HLL INFRA TECH SERVICES LTD. (HITES)

As

Executing Agency of

MINISTRY OF HEALTH & FAMILY WELFARE (MoHFW)

E-Tender

For

Associated Civil & Service Works for setting up of Modular Operation Theatres at Super Specialty Block SNMC Agra on EPC Basis

Volume: 3

DESIGN BASIS REPORT (DBR)

(Sep -2023)

Tender No.: HITES/IDN/2023-24/SNMC/ Associated Works

HITES
HLL INFRA TECH SERVICES LTD

1. **Scope of Work:** A. Design Basis Report- HVAC System

The EPC Contractor shall carry out for Design, Engineering, Supply, Installation, and Testing & Commissioning of HVAC System. The scope shall include below mentioned features but not limited to:-

i. Heating, Ventilation & Air Conditioning System as per Building requirement.

ii. Centralized AC with Air cooled chiller system (3Nos.x 30 TR min.) & winter heating system is proposed for MOT Block.

iii. Energy Efficient, preferably min. 3 star, inverter driven, heating & cooling mode Split ACs are to be provided for LV Rooms, Operator/ Engineer in charge room, BMS & SCADA Room, Fire Control room, Server Rooms other than Hospital, UPS Rooms & any other room of functional importance & as per directions of E-I-C.

iv. Ventilation/ Pressurization system for MOT Block as per relevant norms, standards & statutory bye law's provisions.

v. Provision of Air Curtains shall be considered at the Main Entrance/Vestibule of the Hospital Building.

vi. The entire HVAC works should conform to specifications provided & as per directions of Engineer-in-Charge.

vii. HVAC Plant Room is proposed for mounting Equipment & accessories related to Air Cooled Chiller System.

viii. The rating and capacity of equipment indicated herein below are minimum to be provided. However during detailed designing, if required and found necessary, the capacity / rating of the equipment may be upgraded by the EPC Contractor.

2. **Indoor Air Quality :**

i. Emphasis on maintaining desirable Indoor Air Quality by setting and controlling parameters of Temperature, Air Flow, Humidity Levels and Air Changes per Hour (Total & Fresh Air) for each room/zone/area.

ii. Conformity of Indoor Quality parameters with ISHRAE, ASHRAE and NABH Standards.

3. **Special Considerations for Critical Areas**:-

a. All Critical Areas shall be designed on air recirculation and outside air intake system as per standards specified by ASHRAE, ISHRAE and NABH etc.

b. Critical areas shall include but not limited to OTs, ICUs, Diagnostic Facilities, Isolation

Rooms, Sterile Corridor, Labs, Observation Rooms, Surgery & Treatment Rooms etc.

c. Aluminium Ducting to be provided for OTs, ICUs & Critical Areas. However, as per relevant standards/ norms, if any other room is to be provided with Aluminum duct, same shall be provided.

d. HEPA Filters to be provided for OTs, Isolation Rooms & Sterile Corridors etc. However, as per relevant standards/ norms, if any other room is to be provided with HEPA Filters, same shall be provided.

e. Septic OTs shall be designed for 100% fresh air.

f. All AHU's for MoT's shall be provided with HRW and Pan type humidifier with VFD along with four pipe line system.

g. Compartmentalizing and Zoning of Areas in OT Block to restrict air movement and prevent cross contamination.

h. Ventilation Design and Air Filtration to dilute and remove contamination in the form of odour, airborne microorganisms and viruses, hazardous chemical and radioactive substances. To ensure the same, UVGI System /PHI may be considered. Magnehelic Gauges / Electronic Pressure Gauges to be installed for critical areas for measuring differential pressure between zones.

i. High Efficiency Filtration system to prevent bacterial contamination whether it is from Outdoor Air or from re-circulated air within space.

j. Three Stage Filtration comprising of Pre, Fine and HEPA Filters for Critical Areas.

k. Aluminum Ducting (pre-insulated/insulated separately with suitable material) of suitable gauge/thickness shall be used for supplying air to aforementioned areas to reduce the risk of bacterial formation in the air handling equipment and the ducts.

l. For OTs, the Supply and Installation of HEPA Filters at Terminals, Laminar FlowDiffusers and Inside supply/return OT Ducting shall lie within the scope of Modular OT vendor.

m. Air conditioning scope of work of Contractor will be installing the supply & return duct from AHU till the OT Room Entrance. Inside the OT Room, low side work shall be in the scope of modular OT Vendor's scope.

4. Air Conditioning /Comfort Heating System:

a. Centralized Chilled Water Air Conditioning System (District Cooling) shall be provided for MOT Block etc. in all areas including enclosed corridors except circulation spaces like toilets/staircases & non- critical stores etc. Hot Water Generators will be used forwinter heating of all centrally air conditioned areas & for monsoon reheat of critical areas like

OTs.

b. All the equipment etc. shall be suitable for 415 V, three phases or 220 V, Single phase, 50 Hz A.C. supply.

c. The chilling machines shall be AHRI / Eurovent certified with ecofriendly refrigerant and with best possible COPs as per latest ECBC code, Fans shall be AMCA certified for fan efficiency & Noise, Fire dampers shall be UL & CBRI Roorkee certified preferably with FM certification also.

d. In case of Chilled Water System Scroll Chillers with VFDs are proposed for Summer/Monsoon Cooling. The scope shall include Plant Manager as well.

e. All pumps including Hot Water Pumps&Primary Chilled Water Pumps will be with unit mounted Variable Speed Drives circulating water in the chilled/hot water circuit. Primary Water VFDs in pumps is meant for initial water balancing.

f. Provision of specialized equipment like Vacuum Degasser/Air and Dirt Separator/Dirt Separator /Descalar in the Plant Room to ensure smoother operation, enhanced efficiency of system and longevity. An integrated system consisting features of two or more Equipment will also be accepted.

g. Chilled Water Circuit comprising of MS pipes ("C" Class) with suitable Insulation in case of Centralized Chilled Water System.

h. GI pipes (Class B) for drain pipe with suitable insulation for chilled water system.

i. Fresh air provision for ceiling suspended AHUs/FCUs/VRV/VRF Indoor Units shall be considered as per relevant codes & standards. TFA (Treated Fresh Air Units) to be provided to supply treated chilled air to these units/feeding areas. Dedicated Outdoor Air System (DOAS) shall have HRW along with chilled water coils.

j. Pressurized Expansion Tank to adjust and regulate the pressure of water in the Chilled and Hot Water Circuit shall be provided.

k. Ducting System comprising of GI Ducting with Insulation/Pre-Insulated Ducting depending upon the requirement. Duct Construction and suspension Standards must conform to SMACNA, IS 655 and ASME.

l. Chilled Water flow Modulation by means of Manual/Motorized Butterfly, Non Return Valve, Ball Valve, Balancing Valve, 2 WAY PIBCV with insulation. All the valves must be minimum PN16 rated and suitable for Chilled Water and Hot Water applications. Insulation of valves shall be the same as that of pipe.

m. Air Flow Modulation by means of Air Distribution devices like Volume Control Duct Dampers, Collar Dampers, as per requirements conforming to ASME and SMACNA Standards.

n. Colour scheme for equipment like Chillers/Pumps/AHUs etc. shall be as per manufacturer's standard color scheme or as per directions of E-I-C.

o. The scheme of colour code painting of pipe work services for AC installation shall be as per NBC/CPWD specifications.

