NAME OF PROJECT: - **PROPOSED CONSTRUCTION OF BMC GENERAL HOSPITAL & STAFF QUARTERS ON PLOT BEARING CTS NO. 11A/4, CHANDIVALI, SANGHARSH NA-GAR, KURLA 400072**

TECHNICAL SPECIFICATION FOR MEDICAL GAS & PIPELINE SYSTEM

MEPCON DESIGN STUDIO

MUNICIPAL CORPORATION OF GREATER MUMBAI

1. Project Overview:

It is proposed to provide the Piped Medical Gases, Medical Compressed Air & Medical Vacuum Installation (henceforth referred to as MGPS Installation) to the functional areas of proposed Construction of BMC General Hospital & Staff Quarters on Plot bearing CTS No. 11A/4, Chandivali, Sangharsh Nagar, Kurla 400072.

Gases used for Human Healthcare, also known as Medical Gases, are strictly controlled by both legislation and standards so as to not impair human physiology. Provision of Oxygen, Nitrous Oxide, and Compressed Air is a life-saving therapeutic requirement and are listed in Indian Pharmacopoeia 6 (IP 6) or in National Formulary or in US Pharmacopoeia or European Pharmacopoeia. Therefore, these are considered drugs and have statutory specifications. These are included in National Pharmacopeia like any other drug and need to be complied with. There is a Pharmacopoeia monograph for each of them, which provides a reliable basis for making an independent and objective judgement as to the quality of these substances. The Pharmacopoeia monograph also provides specifications and test methods for determining compliance with this standard.

Medical Gas Pipeline System (MGPS) is intended to be a safe, convenient and cost-effective alternative to the use of "portable" cylinders, portable compressors and portable suction units, providing gas or vacuum for clinical needs associated problems of porterage, noise and space wastage. It delivers medical gases, medical air and other gases from the source of supply to the appropriate terminal unit by means of a pipeline distribution system

The Quality of Gas delivered by MGPS has to be as per various Pharmacopoeia requirements

The provision, installation, operation and maintenance of this MGPS Installation shall be governed by any one of the listed standards and guidelines: HTM02-01 / ISO 7396-1, 2: 2007/ DIN / NFPA -99

2. Technical specifications of Centralized Medical Gas Pipeline system, Manifold system for Hospital.

The system comprises of:

1. Oxygen manifold with automatic control panel and emergency manifold.
2. Nitrous oxide manifold with automatic control panel and emergency manifold.
3. Vacuum (suction) supply system complete.
4. Air supply system.
5. Distribution piping complete with accessories.
6. Area Valve Service System.
7. Area Alarm Systems.
8. Medical gas outlet points
9. Pipe Distribution system
10. Master alarm panel
11. AGSS/ WAGD
12. Accessories

3. Responsibility of Bidder:

Bidder shall be responsible for complete design, supply, installation, testing and commissioning including turnkey works of complete Medical Gases Pipeline System. All the components must comply as per the referred standards and the manufacturing company must be minimum 7 years in existence from the date of inception of registration/ foundation with same trade name / brand name. Bidder must provide country of origin certificate at the time of supply. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed. All specifications should confirm to HTM 02-01 / NFPA 99 / BSEN ISO 7396-1,2:2007 **/** DIN standard where ever mentioned. The Medical Gas System shall design, installed and commissioned above and combination following any one of the three standards mentioned above and combination of both referred standard shall not be allowed.

Bidder must be able to offer an integrated medical gas pipe line system as specified in the tender documents. Bidder must provide manufacturers descriptive literature, illustrations and installation instructions for all components included within this project indicating compliance with applicable referenced standards, size, dimensions, model number, electrical characteristics and connection requirements.

The technical specifications for the functionality of the system are prime criteria for the system design and implementation and the specified standards are the operating guidelines for the compliance and certification purpose. The bidders must offer

products strictly complying with the specifications as specified in the tender documents. No other references whatsoever to any other recommendations, guidelines, and consulting documents would be considered except hence forth defined international standards.

Bidder must follow one of above standards for the items i.e., Manifolds, Emergency manifolds / system, fully automatic control panels, Medical Air Plant, Medical Vacuum Plant, Surgical Air Plant, AGSS/ WAGD plant, Gas Outlets, Alarms, Isolation Valves, and Valves Box with isolation valves, Medical grade copper pipes and fittings.

The color code for Medical gas piping shall however be in accordance with Indian Standards. The bidders are required to survey the site before furnishing the quotations. He should submit complete set of shop drawing along with flow calculations of the system as per approved standard.

Bidder shall execute all required civil, electrical, plumbing, lighting, fire safety, exhaust systems and other works as maybe required for complete installation and trouble-free functioning as a part of the "turnkey work".

The wiring, peripheral lighting, fans, exhaust etc. have to be done by the bidder. Control panel for Vacuum system and Air plant system has to be supplied by the bidder. Bidder will be responsible for trenching or other associated work related to installation and commissioning of complete MGPS system.

The MGPS bidder has to terminate all the medical gas lines outside the MOT. Installation and commissioning of area valve service unit and alarm unit for the operation theatre shall be done by the MGPS bidder. Medical gas pipe line inside the Minor operation theatre & Non Modular OT has to be done by the MGPS bidder. Medical gas pipe line inside the modular operation theatre shall be done by the MOT bidder. MGPS bidder shall cooperate & co-ordinate with the MOT bidder for the successful completion of MGPS inside the modular operation theatres.

Bidder shall be responsible for free maintenance of Gas pipeline system, other plants and manifolds during warranty (DLP+CSMC) period. Bidder shall be responsible for supply, installation, testing and commissioning of Oxygen manifold system, Vacuum plant, Air plant, AGSS system, Medical Gas lines, Area valve service units, Alarm systems Gas out lets and OT pendants & all related equipment's & systems i.e. MGPS complete as per HTM 02-01 / NFPA 99 / BSEN ISO 7396-1,2:2007 **/** DIN standards.

Bidder should provide factory test certificates for the materials used. Bidder should supply complete set of Spare parts manuals, service manuals and user manuals for all the systems and subsystems to be supplied. Final electrical safety test, system test, and calibration should be done by authorized persons using calibrated test equipment as per standards. Bidder or his authorized agent should deploy a trained experienced engineer who should be available at site.

Bidder shall be responsible for connecting the existing pipeline system in the Hospital to the main pipeline system if necessary as per MCGM'S requirement.

4. General Instructions and Terms and Conditions for Comprehensive Annual Servicing and Maintenance of Medical Gas Pipeline System.

4.1 Instructions:

a) The successful Bidder shall undertake the maintenance for the period of three years guaranty period (DLP) & CSMC for the period of five years from the date of satisfactory completion of three years guarantee period of the complete medical gas system. That means for the period of eight years from the date of completion of the work. It will be sole responsibility of the contractor to keep the system in safe working condition at all the time as per relevant Standards, Rules and Regulations in force & safety guidelines.

b) The contractor shall provide the maintenance services directly by employing & appointing trained, appropriately skilled personnel. They shall be qualified and experienced to keep the entire system and/or its equipments in proper working condition. They will also take all reasonable care to maintain the equipments properly adjusted and they will take all reasonable care to maintain the system in efficient, reliable, neat, tidy and safe condition so as to meet all the norms as per relevant Standards, Rules and Regulations in force.

c) The contractor shall provide the services by his personnel and 24 hours a day i.e. round the clock on all days including Sundays, Holidays and night hours, to maintain the medical gas system, receive & attend break-down, complaints, for maintenance and servicing of specified system. The personnel shall take round of complete hospital premises and check the system for its working. Any repairs / breakdown / rectification shall be attended by the staff immediately. The complaints shall be attended free of cost whenever called by MCGM.

d) The contractor will furnish the information about the name & contact no's, etc. of maintenance staff well in advance. The deployed staff shall have mobile phone & number. If not,

then contractor shall arrange to provide the same to them. The contractors will issue the Identity Card to the staff. Any changes in the above shall be informed in Advance.

e) The contractor's staff will co-operate and co-ordinate with the municipal staff / authorities, to give their best services for the medical gas system. Whenever, found necessary, contractor will replace existing or appoint new / additional staff if required by him & if insisted by hospital authority, subject to pre-intimation & approval from user dept.

f) Corporation will not provide any assistance in the form of men/material during DLP & CSMC period of the service contract. The Contractor will have to make their own arrangement for the defects reported / observed. Maintenance team shall comprise of experienced fitter, welder, electrician, mason, helpers and Engineer equipped with various consumable material, tools and tackles to attend breakdown calls and maintain record of all such calls as required at system installation.

g) The contractor shall arrange to attend the system immediately after receipt of break down call from the Municipal Engineer or authorized representative of the user department. The contractors shall give priority in their service, repair and manufacturing facilities to restore the system/ equipments to normal service.

h) The contractor shall arrange to repair the system / installation expeditiously without causing any inconvenience to the functioning of the Hospital, failing which the repairs shall be got done at risk and cost of the contractors. However, in case of any major breakdown the contractor shall consult the MCGM Engineer concerned to carry out the repairs, which shall be completed within shortest period.

i) The contractors shall have to carry out the work of repairs, maintenance and replacement of parts in good workmanship manner as per standard practice & Rules & Regulations enforce.

j) The contractor shall prepare service and maintenance program for every three months in advance and intimate to engineer in charge. The contractor shall direct their said personnel as per scheduled program given and approved by user department to the above said system during working hours to examine, lubricate and adjust the equipment of the system, in presence of either Municipal Engineer or concerned person of user department, if insisted. The contractor shall check, adjust, clean and lubricate all the parts/accessories of system and enter into logbook duly signed, at least quarterly.

k) Whenever, wherever found necessary, the Contractor shall replace the spares and other parts of equipment integrated to the system safety and statutory requirement free of cost. All the spare parts required should be of same makes and specification as per standard.

l) The contractor shall check the performance of the system regularly and during/after servicing by noting various operating parameters such as draft, pressure, temperature, control, load, setting etc.

m) The contractor shall submit the schedule of preventive maintenance at the start of CSMC period for approval of hospital engineer and thereby follow schedule by maintaining record of all the repair, servicing and maintenance works carried out and shall submit the necessary log- cards duly signed and stamped by Municipal Engineer or authorized person of user department to the office of Engineer in-charge (Mechanical & Electrical) hospital at the end of each quarter.

n) Mechanical Works:
- Cleaning, greasing, oiling of moving parts of pumps, compressors.
- Cleaning, oiling and greasing of pump-motor assembly alignment, shaft, bearings, etc.
- Cleaning & Preventive Maintenance of air receivers, drain system, in system/plant room.
- Checking flanged joints of pipeline, valves and tightening nut bolts.
- Calibration of the dew point sensor element
- Replacement of desiccant filter, bacterial filters etc.
- Regular Cleaning of pipeline
- Regular cleaning of plant room and especially flooring.

o. Electrical Works:
- Checking and tightening of cable/wire end terminations/connections
- Checking of motor viz. winding, rotor, brushes etc.
- Checking of circuit breakers, trippers and Capacitors.
- Checking earth continuity of each equipment, panel etc.
- Checking Insulation of pumps, motors, compressors, cables, wiring.
- Replacing fused indicating lights.
- Replacement of dilapidated / malfunctioning parts in system & panel.
- Proper external & internal cleaning of electric panels.

p. If the motor / compressor / pump items is found burnt during normal use, the same shall be replaced / repaired immediately at the cost of contractor. The contractor shall replace all the spare parts free of cost immediately for normal wear and tear whenever necessary.

q. Greasing & Oiling shall be done to all points once in six months. Replacement of compressor oil, all rubber parts, cleaning of electric & control panels shall be done once in three months. Cooling tray shall be replaced, all flow meters / suction meters units to be repaired at site, whenever required or once in six months. Filters shall be replaced in every year. Oil & Grease

for lubrication shall be supplied by the contractor only. Pipeline shall be clean, painted & tagged once in two years (beyond DLP period) as per norms.

r. The material required for cleaning of system /plant, filter, oiling / greasing etc. shall be purchased by contractor and kept ready at service center the tools and equipment's required for the routine maintenance of the plant shall also be procured by the contractors at their own cost.

s. The contractors shall have to carry out any other work which is not included in the above terms and conditions with due approval of rates etc. for the satisfactory working of system.

t. The cost of needful repairs / rectification done by utilizing any spares shall be included in the cost of CSMC charges.

u. CSMC does not include consumables such as Gases, face mask, patient tubing. However includes cost of materials, labours etc. necessary tools carry out the CSMC.

v. The servicing of the system shall be carried out under the supervision of MCGM Engineer (M&E) of Hospital.

w. The complete safety of human Life and the machinery and other parts of the system while carrying out the service and maintenance will be the responsibility of the contractor. Any damages caused to the municipal property will be recovered from the bills.

x. The contractor shall invariably clean the relevant premises, after carrying out the servicing work. Washing of system/plant room shall be done either after each major breakdown in plant room or once in six month.

y. The damage if any caused on account of faulty servicing, the same will be recovered from the contractor. The damage or loss of the medical gas equipments due to improper handling routine maintenance by contractor servicing staff shall also be recovered from the contractor.

z. Municipal Corporation of Greater Mumbai will not be responsible for any financial liabilities in case of any accidental claims or / hazard by the servicing staff of the company and / or III rd party. It is exclusive responsibility of contractor.

aa. In case of disputes Municipal Commissioner's decision will be final and binding to both parties.

bb. During the guarantee as also during comprehensive maintenance contract period, all required spares should be supplied to the equipment site by the Bidder. Shipping clearance,

custom, octroi and any other taxes & duties etc. shall be paid by the contractor. It is the responsibility of the contractor to see that the equipment & all the accessories are maintained in proper functioning condition by providing spare parts where required, whether such accessories are manufactured by the Bidder or not. M.C.G.M. will not enter into any separate service contract with any other manufacturer for the maintenance of these accessories.

cc. The number of visits for preventive maintenance during a calendar year should not be less than four (4). Preventive maintenance should also be available on Sundays and Public Holidays.

dd. The number of visits for attending to breakdown of equipment should be unlimited

ee. On being informed about the breakdown of the equipment telephonically or otherwise the same should be attended within 24 hours. Service should be available 24 hours of the day and 365 days of the year.

1.0 Lockable Ball Valve:

Single Port Ball Valve with Pipe line assembly (pre piped) . Pre Piped Degreased Ball Valve with pipe extension. It should be full-port design.It should be blow-out proof stem. It should be lockable valve. The Valve shall be 3 piece ball-type design with a bronze body and chrome plated brass ball for sizes 1/2″ to 4″. Seats shall be Teflon (TFE) and seals Viton for 1/2″ - 4″ valves. A blow-out proof stem shall be used and the valve shall have a maximum pressure rating of 600 psi [4,137 kPa]. Valves shall be operated by a lever- type handle requiring only a quarter turn from a fully open position to a fully closed position. Valves shall be designed in such a manner that it can be "swung-out" during installation so as to prevent damage due to heat transfer during the brazing operation. Each valve assembly shall be washed and degreased for medical gas service. The valve shall be supplied in a sealed plastic bag to prevent contamination prior to installation. It should comply with NFPA-99, CSA Z7396.1 and CSA Z305.1.

