected at the manufacturer/ authorised dealer's premises, before dispatch to the site by

the contractor. For equipment sourced from abroad, the contractor shall at his own expense arrange for the required pre-dispatched tests at the manufacturer's works and submit to the department the details of the tests carried out and the results there of. Once the go head is given, the material shall be dispatched from manufacturer's works.

1.26.2 The department also reserves the right to inspect the fabrication job at factory and the successful tender has to make arrangements for the same.

1.26.3 The materials duly inspected by Engineer-in-Charge or his authorised representative shall be dispatched to site by the contractor.

1.26.4 No additional payment shall be made to the contractor for initial inspection/ testing at the manufacturer's works by the representative of the Engineer-in-Charge. However, the department will bear the expenses of its representative deputed for carrying out initial inspection/testing.

1.26.5 Final Inspection & Testing

Final inspection & testing will be done by the Engineer-in-Charge or his authorized representation for the equipment and services provided at site.

1.26.6 Safety Measures

All equipment shall incorporate suitable safety provisions to ensure safety of the operating personnel at the times. The initial and final inspection reports shall bring out explicitly the safety provisions incorporated in each equipment.

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CHAPTER 2

PLANNING OF OPERATION THEATRE COMPLEX

2.1 PLANNING OF OPERATION THEATRE

An Operation Theatre (OT) is a facility within a hospital where surgical operations are carried out in an aseptic environment. OT is a specialized facility of the hospital where life saving or life improving procedures are carried out on the human body by invasive/ operative methods under strict aseptic conditions in a controlled environment by specially trained personnel to promote healing and cure with maximum safety, comfort and economy. The Operation theatre, operating room, operation theatre complex etc are the terms used interchangeably by many of us. The standard terminology and definitions of some of the terms are given below:

(i) Operating room: It is an area in which surgical operations are carried out

(ii) Operating suite: Operating room with ancillary areas (lay up room & scrub area).

(iii) Operating Department./OR Complex: A unit consisting of one or more operating suites with ancillary accommodation, office accommodation, patient attendants waiting area, changing area for staff etc.

OT complexes are designed and built to carry out investigative, diagnostic, therapeutic and palliative procedures of varying degrees of invasiveness. OTs can be classified into various categories according to different parameters or considerations. Depending on the type of surgery performed, it can be classified into General, Orthopedic, Neuro/ Spine surgery, Urology, Cardiac/ Thoracic etc. According to type of specialty it can be also categorized as Specialty & Superspecialty OTs. According to type of facilities provided it can be categorized as Modular, Hybrid, Integrated & Digital OTs. According to the material used in the fabrication of OTs it can be categorized as EGP, SS, SMS, Glass OTs. There are minor changes in the design parameters of the different category of OTs based on the type of usage, type of the machinery/ equipment used, type of material used etc but the basic designing parameters are more or less similar for planning an OT complex which are described in the subsequent discussion. These design parameters are developed after extensive research by various international and national organisations & accreditation boards such as ASHRAE, ISHRAE, CDC, NABH, JCI and well accepted by the users worldwide. The difference between the Hybrid, Integrated & Digital ORs are briefly described below:

2.1.1 HYBRID O.R.

Hybrid operating room requirements are usually based around imaging, like CT, MR, C-arm or other types of imaging, being brought into surgery. Bringing imaging into or adjacent to the surgical space means that the patient doesn't have to be moved during surgery there by reducing risk and inconvenience. Depending on the design of operating rooms in hospitals as well as their resources and needs, fixed or mobile hybrid operating rooms may be built.

One-room fixed O.R.s offer maximum integration with a high-end MR scanner, allowing the patient to stay in the room, still anesthetized, during the scan. In two or three room configurations, the patient must be transported to an adjacent room for scanning, increasing the risk of inaccuracy through possible movement of the reference system.

One further understanding of hybrid O.R.s is that they are multi-purpose rooms that are fitted to serve different surgical disciplines. With more and more complex procedures taking place, intraoperative imaging is certainly the future of surgery. Hybrid O.R.s generally focus on minimally invasive and vascular surgery. They are often shared by different surgical departments, such as vascular and spine. Hybrid operating room benefits include scans of the affected part of the body being forwarded and available for review and use immediately in the operating room. This allows the surgeon to continue operating, for example, in a high risk area like the brain with the most up-to-date data.

2.1.2 INTEGRATED O.R.

Integrated operating rooms were introduced in the late 90's as video routing systems capable of distributing video signals from one camera to multiple outputs or products became available. Over time, they evolved to be able to functionally connect the O.R. environment. Patient information, audio, video, surgical and room lights, building automation, and specialized equipment, including imaging devices, could all communicate with one another.

In some setups, when connected, all of these various aspects can be commanded from a central console by one operator. Integrated O.R. is sometimes installed as a functional addition to an operating room to integrate the control of several devices from a single console and offer the operator more centralized access for device control.

2.1.3 DIGITAL O.R.

In the past, a lightbox on the wall was used to display patient scans. A digital O.R. is a setup in which software sources, images and operating room video integration is made possible. All this data is then connected to and displayed on a single device. This goes beyond simple control of devices and software, allowing also for the enrichment of medical data within the operating room.

A digital O.R. setup therefore functions as a central hub for clinical image data inside the operating room and for recording, collecting and forwarding data to the Hospital IT system, where is it centrally stored. The surgeon can control the data inside the O.R. from specified displays according to their desired setup and also has the possibility to display the images from many different devices.

Simply we can say according to the user needs and quantum of accommodation OTs can be divided into three main categories:

(i) The single theatre suite with OT, scrub-up and gowning, anaesthesia room, trolley preparation, utility and exit bay plus staff change and limited ancillary accommodation.

(ii) The twin theatre suite with facilities similar to 1, but with duplicated ancillary accommodation immediate to each OT, sometimes sharing a small post anaesthesia recovery area.

(iii) OT complexes of three or more OTs. with ancillary accommodation including post anaesthesia recovery, reception, porter's desk, sterile store and staff change

There are lot of advantages of grouping Operating Theatres such as it will lead to isolation of the OT complex from general movement of the patient, making it a restrictive zone, so that we can execute a better control on the functioning of the OTs. This will lead to the better Infection control, flexibility in use, resource utilization, operating room discipline, ventilation standards & supervision & monitoring. It will as reduce the operational cost and help us to provide the better ancillary accommodation.

2.2 GENERAL DESIGN PARAMETERS FOR AN OT COMPLEX

The establishment and working of the operation theatre (OT) needs specialized planning and execution and is not a simple civil engineering work. It is an amalgamation of "civil-mechanical-electrical-electronic- bio medical" combo effort driven and coordinated by the needs, preferences and safety of the medical/ surgical team. A medical consultant by virtue of their knowledge of the intricacies of medical and biomedical aspects should preferably be involved from the early stages of planning of operating theatres.

Zoning of various areas of an OT complex is very important from infection control point of view. Four zones can be described in an OT complex, based on varying degrees of cleanliness, in which the bacteriological count progressively diminishes from the outer to the inner zones (operating area) and is maintained by a differential decreasing positive pressure ventilation gradient from the inner zone to the outer zone. Unidirectional flow is very important in the OT complex. OT complex should have One entry and One exit. No criss-cross of the movement is allowed inside the OT complex. Double door airlock should be at the entry and exit of the OT Complex. The zones in an OT complex are divided into following by NABH & other bodies:

(i) Protective zone: It Includes Reception, Waiting, Trolley Bay, Change rooms for all medical and paramedical staff with conveniences, Rooms for administrative staff, Stores & record bay for patient, material & equipment, Kitchenette (pantry), Fire fighting device room, Emergency exits, Service room for staff, Close circuit TV control area & Conference Room

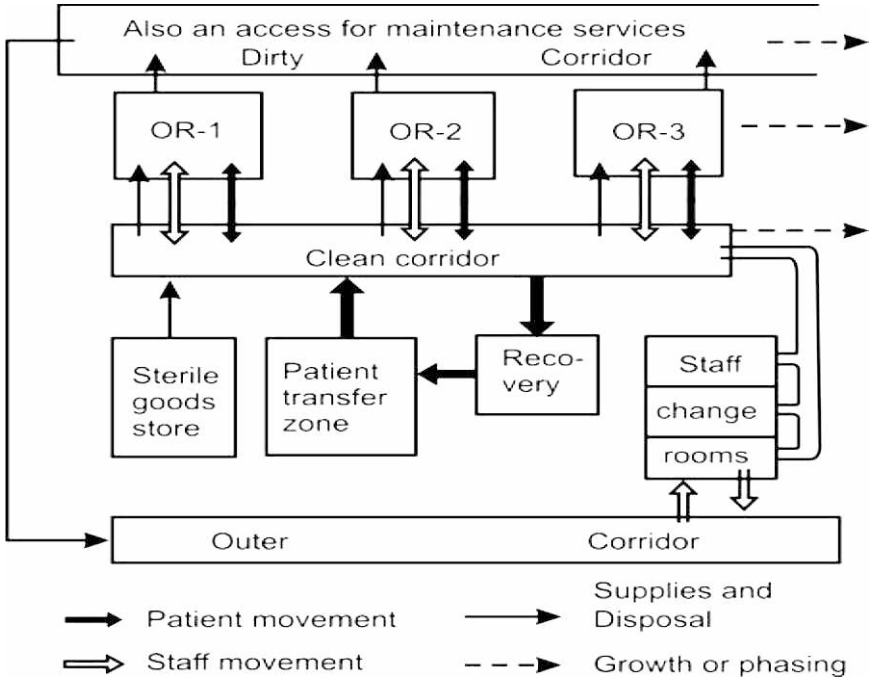
(ii) Clean zone: Connects protective zone to aseptic zone and has other areas also like Pre & post-operative rooms, I.C.U. and P.A.C.U., Sterile stores, Equipment store room & Maintenance workshop.

(iii) Aseptic zone: Includes operation rooms (sterile)

(iv) Disposal zone: Disposal areas from each OR & corridor lead to disposal zone & Dirty Utility.

In addition to above, One TSSU room should be within the OT complex. TSSU room should be well ventilated and equipped with plumbing system and drainline. OT complex should not have any toilet inside the clean area. Toilet should be before entry to the change room. No toilet should be placed in the upper floor of the OT. Seepage or dampness inside the OT should not be present. OT complex should have auto sliding door or double swing door with vision panel at the entry and exit for ease of movement.

SCHEMATIC FLOW DIAGRAM OF OPERATION THEATER COMPLEX



The finer details for the planning of these areas in terms of Mechanical, Electrical, Civil, HVAC etc. should be studied before planning of an OT complex in light of the functional requirements of the organisation. These details are beyond the scope of this document, however the detailed specifications of a typical operating room are described in the next section.

2.3 MODULAR OPERATION THEATRES

2.3.1 MODULARITY

Modularity is a design approach that subdivides a system into smaller parts called modules, that can be independently created and then used in different systems.

A modular system can be characterized by functional partitioning into discrete scalable, and reusable modules.

2.3.2 ADVANTAGE OF MODULAR SYSTEMS:-

Besides reduction in cost (due to less customization, and shorter learning time)
Flexibility in design
Modularity Offers Other Benefits Such As:-

- Augmentation (adding new solution by merely plugging in a new module).
- Modular buildings generally consist of universal parts (or modules) that are manufactured in a factory and then shipped to a build site where they are assembled into a variety of arrangements.
- Modular buildings can be added to or reduced in size by adding or removing certain components.

2.4 PLANNING OF OPERATION THEATRE COMPLEX

2.4.1 OT complexes are designed and built to carry out investigative, diagnostic, therapeutic and palliative procedures of varying degrees of invasiveness. Many such set ups are customized to the requirements based on size of hospital, patient turnover and may be speciality specific. The aim is to provide the maximum benefit for maximum number of patients arriving to the operation theatre. Both the present as well as future needs should be kept in mind while planning different zones of OT complex. The location and flow of the patients, the staff and the materials form the three broad groups to be considered during all stages of design .

2.4.2 Four zones can be described in an O T complex based on varying degrees of cleanliness in which the bacteriological count progressively diminishes from the outer to the inner zones (operating area) and is maintained by a differential decreasing positive pressure ventilation gradient from the inner zone to the outer zone.

2.4.2.1 Protective zone: It includes

(i) Change rooms for all medical and paramedical staff with conveniences, transfer bay for patient, material & equipments

(ii) Rooms for administrative staff stores & records

(iii) Pre & post-operative rooms

(iv) I.C.U. and P.A.C.U.

(v) Sterile stores

2.4.2.2 Clean zone: Connects protective zone to aseptic zone and has other areas also like Stores & cleaner room, Equipment store room Maintenance workshop Kitchenette (pantry) Firefighting device room, Emergency exits, Service room for staff, Close circuit TV control area

2.4.2.3 ASEPTIC ZONE- Includes operation rooms (sterile)

2.4.2.4 DISPOSAL ZONE-Disposal areas from each OR & corridor lead to disposal zone Sub areas (excluding OT place)

(i) **Pre-operative check in area (reception)-** This is important with respect to maintaining privacy, for changing from street clothes to gown and to provide lockers and lavatories for staff.

(ii) **Holding area-** This area is planned for IV line insertion, preparation, catheter / gastric tube insertion, connection of monitors & shall have oxygen and suction lines. Facility for CPR should be available in this area.

2.5 INDUCTION ROOM- (anaesthetic room). It should have all facilities as in OT, but there is controversy as to its need. One for each OT is required, ideally each is a duplicate of the other in each floor. The anaesthetic room will provide a more tranquil atmosphere to the patient than the OT. It should provide space for anaesthetic trolleys and equipment and should be located with direct access to circulation corridors and ready access to the operating room. It will also allow cleaning, testing and storing of anaesthesia equipment. It should contain work benches & sink(s). It should have sufficient power outlets and medical gas panels for testing of equipment.

2.6 POST ANAESTHETIC CARE UNITS (PACU) - preferably adjacent to recovery room. These should contain a medication station, hand washing station, nurse station, storage space for stretchers, supplies and monitors / equipment and gas, suction outlets and ventilator. Additionally 80 sq ft (7.43 sq m) for each patient bed, clearance of 5 ft (1.5 m) between beds and 4 ft (1.22m) between patient bed sides and adjacent walls should be planned.

2.7 STAFF ROOM - Men and women change dress from street cloth to OT attire; lockers and lavatory are essential; rest room, TV, etc. are desirable.

2.8 SANITARY FACILITY FOR STAFF- One wash basin and one western closet (WC) should be provided for 8-10 persons. Showers and their number is a matter of local decision. Inclusion of toilet facilities in changing rooms is not acceptable; they should be located in an adjacent space.