p. Provision of trap door of suitable material & size shall be considered for easy accessibility of moving parts of the concerned equipment/dampers.

q. For Burn Patients, air conditioning shall be so designed that temperature control should be there to maintain a warm environment & high relative humidity.

r. In Mortuary/Autopsy Rooms, comfort conditions are to be maintained with 100% fresh air system with full exhaust. Due to heavy bacterial contamination, & odor, autopsy room shall exhaust all air well above roof to prevent contamination to adjoining areas. This room should also be maintained at negative pressure.

s. In CSSD Areas, as it consists of cleaning area, sterilizing area & storage area, air conditioning along with ventilation arrangement needs to be considered.

t. BMS Compatibility to all Air Conditioning (3 phase equipment) High Side and Low Side Equipment.

u. Touch screen types central controller with stylus & of latest version to be provided with provision to ingrate the same on BMS.

v. The areas other than Mortuary / Autopsy Rooms wherein 100% fresh air is required, they are namely Septic OTs. As per relevant standards/norms, if any other room is to be provided with 100% fresh air, the same shall be provided.

w. Pump/ Motor placed on Terrace /open area should be weather proof type & required size of canopy also needs to be provided.

5. Ventilation System:

a. Mechanical Ventilation System to be considered for Toilets and Individual Floor Smoke Extraction & HVAC Plant Room, MGPS &other areas as per requirements.

b. Ventilation Fans for OT Block shall be provided of sufficient ACPH/CFM for toilet etc. Ventilation, Smoke Extraction & Pressurization Fans (Lift Well/Lift Lobby/Staircase) as applicable needs to be provided in all buildings.

c. Emphasis on maintaining adequate Fresh Air supply, Removal/Exhaust of stale air, particulate matter, fumes and noxious gases.

d. Fan Design, selection and sizing in accordance with Provisions stated in NBC 2016, ASHRAE,

ISHRAE, ECBC 2017 and Fire Bye-Laws.

e. The Fire resistant insulation shall be applied wherever a duct passes a fire zone. This shall be applicable for basements & all floors above it. The EPC Contractor shall submit the design/details conforming to relevant norms/standards for approval.

6. **Heating System:**

a. Comfort heating for all areas and additional Monsoon Reheating for Critical Areas in OT Block is to be provided.

b. Conformity of Indoor Quality parameters pertaining to Comfort and Critical Areas Heating with ISHRAE, ASHRAE and NABH Standards.

7. **Design and Layout Considerations:**

HVAC System design, provisions stated in NBC 2016, latest ECBC and conforming to the latest ISHRAE, ASHRAE and NABH and CPWD standards.

a. Objective of HVAC System Design is to ensure proper Indoor Air Quality, Energy Efficiency, Flexibility of Operation, Cost Optimization, BMS Compatibility.

b. Heat Load is to be computed for OTs of required block which are to be air conditioned. All required parameters/factors like geographical location, orientation of building, ambient conditions, glazing factor, lighting/equipment load, occupant load, area & height of room, fresh air ACPH, CFM/person, ADP of coil, shall be considered as per ASHRAE/ISHRAE/NBC 2016/ECBC standards.

c. Equipment sizing of HVAC system shall take into account factors such as geographical location, climatic conditions, water availability & quality etc.

d. Chilled & Hot water pipes from HVAC Plant Room to various buildings shall be laid underground at suitable depth as per CPWD specs. Adequate no. of Hume pipes having suitable dia. with spare shall be laid across the roads/pathways etc.

e. HVAC Plant Room shall be provided with safety equipment/items like suitable elastomeric mat (as per relevant IS codes) for Panels, fire buckets, fire extinguishers, hand gloves, safety charts, framed Schematic/SLD etc.

f. Suitable size shafts, cutouts, Niche, openings etc. shall be provided to facilitate installation of Pipelines, Ducts etc. in all floor slabs of various buildings for various service areas, as required. All shafts, cutouts, Niche, openings etc. provided on floor slabs shall be suitably closed after laying of services lines asper fire safety

norms as per NBC 2016. Doors shall be provided for all shafts at all floors as per fire safety norms as per NBC 2016.

g. All Services as required like raw/ soft/ hot water supply, drainage, plumbing,

HVAC provisions, ducting etc. shall be adequately provided for all Medical Equipment, Modular OT Rooms, CSSD, MGPS etc. as required.

h. Plant Room Layout :-

i. Plant Room at terrace shall be designed with proper distance between chillers/pumps/other equipment.

ii. The HVAC Plant Room Layout must be planned in such a manner so that it enables easy movement of personnel to conduct daily routine and maintenance procedures. Additional space for circulation shall be considered as per relevant codes. Provision shall also be kept for anticipated future requirements. Minimum clear height of plant room (approx. 4.5 m) shall be maintained as per relevant codes. The entrance to A.C plant room shall be preferably through doors & chillers through rolling shutters having minimum width as per relevant codes.

iii. Proper spacing must be ensured between the foundations of Pumps, Chillers and other equipment to enable repairs and easy replacement of parts.

iv. The Plant Room must be adequately ventilated with Fans maintaining optimum Air Flow and ACPH level. The design and sizing of Fan must be in conformity with the CPWD & NBC norms for the same.

v. Floor loading of approx. 2000 kg/sqm shall be considered for HVAC Plant Room. The Plant Room should have a fresh water connection & drain trap.

vi. The floor shall have suitable drain with grating. Proper sloping shall be provided inside the Plant room to ensure discharge of residual water & channelize it to nearest drain. Stagnancy of water shall be avoided in every respect.

vii. Adequate level of illumination must be ensured to enable smooth maintenance and repair procedures.

i. HVAC Shaft :-

i. Sufficient number of shafts shall be provided for piping/ducting/pressurization etc. so that length of pipe/duct is optimized.

ii. The HVAC Shaft must be adequately sized to enable smooth passage of pipes and ducts with insulation along with its supporting arrangement through it.

iii. The walls of the HVAC Shaft must be lined with Fire Rated Material/or of suitable material as per NBC provisions capable of withstanding 250 degree Celsius for a period of 2 hours.

iv. Inspection Doors must be provided in HVAC Shaft wherever necessary. The door must be Fire rated capable of withstanding 250 degree Celsius for aperiod of 2 hours.

j. AHU Rooms :-

i. The AHU Room Layout must be planned in such a manner so that it allows easy movement of personnel to conduct daily routine and maintenance procedures.

ii. AHU foundation shall be proper (PCC/RCC/Steel frame) in conformance to relevant standards. All measures shall be taken including providing vibration isolation pads etc. should be used to dampen noise generated at source itself.

iii. AHU Room shall be acoustically insulated with suitable material (density, K value) as per CPWD provisions & site requirements.

iv. Floor loading of approx. 800 kg/sqm shall be considered for AHU Room. AHU Room should have a fresh air opening, water connection & drain trap.

v. Fire Damper shall be provided on both supply & return duct preferably wherever duct crosses wall of AHU Room as per relevant norms & standards.

8. Design Basis

This system is designed to cater air conditioning requirement to the different areas of thebuilding. The brief design concept report for HVAC works in the buildings is as below: -

General

The site details are as under for estimating Heat load and HVAC system design.