2.0 Valve Box:

SITC of Gases Valve Box with pressure guage only . It Should fully complies with NFPA-99 standards or CGA standards. It should have zone valve box shall consist of the following components: A steel valve box which can house two to seven shut-off ball valves with tube extensions, an aluminum frame and a pull-out removable window. Gauges are included. The valve box shall be constructed of 18 gauge steel complete with a baked white enamel finish. Affixed to the opposite sides of the box will be two adjustable steel brackets for the purpose of mounting the box to the structural support. The steel brackets shall accommodate various finished wall thicknesses between 3/8" (9.5 mm) and 1-3/16" (30 mm) and shall be field adjustable. The removable front shall consist of a window with a pull-out ring pre-mounted to the center of the window. It should have access to the zone shut-off valves shall be by merely pulling the ring assembly to remove the window from the frame. The window can be reinstalled without the use of tools only after the valve handles have been returned to the open position. The window shall be marked to prohibit unauthorized persons from tampering with the valves with the following silk-screen caution: "MEDICAL GAS CONTROL VALVES CLOSE ONLY IN EMERGENCY"

3.0 Digital Area Alarm Panel:

SITC of Digital Area Alarm with pressure sensor : It should fully comply and meet with NFPA-99 and It must be UL Listed. Medical Gas LCD Alarm : It should comply with NFPA 99, CSA Z7396.1 and CSA Z305.1. It should be UL or ETL Listed. The LCD alarm shall be microprocessor based with a 10" (25.4 cm) screen and capable of monitoring medical gases.Each gas service shall be provided with a digital read-out comprising of 0-249 psi (0-1,717 kPa) for pressure and 0-30"Hg (-100-0 kPa) for vacuum. The digital read-out shall provide a constant indication of each gas being measured, indicating a green "NORMAL" and a red "HIGH" or "LOW" alarm condition. If an alarm occurs, the green indicator will change to red and a continuous audible alarm will sound. Pushing the (mute button/push to test button) will cancel the audible alarm, but the unit will re-main in the alarm condition until the problem is rectified. The default set-points shall be +/- 20% variation from normal condition. In the calibration mode, High/Low set points shall be adjustable by Setup button and selecting set points with up and down buttons. To view the set points, press and hold the mute button for twenty (20) seconds. LCD alarm on a computer screen via the facili-ty's ethernet or internet. In addition, an exact image of the alarm can be displayed on a mobile device on additional cost. The LCD Alarm will update its status every second. It should have self-diagnostic and error message display for ease of maintenance.

4.0 Medical Gas Outlets:

SITC of Medical Gas Terminal Units (Gas Outlets) : It should fully complies and meets with the requirements of the UK DOH Health Technical Memorandum 02-01 (HTM 02-01) standards only. It shall be duly CE marked to the Medical Device Directive 93/42/EEC under the auspices of noti-fied body no. and under this directive, med gas products are classified as Class IIb Medical De-vices. Terminal units shall have gas indexing geometry. Other gas specific indexing geometries are not acceptable. Terminal unit front fascia should be metal and it should be hundred percent metal. Gas specific components comprising the terminal unit second fix shall be manufactured from die-cast zinc alloy or similar hard wearing metal. Plastic components are not acceptable. Ter-minal units socket castings shall be permanently coated with a low friction fluoropolymer for maximum reliability and service life. The terminal unit socket die-casting shall incorporate a gas indexing pin to overcome the risk of loosening due to rough handling or abuse. The second fix socket shall incorporate a sheer- plane to safeguard the first fix and pipeline in the event of acci-dental damage or bed jacking. Gas specific components shall incorporate the gas identity mark-ing permanently stamped or cast into the component surface. The first fix shall be all metal con-struction, with a brass base block and copper stub pipe. The first fix shall incorporate an integral check valve to enable servicing of the second fix and valve seals without isolation of the gas sup-ply. Probe roller pins shall be manufactured from stainless steel. Wall mounted terminal units shall be provided with white ABS mounting box with matching fascia. The mounting box shall have smooth rounded corners to avoid the possibility of injury. A bezel shall be available to cover the plaster edge, provide a neat and easily to clean finish.

5.0 Vacuum Regulator:

SITC of Vacuum Regulator Unit :It shall fully comply and meets with active medical device of class IIa and in compliance with the EN ISO 10079-3: 2009 standard. It should be duly CE marked and comply with 93/42/EEC Medical Devices: General. It shall be CE marked with the notified body number specified. It should be continuous vacuum regulator, compact, strong and ergonomic device. It should have manual adjustment of the vacuum gauge from -45degree to +45degree for a better visibility. Vacuum gauge should be protected by a plastic housing. It should have on/off switch-button providing a quick restoration of the pre-adjusted vacuum level. It should have central regulation knob with a free rotation at the end of the course (impossible blocking). It should have quick adjustment :2.5turns are enough to reach the maximum vacuum level. It should have vacuum levels :0-1000m/bar. The vacuum regulator should be 3-in-1 system. It should have a device with a metal outlet tubing nipple integrated in the body of the regulator for a better safety, emergency suctions can even be processed. It should be supplied with a 100ml safety jar equipped with a mechanical anti-over flow safety valve and single use antibacterial plastic filter upfront. The safety jar should be made of polycarbonate, autoclavable up to 134degree C and unbreakable. The safety jar should be fixed by an easy-click rotation. The safety jar should be able to rotate to avoid any pinch of the tubing. It should have a unit serial number laser engraved on the body of each vacuum regulator ensuring its identifications and traceability. It should be light weight 490g and dimensions (height230mm X Width 70mm X Depth 90mm).

6.0 Oxygen Automatic Control Panel:

SITC of Oxygen Digital Fully Automatic Control Panel of 1000lpm to 1500lpm . The manifold control panel shall consist of two bank regulators used to reduce the cylinder pressure to the two line regulators which in turn controls the final line pressure. The manifold has an intermediate and line relief valve that is internally connected to a common vent port, terminating into a 1/2" FNPT pipe. It should be fully automatic type and shall switch from “Bank in Use” to “Reserve Bank” without fluctuation in the final line pressure. The control panel includes a line gauge, two bank gauges and incorporates six LED‟s. Input power to the manifolds is 110 to 240 VAC, 50-60 Hz. It should have flow capacity 4,500 SCFH [2,000 L/min]. (Maximum tolearance allowed will be only 10%).

7.0 Vacuum Pump:

SITC of Vacuum Pump. : It should be oil lubricated vacuum pump, having each vacuum pump capacity of 1500lpm with IEC Motor rating of minimum 7.5 HP @ 50 Hz or above. Vacuum pump shall comprise of air cooled, oil lubricated vacuum pumps suitable for both continuous and frequent start / stop operation at inlet vacuum vessels between 525mm Hg and 700 mm Hg. The ultimate vacuum of pump shall be 0.1 mbar with gas ballast valve closed. The Vacuum Pump should be air cooled and oil lubricated vacuum pumps designed for use in the field of high quality vacuum. The pump should be having a 4 barriers system that avoids any oil leaks by doubling the 2 lip seals. The use of shaft lip seals Pump shall be lubricated by a fully re-circulated and filtered lubricant supply. Also Pump design should include a lubricant separation system integral to the pump exhaust box consisting of no less than four stages of internally installed lubricant and smoke eliminators through which the exhaust gas stream must pass. This system shall consist of bulk separation, lubricant mist elimination, smoke elimination, synthetic lubricant baffle, and shall be capable of removing 99.9 percent of all lubricant and smoke particles from the exhaust gas stream. The unit should have extremely low vibration. (Maximum tolearance allowed will be only 10%).

8.0 Vacuum Filter:

SITC of Vacuum Filter (Bacteria Filter) of 50cfm to 60cfm – 3″ Filter housing with drain flask.: It fully complies and meets with requirements of UK HTM medical standards. It should have BS 3928 sodium flame test certificate based on requirements of HTM standards.The bacteria filter should be designed for critical application involving removal of dry and wet dust, particulars, oil aerosol and water droplest, high efficiency glass fiber, fieece media from suction side of vacuum pump system. It should have efficiency of at least 99.995% when tested by sodium flame test and that should be according to BS 3928:1969. The Vacuum filtration efficiency should be in excess of 99.9999% as per HTM0201 & AS 2896 standards. The high efficiency medical grade filter element should have custom engineered filter media and deep pleat element technology provides minimal pressure loss and filtration efficiencies. It should have advanced filtration technology for Low pressure loss borosilicate glass microfiber-media and open cell reticulated foam pre-filtration layer captures particulates, bacteria and liquid aerosols reducing energy consumption and overall system costs. It should have corrosion protection Internal and external electrophoretic
painting followed by a tough exterior polyester powder coating. It should have easily removable sterilisable drain flask and differential pressure monitor gauge. It should have push fit element design for quick and easy maintenance with unique push fit element design. It should have element end cap color black. It should have maximum temperature 60 degree centigrade (140-degree F). It should have element of E31140MV grade. It should have pipe size connection 1″ = 60scfm and 110nm3/hr FAA. It should have pressure loss clean & dry = < 3kPa (30m/bar/0.44psig). It should have maximum working pressure 0.5barg(7psig. It should have manual drain valves and 250ml sterilisable glass drain flasks.(Maximum tolearance allowed will be only 10%).

9.0 Air Compressor:

SITC of Oil Free Rotary Screw/Scroll Air Compressor : Oil free Rotary Screw/scroll air compressor.It should be 50Hz, 3 Phase, 440volts. 11 Bar, 116 Psig. 50/60cfm or more at 11 Bar. 15 Kw & 20 Hp. The 50/60cfm flow capacity for each compressor unit having suitable motor rating of Rotary Screw/scroll air cooled compressor. Compressors shall be oil free Rotary Screw/scroll compressors suitable for both continuous and frequent start/stop operation at a nominal outlet pressure of 800 kPa (8 bar). The air quality shall be 100% oil free, certified ISO8573-1. The compressor shall have a sound insulating enclosure. Air is drawn through air filter and should be compressed by the compressor element of each compressor module. The compressed air is discharged via the check valve and a common air cooler..The cooling air is blown over the compressor element via a duct. A separate electric fan provides cooling air for the common air cooler. Each set of compressor modules has its own common aftercooler with an electric fan. Each compressor element is protected by a sensor in the outlet pipe. The sensor is connected to the electronic regulator. When the maximum temperature is exceeded, the compressor element is stopped during two minutes before it can restart. If this happens 2 times within a time span of 2 hours, the element will be stopped during 10 minutes. If the compressor element stops a third time within the 2 hours time span, the element will be shut down and must be reset manually. Dependent on the model, the compressors have 3 or 4 electric motor driven compressor modules, enclosed in a sound insulating canopy. The front door panel houses the Graphic controller and the emergency stop button. An electric cabinet with the electric components is installed behind the front panel. (Maximum tolearance allowed will be only 15%).

10.0 Air Dryer Unit:

SITC of 60cfm Heatless Air Dryer : 60cfm Heatless Air Dryer : It should have air dryer desiccant type with ½" end BSP connection. It should have pre filter and post filter. It should be designed for ISO:7183- 1986 (E) standards. It should have dryer quality class -ISO 8573-1 standards. It should be made of aluminum construction. It should have purge loss 15+/- 1%.

11.0 Coarse coalescing filter:

SITC of Coarse coalescing filter 1" of 50cfm to 60 scfm filter :It should have flow-optimized design for advanced filter head design for optimized flow performance. It should have flexible installation Modular design and accessible fixings enable simple close coupling assembly. It should comply with air quality standard ISO 8573-1: 2010. It should have profiled bowl design and push fit elements ensure quick and for reliable maintenance. It should have corrosion protection Internal and external electrophoretic paint finish followed by a tough exterior polyester powder coating. It should have color coded element end caps of red color for easy and accurate grade identification.It should have element of E30612 grade. It should have particle retention of up to 99.999%, and significantly reduced pressure loss. It should have pipe size connection 1" = 60scfm and 90nm3/hr. It should have particle removal 1 micron. It should have maximum particle size class 2 micron as per ISO 8573-1: 2010 . It should have maximum oil content 3 micron ISO 8573-1: 2010. It should have maximum oil carryover at 68degree F (20degree centigrade) = 0.3ppm (0.3mg/m3). It should have pressure loss clean & dry = 0.8psi (55m/bar). (Maximum tolearance allowed will be only 15%).

12.0 Fine coalescing filter:

SITC of Fine coalescing filter 1" of 50cfm to 60 scfm filter :It should have flow- optimized design for advanced filter head design for optimized flow performance. It should have flexible installation Modular design and accessible fixings enable simple close coupling assembly. It should comply with air quality standard ISO 8573-1: 2010. It should have profiled bowl design and push fit elements ensure quick and for reliable maintenance. It should have corrosion protection Internal and external electrophoretic paint finish followed by a tough exterior polyester powder coating. It should have color coded element end caps of blue color for easy and accurate grade identification.It should have element of E30612 grade. It should have particle retention of up to 99.999%, and significantly reduced pressure loss. It should have pipe size connection 1" = 60scfm and 90nm3/hr. It should have particle removal 0.01 micron. It should have maximum particle size class 1 micron as per ISO 8573-1: 2010 . It should have maximum oil content 1 micron ISO 8573-1: 2010. It should have maximum oil carryover at 68degree F (20degree centigrade) = 0.01ppm (0.01mg/m3). (Maximum tolearance allowed will be only 15%).

13.0 Activated Carbon Filter:

SITC of Activated Carbon Filter 1" of 60cfm to 60 scfm Filter :It should have flow-optimized design for advanced filter head design for optimized flow performance. It should have flexible installation Modular design and accessible fixings enable simple close coupling assembly. It should comply with air quality standard ISO 8573-1: 2010. It should have profiled bowl design and push fit elements ensure quick and for reliable maintenance. It should have corrosion protection Internal and external electrophoretic paint finish followed by a tough exterior polyester powder coating. It should have color coded element end caps of black color for easy and accurate grade identification.It should have element of E30612 grade. It should have particle retention of up to 99.999%, and significantly reduced pressure loss. It should have pipe size connection 1" = 60scfm and 90nm3/hr. It should have particle removal 0.01 micron. It should have maximum particle size class 1 micron as per ISO 8573-1: 2010 . It should have maximum oil content 1 micron ISO 8573-1: 2010. It should have maximum oil carryover at 68degree F (20degree centigrade) = 0.003ppm (0.003mg/m3). (Maximum tolearance allowed will be only 15%).