2.9 THE ANAESTHESIA GAS / CYLINDER MANIFOLD ROOM / STORAGE AREA- A definite area to be designated. It should be in a cool, clean room that is constructed of fire resistant materials. Conductive flooring must be present but is not required if non inflammable gases are stored. Adequate ventilation to allow leaking gases to escape, safety labels and separate places for empty and full cylinders to be allocated.

2.10 OFFICES - FOR STAFF NURSE AND ANAESTHESIA STAFF- The office should allow access to both unrestricted and semi- restricted areas as frequent communication with public is needed.

2.11 REST ROOMS- Pleasant and quiet rest for staff should be arranged either as one large room for all grades of staff or as separate rooms; both have merits. Comfortable chairs, one writing table, a book case etc., may be arranged.

2.12 LABORATORY - Small lab with refrigerator for pathologist to be arranged.

2.13 LECTURE THEATRE- Since staff cannot leave an OT complex easily, it is better to have a Lecture theatre within the OT complex. Intra-departmental discussions, teaching and training sessions for staff (with audio-visual aids) may be conducted here.

2.14 STORE ROOM- This is designed to store large but less frequently used equipment in the OT. There should be storage space for special equipment after cleaning.

2.15 THEATRE STERILE SUPPLY UNIT (TSSU)- Within this area, following are desirable -

i. Temperature between 18°C -22° C, relative humidity of 40%-50% is the aim.

ii. Air conditioned with 10-12 air exchanges per hour

iii. Storage of sterile drapes, sponges, gloves, gowns and other items ready to use.

iv. Option to store in from one side and remove from other side.

v. Proper inventory to prevent running out of stock.

2.16 SCRUB ROOM- This is planned to be built within the restricted area. Elbow/foot operated or infrared sensor operated taps / water source is ideal. It is essential to have non slippery flooring in this area.

2.17 TYPES OF OT COMPLEXES

There are three main categories of operating theatres :

i. The single theatre suite with OT, scrub-up and gowning, anaesthesia room, trolley preparation, utility and exit bay plus staff change and limited ancillary accommodation.

ii. The twin theatre suite with facilities similar to 1, but with duplicated ancillary accommodation immediate to each OT, sometimes sharing a small post anaesthesia recovery area.

iii. OT complexes of three or more OTs. with ancillary accommodation including post anaesthesia recovery, reception, porter's desk, sterile store and staff change.

2.18 PRINCIPLES TO BE TAKEN INTO CONSIDERATION WHILE PLANNING AN O.T. (PHYSICAL & ARCHITECTURE):

i. Location: Low rise buildings limited to two or three storeys are preferred because of maximum advantage of natural light and ventilation as appropriate can be derived. The OT should be separate from general 'traffic' and air movement of rest of the hospital, OT, surgical wards, intensive care units (ICU), accident and emergency department (A & E), Radiological department (X-Ray) should be closely related and access is also required to Sterilizing and disinfecting unit (SDU) and laboratory facilities. The location of the operation complex in a multi- storey building is planned on the first floor, connecting to

surgical and other wards on the same floor. The requirement of height of the floor should also be worked out keeping in view the specifics of pendants, laminar flow, ducting, medical gas pipe lines, cables etc. The provision of lifts near the OT areas should also be taken in to account in planning the overall movement of staff, patients and visitors. Following aspect are also relevant:

ii. Zone wise distribution of the area, so as to avoid crisscross movements of men & machines

iii. Adequate & appropriate space allotted as per utility of the area

iv. Provision for emergency exit

v. Provision for ventilation & temperature control, keeping in mind the need for laminar flow, HEPA filter air conditioner etc.

2.19 OPERATION ROOMS

The number & size can be as per the requirement but recommended minimum size is 6.5 m x 6.5m x 3.5 m. Glass windows can be planned on one side only, as required.

Doors : Main door to the OT complex has to be of adequate width (1.0 to 1.5 m). The doors of each OT should be spring loaded flap type, but sliding doors are preferred as no air currents are generated. All fittings in OT should be flush type and made of steel.

The surface / flooring must be slip resistant, strong & impervious with minimum joints (eg. mosaic with copper plates for antistatic effect) or jointless conductive tiles/ terrazzo, linoleum etc., The recommended minimum con-ductivity is 1m ohm and maximum 10m Ohms.

For each of the OT, the power cables, network cables, medical gas pipe lines, water supply, communication cables, drainage, ducting etc. should be meticulously planned with proper routing, proper separation, proper mounting arrangement and clearances. In order to avoid clashes, the drawings should be prepared using BIMS.

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CHAPTER 3

TECHNICAL SPECIFICATION OF MODULAR OPERATION THEATRE

3.1 SCOPE OF WORK

3.1.1 The Modular OT includes the following turnkey jobs.

(i) Wall paneling system

(ii) Ceiling Paneling System

(iii) Laminar Air Flow System

(iv) Internal HVAC Ducting and Exhaust System

(v) PVC Flooring

(vi) Hermetically Sealed Doors

(vii) Touch Screen Control Panel

(viii) Pressure Relief Dampers

(ix) Hatch Box

(x) Operating List Board

(xi) X-ray Film Viewer

(xii) Scrub Station

(xiii) Storage Unit

(xiv) OT Pendants (Anaesthetist and Surgeon)

(xv) Peripheral Lighting and Clean Room Luminaries

(xvi) Electrical Installation

(xvii) Distribution board

(xviii) Isolation Panel System (IPS)

(xix) Online UPS

(xx) Medical Gas Lines Installations

(xxi) OT Light with Camera, Monitor and Recorder

(xxii) PACS monitor

(xxiii) Earthing

(xxiv) AC system for UPS room

(xxv) Control cabling from AHU to MOT control panel and associated sensors

xxvi. Site modifications

(xxvii) Comprehensive maintenance of MOT installations

3.2 WALL PANELING SYSTEM

The prefabricated Operating Room shall be of SS Sandwich / DIN SS / SMS as per its latest standards.

3.2.1 SS Sandwich: Cladding structure shall consist of insulated stainless steel wall panels with total panel thickness between 50-60 mm. It shall be 0.8 mm thick, 304 grade stainless steel sandwich panel (both side 0.8 mm thick sheet), with core consisting of rigid polyurethane foam injected under high pressure with a minimum density of 40 kg/m3. Make of steel sheet shall be Tata/Jindal/SAIL.

3.2.2 DIN Steel: 0.8 mm thick stainless steel, grade 304 (material no. 1.4301 in compliance with DIN EN 10088-3) combined with glued 18 mm thick plasterboard sheet along with suitable substructure frame.

3.2.3 SMS Panel: It shall consist of 3 mm thick solid mineral composite sheet (SMS) with aluminium backing structural panel (minimum 15 mm thick, consisting of a trapezoidal/honeycomb aluminium corrugated core glued between two flats of aluminium sheets, with suitable substructure frame). Total panel thickness shall not be less than 18 mm (3 mm thick SMS + 15 mm thick aluminium back). SMS panel shall be of bacteriostatic, dense, non-porous and non-flammable (Reaction to fire class 1 norm) material. Anti-bacterial paint should not be applied

Note : The NIT approving authority shall select any one alternative in the NIT out of those mentioned in 3.2.1, 3.2.2 and 3.2.3 in consultation with the hospital authorities/client.

3.2.4 Other specifications for panels

3.2.5 The individual wall panels shall use the tongue and groove/suitable technology for joining two panels. No welding shall be allowed.

3.2.6 It shall have minimum number of junctions. The gaps between panels shall be suitably filled with metal filler/epoxy and sanded flush or medical grade silicone/ monolithic sealing in case of SMS.

3.2.7 Stainless steel plate shall be finished to fine grain surface, and treated properly to take antifungal paint (Not Applicable in case of SMS option). Panelling shall be easy to maintain, durable, antistatic/conductive and fire retardant. Clearance between inner panel and outer wall shall be sufficient to allow the maintenance personnel for service. This closed space shall be flushed continuously to eliminate dust and bacterial accumulation.

3.2.8 Anti-bacterial paint shall be coated on the wall (Not applicable in case of SMS option). Bidder shall maintain anti-bacterial paint during warranty and comprehensive maintenance period. (Not applicable in case of SMS option).Wall elements shall be resistant to all standard cleaning agents, disinfectants and fumigation agents. Panels shall be covered with protective sheath to prevent scratch during installation.

3.2.9 The wall panels shall be CE/UL/ETL/US FDA/BIS/DIN 1.4301 certified/listed (Not applicable in case of SMS option). Third party test certificate for SS/DIN Steel/SMS from Government authorized (NABL accredited) material testing laboratory shall be provided at the time of pre dispatch inspection/supply.

3.2.10 **SUB FRAME/STRUCTURE FOR SMS PANEL:**

Sub Structure frame made of galvanized steel pillars with broad cross section and dual cavity, with geometry designed to achieve exceptional rigidity. The substructure, with its FREE-STANDING technology, minimize the interference with all electro mechanical systems to be installed. Possible to adjust and secure the profiles, ensuring the maximum rigidity and self-loading capacity of the sub frame system.

3.2.11 **WALL CORNERS:**

Angular corners made with a 130°-140° angular modular element with the same finish of the wall panels. Such unit is internally completed by a stainless-steel recovery duct formed by a single sheet/SMS, perfectly integrated and shelled in order to allow the correct element sanitization. A removable front panel allows both access to the canal behind and the regulation of the air flow between the lower and upper opening.

3.2.12 **SEALING GASKETS/MATERIAL:**

Should be non-toxic silicon rubber/material around all the contact perimeters between the various materials, and the hermetically sealed gaps between modules, should ensure optimum space segregation and ensure that sterile air pressure values are maintained in the protected environment (this being a fundamental prerequisite for guaranteed sterility). It should be seamlessly connected surface.

3.3 CEILING PANELING SYSTEM

3.3.1 **SS Sandwich:** The prefabricated ceiling plates/cassettes shall be made up of SS 304 panels with sheet thickness of at least 0.8 mm sandwich panel (both side 0.8mm thick sheet) of PUF with minimum density 40kg/m3, matte finished and coated with antibacterial paint. It shall be from the same manufacturer as that of wall panel. Total thickness shall be 30-40mm.

3.3.2 **DIN Steel:** 0.8 mm stainless steel, grade 304 (material no. 1.4301 in compliance with DIN EN 10088-3) combined with glued 18 mm plasterboard sheet along with suitable supports/substructure frame.

3.3.3 **SMS Panel:** It shall consist of 3 mm thick solid mineral composite sheet (SMS) with aluminium backing structural panel (minimum 15 mm thick, consisting of a trapezoidal/honeycomb aluminium corrugated core glued between two flats of aluminium sheets, with suitable substructure frame).Total panel thickness shall not be less than 18 mm (3 mm SMS + 15 mm aluminium back). SMS panel shall be bacteriostatic, dense, non-porous and non-flammable (Reaction to fire class 1 norm) material.

Note : The NIT approving authority shall select any one alternative in the NIT out of those mentioned in 3.1, 3.2 and 3.3 in consultation with the hospital authorities/client.

3.3.4 **SMS PANEL/SUBSTRUCTURE :**

(i) The hermetic suspended ceiling should be a loading structure in heavy gauge material forming the grid on which the ceiling panels made of Solid Mineral Composite Sheet (SMS) thickness of 03mm.

(ii) The grid should be formed of loading profiles, suspended from the ceiling slab, to which the crossbar profiles are secured by means of rigid mechanical couplings. The thus formed grid should be rigid and remains perfectly stable during all the subsequent site operations.

(iii) The suspended ceiling should be hermetically sealed by means of nontoxic silicon gasket application and it should be durable and non-degradable & resistant to microorganism attack.

(iv) Ceiling should be accessible to provide access to ceiling suspended equipment for installation and services in future.

(v) Color & view of inner surface wall & ceiling of MOT shall be finalized after approval of consignee.

(vi) Support elements: Suspension bracket with tension spring/threaded rod.

(vii) Material of support element: High quality powder coated steel.

(viii) Room lighting, air supply inlet, ceiling service units, return air outlets etc. shall be integrated with SS metal/Din Steel/SMS ceiling system.

(ix) The individual panels except those at the edges shall be removable individually.

(x) The ceiling panels shall be CE/UL/ETL/US FDA/BIS/DIN 1.4301 certified/listed (Not applicable in case of SMS option)

(xi) Anti-bacterial paint shall be coated on the ceiling. (Not applicable in case of SMS option)

(xii) Third party test certificate for SS/DIN Steel/SMS from Government authorized material testing lab shall be provided at the time of pre-dispatch inspection/supply.

3.4 LAMINAR AIR FLOW SYSTEM

3.4.1 The ceiling filtration system shall be designed to ensure unidirectional distribution of sterile air in the surgical theatre to ensure cleanliness of all the area covered by the air flow.

3.4.2 The laminar flow system shall comprise of thick extruded aluminium profiles frame and sealed gasket. The filters installed in the plenum shall be suitable for application for laminar flow and clean rooms. These filters shall meet following specifications:

- Separators: Continuous thermo plastic chord
- Sealant: Polyurethane

- Gasket: One-piece polyurethane
- MPPS average efficiency: > 99.95%
- 3 Micron DOP efficiency:> 99.99%
- Final pressure drop: 600 Pa (maximum)
- Maximum operating temperature: 600°C
- RH: 40-60%

3.4.3 The ceiling system shall be equipped with "H 14" class HEPA filters positioned in the ceiling to achieve 0.25 m/s flow at the diffuser.

3.4.4 Filtration ceiling system holding structure, filter frames and top plenum shall be made of aluminium/stainless steel.

3.4.5 The filtration ceiling system shall have diffuser/flow equalizer to achieve uniform and constant air distribution over the whole surface. It shall be CE/US FDA/ETL/UL /BIS certified/ listed.

3.4.6 The air management system shall be designed to achieve Class 100 Cleanliness with the following parameters:

- Bacteriological class=B (5 CFU/m3)
- Particle decontamination kinetics CP=5 minute
- ISO 14644 /1 or latest classification= ISO 5

Third party validation shall be obtained from Government approved environment laboratory (after installation)

3.4.7 Positive pressure shall be maintained inside the MOT to prevent contamination due to air from outside.

3.4.8 The supplier shall provide test certificate for HEPA filter and laminar air flow systems from the original manufacturers.