Site location.	Super speciality block at SNMC, AGRA
Latitude	27.1 °N
Altitude	169 meters above mean sea level

Source: - www.indiamapia.com

The Air conditioning System shall be designed with following design parameters:-

Outside Conditions

The Recommended outdoor design conditions defined in ISHRAE Weather Data File 2017 (published jointly with Bureau of Energy Efficiency) for Guwahati are given below which will be based on 0.4% annual cumulative frequency of occurrence for Summer & Monsoon and 99.6 % annual cumulative frequency of occurrence for Winter. The design conditions considered are as follows:

S. No.	Season	Outdoor Temperatures	
		DBT	WBT
1.	Summer	43.3 °C (110 °F)	25.5°C (78°F)
2.	Monsoon	28.3 °C (83.0 °F)	35.5°C (96.0°F)
3.	Winter	5.5 °C (42.0 °F)	7.2 °C(45.0 °F)

Inside Conditions

Central air conditioning system shall be provided to maintain the specified inside design conditions during summer, monsoon and winter for the proposed buildings.

Classification of various spaces in terms of temperature, humidity control, Occupancy, air filtration, air changes & pressurization requirements of various departments shall be as per ASHRAE Standard 170. The extracts of the relevant parameter shall be as per following:-

Annexure 1 Table 6, Clause 8.1.1 of PART 8 BUILDING SERVICES. SECTION 3 AIR CONDITIONING, HEATING AND MECHANICAL VENTILATION

GUIDELINES FOR PARAMETERS TO BE CONSIDERED FOR HVAC SYSTEM DESIGN FOR HEALTH CARE FACILITIES

Annexure1.1 ISHRAE Hand BOOK - DESIGN PARAMETERS FOR AREAS AFFECTING PATIENT CARE IN HOSPITALS AND OUTPATIENTFACILLTIES

Annexure 2 Table 7 of PART 8 BUILDING SERVICES. SECTION 3 AIR CONDITIONING, HEATING AND MECHANICAL VENTILATION GUIDELINES FOR FILTER EFFICIENCY REQUIREMENT IN HEALTH CARE FACILITIES

Annexure 2.1 ASHRAE/ISHRAE Hand book - PRESSURE RELATIONSHIPS AND VENTILATION OF CRITERIA AREAS OF NURSING HOMES

Annexure 1

Table 6 Guidelines for Parameters to be Considered for HVAC System Design for Health Care Facilities (Clause 8.1.1) NBC						
Sl No.	**Area/Functional Space**	**Temperature °C**	**Relative Humidity (%)**	**Minimum Total Air Changes per Hour**	**Minimum Air Changes of Outdoor Air per Hour**	**Air Pressure in Relation to Surrounding Area**
i)	Operating theatres	18-24	45-55	25	5	Positive
ii)	Cath labs	20-22	30-60	15	3	Positive
iii)	Delivery rooms	20-22	30-60	25	5	Positive
iv)	Recovery room, ICU, Treatmentrooms	20-24	30-60	6	2	Equal
v)	Endoscopy, Bronchoscopy	20-24	30-60	12	2	Negative
vi)	Patient rooms	24±1	30-60	6	2	Equal
vii)	Toilets	-	-	-	10	Negative
viii)	Protective environment rooms (Immuno suppressed patients)	24±1	30-60	12	2	Positive
ix)	Isolation room (for patients withinfectious disease)	24±1	30-60	12	2	Negative
x)	Corridors	-	-	2	2	Negative
xi)	X-ray/Radiology	20-24	30-60	15	3	Positive
xii)	Laboratories (Other than biochemistry and serology)	22-24	30-60	6	2	Negative
xiii)	Biochemistry and serology labs andpharmacy	22-24	30-60	6	2	Positive
xiv)	Admission/Waiting rooms	22-24	30-60	6	2	Negative
xv)	Diagnostic/Treatment OPD	22-24	30-60	12	2	Negative
xvi)	Sterilizer room	22-26	30-60	10	-	Negative
xvii)	Sterilizer storage	22-26	30-50	4	2	Positive

Annexure 1.1 DESIGN PARAMETERS FOR AREAS AFFECTING PATIENT CARE IN HOSPITALS AND OUTPATIENT FACILLTIES							
Space Function	**Pressure Relationship to Adjacent**	**Minimum outdoor Air-ACH**	**Minimum Total Air-ACH**	**ALL Room Air Exhausted Directly to**	**Air Recirculated by means of**	**Relative Humidity Rh % (k)**	**Design temperature (I) Deg C**
							Std.
All ante Room (u)	(e)	N/R	10	Yes	NO	N/R	N/R
pe Anty Room (t)	(e)	N/R	10	N/R	NO	N/R	N/R
Combination ALL/PE Ante Room	(e)	N/R	10	Yes	NO	N/R	N/R
Labor / Delivery / Recovery /Postpartum (LDRP)(s)	N/R	2	6	N/R	N/R	Max 60	21-24

Labor / Delivery / Recovery (LDR)	N/R	2	6	N/R	N/R	Max 60	21-24
Patient Corridor	N/R	N/R	2	N/R	N/R	N/R	N/R
Nursing Facility							
Resident room	NR	2	2	NR	NR	NR	21-24
Resident Gathering/Activity /dining	NR	4	4	NR	NR	NR	21-24
Resident Unit Corridor	NR	N/R	4	NR	NR	NR	NR
Physical Therapy	Negative	2	6	NR	NR	NR	21-24
Occupational Therapy	NR	2	6	NR	NR	NR	21-24
Bathing room	Negative	N/R	10	YES	NO		21-24
RADIOLOGY (V)							
X-RAY (Diagnostic and Treatment)	N/R	2	6	NR	NR	Max.60	22-26
X-RAY (Surgery, critical care and cauterization)	Positive	3	15	NR	NO	Max.60	21-24
Darkroom (g)	Negative	2	10	YES	NO	NR	NR
DIAGNOSTIC AND TREATMENT							
Bronchoscopy, Sputum collection and	Negative	2	12	YES	NO	NR	20-23
Laboratory, general(v)	Negative	2	6	N/R	NR	NR	21-24
Laboratory, bacteriology (v)	Negative	2	6	YES	NR	NR	21-24
Laboratory, biochemistry (v)	Negative	2	6	YES	NR	NR	21-24
Laboratory, cytology (v)	Negative	2	6	YES	NR	NR	21-24
Laboratory, glass washing	Negative	2	10	YES	NR	NR	NR
Laboratory, histology (v)	Negative	2	6	YES	NR	NR	21-24
Laboratory, microbiology (v)	Negative	2	6	YES	NR	NR	21-24
Laboratory, nuclear medicine (v)	Negative	2	6	YES	NR	NR	21-24

	Annexure 1.1 DESIGN PARAMETERS FOR AREAS AFFECTING PATIENT CARE IN HOSPITALS AND OUTPATIENT FACILLTIES							
	Space Function	**Pressure Relationship to Adjacent Areas (n)**	**Minimum outdoor Air-ACH**	**Minimum Total Air-ACH**	**ALL Room Air Exhausted Directly to Outdoors(j)**	**Air Recirculated by means of Room units(a)**	**Relative Humidity Rh % (k)**	**Design temperature (l) Deg C**
								Std.
	Laboratory, pathology (v)	Negative	2	6	YES	NR	NR	21-24
	Laboratory, secrology (v)	Negative	2	6	YES	NR	NR	21-24
	Laboratory,sterillzing (v)	Negative	2	10	YES	NR	NR	21-24
	Laboratory,media transfer (v)	Positive	2	4	N/R	NR	NR	21-24
	Non-refrigerated body-holding rooms	Negative	NR	10	YES	NO	NR	21-24
	Autopsy Room	Negative	2	12	YES	NO	NR	20-24
	Pharmacy	Positive	2	4	NR	NR	NR	NR
	Exmaination Room	NR	2	6	NR	NR	Max.60	21-24
	Medication room	NR	2	4	NR	NR	Max.60	21-24
	Gastrointestinal endoscopy procdure room (x)	NR	2	6	NR	NO	20-60	20-24
	Endoscope cleaning	Negative	2	10	YES	NO	NR	NR
	Treatment Room	NR	2	6	NR	NR	MaX 60	21-