14.0 Fine Dust Filter:

SITC of Fine Dust Filter 1" of 50cfm to 60 scfm: It should have flow-optimized design for advanced filter head design for optimized flow performance. It should have flexible installation Modular design and accessible fixings enable simple close coupling assembly. It should comply with air quality standard ISO 8573-1: 2010. It should have profiled bowl design and push fit elements ensure quick and for reliable maintenance. It should have corrosion protection Internal and external electrophoretic paint finish followed by a tough exterior polyester powder coating. It should have color coded element blue color end caps for easy and accurate grade identification. It should have element of E30612 grade. It should have particle retention of up to 99.999%, and significantly reduced pressure loss. It should have pipe size connection 1" = 60scfm and 90nm3/hr.It should have particle removal 0.01 micron. (Maximum tolearance allowed will be only 15%).

15. Duplex Anesthetic Gas Scavenging (AGSS) System. 2400 LPM as per HTM 02-01, NFPA 99, ISO 7396-2, DIN Standards:

- A Fully complies to HTM02-01 BS EN 6834 for active anesthetic gas scavenging system shall, be CE marked as class IIb medical device 93/42/EEC with four digit notified number specified
- AGSS system must be compliant with BS EN ISO 80601-2-13:2012 / BS EN ISO 9170-2:2008 / EN ISO 7396-2 Anesthetic gas scavenging disposal system

AGSS System shall have twin standalone AGSS pumps 2400 LPM of 3 phase capacity each with built in flow indication and pressure regulation valve, mounted on single frame with control panel and separate warning label. One pump will be standby with the other in operation. Starting Method will be DOL. 70 dB sound pressure level. 2" Pipe

size and service connection 54mm OD pipe work. Anti vibrator mounts on all pumps Alarm and BMS outputs for remote status indication,24 volt control interface for controllers Pre-set vacuum relief valve and low pressure sensors Copper stubbed outlet and inlet pipe work for ease of connecting to MGPS.

15.1 The Package Consists: -

- Two oil less side channel blowers
- One control panel with vacuum gauge and alarm indications.
- AGSS Pump completely dry, permanently lubricated, and sealed and air cooled operation.
- Control System: Provide automatic changeover from running to reserve with circuit breaker disconnects for each AGSS pump with external operators, full voltage motor starters with overload protection, control circuit transformers, visual reserve unit alarm, and isolated contacts for remote alarm Designed to safely remove exhaled anaesthetic agents from the operating environment and dispose of them to atmosphere, thus preventing contamination of the operating department and providing a safe and healthy workspace for the personal.
- The anaesthetic gas scavenging system must be certified as per Medical Device Directives (93/42/EEC) Annex II having the CE mark with notified number specified and classified as a class IIb device.
- AGSS Remote Indicato r: It should be flush mounted, 24 volt on/off room controller indicating 'red' plant failed, 'amber' duty pump failed and 'green' mains airflow on.

15.2 AGSS Reservoir :

The AGSS Receiver is the practical solution for waste anaesthetic gas discharges and is designed as an integral part of any waste anaesthetic gas system that conforms to clauses 3.2 and 3.4 of BS ISO 6834 The receiver itself conforms to clause 3.3 of BS EN 6834.The receiver comes complete with a transfer system, outlet hose assembly, and user instructions, making it ready for immediate use.

Transfer system- connects to the patient circuit or anaesthetic machine and comprises a 1.5 metre length of 30 mm clear disposable tube with a male 30 mm taper for connection to the side of the receiver, and a 30 mm female tapered breathing circuit connector. It should have air break which prevents suction from the disposal system being

transferred to the patient -flow indicator. Under normal operating conditions the indicator should be visible. -gauze filter built into the top of the vessel to prevent gown fluff and other solid material from reaching and blocking the fixed extraction system.

It should fully confirm to the noise parameters laid down in BS EN ISO 6834. Receiver vessel for active anaesthetic gas scavenging systems body - anodised aluminium, powder coated Collar and Cap - anodised aluminium Indicator Window - clear acrylic Indicator Float - low density polyethylene.

15.3 AGSS outlet hose assembly-

AGSS outlet hose assembly conducts the waste gases to the fixed system outlet point and comprise a 4 metre length of reinforced clear tube (colour coded yellow and blue as per the standard). This is fixed to the top of the vessel allowing the tube unimpaired 360 degree motion to reduce strain on the unit, and tube occlusion. The other end of the tube terminates in an AGSS probe to BS EN ISO 6834

WAGD as per NFPA-99 must be UL .listed Category 1 as per medical gas categorisation

- The WAGD source shall consist of the following:
- Two WAGD producers sufficient to serve the peak calculated demand with the largest single WAGD producer out of service.
- An automatic means to prevent backflow from any on-cycle WAGD producers through any off-cycle WAGD producers.
- A shutoff valve to isolate each WAGD producer from the centrally piped system and other WAGD producers for maintenance or repair without loss of medical–surgical vacuum in the system.
- Piping between the WAGD producers and the source shutoff valve shall be stainless steel to be used as a piping material.
- Anti-vibration mountings shall be installed for WAGD producers as required by equipment dynamics or location and in accordance with the manufacturer's recommendations.

- Flexible connectors interconnecting the producers with their intake and outlet piping as required by equipment dynamics or location, in accordance with the WAGD producer manufacturer's recommendations.

15.4 AGSS Venturi Outlet:

The venturi shall not be user adjustable (i.e., shall require the use of special tools).

- The venturi shall be driven using inert gas, instrument air, or other dedicated air source.

- Medical air shall not be used to power the venturi

- Additional producers shall automatically activate when the producer(s) in operation is incapable of maintaining the required vacuum.

- Automatic or manual alternation of producers shall allow division of operating time. If automatic alternation of producers is not provided, the facility staff shall arrange a schedule for manual alternation.

Each producer motor shall be provided with electrical components including, but not limited to, the following:

- A dedicated disconnect switch installed in the electrical circuit ahead of each motor starter

- Motor starting device

- Overload protection

- Electrical installation and wiring shall conform to the requirements of NFPA 70, National Electrical Code

- Employ a control transformer or other voltage control power device, at least two such devices

Copy of certificate of origin must be submit

16. Medical Grade Copper Tube/ Piping (Distribution Piping):

16.1 Piping specifications:

The color code for Medical gas piping shall however be in accordance with Indian Standards. Copper pipe should be as per standard BS: EN 13348:2008 standards; Solid drawn, seamless, deoxidized, non-arsenical, half hard, tempered and degreased copper pipe conforming to the standard. The pipes should be accompanied with manufacturers test certificate for the physical properties & chemical composition. The mechanical properties of copper tube must be in accordance with BS EN 13348: 2008 in either R250 half hard or R290 hard.

All copper pipes should be degreased & delivered capped at both ends. Degreasing of pipe shall be such that there is less than 20mg/m2 (0.20mg/dm2 of hydrocarbons on the degreased surface when tested by method specified by BS EN 13348: 2008. All copper pipes and fittings must be CE marked as a class IIa medical device 93/42/EEC with notified body number. Certification shall be attached to each batch. Batch numbering for traceability must be included on all pipes; All copper pipes should be BSI Kite mark third party certified for its chemical composition (Carbon and cupro nickel content), mechanical properties (tensile strength, elongation ,thickness) , physical properties (Density , thermal conductivity , electrical conductivity, CUDHP (PHOSPHOUROUS DEOXIDE COPPER Cu 99.90 and P .0015) to ISO 1190-1 complete with 024a to EN 1412-1996 as specified in BS EN 13348.

All relevant certificates to be attached with tender. All sizes from 12 mm to 108 mm shall be from same manufacturer confirming to the quality parameters and specifications referred above. Copper pipe must have reputed third party inspection certificate (Eg. Lloyd‟s or TUV or SGS). Labelling on copper tube will contain date, time and code of manufacturer, tube size, and temper, manufacturer, certified notified number, medical device directive 93/42/EEC, harmonised standard number and this information must be repeated at 400 mm intervals along its length. The supplier should provide Manufacturer's Test Certificate of copper pipes for physical properties and chemical composition. CUDHP to ISO 1190-1 complete with 024a to EN 1412-1996 It should be third party certified.

Copper pipes joined by silver brazing method for copper to copper. Inert gas welding technique should be used by passing Nitrogen gas inside the copper pipes during silver brazing, in order to avoid carbon deposition inside the copper pipes.

All copper pipes and fittings like bends, Tees, reducers and straight couplings should be as per EN 1254-1 specification for capillary copper fittings, BS 684 specifications copper fittings to be used with copper tubes and ASTM B280 cleanliness testing. Copper pipes to be fixed with walls with suitable saddles and supports After erection, all the pipes should be cleaned or purged with the help of dry nitrogen gas, & Should be tested with dry nitrogen at a working pressure of 10 Bar up to 17bar for 48 hour especially made for brazed socket type connections

The isolation valve body shall be made of chromium plated brass with non-lubricated ball type. All valves shall be pneumatically tested for twice the working pressure and factory degreased for medical gas service.

Copper fittings should comply with EN 1254:1 factory degreased and brazing filler metals should comply with EN 1044. Fitting should be degreased, individually packed for medical use.

16.2 Safety parameters:

- The internal cleanliness of medical gas and oxygen tubes is critical in order to prevent gas contamination and potential explosions. Oxygen under pressure may cause spontaneous combustion of residual organic drawing oils if they remain inside tubes after manufacture. Oil or other contaminants may also cause patients serious respiratory problems if not removed prior to installation.

- A unique manufacturing process must ensure the carbon cleanliness does not exceed 0.02g/m2 total carbon as specified in BS EN 13348 for sizes up to 108mm.

- Tests are conducted using the combustion method as stipulated in BS EN 13348.

- After cleaning, all tubes are individually end-capped to maintain their internal cleanliness, then bundled and wrapped in plastic for maximum protection.

- During storage and handling of Medical Gas tube and fittings, particular attention must be given to keeping them clean and dry. When brazing joints, lines must be continuously purged with nitrogen or another appropriate inert gas.

- Medical gas copper tubes and fittings must be joined with a 5% silver brazing alloy. After brazing, all joints should be cleaned and inspected visually.

- Pressure and contaminant testing should be performed on installed tubing before final approval and use of the system

- All copper fittings will be conforming to EN 1254-1, BS -684 should be factory degreased, certified, and individually packed and identified for medical use.

- The pipes will be accompanied with manufacturers test certificate for the physical properties & chemical composition.

- Installation of piping shall be carried out with utmost cleanliness. Only pipes, fittings and valves which have been de-greased and fittings brought in polythene sealed bags shall be used at site.

- Pipe fixing clamps shall be of nonferrous or non-deteriorating plastic suitable for the diameter of the pipe.

- Copper to copper joints shall be made on site using copper, phosphorus and silver brazing alloy CuP 282 to BSEN 17672:2010. Brazing should be carried out using oxygen free nitrogen as an inert gas shield to prevent the formation of oxides on the inside of the pipe. Copper pipes shall be cut square with the pipe axis using a sharp wheel cutter where ever possible, and be cleaned to get rid of any cuttings or burrs.

- After erection, the pipes will be flushed and then pressure tested with dry nitrogen at a pressure equal to 1.5 times of the working pressure or 150 psig, whichever is higher for a period of not less than 24 hours.

- Following installation, pipe line systems are required to be clearly identified with pipe line identification tape. 150 mm wide Colour banding should be applied near to valves, junctions; walls etc. A label every 3m should identify each gas and arrow tape showing the flow direction of gas. All the piping system shall be tested in the presence of the site-engineer or his authorized representative.

16.3 Pipeline supports:

- The pipeline should be adequately supported at sufficient intervals in accordance with Table below to prevent sagging or distortion. Supports for surface mounted pipe work should provide clearance to permit painting of the surface. Where it is essential for pipes to cross electric cables or conduit, they should be supported at intervals on either side of the crossing to prevent them from touching the cables or conduit. Supports should be of suitable material or suitably treated to minimize corrosion and prevent electrolytic reaction between pipes and supports.

- Pipelines shall be supported at intervals to prevent sagging or distortion. The supports shall ensure that the pipeline cannot be displaced accidentally from its position.

- The supports shall be of corrosion-resistant material, or shall be treated to prevent corrosion. Means shall be provided to prevent electrolytic corrosion between the pipes and the contacting surfaces of the supports.

- Where pipelines cross electric cables, the pipelines shall be supported adjacent to the cables.

- Pipelines shall not be used as support for, nor shall they be supported by, other pipelines or conduits.

The Pipe Sizes to be used are from among as under:

Outside Diameter (mm) X Thickmess	Maximum interval between supports (Horizontal and Vertical). (m)
12 mm OD X 0.6 mm	1.5
15 mm OD X 0.7 mm	1.5
22 mm. OD x 0.9 mm	2.0
28 mm. OD x 0.9 mm	2.0
35 mm. OD x 1.2 mm	2.5
42 mm. OD x 1.2 mm	2.5
54 mm. OD x 1.2 mm	2.5
76 mm. OD x 1.5 mm	3.0
108mm. OD x 1.5mm	3.0
Note: Consideration should be given to additional supports near LVAs, elbows etc. where the Potential effects of inadvertently applied torque can result in severe pipeline distortion or fracture.	

Certificate of origin to be submitted

16.4 Copper tube and fittings as per NFPA-99 must be UL. listed Category 1 as per medical gas categorization:

Copper pipes shall be solid drawn, tempered, seamless, phosphorous deoxidized, non-arsenic and degreased for oxygen service conforming to ASTM B-819. The chemical composition shall be as per ASTM B-819. The supply of pipes shall accompany with manufacturers certificates of compliance with ASTM B-819 and shall be marked "OXY", "MED" and/or "ASTM B-819".

Each pipe shall be capped at both ends by the manufacturer. The contractor shall use the following sizes:

Fittings used for connecting copper tubing shall be wrought copper, braze type fittings as per ASME B16.22 or B Med Quick axially swaged fittings. All installation shall be performed in strict accordance with NFPA 99 5.1.10. Brazing shall be performed only by brazers qualified under NFPA 99 or as Competent Persons under HTM 02-01.

Turns, offsets, and other changes in direction shall be made with brazed wrought copper capillary fittings complying with ANSI B16.22, Wrought Copper and Copper Alloy Solder-Joint Fittings; or brazed fittings complying with MSS SP-73, Brazed Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings. Cast copper alloy fittings shall not be permitted.

Brazed joints shall be made using a brazing alloy that exhibits a melting temperature in excess of 538°C (1000°F). Copper-to-copper joints shall be brazed using a copper–phosphorus or copper–phosphorus–silver brazing filler metal (BCuP series) without flux. Flux shall only be used when brazing dissimilar metals such as copper and bronze or brass, using a silver (BAg series) brazing filler metal. Brazing alloy comply with ANSI/AWS A.5.8, Specification for Brazing Filler Metal.

Threaded joints in medical gas distribution piping shall be limited to connections to pressure/vacuum indicators, alarm devices, and source equipment. All threads shall be tapered pipe threads complying with ANSI B1.20.1, Pipe Threads, General Purpose and be made up with polytetrafluoroethylene (such as Teflon™) tape or other thread sealant recommended for oxygen service, with the sealant applied to the male threads only. Where threaded nipples are required these shall be I.P.S. brass.