3.4.9 Size of laminar airflow system shall be minimum 8 feet x 8 feet.

3.4.10 It shall be CE/UL/US FDA/ETL /UL/BIS certified/listed.

Note: Prospective bidders are advised to coordinate with HVAC designer for information regarding CMH and AHU capacity. Total flow rate of filter bank shall match the CMH of AHU.

3.5 INTERNAL HVAC DUCTING & EXHAUST SYSTEM

3.5.1 The MOT firm shall execute all the HVAC ducting, return air grill and inter-connection for supply and return air inside the MOT.

3.5.2 All the ducting shall be of aluminium, insulated and shall conform to CPWD General Specifications for Heating, Ventilation and Air-Conditioning Works-2017 as amended up to the last date of receipt of tenders.

3.5.3 The return air cabinets shall consist of an openable grill and shall be cleanable.

3.5.4 These cabinets shall have suction from bottom and top also.

3.5.5 Designed flow rate shall not be less than 1000 m^3/hour. Distribution of exhaust air volume shall be divided between fluff strainers to maintain the required pressure within the theatre without causing turbulence.

3.5.6 Return air exhaust cabinet shall be made from SS 304. Also, it shall match perfectly with the ceiling system aesthetically.

3.6 PVC FLOORING WITH SELF-LEVELLING

3.6.1 Suitable self-levelling shall be done before PVC flooring to avoid undulation within the MOT.

3.6.2 It shall be minimum 2 mm thick anti-static seamless PVC flooring.

3.6.3 Floor shall be smooth, non-slippery, impervious material conductive enough to dissipate static electricity but not conductive enough to endanger personnel from electric shock.

3.6.4 Continuous roll of PVC flooring shall be used and joints shall be welded by special PVC thermal welding units using PVC welding bars of same colour.

3.6.5 The sheets shall be highly durable and resistant to shock, scratch and indentation. The conductive material shall be uniformly impregnated as grains.

3.6.6 It shall be inert to body fluids, chemicals and disinfectants and shall not be affected by temperature variation within the OT.

3.6.7 The floor shall efficiently discharge electric charges up to 2 kV.

3.6.8 Flooring shall be done by skilled workers of accredited agencies authorized by the supplier of PVC sheets. The electrical resistance (point to ground) shall be within 2.5x104 to 5x106 Ohms. The floor shall not allow build-up of electrical charge beyond 100 Volts due to antistatic effect. The corners shall not be terminated sharply and concealed cove-former (aluminium) shall be used to overlap the wall panel to a height of approximately 25 mm and sealed perfectly and uniformly. Self-levelling compounds shall be used.

3.6.9 The conductive copper grid laid underneath the PVC sheet shall be supported by liquid epoxy compounds allowed to set as a uniform and level surface. The copper strips to be made visible by grinding and no copper strip shall project more than 0.5mm above level surface to avoid damage to the PVC sheet. One earthing lead shall be brought out from every 150 sqft area and attaching it to the main earthing strip/ground.

3.6.10 Copper grounding strips (0.5 mm thick, 50 mm width) shall be laid flat on the floor in the conductive adhesive and connected to copper strip of grounding. The connection from copper grid shall be brought out uniformly at places to form equipotential grid.

3.6.11 Flooring shall be mechanically shock proof, scratch proof, flame retardant and antimicrobial.

3.6.12 Corners shall be uniformly curved.

3.6.13 Colour shall be uniform, pleasant and matching with ambience and as approved by the department.

3.7 HERMETICALLY SEALED DOORS

3.7.1 Door sizes shall be as per below option and quantities will be as per BOQ.

(i) Hermetically sealed doors size: 2.1 m x 1.8 m

(ii) Hermetically sealed doors size: 2.1 m x 1.0 m

(iii) Hermetically sealed doors size: 2.1 m x 1.8 m with Lead Line (As per AERB Norms)

(iv) Hermetically sealed doors size: 2.1m x 1.0 m with Lead Line (As per AERB Norms)

3.7.2 These shall be hermetically sealed, single sliding doors.

3.7.3 The controller shall be capable of being operated by elbow switches/foot switches as well as touch less sensor.

3.7.4 The track and its cover shall be of stainless steel/aluminium and the running surface for the top rollers shall be suitably angled to reduce resistance to movement.

3.7.5 The door leaf shall be hung by means of hard plastic rollers of high quality with double bearing at the top. Rollers shall be provided under the stainless steel/aluminium track to enable smooth and noiseless movement.

3.7.6 Opening and closing of the door shall be microprocessor controlled electro-mechanical movement with the provision of manual operation.

3.7.7 The door material shall be of SMS/ HPL. Colour shall match the interior and care shall be taken to make the leaf strong and light weight.

3.7.8 One shall be able to open and close the door effortlessly in case of failure of automatic mechanism.

3.7.9 Door opening handle shall be strong and sturdy. Material of the handle shall be of SS (gloss/matte finish). Door shall be provided with high quality cylindrical/ ESPAG lock.

3.7.10 Door leaf shall have high quality synthetic rubber gasket with long life to ensure hermetic sealing (to maintain air pressure differential) with air tightness of 99.99% at a pressure of minimum 75 Pa.

3.7.11 The finished floor on either side of the door shall be perfectly level (maximum permissible difference + 1 mm).

3.7.12 The overall thickness of the finished door shall be 50-60 mm. The inner part of the door shall be filled with CFC free polyurethane foam thickness of about 48 mm. (Sealed airtight to prevent further ingress of any microbial organism).

3.7.13 The door and controls shall comply with IEE regulation. All motors used shall be DC brushless / PMDC motors with essential isolation from mains.

3.7.14 Door shall be with vision window of minimum size 300 mm x 300 mm with double glazed panels and hermetically sealed.

3.7.15 Door movement shall have minimum noise.

3.7.16 The starting time after receiving the signal shall be adjustable between 0.5 to 10 seconds.

3.7.17 The door controller shall be CE marked.

3.7.18 Test certificate for hermetically sealed door frame (factory test certificate) shall be enclosed with the pre dispatch documents.

3.8 TOUCH SCREEN CONTROL PANEL: 20" or more

3.8.1 The control panel shall be touch screen panel. This control panel shall work as the central control panel for the HVAC controls, instruction board, touch screen and ON/OFF of MOT light. It shall be CE/US FDA/ETL/UL/BIS certified/ listed.

3.8.2 The touch screen shall be wall mounted, stationed in the visibility line of the surgeon and MOT staff. The access height shall be convenient for the nurse to operate.

3.8.3 The panel shall accommodate digital clock and the elapsed time indicator.

3.8.4 The medical gas alarm shall indicate high and low gas pressures for each gas service (except for vacuum, for vacuum it shall be normal or low) present in the MOT including vacuum. This shall be supported by audio visual alarm also. The panel shall have an alarm mute (fault annunciation) facility. The sensors (pressure switches) shall be at the nearest isolation valve.

3.8.5 It shall have control for general lighting: ON/OFF and dimming controls organized in groups to provide uniform illumination.

3.8.6 On/Off operation of the operating light (major and satellite) shall be provided.

3.8.7 Hands free telephone set with memory shall be located at one side.

3.8.8 Temperature and humidity control for the room connected to the AHU (adjustable from the panel) shall be provided. There shall be a provision of MOT temperature adjustment from the controller (temp adjustment of +/-50C to be achieved within 5 minutes) wherever separate AHU is provided for each MOT.

3.8.9 Digital room pressure indicator in cm of H_2O or equivalent shall be provided (signal from pressure sensor shall be provided to indicate pressure differential between MOT and outside).

3.8.10 HEPA filter bank differential pressure indicator shall be provided.

3.8.11 The Control Panel shall be able to be integrated with HIS (Hospital Information System)/BMS.

3.8.12 The Control Panel shall be able to display the Isolation Panel Alarm Conditions along with MGPS Alarms.

3.9 PRESSURE RELIEF DAMPERS (PRDs)

3.9.1 Pressure relief dampers or over flow ports shall be provided in each room to prevent contamination of air from clean and dirty areas.

3.9.2 Suitably sized air pressure relief damper shall be strategically placed, enabling differential room pressure to be maintained when doors are opened between clean and dirty areas.

3.9.3 Counter-weight balancing system shall be provided in the PRD to maintain positive pressure inside the operation room.

3.9.4 Air pressure stabilizers shall have unique capability of controlling differential pressure to close tolerance. The PRD shall remain closed at pressure below the set pressure and shall open fully at a pressure only fractionally above the threshold pressure.

3.9.5 The frame, body and blade shall be of grade SS 304 stainless steel.

3.10 HATCH BOX

3.10.1 It shall be provided in each operation theatre to remove waste materials from the operation theatre to dirty linen area/corridor just adjacent to MOT.

3.10.2 Each hatch box shall be equipped with two doors and the doors shall be operated electrically/motorised.

3.10.3 The hatch shall be designed in such a way that only one door shall be openable at one time.

3.10.4 The UV light shall be so installed that it is kept ON while both the doors are closed. This UV light has to be automatically turned off in case of opening of either of the doors.

3.10.5 Indicators shall be provided on both sides of the MOT so that door open/close status can be monitored from both sides.

3.10.6 Hatch Box material shall be SS 304 grade.

3.10.7 Length and width of the hatch box shall be minimum 600mm by 600mm.

3.11 OPERATING LIST BOARD

3.11.1 One operating list board shall be provided in each operating theatre.

3.11.2 It shall be made of ceramic having magnetic properties and shall be flushed to the wall of the MOT.

3.12 X-RAY FILM VIEWER

3.12.1 LED type flat panel X-ray viewing panel shall be flicker free.

3.12.2 This shall comply with relevant electrical safety codes.

3.12.3 Mounting shall be flush with the wall to avoid dust accumulation and growth of organisms between wall and panel.

3.12.4 The body shall be of extruded aluminium powder coated with bacteria resistant and disinfectant resistant finish.

3.12.5 The diffuser on the front panel shall be a uniformly lit screen.

3.12.6 Dimming electronic control shall be enclosed at the bottom of the cabinet.

3.12.7 Proper spring-loaded film clip with rollers/holding button shall be provided to hold the films firmly and to remove the film without scratches.

3.12.8 It shall consist of dual panel viewing screen (minimum 14"x17" each).

3.13 SCRUB STATION (MINIMUM SIZE 1500MM)

3.13.1 Compact surgical scrub sink shall be designed for use in MOT complex for pre-procedural scrub. Double sink combination shall be provided.

3.13.2 Each fixture shall be fabricated from heavy gauge type 304 stainless steel (minimum thickness 1.5 mm) and shall be of seamless welded construction, polished to a satin finish.

3.13.3 The scrub sink shall be provided with a front access panel which shall be easily removable for access to the water controlled valve, waste connections, stoppers and strainers.

3.13.4 Hands free operation shall include infra-red sensors with programmable adjustment.

3.13.5 Thermostatic mixing, valve control shall be located behind the access panel and it shall maintain constant water temperature.

3.13.6 Timing shall be adjustable to meet individual application requirements.

3.13.7 It shall be provided with infrared sensors, thermostatic control taps with fail safe temperature controls.

3.13.8 All units shall have reduced anti- splash fronts.

3.13.9 Knee/foot operated switch shall be provided additionally.

3.14 STORAGE UNIT

3.14.1 The storage unit shall be made with at least 0.8 mm thick SS 304 stainless steel panels and size and number of units be optimized taking input from the hospital authorities.

3.14.2 The shelves shall be of SS 304 stainless steel and removable for cleaning.

3.14.3 The storage unit shall be divided in 2 or more parts and each part shall have individual glass doors with high quality locking system.

3.14.4 The overall size shall be 200 cm x 120 cm x 35 cm (approximately). The size can be varied by NIT approving authority based on site requirement and space availability.

3.14.5 It should be flushed with the wall.

3.15 PENDANTS FOR ANESTHETIST AND SURGEON

3.15.1 Double arm moveable pendant for Anesthetist

(a) The pendants shall comply with NFPA 99C/HTM 02-01/DIN/EN/ISO 7396-1 as amended up to the last date of receipt of tenders. The support arms shall be extremely robust and revolve on high quality bearings, so that the pendant head glides smoothly and quickly to any desired position.

(b) It shall have double moveable arms (any combination) with total coverage of minimum 1800 mm and minimum 330 degree. Each arm shall have ability of horizontal movement. Vertical movement shall be motorized and the arm height shall remain at a height greater than 6.5 feet above floor level.

(c) Weight carrying capacity of the arm shall not be less than 180 kg and it shall have electromagnetic/pneumatic brakes.

(d) Each arm shall be capable of minimum 330 degree of rotation, which can be easily adjusted to suit the desired mode of operation.

(e) The pendant shall be European CE Certified with 4 digit notified body number/US FDA/ETL/UL/BIS certified/listed.

(f) The Pendant Service Heads shall be modular with minimum 800mm head. The heads shall be capable of accepting a range of shelves, infusion poles, electrical switch/sockets, gas outlets and other required accessories. The Pendant Heads shall support the range of Physiological Monitor Mounting Solutions.

(g) The Pendant Service Heads shall be supplied with medical gas terminal units and 5A/15A or 6A/16 A hybrid sockets.

(h) Pendant shall be supplied with outlets and probes as mentioned below as per the standard sequence of MGPS outlets for all gas services:

- Oxygen outlets: 2 number
- Vacuum outlets: 2 number
- Nitrous oxide outlet: 1 number
- Air (4 bar) outlets: 2 number
- AGSS outlet: 1 number
- Electrical sockets: 10 number
- Adjustable shelf with two rails one on each side: 3 number
- IV Fluid Pole with 4 hooks: 1 number
- Data socket RJ-45: 2 number

(i) Pendant supplier shall provide cut-outs for Patch Panels in Integrated OTs (only for integrated OT).

(j) Anaesthetist pendant shall have NIST connection for all gases to connect the MGPS system.

3.15.2 Double arm moveable pendant for Surgeon

(a) The Pendants shall comply with NFPA 99C/HTM 02-01/DIN/EN/ISO 7396-1 as amended up to the last date of receipt of tenders. The support arms shall be extremely robust and revolve on high quality bearings, so that the pendant head glides smoothly and quickly to any desired position.

(b) Double moveable arms (any combination) with total coverage of min 1800 mm and minimum 330 degree. Each arm shall have ability of horizontal movement. Vertical movement shall be motorized and the arm height shall remain at a height greater than 6.5 feet above floor level.

(c) Weight carrying capacity of the arm shall not be less than 180 kg. It shall have electromagnetic/pneumatic brakes.

(d) Each arm shall be capable of minimum 330 degree of rotation, which can be easily adjusted to suit the desired mode of operation.