								24
	Hydrotherapy	Negative	2	6	NR	NR	N/R	22-27
	Physical Therapy	Negative	2	6	NR	NR	Max 65	22-27
	STERLIZING							
	STERLIZING Equipment Room	Negative	NR	YES	10	NO	N/R	N/R
	CENTRAL MEDICAL AND SURICAL SUPPLY							
	Solied or decontamination Room	Negative	2	6	YES	NO	NR	22-26
	Clean workroom	Positive	2	4	NR	NO	Max.60	22-26
	Sterille Storage	Positive	2	4	NR	NR	Max.60	22-26
	SERVICE							
	Food preparation Center (i)	NR	2	10	NR	NO	NR	22-26
	Warewashing	Negative	NR	10	YES	NO	NR	NR
	Dietary Storage	NR	NR	2	NR	NO	NR	22-26
	Laundry, General	Nagative	2	10	YES	NO	NR	NR
	Solied Linen Sporting and storage	Negative	NR	10	YES	NO	NR	NR
	Clean Line storage	Positive	NR	2	NR	NR	NR	22-26
	Linen and trash Chute Room	Nagative	NR	10	YES	NO	NR	NR

Annexure 1.1 DESIGN PARAMETERS FOR AREAS AFFECTING PATIENT CARE IN HOSPITALS AND OUTPATIENT FACILLTIES

	Space Function	Pressure Relationship to Adjacent Areas (n)	Minimum outdoor Air-ACH	Minimum Total Air-ACH	ALL Room Air Exhausted Directly to Outdoors(j)	Air Recirculate dby means of Room units(a)	Relative Humidity Rh % (k)	Design temperature (l) Deg C
								Std.
	Bedpad Room	Nagative	NR	10	YES	NO	NR	NR
	Bathroom	Nagative	NR	10	YES	NO	NR	22-26
	Janitor's Closet	Nagative	NR	10	YES	NO	NR	NR
	SUPPORT SPACE							
	Soiled workroom or soiled holding	Negative	2	10	YES	NO	NR	NR
	Clean workroom or clean holding	Positive	2	4	NR	NR	NR	NR
	Hazardous Material Storage	Positive	2	10	YES	NO	NR	NR

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a	Exepct where indicatesd by a "No" in this column, recirculating room HVAC units (with heating or cooling coils) are acceptable for providing that portion of the minimum total air changes per hour that is parmitted by section 701 ASHRAE STD 170-2013 (subparagraph [a][5]. Because of the cleaning difficulty and potential for bulidup of contamination, recirculating room units shall not be used in areas marked "No. "Recirculating devices with HEPA filters shall be parmited in existing facillties as interim, supplemental environmental contols to meet requirements for the control of the airborne infectious agents. The desgin of either portable or fixed systems should prevent stagnation and short circuiting of airflow. The sdesign of such systems shall also allow or easy access for scheduled prevenative maintenance and cleaning.
b	Pharmacy compounding ares may have additional air change, differntial pressure, and filterning requirements beyond the minimum of this table depending on the type of pharmacy , the regulatory requirements which may include adoption of USP 797), the associated lavel of the risk of the work (see USP [2013] in informative AppendixB), and the equipment utillzed in the spaces.
c	The term trauma room as used herein is a first-aid room and/or emergency room used for general initial treatment of of acedent victims. The operating within thetrauma centre that is routinely used for emergency surgrey is considered to be an operating room standred.
d	Pressure relationships need not be maintainted when the troom is unoccupied.
e	All air air need to be exhausted in dark room equipment has a scavenging exhaust duct attached and meets ventilation standard regarding NIOSH,OSHA, and local employe exposure limits $_{2\text{-}3}$ h. A non -refrigerated body-holding room is applicable only to facillties that do not perform autopsies on-site and use the space for short periods while wating for the body to be transferred.

f	Minimum total air change per hour (ach) shall be that required tp provide proper makeup air to kitchen exhausted systems as specifled in ANSI/ASHRAE standard 154.[4] in some cases , excess exfiltration or infiltration to or from exit corridors restrictions of NEPA 90a, [5] the pressure requirements of NEPA 96, [6] or the maximum defined in the table . during operation , a reduction to the number of air changes to any extent required for odor control shall be permitted when the space not in use.
g	In some areas with potential contamination and/or problems. Exhaust air shall be discharged directly to the outdoors and not re circulated to other areas. Individual circumstances may require special consideration for all the exhausted to the outdoors. To satisfy exhaust needs, constantreplacement air from the outdoors in necessary when the system is in operation .
h	The RH ranges listed are the minimum and/or maximum allowable at any point within the design temperature range required for that space.
i	Systems shall be capable of maintaining the rooms within the range during normal operation. Lower or higher temperature hall be permittedwhen patients ' comfort and/or medical conditions require those condition.
j	National institute for occupational safety and health (NIOSH) criteria documents regarding occupational exposure to waste anesthetic gases and vapors, and control of occupational exposure to nitrous oxide[7] indicate a need for both local exhaust (scavenging) systems and general ventilation of the areas in which the respective gases are utilized. Refer to NEPA 99 for other requirements.[8]
k	If pressure-monitoring devices alarm are installed, allowances shall be made to prevent nuisance alarms. Short-term excursions from required pressure relationships shall be allowed while door are moving or temporarily open. Simple visual methods such as smoke trails, ball-in-tube, or flutter strip shall be permitted for verification of air flow direction.
l	Surgeons or surgical procedures may require room temperatures, ventilations rates humidity range, and/or air distribution method the exceedthe minimum indicates ranges.
m	Treatment room used for bronchoscopy rooms. Treatment room used for procedure with nitrous oxide shall contain provisions for exhaustinganesthetic waste gases.
n	In are circulating ventilation system, HEPA filters shall be permitted instead of exhausting the air from these space to the outdoors provided that the return air passes through the HEPA filter before it is introduced in to any other spaces. The entire minimum total be air change per hour ofre circulating airflow HEPA filters. When these area are open to larger, non-waiting spaces the exhaust air volume shall be calculated based on the seating area of the waiting area. (Note: The intent here is not require the volume calculation to include a very large space [e.g.an atrium] just because a waiting area open on to it.)
o	See NEPA 99 for further requirements.[8]
p	For intermediate care , labour/delivery/recovery rooms, and labour/delivery/recovery /postpartum rooms, for total as shall be permittedwhen supplemental heating and/or cooling systems(radiant heating and cooling , baseboard heating , etc.) are used
q	The protective environment airflow design specifications protect the patient from common environmental airborne infectious microbes Recirculation HEPA filters shall be permitted to increase the equivalent room air exchanges; however the outdoors air changes are still required. Constant-volume air flow is required for consistent ventilation for the protected environment. The pressure relationship to adjacent areas shall remain unchanged if the PE room is utilized as normal patient room. Rooms with reversible airflow provisions for the purpose of switching between protective environment and all function shall not be permitted.
r	The all room described in this standard shall be used for isolating the airborne spread of infectious diseases, such as measles varicella, or tuberculosis. Supplemental re circulating devices using HEPA filters shall be permitted in the All room to increase the equivalent room air exchanges; however, the minimum outdoor air changes of tables are still required. All rooms that are retrofitted from standard patient rooms from which it is impractical to exhaust directly outdoors may be re circulated with air from the all room, provided that air first passes through a HEPA filters. When the all room is not utilized for airborne infection isolation, the pressure relationship to adjacent areas, when measured with the door closed, shall remain unchanged and the minimum total air changes rates shall be 6 ach. Switching controls for reversible air flow provisions shall not be permitted.