The use of brass axially swaged, elastic strain preload fittings may be used when making connections to existing piping sizes 2" and smaller. Non-braze fittings shall provide metal to metal seal having pressure and temperature ratings not less than that of a brazed joint and when complete are permanent and non-separable. Axially swaged fittings shall be cleaned and sealed for oxygen service.

Straight-threaded connections, including unions, flared and compression-type connections, including connections to station outlets and inlets, alarm devices, and other components shall not be permitted. All pipe and fittings shall be supplied cleaned and sealed for oxygen service.

Where piping runs underground, install in accordance with copper, tubing, valves and fittings shall be pre cleaned and prepared for oxygen service by the manufacturer and received sealed on the job. Certificates of origin and of proper preparation shall be maintained on the job site attesting the above. Installation of piping shall be carried out with utmost cleanliness. Pipes fixing clamps shall be of non-ferrous and non-deteriorating plastic suitable for the diameter of the pipe.

All pipe joints shall be made using inert gas using flux less brazing method or B Med Quick axially swaged fittings. All brazing shall be performed while continuously purging with oil-free nitrogen. Adequate supports shall be provided while laying pipelines to ensure that the pipes do not sag. All pipe clamps shall be non-reactive to copper. Piping shall not be supported by other piping. Isolation of copper piping from dissimilar metals shall be of a firm, positive nature. Duct tape is not acceptable as an isolation material.

Suitable sleeves and fire stopping shall be provided wherever pipes cross through walls/slabs. Threaded joints in piping systems shall be avoided whenever possible. Where unavoidable, make up the male threads with poly tetrafluoride ethylene (such as Teflon) tape. Do not use liquid sealants after installation of the piping, but before installation of the outlet valves, blow lines clear using oil free dry nitrogen Piping exposed to physical damage shall be protected. Label piping with name of gas service, identification colour and direction of flow. Labels shall be placed at least once every 5 meters (15 feet) of linear run or once in each story (whichever is more frequent). A label shall additionally be placed immediately on each side of each wall or floor penetration. Pipe labels shall be self-adhesive vinyl or other water resistant material with permanent adhesive coloured for the gas type and shall be visible on all sides of the pipe. All exposed pipes should be painted with two coats of synthetic enamel paint, colour per international standards

Piping systems shall be designed and sized to de- liver the required flow rates at the utilization pressures.

- Mains and branches in medical gas piping systems shall be not less than DN15 (NPS ½) (5/8 in. O.D.) Size.

- Mains and branches in medical–surgical vacuum systems shall be not less than DN20 (NPS3/4 (7/8 in O.D) size

- Drops to individual station outlets and inlets shall be not less than DN15 (NPS1/2 (5/8 in OD) size

- Runouts to alarm panels and connecting tubing for gages and alarm devices shall be permitted to be DN8 (NPS1⁄4) (3⁄8 in. O.D.) Size

17.0 Installer Testing:

Installation of piping shall be carried out with utmost cleanliness. Only pipes, fittings and valves that have been degreased and fittings shall be used at site. Pipe fixing clamps shall be of nonferrous or non-deteriorating plastic suitable for the diameter of the pipe. Inert gas welding technique should be used by passing oxygen Free Nitrogen Gas inside the copper pipes during silver brazing, in order to avoid carbon deposition inside the copper pipes. Only copper-to-copper joints are permitted on site except threaded or flanged joints may be made where pipelines are connected to items such as valves and control equipment.

No flux shall be used for joining Copper to Copper joints and on for joints made on site. Copper to copper joints shall be brazed using a 5% silver-copper phosphorous brazing alloy CP104. A total of 5 joints shall be cut out for examination to establish the quality of the joints being made on site. The insides shall be clean and free from oxides and particulate matter and the minimum penetration of the brazing alloy at any point shall be three times the wall thickness of the tube. If the joints examined do not conform to these requirements, then adjacent joints shall be cut out and examined until the extent of faulty workmanship has been made good. Copper-to-brass or gun-metal joints shall only be made under controlled conditions off site. The joints are ordinarily used to join short copper pipe tails to brass, gunmetal or bronze fittings to permit their connection into the pipeline. The sub-assemblies shall be degreased and individually sealed in bags or boxes before delivery to site.

Prior to declaring the lines ready for final verification, the installing contractor shall follow strictly the procedures for verification as described in NFPA 99 and attest in writing over the notarized signature of an officer of the installing company the following;

- That all brazing was conducted by brazers qualified to ASSE 6010 and holding current medical gas endorsements.

- That all brazing was conducted with nitrogen purging. (Procedure per NFPA 99 5.1.10.5.5).

- That the lines have been blown clear of any construction debris using oil free dry nitrogen or air are clean and ready for use. (Procedure per NFPA 99 5.1.12.2.2).

- That the assembled piping, prior to the installation of any devices, maintained a test pressure 1 1/2 times the standard pressures listed in NFPA 99 Table 5.1.11 without leaks. (Procedure per NFPA 99 5.1.12.2.3).

- That after installation of all devices, the pipeline was proven leak free for 24 hours at a pressure 20% above the standard pressures listed in NFPA 99 Table 5.1.11. (Procedure per NFPA 99 5.1.12.2.2.6)

Copy of certificate of origin must be submitted

Length and quantity of individual items (Copper pipes, AVSUs, Alarm panels, Isolation valves, Outlets, pendants etc.) are mentioned. However quantity will be calculated and paid at actuals. Bidder should quote unit price for all the items as detailed

18.0 Painting:

- That the systems have been checked for cross connections and none were found. (Procedure per NFPA 99 5.1.12.2.4)

- Colour code of copper pipe as per NFPA 99

All exposed pipes should be painted with two coats of synthetic enamel paint and colour codification should be as per British standards / end user. Should have Lloyds certification for pipes and other materials.

19.0 Medical Gas outlets as per HTM02-01, NFPA99, ISO7396-1, DIN Standard:

The terminal outlets for compressed air & vacuum, oxygen, AGSS, nitrous oxide, 100% metal shall comply with ISO 9170-1:2008 ISO 9170-2 : 2008.

The terminal outlets must be certified as per Medical Device Directives (93/42/EEC) having the CE mark along with the four-digit code from the certifying agency. The terminal outlets must be manufactured under BS ENISO13485-2003-2012 quality management system duly certified

Meets the requirements of DIN EN ISO 9170, part 1 and DIN 13260, part 2 Quality management certificate acc. to ISO 9001/ISO 13485 and Annex II. 3 MDD

All the internal and external surfaces of the outlets should be appropriately treated and cleaned to ensure strict compliance to the standards.

Each brass component shall have the unique batch number permanently stamped onto a visible position to enable full traceability to EN 9170-1:2008. The first fix assembly shall comprise a minimum 50mm diameter machined brass block to reduce heat transfer of which the unit includes an indexed pin for each different gas service to prevent interchange ability, The unit incorporates a maintenance valve/flutter disc, which will automatically shut off the gas supply if the second fix assembly is removed whilst the pipeline system is under pressure to enable servicing of the 2nd fix and valve without isolation of the gas supply.

The check valve assembly must comprise of a spring-loaded valve housed in a machined brass body. The check valve must permit the gas to flow when a probe is connected and seals off the gas flow when the probe is disconnected. The unit is installed between the first fix and the second fix, the second fix assembly must comprise of a gas specific body, which accepts, retains and releases the probe. It shall be supplied as a complete product with no assembly to be undertaken. The base of the body is indexed to match the first fix assembly. The front face of the second fix assembly incorporates a colour coded gas identity label that indicates the gas type in 2 positions at 180 degrees to each other to Easy installation and servicing: cartridge with sealing elements, replacement possible without blocking the station allow visual acknowledgment of the gas type.

A stainless steel anti-swivel pin shall be located at 12 o'clock to prevent flow meters from falling over while inserted into the 2nd fix. The unit will only accept the probe for the appropriate service. The second fix socket shall incorporate a sheer-plane to safeguard the first fix and pipeline in the event of accidental damage or bed jacking. Gas specific components shall incorporate the Gas Identity marking, EN 9170 and the manufacturer identification mark permanently stamped or cast into the component surface. Probe roller pins shall be manufactured from stainless steel and positioned by the locking ring, these are tamper proof only serviceable using specialist tools. Probe roller pins held captive in cradle designs are not acceptable as this will cause dust settlement and malfunction The second fix check valve will comprise of the following components; 1 no. Brass Valve Body 1 no.Brass Valve Plunger 1 no.Spring 3 no.'O' Rings 1 no. Probe Seal The check valve should be capable of withstanding an inlet pressure of 20 bar.

The second fix assembly will comprise of the following components;

- 1 no. Body (Gas Specific)

- 1 no. Locking Ring
- 1 no. Anti-swivel Pin
- 1 no. Gas Identity

The body and locking ring will be die cast from zinc alloy and Teflon coated. It shall not be possible to insert a probe for a different gas into a body for any particular gas. Each body will also incorporate a gas specific coding hole to match the coding pin position in the first fix assembly. It shall not be possible to assemble a second fix assembly for any particular gas onto a first fix assembly for a different gas. The relevant gas symbol as defined by BS EN 9170-1:2008 will be moulded into the flange of the body e.g. Oxygen=O2

The terminal outlets should operate at the standard distribution pressure level corresponding to the standard line pressure of the medical gas pipeline system, which is around 4-5 bar for compressed gases and 0-400 mbar (absolute pressure) for vacuum. It must be possible to operate the outlets in one hand for the purpose of coupling (locking) and decoupling (unlocking). All the sub-assemblies of the terminal unit should be clearly marked with the type of service it is intended for use. The gas indexing of the various sub-assemblies should prevent any wrong assemblies being made by the installers or service technician

Terminal outlets must complies to HTM02-01 BSEN 7396 shall, be CE marked as class IIb medical device 93/42/EEC with four digit notified number specified

For DIN standard outlet must meet the requirements of DIN EN ISO 9170, part 1 and DIN 13260, part 2 Quality management certificate acc. to ISO 9001/ISO 13485 and Annex II. 3 MDD

Inlet: 8 mm copper pipe Operating pressure: 400 kPa to 500 kPa (overpressure) – compressed gases < 60 kPa (absolute pressure) – vacuum, depth 72mm. Outlets must consist of, actuator, gas specific block, connector mounting, servicing cartridge with sealing elements and replacement must be possible without blocking the station. Colour coding must be in line with DIN EN ISO 5359

Gas outlets as per NFPA-99 must be UL .listed Category 1 as per medical gas categorisation

Wall outlets for oxygen, nitrous oxide, nitrogen, carbon dioxide and medical compressed air service shall be Diameter Index Safety System (DISS) recessed type and only accept corresponding DISS type gas specific adapter Terminal Units (Gas Outlets) with probes and adapters shall be manufactured with a 165 mm long Copper inlet pipe stub which is brazed to the outlet body. The inlet pipe should be capable of swivelling by 360 degrees for enabling the same to be connected to the pipeline system.

Outlet shall be equipped with a primary and secondary check valve and the secondary check valve shall be rated at minimum pressure of 200 PSI. In the event the primary check valve is removed for maintenance there should not be any leakage (on-line maintenance should be possible w/o disrupting the functioning of other outlets). Outlet bodies shall be gas specific by indexing each gas service to a gas specific pin indexing arrangement on the respective identification module. There should be a push button release mechanism for disconnecting apparatus accessible from top, bottom and side of outlets.

A large color-coded front plate shall be used for ease of gas identification and aesthetic appeal. With the back rough in mounted the outlet shall adjust up to 25 mm variation in wall thicken The latch valve assembly should accept only corresponding gas specific adaptors. All outlets shall be cleaned and degreased for medical gas service, factory assembled and tested.

A Certificate of origin must be submitted

20.0 High pressure tube for O2, N2O, Compressed Air, Nitrogen, CO2, & Vacuum:

It should be colour coded for individual services i.e. white for Oxygen, Blue for N2O and Yellow for Vacuum, Black for air. Antistatic rubber tube should be as per ISO standards.

21.0 Master Alarm Panel as per HTM02-01, NFPA 99, IS07396-1, DIN Standards:

- Fully complies to HTM02-01 BSEN 7396 shall, be CE marked as class IIb medical device 93/42/EEC with four digit notified number specified

- The master alarm management system must be manufactured under BS EN ISO 13485:2003-2012 quality management system duly certified with copy of certificate of origin.

- The medical gas area alarm shall fully comply with the requirements of ISO 60601-1-2.

- For DIN master alarm panel must be in accordance with DIN EN ISO 7396-1

- Master alarm panel as per NFPA-99 must be UL .listed Category 1 as per medical gas categorization

Each Master Alarm should be modular in design and be fitted with required number of master alarm modules. The master alarms should be capable to monitor from 10 to 30points in a standard box or 10 to 50 points in a large box.

Each point represents an alarm condition that the source equipment might have. When an alarm condition exists, a red light flashes and the audible alarm sounds. If several alarm conditions occur simultaneously, the most recent alarm light should flash, while the other alarm lights should remain lit. When an alarm condition is created, an audible alarm should be actuated. A dry contact module should be available to interface with a building management system.

The box material should be of gauge steel of requisite thickness and equipped with mounting brackets that are adjustable up to a drywall thickness of 1-1/4" (32 mm). The emissions from alarms should conform with EMC standards.

Bidder shall be responsible for all cabling from local alarm panels to master alarm panel.

Master alarm management system should be designed to display alarm conditions from the source supply units indicating the broad status of the source equipment and manifolds as well as the master distribution status from the source supplies. Depending on the alarm priority, a visual and audible alarm should be initiated to indicate an alarm condition. The display should be in the form of light indicator or flasher on display, for each of the labelled alarm condition as listed below. It must be possible to freely configure the alarm priorities. Each display of alarm condition must be accompanied with audible alarm as well.

There must be facility to mute the audible alarm for short pre-fixed durations by pressing of alarm silence / mute button. There must be facility to test all the display lamps on the alarm panel. All the electronic circuits should be mounted inside the cover frame. The master alarm management system must be certified as per Medical Device Directives (93/42/EEC) Annex II having the CE mark with notified number specified from

certifying agency, copy of certificate of origin must be provided . The Configuration of the Medical Gas Central Alarm panels shall be done via switches within the panel, allowing easy and flexible configuration. Each panel shall display and/or input up to five gas services or up to twenty point alarms. Each gas service shall consist of a bank of five dual circuit indicators, one green (for a 'Normal' indication) and three yellow and one red (for four input conditions) as standard, although panels shall be customisable for individual requirements.

The gas service inputs shall be connected to a five way connector block. The alarm shall monitor the cable connection from the source equipment, and provide a fault alarm in the event of a short circuit or open circuit fault. This shall be distinguishable from a source equipment fault. There shall be a test facility to check the integrity of all the indicators on the panel, and the audible alarm. The test facility shall also provide diagnostic information to aid in fault finding. An adjustable volume audible alarm shall be fitted to the panel to allow installation in all environments, and there shall be a facility to connect the alarm to a remote sounding unit to repeat the audible alarm at other locations, for example a nurse base at the other end of a ward.