(e) The pendant shall be European CE Certified with 4 digit notified body number/US FDA/ETL/UL/BIS certified/listed under medical devices directive.

(f) The Pendant Service Heads shall be modular with minimum 800 mm head. The heads shall be capable of accepting a range of shelves, infusion poles, electrical switch/sockets, gas outlets and other required accessories. The Pendant Heads shall support the range of Physiological Monitor Mounting Solutions.

(g) The Pendant Service Heads shall be supplied with medical gas terminal units and 5A/15A or 6A/16 A hybrid sockets.

(h) Pendant shall be supplied with outlets and probes as mentioned belowas per the standard sequence of MGPS outlets for all gas services:

- O2 and MA4: One each
- Vacuum outlets: 2 number
- Air (7 bar) outlet: 01 number
- CO2 outlet: 01 number
- Electrical sockets: 10 number
- Adjustable shelf with two rails one on each side: 3 number
- Data socket RJ-45: 2 number
- IV Fluid Pole with 2 hooks: 1 number
- (Pole shall be capable of stacking 4 syringe pumps)
- Nitrous oxide outlet: 1 number

(i) Pendant supplier shall provide cut-outs for patch panels in integrated OTs (only for integrated Ots).

(j) Surgeon pendant shall have NIST connection for all gases to connect the MGPS system.

3.16 PERIPHERAL LIGHTING AND CLEAN ROOM LUMINARIES (LED TYPE)

3.16.1 To provide peripheral lighting and clean room luminaries with illuminance of minimum 500 Lux. These shall be minimum 8 in numbers for each MOT and shall be with highly specular anodized aluminium and optical antiglare system.

3.16.2 Luminaries cover shall be made of highly resistant, disinfectant proof laminated safety glass/acrylic with stylish fine grained surface.

3.16.3 The white luminaries' body shall be made of sheet steel/perfectly powder coated.

3.16.4 Recess frames shall be airtight. The fitting shall be flush with the ceiling and shall be removable from top or bottom. The light fitting shall be uniformly and aesthetically distributed on the ceiling to provide uniform illumination in the MOT. Light shall not interfere when green mode endoscopy is performed.

3.16.5 Peripheral lighting shall be done according to IP 65 regulations.

3.16.6 Control equipment for the general lighting and the light dimming shall be provided in the theatre control panel.

3.16.7 The peripheral lights should be placed in such manner that it should provide high lux level in the sterile field area i.e near the OT table and decreasing toward the periphery so that the eyes of the surgeon and operating team may acclimatize with the outer area of OT.

3.17.0 ELECTRICAL INSTALLATIONS

3.17.1 Power distribution within the OT shall be provided from distribution panels placed locally in each theatre. Sub mains power to these panels shall be provided by the general electrical contractor. From these panels all distribution services within the MOT shall be executed by the MOT firm.

3.17.2 Earthed equipment bonding of all exposed metalwork shall be provided.

3.17.3 All Power sockets within the Operating Theatres ancillary areas shall be matched to the rest of the hospital. However these should be anti-microbial coated, flushed to the wall at a height of 1.2m-1.5 m above FFL

3.17.4 Each wall of MOT shall have minimum 02 number 6A/16A hybrid switch sockets. One 32A industrial socket shall also be provided at any two walls as per IEC standard.

3.17.5 Light fittings within the clinical areas shall be recessed LED type with control gear.

3.17.6 Fittings shall conform to IP 65 regulations.

3.17.7 All equipment shall be fully and permanently labelled to identify and describe the function, operation and voltage of the apparatus concerned. Upon completion of the electrical installation, tests in accordance with relevant sections of the local wiring regulations shall be carried out and the results recorded.

3.17.8 All the electrical fittings shall be flushed in the wall /Ceilings.

3.18 DISTRIBUTION BOARD

3.18.1 All high voltage equipment shall be installed in a separate enclosure. The MOT firm shall provide two DBs for each MOT to be installed with suitable wiring (one DB dedicated for UPS power supplies and other for raw power supplies to MOT equipment)

3.18.2 The MOT firm shall provide a remote cabinet which shall house the mains failure relays, MCB, MCCB electrical distribution equipment and circuit protection equipment for all circuits within the operation theatre.

3.18.3 All internal wiring shall terminate in connectors with screw and clamp spring.

3.18.4 Connections of the clip on type mounted on a rail and labelled with indelible proprietary labels shall be provided.

3.18.5 Individual fuses or miniature circuit breakers shall protect all internal circuits.

3.18.6 Complete schematic drawing with description shall be enclosed with the equipment.

3.18.7 DBs shall have minimum two number 32A/16A (as per requirement) extra circuits with MCCB/MCB for future uses like integration equipment etc.

3.19 ISOLATION PANEL SYSTEM (IPS)

3.19.1 Isolation Panel System of required capacity shall be provided for every operation theatre to ensure the safety of staff and patient. System shall have isolators provided through leakage relays etc., if required, according to IEC recommendation. These systems are to be commissioned by specialists. Normally single phase isolation panels of capacity up to 10 KVA are available, which can be used for the purpose. In case of higher capacity requirements, the number can be suitably increased.

3.19.2 It shall be medical grade Isolation panel.

3.19.3 It shall have fault detection feature.

3.19.4 It shall be compliant to CEI 64-8/IEC 60364-7-710/BS 7671 Standard as amended up to the last date of receipt of tenders.

3.19.5 It shall be compact and mountable on wall or flush on brick wall.

3.19.6 The IPS shall be able to integrate with HIS/BMS and Surgeon Control Panel as standard.

3.19.7 Isolation panel system shall have facility to detect fault of leakage current for each circuit (minimum 12 circuits) and same shall be integrated with touch screen control panel of MOT and alarm status shall be displayed on the touch screen control panel.

3.20 ONLINE UPS

3.20.1 Backup shall be minimum 30 min.

3.20.2 The room for the central UPS will be provided by the respective institute/hospital preferably at same OT floor and one point electric supply will be provided to the UPS room by the respective institute/hospital (Applicable only for standalone MOT work to be executed in existing building).

3.20.3 The MOT firm shall provide required electrical wiring from UPS to all MOT as per IEC/International standard.

3.20.4 Electrical control panel complete with MCCB, switchgears etc. shall be provided for distribution of power by the MOT firm..

3.20.5 The UPS load for individual OT should be calculated and UPS system should be provided accordingly.

Typically, UPS load per MOT shall be around 20 kVA.
It is recommended that central UPS system should be provided for the complete hospital building and the capacity should be worked out accordingly. However, in case dedicated UPS system is provided for the Modular OTs only, the system with redundancy (n+1) shall be provided having automatic switchover arrangements. The battery bank may be common for all the UPSs. For example, if there are 10 MOTs with each requiring 20 KVA,

the UPS shall be 20 kVA x 10 and one 20 kVA as standby, total 200 kVA + 20 kVA and battery bank shall be common. If MOTs are in 2 places like 6 MOTs at 4th floor and 4 MOTs at 3rd floor, the provision can be made for 6 x 20 kVA +20 kVA and 4 x 20 kVA+20 kVA,with wiring from UPS room to all MOTs at respective floors.

3.21 MEDICAL GAS PIPE LINE INSTALLATION

3.21.1 The MOT firm shall ensure that MGPS works inside the MOT are carried out as per HTM 02-01/NFPA 99C/DIN/EN/ISO 7396-1 as amended up to the last date of receipt of tenders.

3.21.2 The MOT firm shall provide oxygen, air, vacuum, AGSS and nitrous oxide pipe line connections from the existing lines terminated outside the MOT.

3.21.3 The MOT firm shall do installation, testing and commissioning of complete MGPS system inside the operation theatre including distribution piping, pendants, outlets and other essential accessories.

3.21.4 Terminal units shall be gas specific and only accept the correct medical gas probe. Gas specific components shall be pin indexed to ensure that a correct gas specific assembly is accepted.

3.21.5 Each terminal unit shall be identified by the appropriate recognized name or symbol, colour, coding and shape as per HTM 02-01/NFPA 99C/DIN/EN/ISO 7396-1 as amended up to the last date of receipt of tenders. Outlets shall be European CE with 4 digit notified body number/UL/ETL/US FDA/BIS certified/listed.

3.21.6 Copper pipes shall be of solid drawn, seamless, deoxidized, non-arsenical, half hard, tempered and degreased copper pipe. All copper pipes shall be degreased and delivered capped at both ends. The pipes shall be accompanied with manufacturers test certificate for the physical properties and chemical composition. The copper pipe shall comply with EN 13348 as amended up to the last date of receipt of tenders.

3.21.7 Copper pipe must have reputed third party inspection certificate (eg.Lloyd's, TUV, SGS).

3.21.8 Fittings shall be made of copper and suitable for a working pressure of up to 17 bar and especially made for brazed socket type connections.

3.21.9 The copper fitting shall comply with EN 1254-1 as amended up to the last date of receipt of tenders.

3.21.10 The brazing filler material shall comply with EN 1044 as amended up to the last date of receipt of tenders.

3.22 MOT LIGHT WITH CAMERA, MONITOR AND RECORDER

3.22.1 MOT light – LED

MOT surgical lighting system shall provide an ideal combination of brightness, maneuverability and shadow resolution without sacrificing colour and accuracy through a consistent LED technology. Such lighting system shall have the following technical specifications:

(a) Number of light heads: Two

(b) Colour temperature range: 3800°K to 5000°K (±10%)-Variable colour temperature.

(c) Field size diameter: 20cm to 28cm (+/- 10%)

(d) Working range: 750mm to 1100mm (+/- 10%)

(e) Illumination level: minimum 160,000 lux (both for major dome and minor dome separately)

(f) Controls: control panel (two: one on the wall and other on dome)

3.22.2 HD Camera System – 1080 p/i

Description: Integrated in-light camera system shall be integrated at the centre of one of the domes of this lighting system/third arm in order to capture images and video sequences of the open cases.

Such an autofocus–lockable camera shall have the following specifications -

(a) Signal to noise ratio (S/N Ratio): >50 dB
(b) CCD/CMOS: 1/3" or 1/2.8"
(c) Optical zoom: 10X
(d) Digital zoom: 12-15X
(e) Video output: HD, DVI, S-video and composite video
(f) White balance and gain: Automatic/Manual
(g) MOT light and Integrated Camera shall have a control through touch panel of the control equipment placed inside the operating room.

3.22.3 HD LED Flat Panel Monitor (Only for non-integrated MOTs)

(a) It shall be 30"-32" medical grade high definition progressive scan flat-panel monitors with ceiling mounted spring arm suspension to support high definition/HDTV progressive scan images and shall be able to support and display DVI/HDTV, RGBHV, S-video, composite video signals. Aspect ratio 16:9/16:10. Resolution: 1920x1080 or better. It shall meet IP 54 regulations.

(b) The flat panel suspension shall be ready with the cables for integration of high definition digital (DVI/HDTV), RGBHV (high resolution), SVHS (S-video), composite video signals to travel from the various sources of video like endoscopic camera, room camera, in-light camera, high definition flat panel monitors, while assuring native resolution/signal.

(c) Monitor shall be capable of displaying from other sources like endoscope, microscope etc. Necessary provision for the same shall be made.

3.22.4 Recording system shall be offered separately (Only for non-integrated MOTs).

(a) Recording system shall be offered separately. Recording system shall be full HD medical grade monitor LED minimum 19 inch touch screen and having one TB storage space.

(b) Data cable for communication from both pendants and monitors shall be laid down up-to outside of MOT in a patch port for future expansion for all MOTs where there is no integration.

(c) Patch panel for power and signal shall be laid down for 48 inch LED monitor at wall of MOT.

(d) Recorder shall be capable of recording video from other sources like microscopes, endoscopes etc., suitable provision for the same shall be made.

(e) It shall be flush mounted on the MOT wall with suitable frame.

3.23 PACS (PICTURE ARCHIVING & COMMUNICATION SYSTEM) MONITOR: (FOR NON-INTEGRATED MOT)

It shall be medical grade monitor. Its size shall be minimum 48 inch. It shall be integrated with hospital PACS. The MOT firm shall do the necessary coordination with hospital authorities for connecting the PACS monitor to the hospital PACS. If hospital/institute PACS is not available, MOT firm shall terminate all PACS monitor connection to switch located in MOT corridor for further connection by the hospital.

Monitor shall be flush mounted with suitable frame in MOT wall. Frame shall be openable/serviceable for service.

3.24 EARTHING

It shall comprise of earthing with copper earth plate 600 mm X 600 mm X 3 mm thick including accessories and providing masonry enclosure with cover plate having locking arrangement and watering pipe of 2.7 metre long etc. with charcoal/ coke and salt and connections with 25 mm X 5 mm copper strip in 40 mm dia G.I. pipe from earth electrode. The earthing work shall conform to CPWD General Specifications for Electrical Works Part-I (Internal), 2013 as amended up to the last date of receipt of tender.

3.25 AIR CONDITIONING FOR UPS

The MOT firm shall provide suitable AC for UPS rooms of MOT based on the heat load calculations, as per offered UPS requirement/recommendations from the manufacturer and local site conditions.

The MOT firm shall provide the control cabling from AHU to MOT control panel and associated sensors.

3.26 SITE MODIFICATIONS*

The MOT firm shall carry out following site modification works:

3.26.1 Construction of 230 mm brick wall with plaster on both sides and paint matching the surrounding premises as per CPWD Specifications (Vol. 1 & Vol. 2) as amended up to the last date of receipt of tenders. Payment shall be made as per actual.

3.26.2 Demolition of brick wall. Payment shall be made as per actual.

3.26.3 75 mm thick cement concrete flooring for MOT.

3.26.4 Suitable wiring (including tray/pipes/casing as per requirement) from UPS to control panel.

3.26.5 Wiring from control panel to MOT.

3.26.6 Any minor demolition, reconstruction, water proofing, necessary plumbing, anti-microbial painting, replacement of any door or windows within the MOT area shall be carried out by the MOT firm for successful installation and commissioning of MOT.

3.26.7 All jobs such as providing cut outs, PRD, hatch, shifting and resizing of door/window up to 300 mm etc. with all minor repairing works inside the MOT for successful completion of MOT works.

*Applicable only for standalone MOT work to be executed in existing building

3.27 MAKE IN INDIA POLICY

The MOT work shall fully comply to Public Procurement (preference to make in India) Order (PPP-MII order) 2017 issued by DPIIT and corresponding notifications issued by concerned nodal ministry/department as amended up to the last date of receipt of tenders.