s	when required, appropriate hoods and exhaust devices for the removal of noxious gases for chemical vapors shall be provided in accordance

	with NFPA 99.[8]
t	The requirements that all rooms air is exhausted directly to outdoors applies only to radiology waiting rooms programmed to hold patients whoare waiting for chest X-rays for diagnosis of respiratory disease.
u	If the planted space is designated in the organization's operational plan to be utilized for both bronchoscopy and gastrointestinal endoscopy,the design parameters for "bronchoscopy, sputum collection, and administration" shall be used.
v	For single-bed patient rooms using Group D diffusers, a minimum of six total ach shall be provided and calculatedbased on the volume for the finished floor to 6ft.(1.83 m) above the floor.
Source: ASHRAE STD 170-2013	

GENERAL

Design Basis Report

Electrical and LV works

(a) The EPC Contractor shall carry out Design, Engineering, Supply, Installation, Testing & Commissioning of complete Internal & External Electrification works including Low Voltage (LV) and other works as required for smooth functioning of the proposed for OT Block at Construction for Upgradation of Super Specialty Block, Sarojini Naidu Medical College Agra, Uttar Pradesh under PMSSY-IV. All Electrical & LV works shall be designed and executed as per latest codes of practice for Electrical installations and meeting the requirements of Indian Electricity Rules/Act, applicable I.S. Codes/ Rules and relevant IS/ CPWD Specifications, Special requirements of Assam Electricity Board latest up to date.

(b) The rating and capacity of equipment indicated herein below are minimum to be provided. However during detailed designing, if required and found necessary, the capacity / rating of the equipment may be upgraded by the EPC Contractor.

1. SCOPE OF WORK

Electrical & Allied Services' required for proposed for OT Block at Construction forUp gradation of Super Specialty Block, Sarojini Naidu Medical College Agra, Uttar Pradesh under PMSSY-IV. Covers Internal Electrical Installations, HT/ LT Panels, Distribution Boards, External Electrical Installations, LT Cables, Centralized UPS system, Internal & External Electrical Distribution work. It shall also include Direct Online Solar power station, IP-based Telephones System, Data Centre, LAN Networking & Wi-Fi System, CCTV System, Fire Alarm System, Public Address System, Building Management System, SCADA System, Nurse Call System, Access Control System, Hospital Management Information System (wiring only),and Information Display System etc.

Suitable size shafts, cutouts, Niche, openings etc. shall be provided to facilitate installation of Rising Mains, Pipelines, Cable Trays, Ducts, Pneumatic Tube System etc. in all floor slabs of various buildings for various service areas, as required. All shafts, cutouts, Niche, openings etc. provided on floor slabs shall be suitably closed after laying of services lines as per fire safety norms as per NBC 2016. Suitable doors shall be provided for all shafts at all floors as perfire safety norms stipulated in NBC 2016.

All Services, as required like electrical power panels, Light & Fan Points, Power Points, Telephone Points LAN/Data/Wi-Fi Points, UPS Panels & UPS Power Points, Earth Pits, Earthing Network, Raw/ Soft/ Hot water supply, drainage, plumbing, HVAC provisions, ducting etc. shall be adequately provided as per OEM requirements for all Medical Equipment, Modular OT Rooms, ICUs, CSSD, Laundry, Kitchen, MGPS, Pneumatic Tube System etc.

MGPS Pipelines etc. shall be taken from MGPS Room to various locations in OT Block by the EPC Contractor. The EPC Contractor shall provide the required and suitable MS structure, duly painted at appropriate height (min 6 M clear height) from MGPS Room to Hospital Building.

A Tentative List of Medical Equipment is appended at Annexure-I for reference of the EPC Contractor.

2. ELECTRICAL POWER REQUIREMENT

The Electrical Load requirement has been calculated on the basis of covered area of various buildings/ blocks as per NBC 2016 considering lighting load @ 13 W/Sq.m& power load @ 55 W/ Sq.m.

Load for the Central Air Conditioning Plant, Medical Equipment/Services, Lifts, Pumps, External Lightning, STP, WTP etc. has also been taken in to account.

Electrical load calculation sheets are provided at Para 10 below.

3. ELECTRICAL POWER DISTRIBUTION

The Electrical Power Distribution for electric supply shall be as detailed below.

a. Main LT Panels to HVAC Panel & all Capacitor Panels. Adequate runs of XLPE insulated armouredAluminium conductor cables shall be laid from Main LT Panel to LT Panels of MOT block.

b. In MOT Block the separate distribution system shall be provided for lighting load, Power & AC Load & UPS load. Each distribution system shall be with Electrical panels, sandwich rising mains, Floor panels, Double door MCB Type DB's, VTPN DBs etc. Various LT Panels & UPS panels installed in MOT blocks shall be interconnected with each other with suitable change over switches.

c. MOT Block shall have suitable Nos. of rising mains for catering to loads of Lighting, HVAC equipment, Power, Medical Equipment (MOT Block), UPS etc. connected to Main LT Panel, as applicable.

d. Each rising main shall be sandwich type and have Tap off at every floor, feeding thefloor panels with incoming & outgoing MCCBs of required capacities and numbers feeding the double door DBs/VTPN DBs.

e. Sub mains from floor panel to DBs shall be connected with armored cable on surface/cable tray.

f. Hot Dip Galvanized Perforated Type Cable trays of suitable size with perforation notmore than 17% shall be provided as required in all the buildings.

g. The power cabling shall be sized so that the distribution losses do not exceed 3% of the total power usage in buildings. Voltage drop for feeders shall not exceed 2% at design load and for branch circuit; it shall not exceed 3% at design load as per ECBCnorms.

h. Main electrical panel for all MoT's should be considered dual source type along with suitable electrical circuit breaker for UPS Systems.

4. EARTHING NETWORK

Earthing with GI Plate Earthing System & Copper Plate Earthing system, as required, shall be provided for earthingof Electrical Panel Boards, UPS and other Equipment /installations in each building. Earthing shall

be in conformity with provisions of Indian Electricity Rules 1956& as per IS-3043 & IEEE 80 as amended up to date. Copper/GI earth strips shall be used for connecting the Electrical equipments and Medical equipments with Earth pits as per prevalent norms. Earth Leakage circuit breakers/RCBO shall be provided in the DBs for individual units.

Copper Earth strips and Copper Electrode Earth Pits shall be provided for Body & NeutralEarthing of all electrical equipment in the Substation area as per CPWD Specifications. Copper Earth strips and Copper Electrode Earth Pits shall also be provided for all MedicalEquipment or as per OEM recommendations.