There shall be a mute facility which silences the audible alarm for a period of fifteen minutes, or until another alarm condition occurs. There shall be a selectable option to indicate to other repeater panels around the system that an alarm condition has been acknowledged and appropriate action is being taken. A volt-free contact shall be provided to output normal/fault status for the panel. It should be wired on to a dedicated data transmission cable and shall be permanently connected to the "Essential Supply" within the hospital via a 3A fused spur. Each gas service will display a green 'Normal' indication when all conditions are not in a fault condition. When an input condition fault, the respective indicators shall indicate the type of failure. Any data communication errors shall cause a 'System Fault' alarm.

The alarm panel shall be an open end device like a freely configurable screen with capability to reproduce not only the minimum source monitoring as above but to reproduce the complete real-time status of the medical gas management system even from each area control stations

Copy of certificate of origin must be submitted

Master alarm panel as per NFPA-99 must be UL listed Category 1 as per medical gas categorisation

- Master alarm panels for medical gas and vacuum systems shall each include the following signals:

- An alarm indication when, or just before, changeover occurs in a medical gas system that is supplied by a manifold or other alternating-type bulk system that has as a part of its normal operation a changeover from one portion of the operating supply to another

- An alarm indication when, or just before, the changeover to the reserve supply occurs in a medical gas system that consists of one or more units that continuously supply the piping system while another unit remains as the reserve supply and operates only in the case of an emergency

- An alarm indication when the pressure in the main line of each separate medical gas system increases 20 percent or decreases 20 percent from the normal operating pressure

- An alarm indication when the medical–surgical vacuum pressure in the main line of each vacuum system drops to or below 300 mm (12 in.) gage HgV

- Back up or lag compressor in operation to indicate when the primary or lead air compressor is incapable of satisfying the demand of the requirements of the system

- High carbon monoxide level to indicate when the carbon monoxide level in the medical air system is 10 ppm or higher.

- Medical air dew point high to indicate when the line pressure dew point is greater than +4°C (+39°F).

- Back up or lag vacuum pump in operation to indicate when the primary or lead vacuum pump is incapable of satisfying the demand of the requirements of the system,

- When a central dedicated WAGD producer is provided WAGD lag in use.

- Instrument air dew point high to indicate when the line pressure dew point is greater than −30°C (−22°F).
- High visibility LED/LCD readouts

- Circuitry allows for Normally Open or Normally Closed.
- Adjustable audible alarm repeat (from 1 to 99 minutes)
- Can be interfaced with BMS

22.0 Area Valve Service unit as per HTM02-01, NFPA 99, ISO-7396-1, DIN Standard:

- Fully complies to HTM02-01 BSEN 7396, shall be CE marked as class IIb medical device 93/42/EEC with four digit notified number specified

- Area valve service unit must be manufactured under BS EN ISO 13485:2008-2012 quality management system duly certified with copy of certificate of origin

- For DIN area valve must be in accordance with DIN EN ISO 7396-1

The Area Valve Service Unit (AVSU) should incorporate a ball valve with NIST connectors either side, mounted in a lockable box with emergency access to facilitate easy purge, sample & pressure testing and emergency supply system. It should provide a zone isolation facility for use either in an emergency or for maintenance purpose. The valve should be complete with copper stub pipes that extend to the outside of the box to enable easy connections to the Medical Gas Pipeline System (MGPS).

The unit should be pre-piped, wired and tested ready for installation into a finished building. Medical gas/vacuum services should be fixed copper, piped to and from their respective area valve service units.

The unit should provide a zone isolation facility, for use either in an emergency or for maintenance purposes. The box shall be made from extruded aluminium to prevent corrosion. All wetted parts (except seals and gaskets) should be brass or copper. Each unit assembly should be factory tested for gas tightness. Rubber pipe grommets should be provided to ensure any leaking gas does not escape from the unit into a wall cavity. All visible aluminum surfaces should be powder coated

The valve should operate from fully closed to fully open with a quarter turn of the handle. The spades should be injection moulded and colour coded to show through or blank identification. Should be full bore valves for minimum pressure loss and should have lockable in open or closed position. NIST connectors are fitted upstream and downstream of valve. The NIST connector must provide the facility to purge the system before the working gas is introduced and also following any downstream interruption of supply.

The NIST connection must allow for pipeline pressure to be tested and provide an accessible point for gas sampling. A colour coded service identity label will be fitted behind the valve handle and visible through the window. The door should incorporate an emergency access window manufactured from Safe Glass/ Acrylic; Each AVSU shall have a label manufactured from a printed vinyl substrate with a 2 piece protective polypropylene laminate.

The label will bear the relevant gas name or symbol and be colour coded as a minimum and mounted on the 1st fix section of the AVSU ensuring anti confusion. AVSU ball valves shall be manufactured from die- cast nickel plated brass alloy with male threaded 2 piece valve, chrome plated brass ball, PTFE seals and flat face connections to allow removal of the valve without the requirement to distort the pipeline.

The brass NIST connectors shall be located upstream and downstream of the valve and brazed into the brass stub pipe assembly for strength, NIST soldered directly into copper pipe shall not be acceptable as excessive force in an emergency could cause rupture of the pipe and ultimate shutdown of whole departments. These facilitate easy purge for testing and emergency supply form part of each stub pipe shall incorporate a check valve with metal seat thus avoiding the possibility of degradation over time. Each NIST shall include a NON Return valve with a 100% seal. AVSU stub pipes shall protrude outside of the box by minimum 400mm each side to avoid scorching when brazing to pipeline

Valve box as per NFPA-99 must be UL .listed Category 1 as per medical gas categorisation

The valve box shall be constructed of 18 gauge steel complete with a baked enamel finish. The doorframe assembly shall be constructed of anodized aluminium and shall be mounted to the back box assembly by screws as provided. The removable front shall consist of a clear window with a pull out ring pre-mounted to the centre of the window. The doorframe assembly shall be constructed of anodized aluminium mounted to the back box assembly by screws as provided and shall have a sliding removable front consisting of an opaque door with a pre-mounted pull-out ring and clear gauge window. Access to the zone shut-off valves shall be by merely pulling the ring assembly to remove the window from the doorframe. The window shall be capable of re-installation without the use of tools and only after the valve handles have been returned to the

open position. The window shall be labelled "Caution – Medical Gas Shut-Off Valve - Close Only in Emergency", or equivalent wording in accordance with NFPA 99.

Valves shall be same as specified herein for line shut-off valves except locking devices are not required.

Each valve shall be supplied with an identification bracket bolted directly onto the valve body for the purpose of applying an approved medical gas identification label. A package of labels shall be supplied with each valve box assembly for application by the installer.

Access to the zone shut-off valves shall be by merely pulling the ring assembly to remove the window from the doorframe or by sliding the cover to one side. The window can be reinstalled without the use of tools only after the valve handles have been returned to the open position Valves shall be a 4-bolt design, bronze body, double seal, union ball-type, with Teflon (TFE) seats and Viton seals, "O" ring packing, and ball which seals in both directions, blow-out proof stem, with a pressure rating of 2760 kPa (400 psig).

Valves shall be operated by a lever-type handle requiring only a quarter turn from a fully open position to a fully closed position. All valves shall be equipped with type "K" washed and degreased copper pipe stub extensions of sufficient length to protrude beyond the sides of the box. The entire valve body and pipe stubs shall be plated to a minimum of 25 mm (1") beyond the sides of the back box, but in no instance shall the plating be extended to the ends of the pipe stubs. All pipe stub extensions shall be supplied with suitable plugs or caps to prevent contamination of the assembly prior to installation.

Each valve shall be supplied with an identification bracket bolted directly onto the valve body for the purpose of applying an approved medical gas identification label. A package of labels shall be supplied with each valve box assembly for application by the installer. Valves shall be available with line pressure gauges, as required. Gauges shall be 51 mm (2”) diameter, with metal case and ring. Pressure gauges shall read 0-700 kPa (0-100 psig) vacuum, which shall read -100-0 kPa (0-30" H.

Copy of certificate of origin must be submitted

23.0 Touch screen digital Area Alarm as HTM02-01/NFPA 99 / ISO7396-1/ DIN Standard:

- Fully complies to HTM02-01 BSEN 7396 shall, be CE marked as class IIb medical device 93/42/EEC with four digit notified number specified

- Area alarm for up to 5 gases 220-240V, 50-60Hz, single phase, 3 Amp supply. Confirming to 89/336 the EMC Directive, 73/23 Low Voltage Directive.

- For DIN area alarm must be in accordance with DIN EN ISO 7396-1

The area alarm should have a digital/analogue display of pressures.

The area alarm panel shall be designed to be used to monitor the pipeline pressure within a theatres, intensive care units, private rooms, wards etc. The pressure is monitored by pressure switches/ Transducers in the pipeline downstream from the last AVSU.

The integrity of the cabling between the pressure switches/ Transducers and the alarm panel is monitored, and a fault on this cable would result in a system fault alarm, with all affected alarm conditions going into alarm conditions. Alarm unit shall provide indication of 3 conditions of gas, normal pressure, high pressure and low pressure.

Each gas service should be displayed by coloured LED's to show 'Normal' (green), 'Low' and 'High Pressure' (red) conditions. Medical vacuum systems should be displayed in the 'Normal' (green) and 'Low Vacuum' (red) conditions only.

For medical vacuum only normal and low vacuum are provided) for up to 6 gas services. Each service has a green normal, red high pressure and red low pressure indication, vacuum service a green normal and red low pressure indication are provided. The panel shall have a mutable audible alarm. The mute is operated by pressing and holding the bell symbol for 3 seconds. Operating the mute will silence the audible alarm.

Failure indications should be displayed by flashing lights and normal indications should be steady light. An audible warning should sound simultaneously with any failure indication and a mute facility should be provided. Following a mute selection the audible should resound after approximately 15 minutes, or should operate simultaneously should a further alarm condition

occur. A maintenance "Mute" switch should be provided internally to the panel for use during maintenance which results in prolonged pipeline or plant shutdown.

This facility should automatically reset when the gas service returns to normal. The alarm panel should have a 'test' facility to prove the integrity of the internal circuits, LED's and audible warning. The alarm panel should incorporate a volt free normally closed relay to allow for interconnection to either a medical gas central alarm system or an event recording circuit of a building management system.

The alarm shall be supplied with an optional module to be used with pressure transducer operating in a 4-20mA standard extends the capacity of alarm with the following features:

- Real-time indication of pressure level of measured gases,
- Adjustable set points triggering the alarm over the entire measurement range,
- Monitoring the status and gas pressure via a MODBUS BMS system through an RS485 interface The transducer module plugs directly into the Alarm PCB to allow for ease of upgrade The pressure set points triggering the alarm can be set over the entire measurement range (0 to 10 Bar for O2, N2O, O2/N2O, MA4, SA7, and 0 to -760mm Hg Bar VAC).

Medical gas alarm as per NFPA-99 must be UL. listed Category 1 as per medical gas categorisation

Medical Gas Alarms shall fully compliant with NFPA 99. Alarms manufacturer shall be a reputable supplier capable of demonstrating service capability resident within India. The alarm shall meet the U.S. electromagnetic compatibility standard for medical device 201-0004 to reduce the possibility of magnetic radiation interface with the other equipment, or other equipment's interface with the alarm.
Alarms shall provide signals as required by the latest edition of NFPA 99. Alarms shall be listed to UL 1069 and CSA C22.2 NO 601.1-M90 and comply with the following electromagnetic compatibility standards: FCC Part 15 Class A, ICES 003 Class A, EN 61326, EN 61000-3-2 and EN 61000-3-3. All field wiring and signals shall be self-monitoring and of the close circuit type with the fault signalled on an open circuit.

Each panel shall include an internal power supply module converting 230 VAC to low voltage DC. The power supply module shall contain a fuse to protect the system from voltage and amperage surges. A green POWER ON indicator shall illuminate when electrical power is available to the power supply module, the visual signal will automatically cancel when the fault is corrected.

The visual signals for system pressure or vacuum shall read NORMAL (green LED) LOW (red LED) or high (red LED).

Area alarm panels shall be provided to monitor all medical gas, medical/surgical vacuum, and piped WAGD systems supplying anesthetizing locations, and other vital life support and critical areas such as post anaesthesia recovery, intensive care units, emergency departments, and so forth.

Area alarm panels for medical gas systems shall indicate if the pressure in the lines in the area being monitored increases or decreases by 20 percent from the normal line pressure.

Area alarm panels for medical/surgical vacuum systems shall indicate if the vacuum in the area drops to or below 300 mm (12 in.) gage HgV.

24.0 Sensors for area alarms shall be located as follows:

Vital life support and critical areas shall have the alarm sensors installed on the outlet side of any of the individual zone valve box assemblies.

Areas for anesthetizing gas delivery shall have the sensors installed on the source side of any of the individual room zone valve box assemblies, so that shutting down one or more of the anesthetizing area zone valves will not cause an alarm.

25.0 Medical gas hose assemblies as per HTM 02-01/DIN/ISO/NFPA-99:

Medical gas hose assemblies shall comply with BS EN ISO 5359, BSEN 5682. BS EN 7396-2, BS EN 9170-1 NIST fittings compliant to BSEN ISO 18082

PVC hoses and hoses containing phthalates are not acceptable. Hoses shall be colour coded throughout their length as specified in BS EN 5359 as follows: Medical oxygen - white Nitrous oxide – blue Medical and surgical air - black Vacuum - yellow All hoses shall incorporate an anti-static inner core. Hose shall be permanently secured to all fittings with stainless steel crimped ferrules, and shall incorporate a window to enable verification that the hose is fully secured onto the hose barb.

Low pressure hose assemblies shall be in accordance with DINISO 5359 for coupling into outlet Colour coding must be in accordance with ISO 32. Angle type plug and NIST fittings must be in accordance with DIN 13260-2 and DIN EN 15908 respectively

Hose assembly shall consist of a UL-listed high-pressure color-coded conductive hose with a DISS nut and gland on the upper end. Provide a DISS Hand-I-Twist check unit on the lower end for all services except WAGD. Provide a Diamond quick-connect on the lower end for the Waste Anaesthesia Gas Disposal service

NAME OF PROJECT: PROPOSED CONSTRUCTION OF BMC GENERAL HOSPITAL & STAFF QUARTERS ON PLOT BEARING CTS NO. 11A/4, CHANDIVALI, SANGHARSH NAGAR, KURLA 400072

TECHNICAL SPECIFICATION MODULAR OPERATION THEATRE (MOT)

MEPCON DESIGN STUDIO

MUNICIPAL CORPORATION OF GREATER MUMBAI

Advanced Modular theatres (MOT):

Advanced Modular theatres (MOT) should be furnished on turnkey basis including Design, Engineering, fabrication, Installation, Integration, Testing & Commissioning of all items mentioned in the BOQ attached. It should be free-standing structure which allows easy repair, maintenance, integration & future expandability. The Operation Theatre must be warranted for a period of three years from all defects, and the constructor must be willing to offer an AMC for an addition period of 5 years.