CHAPTER 4

COMPREHENSIVE MAINTENANCE OF MODULAR OPERATION THEATRE

4.1 COMPREHENSIVE MAINTENANCE:

4.1.1 The contractor shall be responsible for comprehensive maintenance of MOT installations for 5 years after completion of Defect Liability Period/Warranty Period of five years from the date of completion of the work through the same MOT firm and handing over to the department. If the same MOT firm is not available, another firm may be engaged with the approval of hospital/institute. The MOT firm shall be approved on the basis of work experience mentioned in clause 1 of Additional Conditions. The comprehensive maintenance of MOT installations includes complete MOT installations, labour, spares, all consumables etc. (except HEPA and other filter) as required including the following.

(i) All motors.

(ii) Plastic and glass parts against any manufacturing defects.

(iii) All kinds of sensors.

(iv) All kind of coils, probes and transducers.

(v) Printers and imagers including laser and thermal printers with all parts.

(vi) UPS including the replacement of batteries.

(vii) Air-conditioners

(viii) All kinds of painting, civil, HVAC and electrical work

(ix) Preventive maintenance including testing & calibration as per technical/service /operational manual of the manufacturer.

(x) MGPS installation inside the MOT.

Note: HEPA & other filters shall be covered as an additional item payable based on actual replacement done at site, being a consumable item. Suitable item should be kept in the NIT for the same by the NIT calling authority.

4.1.2 In the case of MOT equipment, the comprehensive maintenance shall be done with back-to-back support from OEM. In such cases, authorized agent of OEM shall reach the site within 8 hours of raising a service call.

4.1.3 The MOT firm shall ensure uninterrupted service without compromising functioning of MOT/ICU.

4.1.4 The MOT firm shall set-up a maintenance base in the vicinity of the hospital, to provide maintenance service of the entire MOT installations.

4.1.5 If the performance of any individual equipment or system is not satisfactory, the same shall be replaced free of cost.

4.1.6 If it is found that to meet the performance criteria, any extra equipment is required, the same shall be provided free of cost.

4.1.7 All faults and their rectification shall be promptly intimated to the hospital.

4.1.8 Any lacunae noticed in the functioning of the installation as a result of any design feature/fault shall be rectified free of cost.

4.1.9 Proper marking has to be made for all spares for identification like printing of installation and repair dates.

4.1.10 On receipt of any complaint, the MOT firm shall, within 8 hours on a 24(hours) x 7 (days) x 365 (days) basis respond to take action to repair or replace the defective goods or parts thereof free of cost. The MOT firm shall take over the replaced parts/goods after providing their replacements and no claim, whatsoever shall lie on the hospital/institute for such replaced parts/goods thereafter. The penalty clause for non-rectification will be applicable as per tender conditions.

4.1.11 If the MOT firm fails to attend the complaint within 8 hours a penalty of Rs.10000/hour will be charged from the firm and recovery made accordingly. The decision of the Engineer- in- Charge shall be final and binding on the firm with respect to the imposition of overall penalty decision taking into view overall circumstances of the case.

4.1.12 The contractor/MOT firm along with the Indian agent of the manufacturer shall ensure continued supply of the spare parts for the machines and equipment supplied by them for 10 years from the date of completion of the work.

4.1.13 The payment of comprehensive maintenance will be made on six monthly basis after satisfactory completion of said period duly certified by end user.

4.1.14 The contractor shall ensure regular updates of newer technology as and when evolved during warranty period for all the equipment.

4.1.15 The contractor shall deposit performance guarantee @ 3% of the value of the comprehensive maintenance contract before commencement of comprehensive maintenance, which shall be held by the hospital/institute till completion of comprehensive maintenance period.

4.1.16 Periodic maintenance schedule shall be provided to the department by the vendor for each component of the MOT (as per OEMs recommendations) with clear instructions about the usage and maintenance of the components including cleaning and infection control practices to be followed. The same shall be approved by the department for the complete period and the firm will be bound to carry out the activities of maintenance and services accordingly. The department reserves the right to modify the schedule as per site requirements or clients recommendations and the decision of the department shall be final and binding on the firm.

4.1.17 Periodic Maintenance visits atleast every three months need to be done with detailed report of optimal functioning of all the components.

4.1.18 Downtime of any component of the MOT installation cumulative should not be more than 5%, to be calculated on half yearly basis failing which the department shall have right to impose penalty as deemed fit, and the decision shall be final and binding on the firm.

4.1.19 There shall be no extra cost for software upgradation/ supply and installation of security patches/ lifetime license fee for system. The software upgradation including security patches shall be provided free of cost during the CAMC period. Bidder should submit OEM certificate to the effect that the software as well as security patches etc. shall be made available for enabling free upgradation of the system till the expiry of the defect liability period and CAMC period. The software validity shall be till the end of the CAMC period and will be got done by the OEM/through their authorised channel partners within the tendered cost.

NOTES:

(1) Necessary modifications may be made in the additional conditions by the NIT approving authority as per actual requirements at site and/or to safeguard government interest.

(2) It is advised not to stipulate makes of materials/equipment in the NIT. The makes which conform to these specifications may be accepted.

(3) It is advised that procurement, installation, testing and commissioning of the MOT medical equipment may preferably be included in the scope of EPC/composite contract in hospital projects.

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CHAPTER 5

SAMPLE BOQ OF MOT

Following is the Sample BOQ for 750 bed AIIMS Hospital. However, the items and quantities of BOQ may be derived as per individual site requirement

BOQ FOR MOTs			
S No	**Name of items as per Technical Specifications, terms and conditions of the NIT**	**Unit**	**Quantity**
1	Supplying, Installation, Testing and Commissioning of Wall panelling system	sqm	
2	Supplying, Installation, Testing and Commissioning of Ceiling panelling system	sqm	
3	Supplying, Installation, Testing and Commissioning of Laminar air flow system	each	
4	Supplying, Installation, Testing and Commissioning of Internal HVAC ducting including inter-connection with outer ducting and exhaust system	sqm	
5	Supplying, Installation, Testing and Commissioning of PVC flooring with self-levelling compound	sqm	
6	Supplying, Installation, Testing and Commissioning of Hermetically sealed doors:		
(a)	Supplying, Installation, Testing and Commissioning of Hermetically sealed doors of size 2.1 m x 1.8 m	each	
(b)	Supplying, Installation, Testing and Commissioning of Hermetically sealed doors of size 2.1 m x 1.0 m	each	
(c)	Supplying, Installation, Testing and Commissioning of Hermetically sealed doors of size 2.1 m x 1.8 m with lead line (as per AERB norms)	each	
(d)	Supplying, Installation, Testing and Commissioning of Hermetically sealed doors of size 2.1 m x 1.0 m with lead line (as per AERB norms)	each	
(e)	Supplying, Installation, Testing and Commissioning of View window with motorized (optional)	each	
7	Supplying, Installation, Testing and Commissioning of Touch screen control panel	each	
8	Supplying, Installation, Testing and Commissioning of Pressure relief dampers	each	
9	Supplying, Installation, Testing and Commissioning of Hatch box	each	
10	Supplying, Installation, Testing and Commissioning of Operating list board	each	
11	Supplying, Installation, Testing and Commissioning of X-ray film viewer	each	
12	Supplying, Installation, Testing and Commissioning of Scrub station	each	

13	Supplying, Installation, Testing and Commissioning of Storage unit	each	
14	Supplying, Installation, Testing and Commissioning of OT pendants		
14.1	Supplying, Installation, Testing and Commissioning of Anaesthetist pendant	each	
14.2	Supplying, Installation, Testing and Commissioning of Surgeon pendant	each	
15	Supplying, Installation, Testing and Commissioning of Peripheral lighting andclean room LEDluminaries	each	
16	Supplying, Installation, Testing and Commissioning of Electrical installation (per MOT)	Job	
17	Supplying, Installation, Testing and Commissioning of Distribution board (UPS and Raw Power one each)	set	
18	Supplying, Installation, Testing and Commissioning of Isolation panel system (IPS)	each	
19	Supplying, Installation, Testing and Commissioning of Online UPS (for all MOTs)	each	
20	Supplying, Installation, Testing and Commissioning of Medical gas lines installations (Per OT)	job	
21	Supplying, Installation, Testing and Commissioning of OT light with camera, monitor andrecorder		
21.1	Supplying, Installation, Testing and Commissioning of OT light	each	
21.2	Supplying, Installation, Testing and Commissioning of HD camera	each	
21.3	Supplying, Installation, Testing and Commissioning of HD monitors with spring arm	each	
21.4	Supplying, Installation, Testing and Commissioning of HD recorder	each	
22	Supplying, Installation, Testing and Commissioning of PACS monitor	each	
23	Supplying, installation, testing and commissioning of earthing with copper earth plate 600 mm X 600 mm X 3 mm thick including accessories and connections etc.	each	
24	Supplying, installation, testing and commissioning of suitable AC system for UPS room	each	
25	The control cabling from AHU to MOT control panel and associated sensors	m	
26	Site modifications*		
	Construction of 230 mm brick wall and plaster on both sides with paint matching the surrounding premises.	sqm	
(a)	Demolition of brick wall	cum	
(b)	75 mm thick cement concrete flooring	sqm	
(c)	Wiring from UPS to control panel	m	

(d)	Wiring from control panel to MOT	m	
(e)	Any minor demolition, reconstruction, water proofing, necessary plumbing, anti-microbial painting, replacement of any door or windows within the MOT area for successful completion of MOT work.	job	
(f)	All jobs such as providing cut outs, PRD, hatch, shifting and resizing of door/window up to 300 mm etc. with all minor repairing works within the MOT area for successful completion of MOT work.	job	
27	Comprehensive maintenance of the complete MOT installation for 5 years after completion of Defect Liability Period/Warranty Period of five years as per terms and conditions of comprehensive maintenance described in the NIT as per following:		
27.1	1st year	job	
27.2	2nd year	job	
27.3	3rd year	job	
27.4	4th year	job	
27.5	5th year	job	

*Applicable only for standalone MOT work to be executed in existing building.

Note : NIT issuing authority shall put the suitable clause to safeguard the Govt. interest against front loading of bid by the contractor.

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CHAPTER 6

SAMPLE COMPLIANCE SHEET OF MODULAR OT

Note :

- The compliance sheet as given below has to be submitted by the firm at appropriate stage prior to placing of orders for the supply of goods/equipment and execution of work.
- The firm will submit the compliance sheet in detail for each of the item along with the relevant catalogues and technical literature conforming compliance to NIT. The deviations, if any, to be categorically brought out.
- In case of non-compliance of specification, the firm will be bound to offer alternate item of required specification.
- Only after approval of the same the firm will place the order and take execution of work.

S.N.	Item of Modular OT	As per NIT	As offered by firm	Deviation if any/Remarks
1.	Wall paneling system and Ceiling Paneling System SS Sandwich	Make /Model/Country of origin		
		For SS Sandwich: Thickness of insulated stainless: 50-60 mm.		
		Material and sheet thickness: 0.8 mm thick,		
		304 grade stainless steel sandwich panel(both side 0.8 mm thick sheet),		
		Core consisting of rigid polyurethane foam injected under high pressure with a minimum density of 40 kg/m^3 conforming to BIS : 12436 - 1988.		

2	Wall paneling system and Ceiling Paneling System DIN Steel	Make /Model/Country of origin		
		DIN Steel 0.8 mm thick stainless steel,		
		Grade 304 (material no. 1.4301 in compliance with DIN EN 10088-3)		
		Combined with glued 18 mm thick plasterboard sheet along with suitable substructure frame. Provide substructure details		
3.	Wall paneling system and Ceiling Paneling System SMS Panel	Make /Model/Country of origin		
		SMS Panel		
		It shall consist of 3 mm thick solid mineral composite sheet (SMS)		
		With aluminium backing structural panel (minimum 15 mm thick, consisting of a trapezoidal/honeycomb		
		Aluminium corrugated core glued between two flats of aluminium sheets, with suitable substructure frame).		
		Total panel thickness shall not be less than 18 mm (3 mm thick SMS + 15 mm thick aluminium back).		
		SMS panel shall be of bacteriostatic, dense, non-porous and non-flammable (Reaction to fire class 1 norm) material.		
	Substructure detail	GI/Steel		
4.	Laminar Air Flow System	Make /Model/Country of origin		
		HEPA filters		
		MPPS(most penetrating particle size) average efficiency: > 99.95%		
		3 Micron DOP(Dispersed Oil Particulate)		

		efficiency: > 99.99%		
		Final pressure drop: 600 Pa (maximum)		
		Maximum operating temperature: 60^0 Celsius at RH: 40-50%		
		"H 14" class HEPA filters - 0.25 m/s flow at the diffuser conforming to BS EN 1822-1:2009.		
		Filtration ceiling system holding structure, filter frames and top plenum:made of aluminium/stainless steel.		
		Size of laminar airflow system minimum 8 feet X 8 feet.		
5.	Internal HVAC Ducting and Exhaust System	Make /Model/Country of origin for sheet and thermal insulation.		
		Material of duct: Alluminium/SS		
		Material of thermal insulation and its specification: As per CPWD Specification		
		Factory Fabricated/site fabricated		
		Connection outside the Modular OT for supply air from AHU to the external wall of Modular OT and return air from Modular OT to atmosphere/ AHU shall be in the scope of HVAC contractor.		
6.	PVC Flooring (anti-static seamless PVC)	Make /Model/Country of origin		
		• Thickness: 2 mm thick Minimum • Continuous roll • Welded by special PVC thermal welding units		
		Specification: smooth, non-slip, impervious material conductive enough to dissipate static electricity		
		The floor shall efficiently discharge electric charges up to 2 kV.		