Earthing shall be carried out for all power distribution system and effectively bonding the equipment. Separate and dedicated earthing with copper electrode earth pits and suitable size copper earthing strips (as recommended by OEM) shall be provided for critical largemedical equipment like MRI, CT Scan, X-Ray, Mammography, Fluoroscopy, Modular OT Equipment, OT Isolation Panels/Transformers, OT UPS & its Panels, Linear Accelerators, Ultra Sound etc. All other medical equipment shall be connected through a common earthing grid.

Separate and dedicated earth pits/stations with Copper electrode & Copper earth strips shall be provided for the following:

- Main LT Panels, Capacitor Panels, RTCC Panel&HVAC Panels
- Sandwich Bus ducts
- UPS system – Body & Neutral
- EPABX , LAN/DATA Server and other ELV Equipment
- Modular OT's
- ICU Equipment
- All types of Medical Equipment
- MGPS Equipment
- Any other equipment as required

However, GI strip earthing with GI electrode earth pit shall be provided for Electrical Floor panels located in various buildings.

Suitable sized Elastomeric Safety Mats with suitable thickness shall be provided for all LT Panels installed in the all buildings, as required.

All three phase electrical installations shall be provided with double Earth connection and single phase electrical installations with one Earth connection as per CPWD specifications & NBC 2016.

5. LIGHTNING PROTECTION SYSTEM

ighting protection of various buildings and blocks shall be provided as per IS/ IEC-62305-1:2010 (latest as amended), CPWD Specifications and NBC 2016 norms. The main and most effective measure for protection of structures against physical damage is considered to bethe lightning protection system (LPS). An external LPS which consists of air-termination system, down-conductor system and earthing system is intended to:

a) Intercept a lightning flash to the structure (with an air-termination system),

b) Conduct the lightning current safely towards earth (using a down-conductor system),and,

c) Disperse the lightning current into the earth (using an earth-termination system).

Accordingly a standard lighting protection system will be provided in all the buildings as per NBC 2016 Standards, using single prone finials, horizontal and down comer Copper earthing strips of suitable size, terminating in the Copper Plate Earth Pits. Aviation Obstruction Light (AOL) shall be provided in various buildings as per Civil Aviation regulations, NBC norms & CPWD Specifications as applicable.

All Aviation Obstruction Lights shall be fed with UPS supply only.

6. INTERNAL ELECTRIFICATION, LV & ALLIED WORKS

a. Following works shall be carried out in coordination with the civil work within the buildingscomplete in all respects as per latest IS Codes and CPWD Specifications.

i. Wiring & Conduiting (MS/PVC Conduits) for internal electrification, LV & Allied works, Cable & MATV.

ii. LED Light fixtures, Fan (Ceiling & Wall) & Exhaust Fans.

iii. 6A Light Point /UPS Modular Switch & Socket Outlets.

iv. 16A/ 20A Power/UPS Modular Switch & Socket Outlets

v. L.T. Cables and Sub main wiring, circuit wiring.

vi. GI perforated Cable Trays

vii. Raceways

viii. Sandwich Type Rising Mains / Sandwich type Bus Ducts

ix. Floor Panels, Distribution Boards & VTPN DBs.

x. Earthing

xi. Extra Low Voltage system like Telephone/IPBAX, LAN & Wi-Fi, Fire Detection & Alarm System, CCTV System, MATV System, Public Address System, Access Control System, Boom Barriers etc.

xii. Audio Visual System & Stage Lighting for Auditorium.

xiii. Audio Visual system for conference Room, Seminar Hall, Lecture Theaters etc.

xiv. Nurse Call System.

xv. Information Display System.

xvi. Any other system as required.

b. Following points shall be generally followed for internal and external electrification of various areas:

i. Internal areas like rooms, corridors, lobbies, staircases, terraces, washrooms etc. of allbuildings and blocks shall be adequately illuminated conforming to provisions stipulated in NBC 2016, ECBC and CPWD technical specifications maintaining the indicated Lux levels and Light Power Density.

ii. The Internal Electrification work shall be carried out in recessed/surface mounted MS or PVC conduits in accordance with CPWD General Specifications for Electrical Works Part-I (Internal)-2013 and Part-II (External)-1994 with up to date amendments.

iii. MS/ PVC Conduits shall be surface mounted or laid on GI angle/channels with suitable hanging GI supports in areas wherever there is false ceiling provision. In case there is no provision for false ceiling, MS/PVC Conduits shall be concealed in concrete during slab casting. Wiring for lighting/power shall be generally done in MS Conduits whereas wiring for LV works shall be generally done in PVC conduits unless stated otherwise.

iv. FRLS PVC insulated Copper conductor wires will be used for points, circuit & sub-main wiring conforming to relevant IS-Codes. Wiring shall be carried out with following sizes of PVC insulated FRLS multiple stranded single core copper conductor wire/cable.

a. Light Point - 1.5 sq.mm
b. Ceiling /Cabin/Exhaust Fan Point - 1.5 sq.mm
c. Call Bell Point - 1.5 sq.mm
d. 6A Plug Point/ UPS Computer outlets (up to 3 outlets on one ckt.) - 2.5 sq.mm
e. Circuit Wiring - 2.5 sq.mm
f. General Power Point – 4 sq.mm
g. Industrial Socketwith 20ADP MCB forGeysers – 6 Sqmm
h. 20A Industrial Socket Outlet – 6 Sqmm
i. Special Power Point – 6 Sqmm
j. A/C Industrial Socket with 32A DP MCB- 6 Sqmm
k. Sub Main wiring from VTPNDB/ Floor Panel to DB:-

i. For DB Incomer Size 25 A DP – 2RX6 Sqmm + 1R X6 Sqmm
ii. For DB Incomer Size 32/40 A DP – 2RX10 Sqmm + 1R X10 Sqmm
iii. For DB Incomer Size 63 A DP – 2RX16 Sqmm + 1R X16 Sqmm
iv. For DB Incomer Size 25 A 4 Pole – 3RX6 Sqmm + 2R X6 Sqmm
v. For DB Incomer Size 32/40 A 4 Pole – 3RX10 Sqmm +2R X10 Sqmm

vi. For DB Incomer Size 63 A 4 Pole – 3RX16 Sqmm + 2R X16 Sqmm

v. Agency shall execute the work after obtaining necessary approval of the layoutfor internal electrification of MOT Block, & common areas

vi. Modular type switches, sockets and stepped type electronic fan regulators, bell push button along with matching mounting boxes of same make shall be used.

vii. Colour coding of the conduits, switches, sockets shall be provided for Normal & UPS power supply as per NBC 2016.

viii. TV Outlet point wiring shall be terminated in suitable size of G.I. box along withsplitter boxes at every floor. The interconnections of all splitter boxes fixed at all floors shall be done properly with conduits to form proper distribution system with the prior approval of Engineer-in-charge.

ix. LED Type Lighting Fixtures with inbuilt harmonic suppression mechanism shall be provided and all Internal and External LED Light fixtures shall have THD less than10%.

x. Suitable size & capacity Exhaust Fans shall be provided in MOT Block MGPS/Air Compressor room, and other utility/service buildings as per NBC 2016 provisions.

xi. Suitable size & capacity Ceiling Fans/ Wall Fans (White/Off White color) shallbe provided in the rooms and areas of various buildings as required, where there is provision neither for air-conditioning nor for forced ventilation as directed byEngineer-In-Charge. Accordingly, Ceiling Fans/Wall Fans shall be provided in MOT Block etc.