The MOT shall comprise of free-standing wall substructure, SS wall paneling system, SS ceiling system, conductive flooring with necessary levelling, laminar air flow system, SS Exhaust air Cabinet with bottom fluff strainers, Auto / manual doors having double glass window in door leaf with necessary operators, illumination peripheral lights, Operating Theatre lights, HD Cameras, Control Panel, X-Ray viewing screen, Writing board, scrub station.

The Modular OT wall system shall have certification for hygiene, noise protection, radiation protection & fire protection. The bidders shall provide Test Reports/certification.

a. The fire resistance for single panelled wall system including substructure work shouldconfirm to Class A2, according to DIN 4102 (or equivalent BIS) required.

b. Power operated windows, doors should comply ZH 1/494 directives and to be certified bymanufacturer.

c. Metal structure work should be in accordance to DIN 18360 (or equivalent BIS) to becertified by manufacturer/ installer.

A. Wall & Ceiling System:

1. Wall Sub-structure:

It should be made of galvanized steel having thickness not less than 1.5mm.

This steel substructure will provide backing for prefabricated wall panels mounting and flush mounted equipment, display and control units, storage etc. The cavity between the inner and outer walls should be left with minimum obstructions for the possible addition of equipment at a later date and to enable services, pipes, conduits etc., to be run within the cavity.

2. **Wall Panel:**

The Operation Theatre wall panels system shall be fabricated in factory and shall be made from ANSI 304 Stainless Steel of thickness (1.2 or more) backed by class 2A fire rated material such as gypsum boards. Wall panels must be mounted onto the sub-structure in such a manner so as to enable easy installation. The gap between panels should be sealed with silicon gasket or suitable sealant to make it a continuous surface. Liquid silicone should not be used for sealing. Once fixed, they have to provide complete hygienic and hermetic sealing. The inner surface of OT should have coating with anti-bacterial and anti-mycotic properties.

All wall-mounted equipment should be flush mounted. The wall panel design and construction should allow for the installation and support of all equipment and the provision of openings required for installations, without affecting rigidity and strength. There should not be any sharp edges and corners should be smoothened.

The individual wall panels should be made of single sheet without any joints. The individual wall panels should be attached to each other with suitable joining mechanism or an equivalent fastening system which will allow easy installation.

The prefabricated wall panels should be highly durable against mopping and steam cleaning. Colour scheme of OT should be co-ordinate with Architect. Resistance against common hospital cleaning and disinfection agents must be ensured.

In all the corners of the OTs, especially fabricated, one piece, angular SS wall panels shall be used both inside & outside the OTs. There shall not be any

rubber seal / joint at any corner. Wall panelsshall not have any horizontal joint, at any height from floor to false ceiling, except for installation modules i.e. control panel, X-ray, monitor, doors & cabinets etc.

Finished Floor to False Ceiling Height inside the OTs shall be minimum 3000 mm.

The wall system (panels and substructure) should be made of non-flammable material. No dangerous concentrations of gases should be produced in an event of fire. It should confirm to Class A2, according to DIN 4102 (or equivalent BIS) required

3. **Ceiling:**

The ceiling system should also be made from Panels of ANSI 304 Stainless Steel of thickness (1.0mm or more) backed by class 2A fire rated material such as gypsum boards and be made of panels for easy installation and access for maintenance. It should be similarly prefabricated in the factory. It should have perfect sealing. The joints should be provided with a silicone sealing for a continuous optical closure and hermetical sealing. It should be stable and nonslip after adjustment. The material of construction should be with a thickness of 1.0 mm or more. All ceiling panels should have folded edges.

The ceiling system (panels and substructure) should be made of non-flammable material. No dangerous concentrations of gases should be produced in an event of fire. It should confirm to Class A2, according to DIN 4102 (or equivalent BIS) required

4. **Imported Antimicrobial Paint with Primer for OT:**

All the sharp edges and corners should be smoothened to avoid bacteria contamination.The internal surfaces of the room walls and ceiling should be sprayed with anti- microbial paint, to a minimum dry film thickness of 300 microns. The coating should overlap the floor covering, ceiling system and doorframes by 25mm to provide a continuous sealed surface. The plastic coasting should be non-reflective.

The biological efficiency of the anti-bacterial painting finish shall provide for

minimum of 10 years ability to prevent mildew, bacteria and blight. The paint shall also be resistant to other pathogens which are prevalent in the hospital area and listed below: Acinetobacter sp, Aerobacter aerogenes, Bacillus subtilis (vediğer Bacillus sp), Enterobacter aerogenes, Escherichia Coli, Listeria Mozocytogenes, Pseudomonas Aeruginosa, Pseudomonas putida, Salmonella Typhimurium, Serratia Maercescens, Staphylococcus aureus.

The Anti-Bacterial paint shall be resistant against abrasive and diluted acid and also alkali's whichare in detergents etc.

5. **Electro Static Dissipative/ Conductive Flooring (Imported):**

   a. **Conductive Flooring:**
   Providing and fixing 2mm thick, permanently static conductive, pressed homogeneous vinyl sheet flooring with carbon backing as necessary of total thickness 2.00 mm. The flooring shall include necessary copper backing for necessary grounding. The flooring shall be polyurethane reinforced, scratch resistant, fire resistant, chemical resistant, slip resistant, resistant to fungal and bacterial growth with necessary coving of 100 mm.height. All floor joints shall be welded with compliant welding rods with adequate coving and a (skirting) level of 100mm shall be achieved on the wall.

   b. **Self-Levelling Subfloor**: The entire floor shall be covered with self-levelling compound (of Make Ardex, Sika or equivalent) so as to achieve a levelled surface that will facilitate laying ofthe conductive flooring within necessary tolerances.

6. **Recess mounted digital image viewing station designed for use in OT (Imported):**
   The device can operate in an independent mode by accessing radiological images from either USBstorage device, or an optical disk; or in conjunction with PACS, RIS, HIS of Radiology department. Monitor of screen size 40 inches with anti-glare glass, and calibrated for viewing DICOM images. Unit equipped with easy to disinfect medical grade keyboard, touch pad, and optional USB mouse. Minimum requirements for integrated hardware – Intel i7 processor, 4GB RAM, 500GB HD, professional graphic card, and Windows7 Pro operating

system.

7. **Surgeon Control Touch screen panel (Imported):**

The surgeon Control panel should be able to incorporate all the services within the operating theatre. The panel shall be touch screen type for premium Ots and membrane type for other OT's and shall be mounted on the theatre wall.

The panel shall be able to control the following services:

- Digital type Time day clock with high brightness characters
- Digital type Time Elapsed day clock with high brightness characters
- General Lighting Control System (on/off/endo)
- Control for Operating Theatre Lights with intensity, on/ off function.
- Control for laminar flow (on/ off/ intensity setting)
- Control for OT table
- Operating Theatre temperature indicator
- Operating Theatre humidity indicator
- Medical gases with High and Low gas pressure indicator for each gas service present in theoperating theatre and will have an audible buzzer with mute facility.
- Hands free Telephone system with memory
- HEPA filter status.
- Control for temperature and AGSS
- Music Control
- The touch panel should be upgradable type

8. **Ceiling Air Management System:**

The Ceiling Air Management System shall comprise of the following:

a. **Laminar Air Flow H14 HEPA System (Imported):**

The ceiling filtration system should be designed to ensure unidirectional distribution of sterile air with differential flow velocities decreasing from centre to perimeter of the surgical theatreto ensure the cleanliness of all the area covered by the air flow. The ceiling system should be equipped with HEPA filters with different performances according to their position in the ceiling to achieve different flow velocities. The complete filtration ceiling

system should be factory assembled its holding structure, Filter frames and top plenum should be made of ANSI 304 stainless steel. Filtration ceiling system should have HEPA filters, according to EN 1822. The filtration ceiling system should have flow equalizer to achieve uniform & constant air distribution over the whole surface it should also have connection for surgical lamp to be fitted in place of any filter.

The HEPA filters should have dust spot efficiency of 99.997% for 0.3 micron particles. Number of air changes should be such that Clean room classification can be maintained atClass 100, as per ISO 14644 System shall have CE mark as per MDD 93/42/EEC.

Air extraction modules of the laminar flow system having two openings each, should be placed at four corners of the OT. The material of construction of the front cladding panel should be same as that of wall panels, and for riser duct may be same as that of air ducting inside OT. The extraction module openings should have suitable grills with fine washable filter, for easy cleaning and prevent residue build-up in the extraction chamber.

9. **X-Ray/ CT scan LED Viewing Box (Indian / Imported):**

Two plate X-ray/CT view screens should be provided with electrical safety for high & low voltage system. It should be designed to provide flicker free luminance for the film viewing purpose. It should be installed flushed with the wall for hygiene and ease of cleaning.

10. **Pressure Relief Dampers Stainless Steel:**

Pressure relief dampers should be provided in each room to prevent contamination of air from clean and dirty areas. Suitably sized air pressure relief damper should be strategically placed, enabling differential room pressure to be maintained and ensured when doors are opened. Counter-weight balancing system should be provided in the PRD to maintain positive pressure inside the operation room.

Air pressure stabilizers should have unique capability of controlling differential

pressure to close tolerance. The PRD should remain closed at pressure below the set pressure and should open fully at pressure only fractionally above the threshold pressure of 25 KPa. The body should be stainless steel grade 304 with stainless steel grill. Stainless Steel 304 Grade Plate should be used for body and with high grade SS 304 stainless steel for blades. Overall size of the P.R.D: 305 x 335mm or as per room size.

11. **Storage Unit:**

Size 2000mm x 1000mm x 230mm deep. The storage unit made from 1.5 mm of Stainless steel of SS304 grade. The doors shutter of the storage cabinet should house glass, and should be installed on the storage units with the help of fittings allowing an opening allowance of at least 160.

The storage unit should be divided in 2 equal parts and each part should have individual doorswith stopper system. Each part should be provided with glass racks as per user department, and should be adjustable type.

12. **Writing Board (Indian / Imported):**

(List Board) Size: about 950mm x 650mm, flush mounted with wall panel

13. **Hermetically Sealed Door & Frames:**

The doors of the theatres should maintain sterility and the correct air pressure in the room. All doors into and out should be of the sliding, 100% hermetically sealing type. These doors should bedurable and with ease of control, and versatility for clean environments. Each door should have vision panels of a minimum size of 300mm X 300 mm. In case of 2 doors, each leaf should have vision panels of a minimum size of 300mm X 300 mm.

The doors should meet the following specifications:

- The doorframe and the door panels should be made of high quality ANSI 304 Stainless Steelthat can withstand high abrasion.
- The door should seal on all four edges in the closed position & should be surface installedtype. Doors should be wired to the current IEE regulations & BS7971 standard.
- Motor should be DC 24V 70 W brush less DC Motor

- Noise level of movement should not be more than 60 decibel.
- Controller should be microprocessor based and be CE marked.
- Power efficiency should be .95 (in AC 100V full load).
- The track should be made up of single piece extruded aluminum.
- Environment temperature should be -20°C to +55° C.
- Starting time should be able to regulate from 0.5 second to 23 second &starting speed shouldbe 600 mm per second.
- Electrical safety codes for high & low voltage system.
- Design should meet HTM 2020/2021 standards.
- Nylon runner guides should be fixed to the door in such a way they do not obstruct trolleymovement through the door.
- The door controller should be sensing overload condition and in overload in case the doorwill automatically stop & reverse the direction of travel.
- The controller should be capable of either being operated by elbow switches/foot switches,radar switch (touch less sensor).
- All doors should be able to be operated easily manually in the event of failure of the powersupply or the automation unit
- Automation with 2 sensors - foot operation and hand sensors (magic switch).
- Opening, closing and stay-open times should be programmable.
- Electrical motor drive should offer various control types such as energy saving feature (partial opening adjustable for distance and time); automatic closing (full opening, adjustable for time); sluice function and permanent opening
- Lead protection on view window is necessary.

14. Medical Grade Copper Tube /Piping:

All Copper Pipes must be duly Medical Grade, seamless, fully degreased and half hard (designated to R 250). It should confirm and meet with the latest BS

EN13348:2008 standard or equivalent. Chemical composition as per CU. DHP to 1190-1 and CW024A to EN 1412 or equivalent. Maximum total carbon content 20mg/m2. Copper Pipes must have BS EN 13348:2008 and Kite mark or Llyod or equivalent stamped on it.

15. **Electrical wiring, Conduits with fixtures inside the OT:**
    Wiring with Low leakage current wires of FRLS wires as per requirements including providing and fixing of conduits and boxes, etc. to complete the work in all respect.

16. **Air Exhaust shaft / box:**
    Exhaust Air Cabinets (4 nos. in each OT):
    Especially designed Exhaust Air Cabinets (4 nos. in each OT) made of SS material, SS 304, same as used in wall system. Complete Cabinet should be a SS hollow box with a rectangular opening and Each of opening shall have fluff strainers (exhaust grills) for exhaust shall have openable access from the front for routine / periodic cleaning of accumulated bacteria (Fixed, non-openable exhaust grills shall not be used.

17. **Peripheral Lights:**
    Peripheral lights should be integrated with the SS Ceiling/ Air Management System. The lights shall be have laminated safety glass cover with highly efficient reflectors to achieve glare free, flicker free, even lamination of 500 - 800 lux within the Operation Theatre. Body should be designed such as to achieve minimum IP 54 protection against dust and humidity. The Peripheral light should be LED Type, single colour with an addition facility for Endoscopy procedure.

18. **Scrub Station (Indian/Imported):**
    The scrub unit shall be made of one piece ANSI 304 Stainless Steel material and shall be of anti- splash design with minimum 1.0mm thickness. Each scrub station shall have four manual soap dispensers (two for each bay) and two taps Foot operated + (battery operated with individual/independent optical sensor. The taps shall have individual automatic mixer for hot & cold water through a temperature regulator/knob as a part of the tap.

19. **Modular Operating Theatre Lights: Ceiling suspended Double Dome LED Surgical Light (Imported):**

The Operating Theatre lights should be hung rigidly from the ceiling of the modular operation theatre. Each dome should have a multi-lens matrix for a shadow free, homogenous, pure white, natural light field with sterilisable handle. The light should be shaped such as not to obstruct the laminar air flow.

The ceiling mounted Double Dome LED OT lights shall have following features:

- Illumination/ light head at 1m – 160,000 lux
- Bulb Type – LED
- Illumination adjustment - 30 – 100%
- Light Rotation – 360
- Color temperature – 4500 K fixed +/- 300 K
- Working range - 700 - 1400 mm
- Color rendering index > 90
- Power supply - 90 – 250 V AC
- Service Life > 40,000 hrs
- Power consumption - 60 - 110W
- It should be a flat, aerodynamic, open design suitable for laminar air flow ceilings.
- It should have a IR-free Illumination.
- Should have ENDO light function in OT light or Air Ceiling System.