		• Copper grid to be provided with Copper grounding strips (0.5 mm thick, 50 mm width) • One earthing lead shall be brought out from every 150 sqft area		
7.	Hermetically Sealed Doors	Make /Model/Country of origin		
		Size: 2.1 m x 1.8 m with Lead Line (As per AERB Norms) Or Size: 2.1m x 1.0 m with Lead Line (As per AERB Norms)		
		The controller shall be capable of being operated by elbow switches/foot switches as well as touch less sensor.		
		The door leaf shall be hung by means of hard plastic rollers of high quality with double bearing at the top.		
		Door shall be with vision window 300 mm x 300 mm with double glazed panels and hermetically sealed.		
8.	Touch Screen Control Panel	Make /Model/Country of origin		
		Touch screen control panel : 20" or more		
		Touch screen panel to control: HVAC (Temperature and humidity) controls, Instruction board, Touch screen and ON/OFF of MOT light		
		Digital clock and the elapsed time indicator.		
		Medical gas alarm to indicate high and low gas pressures for each gas service (except for vacuum, for vacuum it shall be normal or low) present in the MOT including vacuum.		
		Control for general lighting: ON/OFF and dimming controls organized in groups to provide uniform illumination.		
		On/Off operation of the operating light (major and satellite)		

		MOT temperature adjustment from the controller (temp adjustment of +/-5^0 C to be achieved within 5 minutes)		
		Digital room pressure indicator		
		HEPA filter bank differential pressure indicator shall be provided.		
		The Control Panel shall be able to be integrated with HIS (Hospital Information System)/BMS.		
		The Control Panel shall be able to display the Isolation Panel Alarm Conditions along with MGPS Alarms.		
9.	Pressure Relief Dampers	Make /Model/Country of origin		
		Size:		
		Frame, body and blade: Grade SS 304 stainless steel		
10.	Hatch Box	Make /Model/Country of origin		
		Size:		
		Two doors and the doors shall be operated electrically/motorised.		
		Only one door shall be openable at one time.		
		The UV light kept 'ON' while both the doors are closed.		
		Automatically turns off in case of opening of either of the doors.		
11.	Operating List Board X-ray Film Viewer	Make /Model/Country of origin		
		LED type flat panel X-ray viewing panel shall be flicker free.		
		The body shall be of extruded aluminium powder coated with bacteria resistant and disinfectant resistant finish.		
		The diffuser on the front panel shall be an uniformly lit screen.		
		Dimming electronic control shall be enclosed at the bottom of the cabinet.		
		Proper spring-loaded film clip with rollers/holding button shall be provided to hold the films firmly and to remove the film without scratches.		

		It shall consist of dual panel viewing screen (14"x17" each)		
12.	Scrub Station	Make /Model/Country of origin		
		SCRUB STATION (minimum size 1500 mm)		
		Compact surgical scrub sink shall be designed for use in MOT complex for pre-procedural scrub. Double sink combination shall be provided.		
		Fabricated from heavy gauge type 304 stainless steel (minimum thickness 1.5 mm) and shall be of seamless welded construction, polished to a satin finish.		
		With a front access panel which shall be easily removable for access to the water controlled valve, waste connections, stoppers and strainers.		
		Hands free operation shall include infra-red sensors with programmable adjustment.		
		Thermostatic mixing, valve control shall be located behind the access panel and it shall maintain constant water temperature.		
		Timing shall be adjustable to meet individual application requirements.		
		It shall be provided with infrared sensors, thermostatic control taps with fail safe temperature controls.		
		All units shall have reduced anti- splash fronts.		
		Knee/foot operated switch shall be provided additionally		
13.	Storage Unit	Make /Model/Country of origin		
		The storage unit shall be made with at least 0.8 mm thick SS304 stainless steel panels.		
		The shelves shall be of SS 304 stainless steel and removable for cleaning.		
		The storage unit shall be divided in 2 or more parts and each part shall have		

		individual glass doors with high quality locking system.		
		The overall size shall be 200 cm X 120 cm X 35 cm (approximately)		
14.	OT Pendants (Anaesthetist and Surgeon)	Make /Model/Country of origin		
		Double arm moveable pendant for Anesthetist		
		The pendants shall comply with NFPA 99C/HTM 02-01/DIN/EN/ISO 7396-1 as amended up to the last date of receipt of tenders. The support arms shall be extremely robust and revolve on high quality bearings, so that the pendant head glides smoothly and quickly to any desired position.		
		It shall have double moveable arms (any combination) with total coverage of minimum 1800 mm and minimum 330^{o}. Each arm shall have ability of horizontal movement. Vertical movement shall be motorized and the arm height shall remain at a height greater than 6.5 feet above floor level.		
		Weight carrying capacity of the arm shall not be less than 180 kg and it shall have electromagnetic / pneumatic brakes.		
		Each arm shall be capable of minimum 330^{o} of rotation, which can be easily adjusted to suit the desired mode of operation.		
		The pendant shall be European CE Certified with 4 digit notified body number / US FDA / ETL / UL / BIS certified / listed.		

		The Pendant Service Heads shall be modular with minimum 800mm head. The heads shall be capable of accepting a range of shelves, infusion poles, electrical switch/sockets, gas outlets and other required accessories. The Pendant Heads shall support the range of Physiological Monitor Mounting Solutions.		
		The Pendant Service Heads shall be supplied with medical gas terminalunits and 5A/15A or 6A/16 A hybrid sockets.		
		Pendant shall be supplied with outlets and probes as mentioned below.		
		Oxygen outlets: 2 number		
		Vacuum outlets: 2 number		
		Nitrous oxide outlet: 1 number		
		Air (4 bar) outlets: 2 number		
		AGSS outlet: 1 number		
		Electrical sockets: 10 number		
		Adjustable shelf with two rails one on each side: 3 number		
		IV Fluid Pole with 4 hooks: 1 number		
		Data socket RJ-45: 2 number		
		Pendant supplier shall provide cut-outs for Patch Panels in Integrated OTs (only for integrated OT).		
		Anaesthetist pendant shall have NIST connection for all gases to connect the MGPS system.		
		Double arm moveable pendant for Surgeon		
		The Pendants shall comply with NFPA 99C/HTM 02-01/DIN/EN/ISO 7396-1 as amended up to the last date of receipt of tenders. The support arms shall be extremely robust and revolve on high quality bearings, so that the pendant head glides smoothly and quickly to any desired position.		

		Double moveable arms (any combination) with total coverage of min 1800 mm and minimum 330°.Each arm shall have ability of horizontal movement. Vertical movement shall be motorized and the arm height shall remain at a height greater than 6.5 feet above floor level.		
		Weight carrying capacity of the arm shall not be less than 180 kg. It shall have electromagnetic/pneumatic brakes.		
		Each arm shall be capable of minimum 330° of rotation, which can be easily adjusted to suit the desired mode of operation.		
		The pendant shall be European CE Certified with 4 digit notified body number/US FDA/ETL/UL/BIScertified/listed under medical devices directive.		
		The Pendant Service Heads shall be modular with minimum 800 mm head. The heads shall be capable of accepting a range of shelves, infusion poles, electrical switch/sockets, gas outlets and other required accessories. The Pendant Heads shall support the range of Physiological Monitor Mounting Solutions.		
		The Pendant Service Heads shall be supplied with medical gas terminal units and 5A/15A or 6A/16 A hybrid sockets.		
		Pendant shall be supplied with outlets and probes as mentioned below.		
		O_2 and MA4: One each		
		Vacuum outlets: 2 number		
		Air (7 bar) outlet: 01 number		
		CO_2 outlet: 01 number		
		Electrical sockets: 10 number		

		Adjustable shelf with two rails one on each side: 3 number		
		Data socket RJ-45: 2 number		
		IV Fluid Pole with 2 hooks: 1 number		
		(Pole shall be capable of stacking 4 syringe pumps)		
		Nitrous oxide outlet: 1 number		
		Pendant supplier shall provide cut-outs for patch panels in integrated OTs (only for integrated OTs).		
		Surgeon pendant shall have NIST connection for all gases to connect the MGPS system.		
15.	Peripheral Lighting and Clean Room Luminaries	Make /Model/Country of origin		
		To provide peripheral lighting and clean room luminaries with illuminance of minimum 500 Lux. These shall be minimum 8 in numbers for each MOT and shall be with highly specular anodized aluminium and optical antiglare system. Size of Peripheral Light shall be 2 feet x 2 feet size.		
		Luminaries cover shall be made of highly resistant, disinfectant proof laminated safety glass/acrylic with stylish fine grained surface.		
		The white luminaries' body shall be made of sheet steel/perfectly powder coated.		
		Recess frames shall be airtight. The fitting shall be flush with the ceiling and shall be removable from top or bottom. The light fitting shall be uniformly and aesthetically distributed on the ceiling to provide uniform illumination in the MOT. Light shall not interfere when green mode endoscopy is performed.		
		Peripheral lighting shall be done according to IP 65 regulations.		
		Control equipment for the general lighting and the light dimming shall be provided in the theatre control panel		

16.	Isolation Panel System (IPS)	Make /Model/Country of origin		
		Capacity: 20 kVA. System shall have isolators provided through leakage relays etc., if required, according to IEC recommendation. Compliance to: EN/European CE/UL/BIS/FDA/ETL listed/certified.		
		Medical grade Isolation panel.		
		With fault detection feature.		
		Compliant to CEI 64-8/IEC 60364-7-710/BS 7671 Standard as amended up to the last date of receipt of tenders.		
		Compact and mountable on wall or flush on brick wall.		
		Capable to Integrate with HIS/BMS and Surgeon Control Panel as standard.		
		Isolation panel system shall have facility to detect fault of leakage current for each circuit (minimum 12 circuits) and same shall be integrated with touch screen control panel of MOT and alarm status shall be displayed on the touch screen control panel.		
17.	Online UPS	Make /Model/Country of origin		
		Capacity: As per NIT calculated in N+1 configuration (N-Nos. of OTs in each cluster) for each OT-20 KVA required.		
		Backup of UPS system shall be minimum 30 minutes.		
		Electrical control panel complete with MCCB, switchgears etc. shall be provided for distribution of power.		
		Add specification for UPS and battery backup		
18.	Medical Gas Lines Installations	Make /Model/Country of origin		
		The MOT firm shall ensure that MGPS works inside the MOT are carried out as per HTM02-01/NFPA 99C/DIN/EN/ISO 7396-1 as amended up to the last date of receipt of tenders.		

		The MOT firm shall provide oxygen, air, vacuum, AGSS and nitrous oxide pipe line connections from the existing lines terminated outside the MOT.		
		Terminal units shall be gas specific and only accept the correct medical gas probe. Gas specific components shall be pin indexed to ensure that a correct gas specific assembly is accepted.		
		Each terminal unit shall be identified by the appropriate recognized name or symbol, colour, coding and shape as per HTM 02-01/NFPA 99C/DIN/EN/ISO 7396-1 as amended up to the last date of receipt of tenders.		
		Outlets shall be European CE with 4 digit notified body number/UL/ETL/US FDA/BIS certified/listed.		
		Copper pipes shall be of solid drawn, seamless, deoxidized, non-arsenical, half hard, tempered and degreased copper pipe. All copper pipes shall be degreased and delivered capped at both ends		
		The pipes shall be accompanied with manufacturers test certificate for the physical properties and chemical composition. The copper pipe shall comply with EN 13348 as amended up to the last date of receipt of tenders.		
		Copper pipe must have reputed third party inspection certificate (eg.Lloyd's, TUV, SGS).		
		Fittings shall be made of copper and suitable for a working pressure of up to 17 bar and especially made for brazed socket type connections.		

		The copper fitting shall comply with EN 1254-1 as amended up to the last date of receipt of tenders.		
		The brazing filler material shall comply with EN 1044 as amended up to the last date of receipt of tenders		
19.	MOT Light with Camera, Monitor and Recorder	Make /Model/Country of origin		
		MOT light with camera monitor and recorder		
		MOT surgical lighting system shall provide an ideal combination of brightness, manoeuvrability and shadow resolution without sacrificing colour and accuracy through a consistent LED technology.		
		Such lighting system shall have the following technical specifications: • Number of light heads: Two • Colour temperature range: 3800^{o} K to 5000^{o} K (±10%)- Variable colour temperature. • Field size diameter: 20 to 28 cm (+/- 10%) • Working range: 750 to 1100 mm (+/- 10%) • Illumination level: minimum 160,000 lux (both for major dome and minor dome separately) • Controls: control panel (two: one on the wall and other on dome)		
		Camera Specification for OT Light		
		Description: Integrated in-light camera system shall be integrated at the centre of one of the domes of this		

		lighting system/third arm in order to capture images and video sequences of the open cases.		
		Such a autofocus–lockable camera shall have the following specifications		
		Signal to noise ratio (S/N Ratio): >50 dB		
		CCD/CMOS: 1/3” or 1/2.8”		
		Optical zoom: 10X		
		Digital zoom: 12-15X		
		Video output: HD, DVI, S-video and composite video		
		White balance and gain: Automatic/Manual		
		MOT light and Integrated Camera shall have a control through touch panel of the control equipment placed inside the operating room.		
20.	PACS monitor (Picture archiving and communication system monitor)	Make /Model/Country of origin		
		It shall be medical grade monitor.		
		Its size shall be minimum 48 inch.It shall be integrated with hospital PACS.		
		The MOT firm shall do the necessary coordination with hospital authorities for connecting the PACS monitor to the hospital PACS. If hospital/institute PACS is not available, MOT firm shall terminate all PACS monitor connection to switch located in MOT corridor for further connection by the hospital.		
		Monitor shall be flush mounted with suitable frame in MOT wall. Frame shall be openable/serviceable for service.		
21.	Earthing	Make /Model/Country of origin		

		Suitable size earthing sets provision for equipment earthing of OT and other earthing requirement of OT shall be in the scope of Modular OT contractor.		
		Note: The firm to provide details of the proposed earthing specification and nos.		
22.	AC system for UPS room	Make /Model/Country of origin		
		A suitable AC and ventilation system shall be provided for UPS panel and ventilation for UPS battery room. **Note: The firm to provide details of the proposed air conditioning and ventilation details.**		
23.	Control cabling from AHU to MOT control panel and associated sensors	Make /Model/Country of origin		
		Provision and co-ordination with main contractor of HVAC for providing control cable from Modular OT sensor to AHU room shall be in the scope of Modular OT agency.		
		Suitable Air conditioning load for Modular OT shall be kept while designing the HVAC plant for hospital. Modular OT agency shall inform well in advance for above noted action to HVAC design team.		
24.	HD LED Flat Panel Monitor (Only for non-integrated MOTs)	Make /Model/Country of origin		
		It shall be 30"-32" medical grade high definition progressive scan flat-panel monitors with ceiling mounted spring arm suspension to support high definition/HDTV progressive scan images and shall be able to support and display DVI/HDTV, RGBHV, S-video, composite video signals. Aspect ratio		

		16:9/16:10. Resolution: 1920X1080 or better. It shall meet IP 54 regulations. The flat panel suspension shall be ready with the cables for integration of high definition digital (DVI/HDTV), RGBHV (high resolution), SVHS(S-video), composite video signals to travel from the various sources of video like endoscopic camera, room camera, in-light camera, high definition flat panel monitors, while assuringnative resolution/ signal.		
		Monitor shall be capable of displaying from other sources like endoscope, microscope etc.Necessary provision for the same shall be made		
25.	HD Camera System-1080 p/i	Make /Model/Country of origin		
		Description: Integrated in-light camera system shall be integrated at the centre of one of the domes of this lighting system/third arm in order to capture images and video sequences of the open cases.		
		Such an autofocus–lockable camera shall have the following specifications -		
		Signal to noise ratio (S/N Ratio): >50 dB		
		CCD/CMOS: 1/3” or 1/2.8”		
		Optical zoom: 10X		
		Digital zoom: 12-15X		
		Video output: HD, DVI, S-video and composite video		
		White balance and gain:Automatic/Manual MOT light and		
		Integrated Camera shall have a control through touch panel of the control equipment placed inside the operating room.		