xii. However, Ceiling Fans/ Wall Fans shall be provided in aMGPS, and its common areas (in addition to air-conditioning/ ventilation provision) as directed by Engineer-In-Charge.

xiii. Separate shafts shall be provided for laying of pipes for Electrical, ELV, Mechanical and Fire Services.

xiv. After completing the work, necessary test results as envisaged in latest CPWD General Specifications Part-I (Internal) & Indian Electricity Rules, shall be recorded and submitted. The results shall be within the permissible limits.

xv. Power Points, LAN points, UPS power points, Telephone Points (with telephone instrument as required) shall be provided for all counters like registration, reception, nurse call station etc. and as directed by Engineer In-Charge.

xvi. Requisite size of raceways shall be provided in slabs with fillers, wherever required for drawing the wires and cables for the work stations etc.

xvii. For areas having grid type false ceiling, recessed type LED Light Fixtures of size 600 mm X 600 mm shall be provided as per directions of Engineer-In-Charge unless otherwise stated. For areas having false ceiling with Gypsum board, Down Lighter type fixtures of suitable size

shall be provided as per directions of

Engineer-In-Charge unless otherwise stated. Surface mounted Light Fixtures shallbe provided in the areas without False Ceiling.

xviii. Industrial weather proof sockets (single phase and three phase) shall be provided in the kitchen on the corresponding walls.

xix. 2 No. 6/16 amps UPS power socket outlets and 2 No. 6/16 amps raw power socket outlets shall be provided with each bed of General ward or in Bed HeadPanel. In addition, normal raw power socket outlets shall be provided for TV, cleaning socket and / or laptop/mobile charging.

xx. 4 No. 6/16 amps UPS power socket outlets and 4 No. 6/16 amps raw power socket outlets shall be provided with each bed of critical care units or in Bed Head Panel.

Lighting Design & Lighting Fixture

LED lighting fixtures shall be provided with inbuilt Harmonic suppression system to achieve harmonic distortion less than 10% in all areas and buildings to achieve the illumination levels conforming to latest IS Code, NBC 2016, ECBC latest up to date. All LED lighting Fixture shall have luminous efficacy of more than 100 Lumens per watt and a minimum Color Rendering Index of 80. Lighting Power Density (LPD) shall be achieved for various buildings/ areas as per lighting simulation requirements as per ECBC norms. Number of Light Fixtures (not less than 10%) shall be fed with UPS power in all areas of various buildings. However, at least 1 No Light Fixture shall be fed with UPS power in all rooms and areas.

Occupancy/ Movement sensors and Light Dimmers shall be provided for automaticlighting control in Office rooms / Consultant rooms / toilets and other areas as required under NBC and latest ECBC norms.

Computer / LAN Networking/ Wi-Fi Points/IP-BAX

RJ 45 data outlets points will be provided for Computers, Networking, Telephones, Wi- Fi, Access Control, CCTV, Information Display system, BMS, SCADA& IP-BAX System etcShall be providedas per the functional requirement in Modular OT Block.

The Data Outlet points shall be connected to Rack Panel/Computer hub with 4 pair CAT-6a wiring in Raceways, recessed/ surface conduit as required. UPS Power supply shall be provided to Network Rack, Servers & Computers wherever required.

The maximum length of the CAT 6a cable from end user point to the Hub or Edge switches shall not be more than 90 M. Beyond 90 M length Fibre Optic Cable shall beused.

The Rack Panel/computer hub at OT Block will be connected to Main rack of the building/ block with Fibre Optic Cable through conduit or raceways on surface/ recess.

Suitable Data Centre with false flooring shall be established in the OPD block of OT Block, which comprises both LAN server & IPABX server. A redundant Data Centre/ LAN server will also be provided in Medical College in parallel to Hospital LAN server.

The server shall be connected to Distribution switch through Optical Fibre cable. Distribution switch shall be connected to Edge switches of OT block with optical fiber cable in underground DWC HDPE pipe of suitable size for outside connectivity or in cable raceway/conduit inside the buildings.

The Rack panel comprising of jack/Patch panels, Network switches, patch cords, power supply units, Cooling Fans, Wire managers, LIUs, Trans-receivers, Fiber patch cord etc. of individual buildings/Blocks/ floors.

LAN Infrastructure at different Floors of various building shall be used commonly for IPABX, BMS, Access Control System, CCTV, Nurse Call System, HMIS (Hospital Management Information System) etc. along with LAN.

For HMIS, only wire/cable network with copper cables/CAT6A/Optical Fiber Cable shall be provided as required.

Brick masonry manholes with covers shall be provided at suitable lengths to facilitate easy wire/cable pulling.

Wireless access points for Wi-Fi connectivity having data speed, 4 Mbps minimum, shall be provided in OPD & Hospital Block, Medical & Nursing College, Ayush Hospital, Hostel Blocks, Auditorium etc. All types of hostel shall have only Wi-Fi connectivity whereas all residential buildings in the complex shall be provided with wired data outlets along with the Wi-Fi connectivity.

Fire Detection / Alarm System

Addressable Intelligent fire detection and Alarm system of latest technology with Fire alarm panels, multi Sensor detectors, smoke detectors, heat detectors, response indicators, manual call point and hooters, light strobe etc. shall be provided. It shall meet the requirement of NBC 2016/CPWD Specifications/ State By-laws. License/Approval of Local Fire Authorities shall be provided for the complex. There shall be the proper Zoning of the complex/buildings considering the Non Critical & Critical areas (critical area like OT & ICUs Block etc.) Repeater panels shall be provided in Modular OT Block as per functional requirement of the system.

There shall be Independent fire Alarm Panel for Modular OT Block, etc. and all fire control panels shall be interconnected with each other. Fire Detectors and devices of other blocks shall be connected to Fire Control Panel of the nearest building through necessary cables in DWC HDPE pipes. The monitoring of whole complex shall be in the Main Fire Control Room of MOT Block . For Central Monitoring of all the Fire Panels, necessary devices like PC, Printer, modules & Software etc. of latest technology with minimum 1 TB hard disk shall be provided in the Control room. Fire Alarm control Panel shall have

maximum 159 devices and 159 detectors in one loop. The details of the system proposed shall be asfollows:

a) Addressable intelligent dual type Fire Detectors is suggested.

b) Detector should be with inbuilt Short circuit isolator & automatic addressing.

c) Detectors should be installed as per coverage defined in NBC 2016 and NFPA 72. It should include all rooms, halls, storage areas, basements, attics, lofts, and spaces above suspended ceilings including plenum areas utilized as part of the HVAC system.

d) Suitable numbers of input/ output (C/M) relay modules are suggested for connecting other equipment like Electrical Panels, firefighting system, AHUs, Ventilators, PASystem etc.

e) Spacing between two detectors shall be as per relevant code & manufacture standards.

f) Cabling shall be with Fire Survival category Armoured copper cable as per NBC 2016 norms.

g) Suitable addressable loop powered sounders/ hooters with strobe for minimum 90db sound level.

h) Addressable manual call boxes shall be provided near all exits, stair cases, lift lobbies etc. as per relevant Norms.

i) The Response Indicators shall be used wherever required.

j) Microprocessor IP based fire alarm control panel (fully redundant) for number of required loops with 24 hrs. Battery backup with LCD display, printer etc. shall be located in the fire control room.

k) Fire Alarm Panels shall be integrated with PA system and with BMS also.

l) Two Way communication Fire Fighters Telephone Jack & Handset with necessary accessories are to be provided in MOT Block as required.

m) Fire alarm system to be provide in MoT and integrated with MoT Access door as per latest NBC Code.

n) Temperature and Relative Humidity to be controllable from MoT Control Panel as per latest ASHRAE specifications.

o) Dedicated copper earthing strip (min-25mm X 5mm) shall be provided for UPS system, isolation transformer and static floor.

p) All Copper earthig should be maintenance free.

q) Scrubber for All MoT's to be provided with inbuilt soap dispenser(foot and sensor operated) along with hot and cold provision with latest MoT Specifications

r) Dedicated isolation transformer shall be provide for all MoT's.

s) Digital control panel with latest specifications shall be provide in all MoT's

All Fire Alarm Panels shall also be integrated with each other on a peer to peer network. A Repeater panel shall be installed in the Main Security Room of MOT Block and in secured area manned 24 hours a day.