20. **Premium OT's - Ceiling suspended Triple Dome LED Surgical Light with HD Camera (Imported)**:

The Operating Theatre lights should be hung rigidly from the ceiling of the modular operation theatre. Each dome should have a multi-lens matrix for a shadow free, homogenous, pure white, natural light field.

The ceiling mounted triple dome LED OT lights with HD Camera shall have following features:

- Illuminaiton/ light head at 1m – 160,000 lux
- Bulb Type – LED
- Illumination adjustment - 5 – 100% stepless

- Light Rotation – 360
- Color temperature – 4500 K +/- 300 K
- Working range - 700 - 1400 mm
- Color rendering index > 93
- Power supply - 90 – 250 V AC
- Service Life > 40,000 hrs
- Power consumption < 80 W-110W
- It should be a flat, aerodynamic, open design suitable for laminar air flow ceilings.
- It should have a IR-free Illumination.
- Should have ENDO light function in OT light or Air Ceiling System.

21. **High Definition Camera (Imported)**:

The OT lights and camera system should have CE certification.

The Camera should have full HD video Output and following specification:

- CCD Sensor – 1/3" CMOS
- Zoom – 120 x motorized zoom (10 optical x 12 digital)
- Signal – HD 1080i
- Effective Pixels - Approx. 2 million
- Aperture – F1.8 – F2.1
- White Balance – Auto/ Manual
- Focus System – Yes (lockable)
- Antiflicker – Integrated
- Freeze – Integrated
- Contrast Enhancement – Auto
- Foot Control – Yes
- Location of camera – Integrated within OT light
- Monitor for HD Camera
- Picture Size > 19"
- LCD Panel – Active Matrix
- Resolution – 1920 x 1200

22. **Operation Theatre Control Panel Membrane Type (CE-Mark):**

The Product should be CE Certified make, manufactured as per standards in accordance with Medical Devices Directives 93/42/EEC. The Product should be factory tested, provision for pre dispatch Inspection necessary. The Operation Theatre Control Panel should be having following controls.

- Digital clock with battery
- Time Day Clock
- Time Elapse Day Clock
- Temperature measurement & display
- Humidity measurement & display
- OT light controls
- General light controls
- Hand free Telephone
- Medical Gases Alaram
- HEPA STATUS
- DIFFERENTIAL AIR PRESSURE GAUGE - DIGITAL OR ANALOG

The Surgeon control panel should meet electrical safety codes for high and low voltage system, wired to the current IEE regulations and The Operating room's surgeon control panel should be designed to cope with changing technology and equipment in operating environments. Control panel should be user friendly and with ease of operating & maintaining purpose.

The panel should be configured to incorporate all the services that operation room staff requires and control.

The fascia should be membrane made with superior quality material, UV Resistance with sterilization feature as per Operating Room requirement.

The Control Panel should have Isolated "NO" "NC" FOR HVAC and OT lights

The interior part of the panel can be accessed two ways front part inside the operation theatre or rear part outside the room. The access from inside the room through tillable doors. When access isdone from outside, there will be rear door accessible from "dirty service" corridor if provision is there.Should have been factory assembled and tested should be Inspected at factory before delivery and type tested in accordance with MDD and CE Certified.

23. Ceiling Suspended Pendants:

a. Ceiling Suspended Pendants Anaesthesia (Imported):

- Dual Arm of about 800 mm + 800 mm
- The 2 swivel arms, carrying the supply column, should have the maximum degree of rotary motion (3 x330degree)in the horizontal plane and should be able to hold a weight of upto 200kg
- The distribution column should be at least 1000mm in height.
- Minimum clearance from finished floor to bottom of pendant should be about 700 mm.
- Should have 2 platforms of about 500 x 450mm. The platforms should be adjustable along its vertical support and hence should be adaptable to the terminal units for which they areintended
- The following medical gas outlets should be provided on the back of the service head. It shall be CE marked.
  - O2 – 2 Nos
  - Nitrous Oxide – 1 Nos
  - Vacuum – 2 Nos
  - Medical Air – 1 No
  - AGSS -1 No
- All Gas Outlets should come fitted from the factory
- 12 electrical sockets should be provided on the service head (6 on each side), and should becompatible with the Indian plugs.
- Should have
- Data Port – 2 No's,
- Video –Out/IN, Audio Out/In Socket
- The length of the drop tube from the extension arm should be suitable to the OT height
- The pendant should have a Pneumatic braking system or Electromagnetic type
- Main material used should be of high strength aluminum alloy or stainless steel, with a sealeddesign. Resistance against common hospital cleaning and disinfection agents must be ensured.
- It shall be CE marked.

b. <u>Ceiling Suspended Pendants Surgeon (Imported):</u>

- Dual Arm of about 800 mm + 800 mm
- The 2 swivel arms, carrying the supply column, should have the maximum degree of rotary motion (3 x330degree)in the horizontal plane and should be able to hold a weight of upto 150kg
- The distribution column should be at least 1000mm in height.
- Minimum clearance from finished floor to bottom of pendant should be about 700 mm.
- Should have 2 platforms of about 500 x 450mm. The platforms should be adjustable along its vertical support and hence should be adaptable to the terminal units for which they areintended.
- The following medical gas outlets should be provided on the back of the service head. It shall be CE marked.
  - O2 – 2 Nos
  - Vacuum – 2 Nos
  - Compressed air supply – 1 No
  - Medical Air – 1 No
  - CO2 - 1 No
- All Gas Outlets should come fitted from the factory
- 12 electrical sockets should be provided on the service head (6 on each side), and should becompatible with the Indian plugs.
- Should have
  - Data Port – 2 No's,
  - Video –Out/IN, Audio Out/In Socket
- The length of the drop tube from the extension arm should be suitable to the OT height

- The pendant should have a Pneumatic braking system or Electromagnetic type
- Main material used should be of high strength aluminum alloy or stainless steel, with a sealed design, surface having antimicrobial and antifungal coating. Resistance against common hospital cleaning and disinfection agents must be ensured.
- It shall be CE marked.

c. Ceiling Suspended Percussionist Pendants (Imported):

- Slim and light weight unit with spring arm.

- The spring arm of length 1000mm and service head of 700mm with the support head should beable to hold a weight of 15kg.
- Platform on the support head of size 500 x 350mm, should be adjustable along its verticalsupport.
- The following medical gas outlets should be provided on the back of the service head. It shallbe CE marked.
  - Oxygen – 2 Nos.
  - Medical Air – 1 No
- All Gas Outlets should come fitted from the factory
- 4 electrical sockets should be provided on the service head (6 on each side), and should becompatible with the Indian plugs.
- Data port – 1 No
- It shall be CE marked.

24. **Audio System (Indian / Imported):**
Audio system for Operating room to hear soothing music and radio channels. It should be able to play CDs, pen drive, hand held device.

Writing board should be made of ceramic having Magnetic properties and should be flushed to thewall of the operation room.

25. **Degreasing**:
All pipes, fittings and valves shall be degreased, steam cleaned internally, dried, shot blasted and blown through with medical quality air and individually capped at both ends after passing a visual internal inspection.

26. **Fittings**:
Fittings shall be wrought copper, brass or bronze conforming to BS: 864 parts 2 and suitable for a steam working pressure of 17 bar and especially made for brazed socket type of connections.

27. **Area Valve Unit Module with single service valve box and area alarm fitted in module:**
It should fully comply with HTM 2022, HTM02-01and C11, or DIN standard or EN or NSPA or equivalent and must be duly CE marked with CE no. specified on it. It should be easy to operate and reliable.

28. **AGSS hose kit with probe:**
    It should fully meets and complies with BS 5684, BS 6832 and HTM 2022, HTM02-01, C11 standards and must be duly CE marked or equivalent.

29. • **Air Exhaust shaft / box**

30. • **Exhaust Air Cabinets (4 nos. in each OT):** Especially designed Exhaust Air Cabinets (4 nos. in each OT) made of SS material, SS 304, same as used in wall system. Complete Cabinet should be a SS hollow box with a rectangular opening and Each of opening shall have fluff strainers (exhaust grills) for exhaust shall have openable access from the front for routine / periodic cleaning of accumulated bacteria (Fixed, non-openable exhaust grills shall not be used.

NAME OF PROJECT: - **PROPOSED CONSTRUCTION OF BMC GENERAL HOSPITAL & STAFF QUARTERS ON PLOT BEARING CTS NO. 11A/4, CHANDIVALI, SANGHARSH NAGAR, KURLA 400072**

TECHNICAL SPECIFICATION FOR AUTOMATED MATERIALS TRANSPORT MATERIALS (PNUEMATIC TUBE SYSTEM)

MEPCON DESIGN STUDIO

MUNICIPAL CORPORATION OF GREATER MUMBAI

NAME OF PROJECT: PROPOSED CONSTRUCTION OF BMC GENERAL HOSPITAL & STAFF QUARTERS ON PLOT BEARING CTS NO. 11A/4, CHANDIVALI, SANGHARSH NAGAR, KURLA 400072

TECHNICAL SPECIFICATION FOR AUTOMATED MATERIALS TRANSPORT MATERIALS (PNUMATIC TRANSPORT SYSTEM)

Supply, Installation, testing and commissioning of Automated Materials Transport System AMTS [AUTOMATED MATERIALS TRANSPORT SYSTEM] on Turn Key Basis high speed spontaneous automated vertical and horizontal transports of blood samples, tissue samples, pharmaceuticals, x-ray reports etc.

Broad Specifications:

Automated Materials Transport System [PTS [PNEUMATIC TUBE SYSTEM]] on Turn Key Basis high speed spontaneous automated vertical and horizontal transports of blood samples, tissue samples, pharmaceuticals, x-ray reports etc.

1.0 General Specifications

i. The systems should be imported including all devices, software and network and conform to different DIN / EN / CE and ISO standards.

ii. The System should be Flexible modular technology for Spontaneous transport with speeds up to 4-5mps

iii. Should have provisions for PowerLine and PowerTrain for multi-carrier transports and transports over long distances for optimisation of transport frequency and efficiency.

iv. Should have provisions for Automatic return feature of empty carriers to origin or to the station with highest deficit

v. RFID technology for tracking and tracing the transport goods, eliminating the risk of loss with each station having RFID readers and each transport carrier/capsule with RFID transponders.

vi. The System should be only PC (Computer) Controlled with PC Software driven with WIN 2007 operating system with remote accessibility using T-control and supervision software.

vii. The system should be with Live and Real Time Supervision with the Entire network view with remote accessibility.

viii. The system should have Live and Real Time communications channels between all the devices and should be visible on PC monitor in graphs and numerical values.

ix. The Station should be operated with 230V single phase 25W UPS backed up power supply (UPS backed up power point for each station will be provided by the institute)

x. All devices should be connected with LVDC 36V using RS232 to RS485 platform using unicore cable based on RS485 connectivity which provides composite LV power supply and communication to all stations and devices in the network and hence are digital in nature and maintaining a real time live connectivity speed of minimum 70 – 120 devices per second which can be constantly monitored Live and Real Time on the PC monitor. The control cable of high grade composite with grounding, power and data-com all three in one and should be fully screen and use grounded system concept to minimize electromagnetic and radio-frequency interference. Instrumentation wire type 2x2x0.22 x 1.9^2 conforming to CE or EN standards with following specs:

- 4 Core (0.22 SQ MM ABC PE Insulated, polyester taped Cu-Braid & PVC Sheathed)
- +2 core (2.0 SQMM ABC, PVC Insulated)
- Drain Wire (1.50 SQMM)
- laid up collectively Aluminum Polyester tapped and overall PVC Sheathed

Specification		Core			Core Colour	Sheath Colour			Marking Method
Control Cable		7/0.200 mm ABC (Insulation PE)			Red Pink Black Blue	Blue			Ink Black / White
		19/0.36 mm ABC (Insulation-PVC)			Red Blue				
Conductor		Insulation (PVC/PE)				PVC Sheath			
Area mm^2 (Nom)	No./ mm	Insulation Diameter	Nom Thickness	Min. thickness at		Nom. Thickness	Min. Thickness at		Overall Diam

		r (mm)	(mm)	any point (mm)	(mm)	any point (mm)	eter (mm)
0.22	7/0.200 mm	1.30+/-0.05 (4C-PE)	0.35	0.25	1.35	0.85	10.0 ± 0.25
		4.80±0.20 (outer Sheath-Grey)	0.60	0.42			
1.80	19/0.36	2.90+/-0.10	0.50	0.35			

	mm	(2C- PVC)					

Conductor Bunching Lay :7/0.200 ABC - 20 mm (max.), 19/0.36 ABC-60 mm (Max)	
Lay Length	: 4C- 100 mm (Max), Over all Laid up Lay-150 mm (Max)
Polyester Tape	: 10X0.025 mm
Cu-Braiding	: 16X5X0.12 mm ATC , Coverage : 75% (Approx)
Polyester Tape over Braid : 10X0.025 mm	
Drain Wire	: 30/0.250 ABC
Over all laid up lay	: 150 mm (Approx)
Aluminum Polyester Tape : 20X0.050 mm	
Polyester Tape	: 20X0.025 mm
PVC Grade	: Insulation Type 'A' , Sheathing Type ' ST1' to IS: 5831-84
Insulation PE	: HDPE

Electrical Properties:

Conductor Resistance at 20°C	7/0.200 mm – 87.6 Max. Ohm / KM 19/0.36 mm ABC - Max. 9.7 Ohm / KM
Wire Elongation	0.200 - 9% (Min) 0.36 - 13.50(Min)
Wire Diameter	0.200 ± 0.01mm 0.36 ± 0.01 mm
High Voltage Test	All specimens to withstand AC 1500V / 1 Minutes
Spark Test	All specimens to withstand 3.0 KV for 0.15 seconds without breakdown.
Insulation Resistance Test At 27°C At 70°C	36.70 Mega Ohm -KM (Min.) 0.037 Mega Ohm-Km(Min)
Volume Resistivity	$1X10^{16}$ Ohm-Cm (Min)

Physical Properties:

T.S and Elongation of PVC Insulation & Sheath	Before Ageing	Tensile Strength	12.5 N / mm^2, Min.
		Elongation	150% Min.
	After Ageing at 80°± 2° / 168 hours (7 days)	Tensile Strength	12.5 N/mm^2 Min, Variation ± 20% Max.
		Elongation	150% Min, Variation = +/- 20% Max.
T.S & Elongation of PE Insulation	Before ageing	Tensile Strength	10.0 N / mm^2, Min.
		Elongation	300% Min.
Loss of Mass Test of PVC	Temp. : 80 +/- 2°C / 168	2 mg/ cm^2 Max.	