26.	MOT Light - LED	Make /Model/Country of origin		
		MOT surgical lighting system shall provide an ideal combination of brightness, manoeuvrability and shadow resolution without sacrificing colour and accuracy through a consistent LED technology. Such lighting system shall have the following technical specifications:		
		Number of light heads: Two		
		Colour temperature range: 3800^{o}K to 5000^{o}K (±10%)-Variable colour temperature.		
		Field size diameter: 20cm to 28cm (+/-10%)		
		Working range: 750mm to 1100mm (+/-10%)		
		Illumination level: minimum 160,000 lux (both for major dome and minor dome separately)		
		Controls: control panel (two: one on the wall and other on dome)		
27.	Recording system shall be offered separately (Only for non-integrated MOTs).	Make /Model/Country of origin		
		Recording system shall be offered separately. Recording system shall be full HD medical grade monitor LED minimum 19 inch touch screen and having one TB storage space.		
		Data cable for communication from both pendants and monitors shall be laid down up-to outside of MOT in a patch port for future expansion for all MOTs where there is no integration.		
		Patch panel for power and signal shall be laid down for 48 inch LED monitor at wall of MOT.		
		Recorder shall be capable of recording video from other sources like microscopes, endoscopes etc., suitable provision for the same shall be made.		
		It shall be flush mounted on the MOT wall with suitable frame		

CHAPTER 7

CODES & GUIDELINES FOR MEP SERVICES IN HOSPITALS

- ASHRAE 170-2017 covers patient care areas of Healthcare facilities in new buildings, additions to existing buildings, and alterations to existing buildings. It provides a guideline for Healthcare facility safety and dictates the air changes per hour required in Healthcare settings, pressure relationship requirements, exhaust requirements, filtration and air distribution requirements, humidity and temperature requirements, etc.
- ASHRAE 189.3 Construction, and Operation of Sustainable High-Performance Healthcare Facilities
- Bio-Medical Waste Management Rules, 2016, for Treatment and Disposal of Hospital generated waste.
- FGI Guidelines 2018, Guidelines for Design and Construction of Healthcare Facilities, provides minimum design requirements for Hospitals and its environment.
- IS/ISO 7396 for Medical Gases Pipeline Systems
- ISO 13485, Quality Management System, Medical Devices, Key Standard for installation and servicing of medical devices and related engineering services
- ISO 20017, RFID Standard for Healthcare
- NABH, Hospital Accreditation Standards
- NABL, Hospital Laboratories Accreditation Standards
- NBC 2016 provides Guidance for all services. Its part 4 provides specific Fire & Life Safety guidance and part 9 provides Plumbing & Drainage Guidelines.
- NEC 2011 provides Guidance for all Electrical Services and Lighting Services.
- NFPA 92, A group of Standard on Smoke Control & Management Systems
- NFPA 99, 2018, Healthcare Facilities Code provides comprehensive Guidance for mitigating the hazards of fire, explosion, and electricity.
- NFPA 101, Life Safety Code provides building requirements necessary to protect Hospital Building Occupants from dangers caused by fire, smoke, and toxic fumes.
- Occupational Safety and Health Administration (OSHA) standards for Use of construction materials in Hospital Engineering Services
- The regulations for Radiation safety of International Atomic Energy Agency and Atomic Energy Regulatory Body of India.

- The Rights of Persons with Disabilities Act, 2016 provides for the design of products, environments and services to be usable by all people including Persons with Disabilities to the greatest extent possible.
- Whole Building Design Guide, Hospitals, 2017, design Criteria for Public Hospital buildings in USA
- ANSI/TIA/EIA-569 Telecommunications Pathways and Spaces
- MIL-HDBK-419A Grounding, Bonding, and Shielding for Electronic Equipment and Facilities, Basics, Volume 1 of 2
- MIL-HDBK-419A Grounding, Bonding, and Shielding for Electronic Equipment and Facilities, Application, Volume 2 of 2
- CPWD General Specifications for Heating, Ventilation & Air-Conditioning (HVAC) 2017.
- CPWD General Specifications for Electrical Works Part I Internal -2013.
- CPWD General Specifications for Electrical Works Part IV Sub-Station -2013.
- CPWD General Specifications for Electrical Works Part V Wet Riser & Sprinkler System -2013.
- CPWD General Specifications for Electrical Works Part VI Fire Detection and Alarm System -2013.
- CPWD Compendium of Norms for Designing of Hospitals and Medical Institutions
- In addition, now Green Building Council Guidelines and Energy Audits and preliminary Audits of Gas Services are also applied at pre-construction stage.

INDIAN/INTERNATIONAL STANDARD FOLLOWED IN WORK OF HOSPITAL SERVICES SYSTEM

Indian Standard	International Standard	
IS/ISO 7396 :Part 1	ISO 7396-1:2016	Medical Gas Pipelines Systems : Part 1 Pipelines Systems for Compressed Medical Gases and Vacuum
IS/ISO 7396 :Part 2	ISO 7396-2:2007	Medical Gas Pipeline Systems : Part 2 Anaesthetic Gas Scavenging Disposal Systems
NIL	ISO 3746:2010	Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane
NIL	ISO 5359:2014	Anaesthetic and respiratory equipment — Low-pressure hose assemblies for use with medical gases
NIL	ISO 8573-1:2010	Compressed air — Part 1: Contaminants and purity classes
IS/ISO 9170 :Part 1	ISO 9170-1:2008	Terminal units for medical gas pipeline systems — Part 1: Terminal units for use with compressed medical gases and vacuum
IS/ISO 9170 :Part 2	ISO 9170-2:2008	Terminal Units for Medical Gas Pipeline Systems, Part 2 Terminal Units for Anaesthetic Gas Scavenging Systems
IS/ISO 10524 :Part 1	ISO 10524-1:	Pressure Regulators For Use with Medical Gases Part 1 Pressure Regulators and Pressure Regulators with Flow-Metering Devices
IS/ISO 10524 :Part 2	ISO 10524-2:2005	Pressure regulators for use with medical gases — Part 2: Manifold and line pressure regulators
IS/ISO 10524 :Part 3	ISO 10524-3:	Pressure Regulators for Use with Medical Gases Part 3 Pressure Regulators Integrated with Cylinder Valves
IS/ISO 10524 :Part 4	ISO 10524-4	Pressure Regulators for Use with Medical Gases Part 4 Low-pressure Regulators
NIL	ISO 11197:2004	Medical supply units
NIL	ISO 14644-1:1999	Cleanrooms and associated controlled environments — Part 1: Classification of air cleanliness
NIL	ISO 14971:2007	Medical devices — Application of risk management to medical devices
IS/ISO 15001	ISO 15001:2010	Anaesthetic and respiratory equipment — Compatibility with oxygen
IS/ISO 15002	ISO 15002:2018	Flow-Metering Devices for Connection to Terminal Units of Medical Gas Pipeline Systems
NIL	ISO 17672:2010	Brazing — Filler metals
NIL	ISO 18082:2014	Anaesthetic and respiratory equipment — Dimensions of non-interchangeable screw threaded (NIST) low-pressure connectors for medical gases
NIL	ISO 21969:2009	High-pressure flexible connections for use with medical gas systems
NIL	ISO 29463-1:2011	High-efficiency filters and filter media for removing particles in air — Part 1: Classification, performance testing and marking

NIL	ISO 80601-2-69:2014	Medical electrical equipment — Part 2-69: Particular requirements for basic safety and essential performance of oxygen concentrator equipment
IS 11478:2018	IEC 60601-1-8:2006	Medical electrical equipment — Part 1-8: General requirements for basic safety and essential performance — Collateral standard: General requirements, tests and guidance for alarm systems in medical electrical equipment and medical electrical systems
IS 2825:1969	EN 286-1:1998	Simple unfired pressure vessels designed to contain air or nitrogen — Part 1: Pressure vessels for general purposes
IS/ISO 15223 :Part 1	ISO 15223-1:2016	Medical Devices - Symbols to be used with Medical Device Labels, Labelling and Information to be Supplied Part 1 General Requirements
NIL	EN 1254-1:1998	Copper and copper alloys - Plumbing fittings - Fittings with ends for capillary soldering or capillary brazing to copper tubes
NIL	EN 1254-4:1998	Copper and copper alloys - Plumbing fittings - Fittings combining other end connections with capillary or compression ends
NIL	EN 13348:2008	Copper and copper alloys — Seamless, round copper tubes for medical gases or vacuum
IS/ISO 10079 :Part 2	ISO 10079-2:2014	Medical Suction Equipment Part 2 Manually Powered Suction Equipment
IS/ISO 10079 :Part 3	ISO 10079-3:2014	Medical Suction Equipment Part 3 Suction Equipment from a Vacuum or Pressure source
IS 8382:1977		Pressure Regulators, Pre-set Used with Medical Gas Cylinders
IS 5355		Oxygen flowmeter (dry bobbin type for Therapy purposes)
IS 6207		Trolleys for Oxygen Cylinders
IS 3624		Pressure and Vacuum Gauges
IS 2379:1990		Colour code for identification of pipe lines

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CHAPTER 8

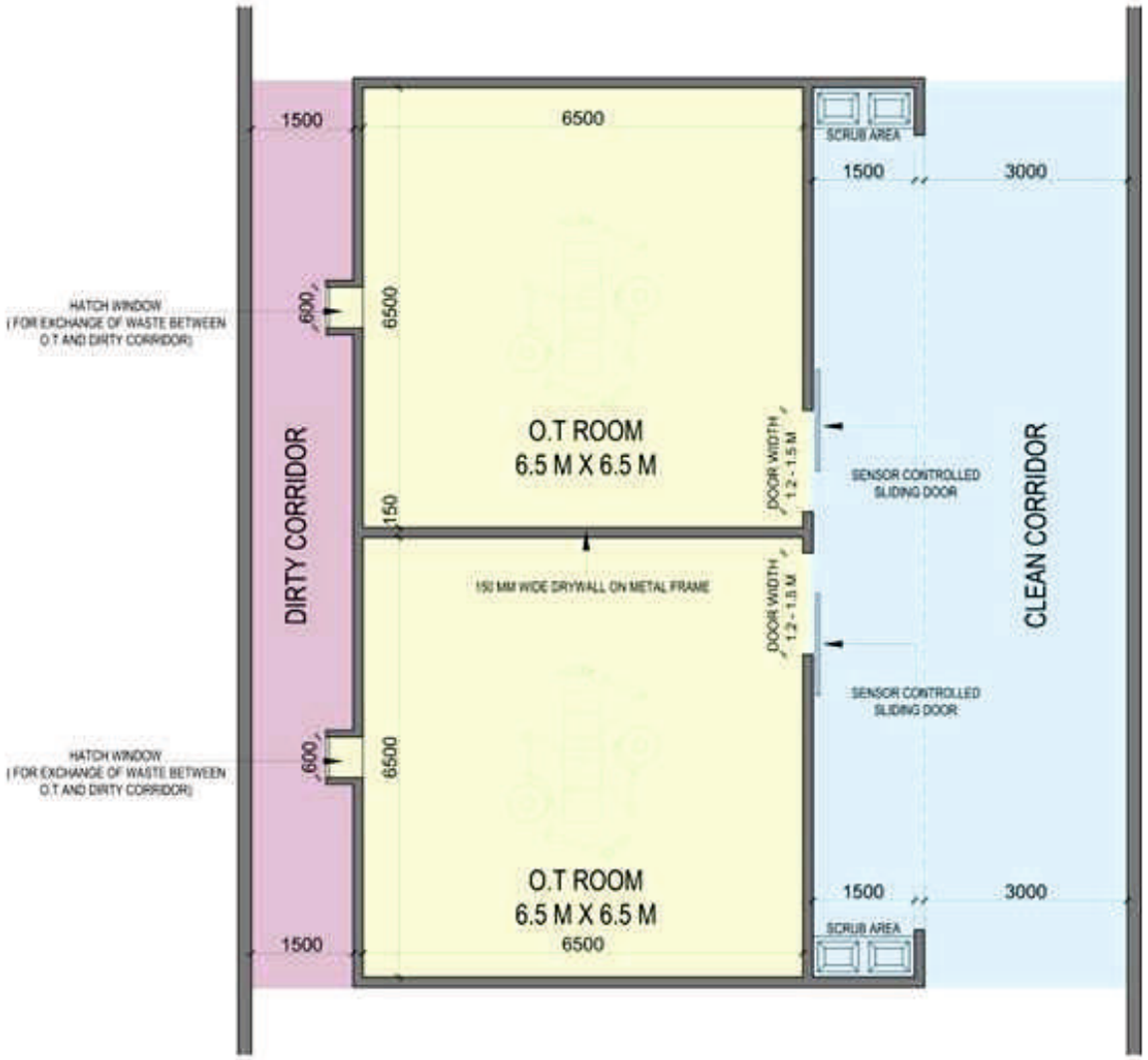
LICENSES, PERMITS & STATUTORY OBLIGATIONS FOR HOSPITALS IN INDIA

- Air (Prevention and Control of Pollution) Act, 1981 along with Rules, 1982
- Atomic Energy Regulatory Board
- Bio-Medical Waste Rules, 2016
- Boilers Act 1923
- Building Permit (Completion Certificate)
- Child Labour (Prohibition and Regulation) Act 1986 along with Rules, 1988 and Children (Pledging of Labour) Act 1933.
- Consumer Protection Act, 1986 along with Rules, 1987 amended in 1998
- Delhi Nursing Home Registration Act 1953
- Delhi Private Medical Establishment (Regulations) Act 1956
- Drugs & Cosmetics Act, 1940
- Explosive Act, 1884 along with The Explosive Substance Act 1908 and The Explosives Rules, 1983
- Govt. Order No. 73231/SS B4/92/Home dated 29.09.1993 - Section 304 not applicable in Hospital deaths.
- Indian Lifts and Escalators Act
- National Building Code
- National Electrical Code
- National Commission Acts [Containing 4 Acts -Women Act ,1990 Safai Karamcharies Act, 1993 and Allied Information]
- National Environmental Tribunal Act, 1995
- No Objection Certificate from the Chief Fire Officer
- No Objection Certificate under Bio-medical Waste Rules, 1998
- No Objection Certificate under Pollution Control Act
- Pre-Natal Diagnostic Techniques (Regulation & Prevention of Misuse) Act, 1994 along with Rules, 1996
- Radiation Protection Certificate in respect of All X-Ray Equipment from BARC
- Radiation Protection Rules under BARC Act
- The Blood Bank Permit under Drugs Act
- The Excise Permit to store Spirit
- The Permit to Operate Lifts under the Indian Lifts and Escalators Act