Public Address System (PA System):

Public Address System shall be provided in MOT Block, as required. Speakers in the Ceiling/Wall shall be provided in corridors, lift lobbies and other common areas as per NBC 2016/relevant IS codes.

a) Box type speaker shall be provided in the entrance lobby.

b) Horn type speaker are suggested in the basement.

c) Recessed speakers in the false ceiling areas.

d) Proper zoning are to be done considering the user requirement, critical areas & flooretc.

e) Control console shall be located in the fire control room with pre amplifiers, amplifiers, CD, DVD/Pen-drive, FM Player & gooseneck microphone.

f) System shall have the facility to make announcement on all floors simultaneously or on individual floors.

g) Wiring shall be done with twin twisted tinned copper industrial armored speaker cable.

h) The system shall be Integra table with Fire alarm panel and with the BMS also.

Closed Circuit Television System (CCTV System)

The CCTV and Surveillance System shall control and monitor MOT Block in the Campus as per NBC 2016/ relevant IS codes/Local by laws. MOT Block shall have IP Based Dome Cameras, Bullet Cameras and PTZ Cameras for surveillance. The types of cameras & locations of various Cameras indicated herein are minimum to be provided. However during detailed designing if required and found necessary the type / rating of the Cameras shall be upgraded.

a) MOT Block – Dome/ Bullet Cameras (Indoor Type) + PTZ Cameras on pole or Rooftop (Outdoor)

b) Entry/ Exit Gates- Bullet Cameras (Outdoor Type)

The indoor Dome Cameras and Bullet Cameras are proposed to be installed at Entry & Exit Points on MOT Block , main corridor, Lift lobbies, Reception Areas, Waiting areas and other common areas of MOT Block.

All the outdoor cameras shall be in IP-66 Housing with Junction box, media converter etc. is proposed in weather proof housing. The existing LAN network switches would be used for CCTV connectivity and will be connected to central CCTV server & cameras shall have POEconnectivity ports.

Network connectivity for outdoor cameras having distance more than 75 metres, shall be on optical fiber. Suitable provision shall be provided to connect with existing LANinfrastructure. The power supply to LAN switches and all Monitors will be on UPS. The video recording shall be non-embedded based

recording server with video managementsoftware.

a. **Bullet/Dome camera: -** These cameras shall be Full HD IR Camera suitable for Day and night operations. All the cameras shall be operative on automotive manual & scheduled mode. The cameras shall be UL/FM Listed. RJ- 45 Cable connectors will be used for Network/POE connectivity.

b. **PTZ outdoor cameras: -** The true IP day and night viewing PTZ cameras proposed are 20x optical zoom, Auto iris & auto focus lens with focal length 4.7 mm to 94 mm or better. The PTZ camera shall automatically track the object to use its Pan/Tilt/Zoom feature and record 30 frames/ sec. The cameras shall be UL/FM Listed. RJ- 45 Cable connectors will be used for Network/POE connectivity.

c. **Central Core & Recording Server:-** The main servers will be Intel Xeon processor E5-2600, minimum speed of 2.3 GHz with 6 Core, dual Gigabit Ethernet Port, USB port, Video port. The server memory will be 16 GB DDR4 RAM with operation and management Licenses tomanage at least 15 Recording Servers and 300 Cameras or as required in MOT Block

d. **LED Display Monitor:**- The sufficient no. of Full HD LED Monitors with high resolutions screen size of 43" (Diagonal) are to be provided for viewing all live/ recorded camera proceedings. The resolutions of 1920(H) x 1080(V) pixels with comfortable viewing angle is proposed for all monitors suitable for operation on 220-240V AC 50 Hz power for thedisplay panel should be equipped with all standard features such as video in, Audio in,HDMI/DVI, RJ 45 Port etc or as required in MOT Block

Control Room shall be located in the Security /Control Room of the Hospital block. The wiring inside the building shall be with CAT 6A cable in conduit and for Outdoor connectivity Armoured fiber Optic Cable shall be used. Optical fiber cable shall be laid underground in HDPE pipes with suitable Manholes for easy pulling and properMaintenance. PTZ cameras will be placed on roof top and on Street light Poles with necessary mounting arrangements in external areas. The video management server shouldhave minimum 30 days storing capacity.

Access Control System:

Access Control system will be magnetic door type controlled through Card readers and biometrically. All sensitive areas like OT's/ICUs Corridor etc. shall be provided with Access Control System. IP based door controllers shall be provided as required. Existing LAN infrastructure shall be used for network connectivity of IP based door controllers. Each Controller will control four No. of Magnetic locks which can be for single or double leaf door. The centralized control will be managed through a server to be installed in main Security Control/ Server Room. For Overriding purpose Push Button will be provided insidethe rooms.

The system will be capable to record the biometric attendance of the authorized personnel and the records will be stored in server.

HMIS:

For HMIS, required wire/cable network with copper cables/CAT6A/Optical fiber cable shall only be

provided. Required wire/cable network for HMIS shall be provided considering Q-Management and all aspects of HMIS. As HMIS is user specific tool, Software/Hardware for HMIS shall be separately dealt as the same is not beingconsidered in this proposal.

UPS units suitable for 3-phase power supply shall be provided. Suitable capacity of Centralized UPS shall be installed for computers, Operation theatres, Medical equipment and other essential loads as required in the MOT Block. Microprocessor Based True online Double conversion UPS with latest IGBT technology with isolation transformer are to be provided for uninterrupted power supply for all Emergency requirements. UPS with separate Power distribution system (comprising of distribution panels, rising mains, distribution boards, incoming isolators etc.) shall be provided. The UPS System shall have minimum efficiency shall be as per ECBC.

The UPS power Supply to OT's shall be with isolation transformers. The UPS System shall be for 30 Min Backup with Maintenance Free batteries and Bypass system. The system shall have the incoming and outgoing switchgear panel. The system shall include the interconnection of UPS Input/output power supply Panels & UPS units, UPS & Batteries through flexible copper cables of suitable size. UPS shall be equipped with communication card for data monitoring on SCADA & BMS System.

Proposed minimum UPS capacity details are as given below:-

S. No.	**UPS LOAD in KVA**			
	MoT Block			
1.	40			
	Total - 40 KVA			

43" inch LED monitors shall be provided in DEMO rooms of the Hospital Building todemonstrate real time OT procedures.

Video wall Matrix system of Minimum 9 units of 46"/43"inch ultra-thin professional LEDMonitors shall be provided in the OPD block entrance area.

END OF VOLUME