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CHAPTER 9

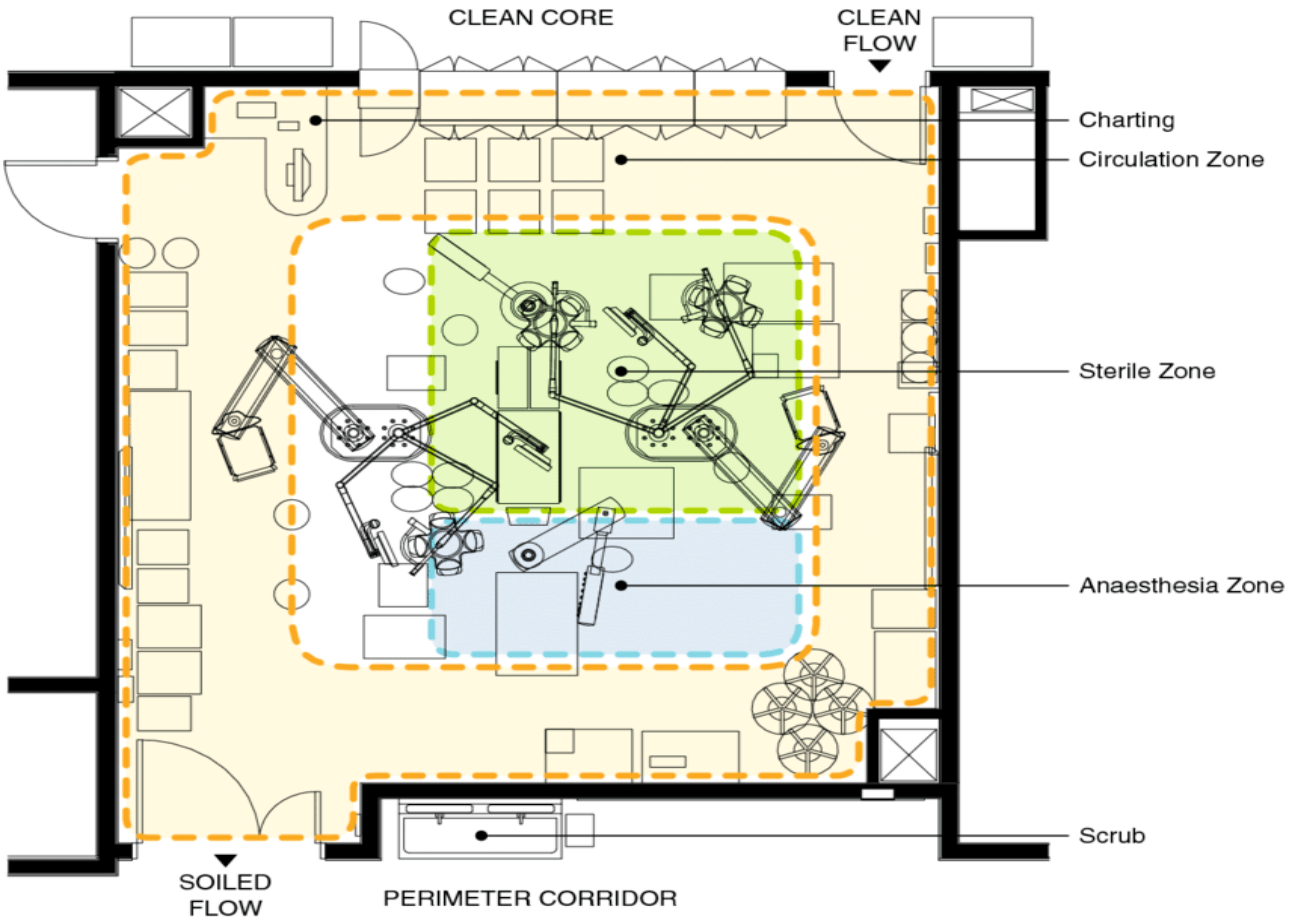
SKETCH OF TYPICAL MODULAR OTs



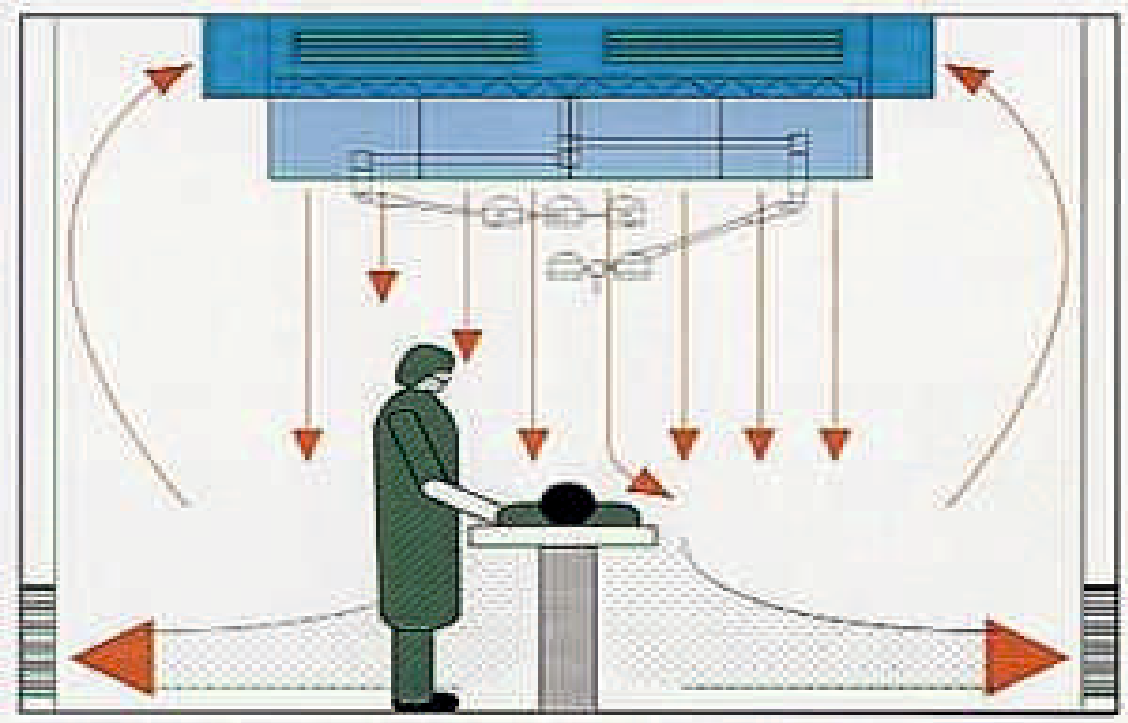
SKETCH OF TYPICAL MODULAR OT COMPLEX



SKETCH OF TYPICAL MODULAR OT SHOWING ARRANGMENT OF DIFFERENT EQUIPMENT AND ZONES



LAMINAR FLOW OF AIR IN MODULAR OT



CHAPTER 10

REVISED GUIDELINES FOR AIR CONDITIONING IN OPERATION THEATRES

(2018)

Air Conditioning in OT

A. **The air conditioning requirements for operation theatre in HCO have been revisited in the context of points raised by various HCOs during surveys. These standards were examined by Technical committee and various latest international and national standards on air conditioning were reviewed. Retrofitting in the HCOs constructed before these guidelines came in to being was also considered. SHCOs and Eye HCOs were also considered while recommending certain new requirements.**

B. **Though these guidelines are desirable under all programs, they are NOT MANDATORY for the SHCOs and HCOs implementing pre-entry certification standards.**

C. **Modular Operation Theatre is NOT A MANDATORY REQUIREMENT under any program. It is totally left to HCO whether they want to install it.**

D. **For this purpose operation theatres have been divided into two groups:**

1. ***Type A (Erstwhile Super specialty OT):*** Type A OT means operation theatres for Neurosciences, Orthopaedics (Joint Replacement), Cardiothoracic and Transplant Surgery (Renal, Liver, heart etc.).

2. ***Type B (Erstwhile General OT):*** This includes operation theatres for Ophthalmology, day-care surgeries and all other basic surgical disciplines.

REQUIREMENTS – Type A (Erstwhile Super Specialty OT)

1. Air Changes Per Hour:

   Minimum total air changes should be **20** based on biological load and the location.

   The fresh air component of the air change is required to be minimum **4** air changes out of total minimum **20** air changes.

   If Healthcare Organization (HCO) chooses to have 100% fresh air system then appropriate energy saving devices like heat recovery wheel, run around pipes etc. should be installed.

2. **Air Velocity:** The airflow needs to be unidirectional and downwards on the OT table. The air face velocity of **25-35 FPM** (feet per minute) from non-aspirating unidirectional laminar flow diffuser/ceiling array is recommended

3. **Positive Pressure:** The minimum **positive pressure** recommended is **2.5 Pascal** (0.01 inches of water). There is a requirement to maintain positive pressure differential between OT and adjoining areas to prevent outside air entry into OT. Positive pressure will be maintained in OT at all times (operational & non-operational hours)

4. **Air handling in the OT including air Quality:** Air is supplied through Terminal HEPA (High-Efficiency Particulate Air) filters in the ceiling. The HEPA can be at AHU level if it not feasible at terminal level inside OT. The minimum size of the filtration area should extend one foot on all sides of the OT table.

5. **Air Filtration:** The AHU (i.e. air handling unit) must be an air purification unit and air filtration unit. There must be two sets of washable flange type filters of efficiency 90% down to **10 microns** and 99% down to **5 microns** with aluminium / SS 304 frame within the AHU. The necessary service panels to be provided for servicing the filters, motors & blowers. HEPA filters of efficiency 99.97% down **to 0.3 microns** or higher efficiency are to be provided. Air quality at the supply i.e. at grille level should be Class 100/ISO Class 5 (at rest condition).

   Note : Class 100 means a cubic foot of air should not have more than 100 particle measuring 0.5 microns or larger.

6. **Temperature & Relative Humidity:** It should be maintained **21°C ± 3°C** (except for Joints replacement where it should be **18°C ± 2°C**) with corresponding relative humidity between **20 to 60%**, though the ideal RH is considered to be **55%.** Appropriate devices to monitor and display these conditions inside the OT may be installed.

REQUIREMENTS – Type B (Erstwhile General OT)

1. Air Changes Per Hour:
   Same as Type A OT requirements given above

2. Air Velocity:
   Same as Type A OT requirements given above.

3. Positive Pressure:
   Same as Type A OT requirements given above

4. Air Filtration:

The AHU (i.e. air handling unit) must be an air purification unit and air filtration unit. There must be two sets of washable flange type filters of efficiency 90% down to **10 microns** and 99% down to **5 microns** with aluminium/ SS 304 frame within the AHU. The necessary service panels to be provided for servicing the filters, motors & blowers. HEPA filters of efficiency 99.97% down **to 0.3 microns** or higher efficiency **may be** provided. The Air quality at the supply i.e. at grille level should be class 1000/ISO Class

6 (at rest condition). Note: Class 1000 means a cubic foot of air must have no more than 1000 particles measuring 0.5 microns or larger.

5. Temperature & Relative Humidity:

The temperature should be maintained at 21°C ± 3°C inside the OT at all times with corresponding relative humidity between 20 to 60%. Appropriate devices to monitor and display these conditions inside the OT may be installed.

Design considerations for Operation Theatres

A. The AHU of each OT should be **dedicated one** and should not be linked to air conditioning of any other area in the OT and surroundings.

- ✓ One AHU for multiple OTs is permitted provided there is a back-up/contingency plan to accommodate surgeries in other OTs in the eventuality of failure of infection control in these OTs. Redundancy in terms of multiple fans for return and input air with UPS and DG set supply is provided to such type of common AHU. Direct drive fans will be required in such common AHU. The specific evidence of validation for the above will have to be provided either by the vendor/third party.

B. Outdoor Air intakes: The location of outdoor air intake for an AHU must not be located near potential contaminated sources like DG exhaust hoods, lab exhaust vents, and vehicle parking area.

C. Window & Split A/c **should not** be used in any type of OT because they are pure re-circulating units and have pockets for microbial growth which cannot be sealed.

D. For old constructions and for retrofitting (constructed/renovated prior to 2015)

1. Where space is a constraint, ceiling suspended AHU is permitted provided there is accessibility for maintenance of filters and other parts of AHU.

2. Dx unit with AHU is recommended for OTs where retrofitting solution is possible. It is also recommended as cost effective solution for OTs in **SHCO/Eye** care hospitals.

3. All requirements spelt out for new constructions and Type A and Type BOTs given earlier above in terms of air changes, particle count, positive pressure, temperature, humidity and air velocity will have to be met by such OTs in old constructions/HCOs.

4. During the non-functional hours AHU blower will be operational round the clock (may be without temperature control). Variable frequency devices (VFD) may be used to conserve energy. Air changes can be reduced to 25% during non-operating hours thru VFD provided positive pressure relationship is not disturbed during such period.

Maintenance of the system

Validation of system should be done every 6 months and as per ISO 14644 standards.
This should include:

- Temperature and Humidity check
- Air particulate count
- Air Change Rate Calculation
- Air velocity at outlet of terminal filtration unit /filters
- Pressure Differential levels of the OT with respect to ambient / adjoining areas
- Validation of HEPA Filters by appropriate tests.

Preventive Maintenance of the system: It is recommended that periodic preventive maintenance be carried out in terms of cleaning of pre filters, micro vee filters at the interval of **30 days.** Preventive maintenance of all the parts of AHU is carried out as per manufacturer recommendations.

References

1. ANSI/ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers) /ASHE standards 170-2017.
2. Previous NABH guidelines for air conditioning in operation theatre 2015.
3. Memarazadeh I, and A. Manning 2002. Comparison of operating room ventilation systems in the protection of surgical site.
4. HVAC Design Manual for hospitals and clinics 2nd edition, ASHRAE 2016.
5. CPWD design guidelines HVAC guide 2017 Ministry of Public works New Delhi 2017.

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