	Hours (7 Days)	
Heat Shock Test for insulation & sheath	Temp.: 150 +/- 2°C / 1hr Mandrel Diameter = 2 to 2.5 times of average diameter of specimen	The sample shall not show any crack or scale on the surface.
Hot Deformation Test for insulation & sheath	Temp.: 80+/-2°C / 4 hr Wt. for Insulation = 100g Wt. for Sheath = 210g	The thickness of sample shall not decrease more than 50%.
Heat Shrinkage Test	Oven Temp.: 150°C +/- 2°C / 15 Minutes.	Max. 4%

xi. All Stations and Diverter units should function using only linear gear mechanism with electronic digital communicating and self sealing optical sensors and sensor based stoppers.

xii. The system should be Green technology (Eco friendly) in nature, should run on low voltage 36V DC with power boosters to maintain signal & communications with each device in the system, (except blowers which should be 3phase)

xiii. All devices should have built-in electronic proximity sensors, operable on low voltage frequency;

xiv. All devices should also have built-in and integrated reset switch and termination point to prevent leakage of current.

xv. All devices should have Optical sensors switch which should be modular and provided built-in various devices. Should be portable in nature, easily replaceable. Should be com-connectable to various devices.

xvi. The system should be provided with integrated power pack at strategic points; made of plastic case as per IP66/67 rating; 200Va. The power pack should be compatible for activation & de-activation of slave power packs through centralized built-in switch and L/ connection.

2.0 Online UPS Back-up for PC & peripherals of quality and standard make with following specifications

2.1 Capacity of 3000VA/2400W

2.2 Frequency range 400Hz-70Hz

2.3 Single Phase with ground

2.4 Power factor >-0.99 @ 220 to 230 VAC (input voltage)

2.5 Lowline transfer

160VAC/140VAC/120VAC/110VAC +-5%

(based on load percentage 100-80%/80-

70% /70-60%/60-0%)

2.6 Low Line come back 175VAC+-5%

2.7 High line transfer 300VAC+-5%

2.8 High Line come back 290VAC+-5%

2.9 Output voltage 208/220/230/240VAC

2.10 AC Voltage regulation +-3% battery mode

2.11 Output synchronized Frequency range 47 to 53 or 57 to 63Hz

2.12 Output frequency range battery mode 50Hz+-0.25Hz

2.13 Pure Sinewave form in battery mode

2.14 AC mode efficiency of approx.. 88% and battery model 83%

2.15 With battery and battery charge and cabinet

3.0 Control Room Specifications

3.1 Overall approx. dimension of the room should be 12m x 12m x 4.5m; suitable space with clear access will be provided by the institute; Any approval certificates or letters / sanctions if required and applicable from competent authorities and concerned departments will be provided by the institute.

3.2 Structure with ceiling and walls of control room will be provided by the institute at suitable space. Finishing of the Room and complete with accessories and fitments as follows will be provided by the vendor / institute as specified:

3.3 Walls will be made of ash bricks or masonry bricks of 4.5"/5" thickness and will be finished with plaster and punning with plaster of paris and finally finished with plastic emulsion paint [by institute]

3.4 Ceiling will be made of concrete & water proofed and finished with plaster and punning with plaster of paris and finally finished with plastic emulsion paint [by institute]

3.5 The flooring will be hard concrete with PCC (and finished with vitrified tiles of minimum 500mmlx500mmw [by institute]

3.6 Providing General furniture including one work station desk of minimum 1000mmLx750mmWx800mmH. Two numbers of swivel, rotation and chairs with castors, arm rests, with reclining backrest, Chair seat height adjustable with pneumatic gas cylinder pump with lever handles. One number of storage cabinet of made of wood with fine laminate finish with 4nos. of shelves & with two lockable doors with overall approx. size of 900mmLx450mmDx1800mmH. One number of imported wire shelving of chrome finished approx. with 4nos. of shelves & with two lockable doors with overall approx. size of 900mmLx450mmDx1800mmH each shelf with approx. loading capacity of 450kgs. Two numbers of imported utility carts with wire shelving with two single piece handles and designated castors with crash bumpers with two shelves with over all dimensions of 450mmWx900mmLx950mmH with approximate loading capacity of 170kg. [by Vendor]

3.7 Providing and fixing General lighting with LED lights providing atleast 500lux of illumination [by Vendor].

3.8 Providing and fixing of one number of U-PVC Windows with frame; with two fixed mesh panels and two openable panels with latch. Overall dimension of window of approx. 900mmx900mm. The Window should be made of unplasticised polyvinyl chloride and should be sound-resistant, monsoon proof, termite resistant, dust resistant and energy saving [by institute] .

3.9 Providing and fixing of one number of Door with frame two openable and lockable panels with latch. Overall dimension of the door

1250mmWx1800mmH. The Door should be made of unplasticised polyvinyl chloride and should be sound-resistant, monsoon proof, termite resistant, dust resistant and energy saving. [by institute]

3.10 Providing and fixing of Exhaust fan and fan for general ventilation of standard general make and specifications. [by Vendor].

3.11 Internal wiring and cabling with ground for Fans, general lights and switches with switch board for the same of standard fire retardant quality and make [by Vendor].

3.12 Providing Control PC with peripherals (Internet with access for remote access will be provided by the institute for the PC at the Control Room). PC with CPU with INTEL I7 @ 3.4GHz/8GB RAM, 500GB HDD with Cabinet with RS232 Port (atleast 2), USB Ports (atleast 4) with built-in SMPS, with Dell Keyboard and optical mouse; minimum 19" flat LCD Monitor; standard HP mono laser A4 printer with original licenses MS-Office and Win 2007 OS. [by Vendor]

3.13 The Control room should be provided with general window or split air conditioner single or multiple numbers to provide a total of 5-6tr approximately working on single phase of minimum 5 star rating of any reputed make to provide following conditions [by Vendor] :

3.14 Operating Temperature: 25degrees Celcius +-10%

3.15 Relative humidity: 50-60% +-10%

3.16 Electrical distribution: Institute will supply and provide generator backed-up electric energy connection of one 3-phase connection of 400V with total load of 82.5kw with ground. Internal distribution including cabling will be done by the vendor for each blower as per specifications each with terminal disconnect with NCN332A 32A type C 10kA triple pole MCB with short circuit capacity of 10kA and connection capacity of 25mm2 flexible conductor 35mm2 rigid conductor with 3 module 52.5mm width suitable for trip between 5 to 10 times the full load

current. Institute will also supply and provide one UPS backed up electric energy connection of 220v / 50-60Hz/ 11A connection with load of approx. 5Kva. Internal distribution including cabling and wiring with ground with minimum 6nos. of switches and plug points of 6/11A will be done by the vendor.

3.17 All other civil works, removal and replacement of existing walls, wall coverings, core-cut outs, ceilings, floor coverings, Civil finishing works as & if required & Supply of electrical supply during installations; scaffolding and supports for difficult or inaccessible areas and locations, will be provided by the institute.

4.0 Control Center

4.1 Control PC with peripherals

PC with CPU with INTEL I7 with
SMPS Cabinet 3.4GHz/8GB RAM
500GB HDD
RS232 Port
(atleast 2) USB
Ports (atleast 2)
PCI Slot for
ISDN/Modem Card
Data Port
Ethernet 100/1000
Lan Card Standard
Keyboard Standard
Optical mouse; 22"
flat LCD Monitor
Standard Mono laser A4 printer
Original licensed MS-Office and Win 2007 OS.

4.2 Compact Automatic Linear Multi-zone Transfer unit for connecting

and interchange of all zones and powerlines as specified:

i. Conforming to DIN 6663, EU Directive Electromagnetic tolerance 2004/108/EC, EEC Directive for Low Voltage Device 93/68/EEC, EEC Directive Machine Director 98/37/EEC;

ii. Should be linear automatic compact transfer unit for space saving and integration of all zones;

iii. Each zone should be capable of storing carriers; with priority by-pass; with powerline & powertrain capabilities for sending multiple carriers in runs.

iv. The movements of mechanism should be using low-noise gear mechanism.

v. Should be capable of handling upto 6 Zones and 6 PowerLines

vi. With capabilities of carrier cradle moving from zone to zone at very high speeds

vii. As per list of approved makes attached.

5.0 **Control software (pre-loaded on Control PC) with license dongle key consisting of following software modules, features and capabilities**:

5.1 The software has basic features that enable:

Supervision with Real time monitoring for viewing and maintenance of system Priority settings;

Network viewing;

System access and controls for each device on the network; Traffic flow analysis;

Delay analysis;

Logging of each transaction and error;

Inventory controls;

Location of carriers,

Password

controls, Carrier
re-distribution;
Pro-remote
accessibility;
Automatic Return feature of carriers to origin or to station with highest deficit Programmable timetable for recurring functions
Divert Carrier function in case of absence, job rotation or vacation Various Priority Settings for urgent and emergency transports Optimisation of pathways with intelligent alternate routing of carriers Mechanical and electrical Control of all devices
System configuration
Access and timetable features
User Groups and group
conditions and functions Carrier
Management
PowerLine and Powertrain for multi-carrier transports for optimized frequency and over long distances Print module for reports and stastics, analysis reports
User profiles and
rights System
graphic
visualisations
Reports editing

5.2 System Parameter Settings for Management and Maintenance Flexibility: Runtime configuration sets the transport time between the different devices with alarm notification if a runtime is being exceeded.

Automatic targeting allocates a specific destination to one carrier or a group of carrier. Variation of the transport speed depending on the carrier content.

5.3 Access Features for Security and Safety: Different authorization levels via PIN code, ID card transponder; designated stations in departments where security and safety are of paramount importance.

5.4 Timetable Features for Guaranteed Delivery: Priority settings configure the priority of the transport of goods from and/or to designated stations: carriers with priority have right of way in the system and will optionally bypass other carriers at diverters. Absent feature sets station on absence mode either by the administrator for recurrent absence or by user via entry on station keypad for sporadic absence. This feature should not affect the rest of the system. When carriers are addressed to an absent station, the sender is informed by an audible alarm and a text message at the sending station.

5.5 Grouping with conditions for carrier distribution with Total Carrier Management for Process Optimization with RFID transponder technology & Dedicated carrier slow speed for transport of sensitive goods; Tracking & Tracing for real-time location of carriers and transaction history; Stock control and empty carrier management, balancing the stock of carriers at the station and in the system in a logical way, sending empty carriers to the station with the highest deficit; Carrier maintenance schedules facilitate washing and inspection after a predetermined number of transport or specific usage.

5.6 PowerLine for High-Traffic Frequency to enable automated transports of multiple carriers or carrier over long distances several floors, between buildings or underground

5.7 User Profiles and Rights: User profiles determine the access level to data and devices in the system. User rights are permissions granted to users according to their user profile. They define what data and devices a user profile can read or modify.

5.8 System Visualization for remote Monitoring, Controlling, and Maintenance Remote assistance from anywhere on-site and/or off-site.

5.9 Topographic view of the system offers a detailed, accurate diagram in real

time.

5.10 Track & Trace tools for information and Analysis: Transinfo generates a basic view of every realized transport whereas infoLog generates a detailed view. LogBook records chronologically many kinds of information that user might want to record manually.

5.11 Reporting and editing with wide range of standard reports with system editor to customise reports and changes the settings if charts and diagrams; providing statistics to analyze system usage and optimization.

5.12 The system should show real time communication speeds of minimum 70 dps.

5.13 The Software should be operable & system should be accessible via License Dongle Key only to prevent unauthorized access to the control software.

6.0 Side Channel Blowers

6.1 The unidirectional side channel blower should confirm to EC machines directives 98/37/EC and low voltage director 73/23/EEC f.; DIN EN292 for safety of machines; EN60034-1 / DIN VDE 0530 Part 1 for rotating electrical machines; EN 60034-5 / DIN VDE 0530-5 classification of degree of protection DIN EN 60204 for safety of machine electrical equipment of machine Part 1 of Electric Motors and DIN VDE 0110-1 insulation coordination for equipment within low voltage systems. The blower should be of Electror make of EU origin and ashould conform to following specifications:

i. Volumetric flow rate (m3/min): 9.0
ii. Total pressure difference (mbar): 300
iii. Maximum blower speed (rpm): 3000
iv. Voltage (V): 400
v. Frequency (Hz): 50/60
vi. Current consumption (A): 11.0
vii. Motor outpu (Kw): 5.5
viii. Weight (kg): 75

ix. Rating plate should have details of data which should also include the model number (SD80) and make (Elektror)

x. The side channel blower should have high degree of safety and should produce powerful suction effect.

xi. The blower should be provided with safegaurd with motor circuit-breaker.

xii. The maximum permissible temperature of the conveyed medium shoul be -30degrees to +40 degrees celcius.

xiii. Solid particles or contaminants must be withheld using the filters before entering the side channel blower.

xiv. Maximum ambient tempeature must not exceed +60 degrees and minimum should not be below -20degrees celcius.

xv. The blower should produce below 85db of noise levels at peak volumetirc airflow of 9m3/min.

xvi. The open intake and discharge ports should be protected by wire guards in accordnance to DIN EN 294 standards.

6.2 Should be supplied with Complete with silencer, filters, dampers & installation accessories and air switch device.

6.3 The blower should be based on unidirectional rotation and equipped with unique electronic air-switch to switch between compressed air and vacuum reducing air and energy losses. The electronic air switch is equipped with state-of-art maintenance free linear gear drive mechanism and electronic modular optical sensor switch for activation and deactivation of the air switch.

6.4 The blower should be is automatically activated through centralized control system

6.5 The turbine is with independent power control module with automatic protection system tripper / VFD / inverter which is interfaced with

centralized control system. The VFD or variable frequency / inverter device should be installed for green building / environment enabling low energy consumption / conservation of energy while maintaining optimal speeds and should conform to the following specifications / features:

i. Should conform to EMC director 2003/108/EC for MX2 inverter and use dedicated EMC filter
ii. Carrier frequency of 15kHz with shielded motor cable
iii. 3-phae 200/400v class with appropriate Amps filter
iv. With input chole to comply with EMC directive for harmonic distortion IEC 61000-3-2 and 4
v. Should conform to safety norms of ISO 13849-1 with safe stop according to EN60204-1, stop category 0; PL=d.

7.0 Receiving & Sending Stations, with 10" Touch Screen Panel

7.1 The receiving and sending stations for automatic receiving and sending of materials in the carriers.

7.2 Should conform to EU Director for Electromagnetic tolerance 2004/108/EC; EEC directive for low voltage devices 93/68/EEC; EEC machines directors 98/37/EEC.

7.3 Should have ergonomically adapted sending and receiving heights.

7.4 Station should be provided / fitted with:

a. Minimum 10" Touch Screen Panel with built-in security features; speed dials, director; help menu with informative user guides; with built in user movie guides and other information.
b. Built-in integrated RFID reader device
c. Carrier sending port at ergonomic height
d. Outer housing of the stations should be constructed with rigid steel minimizing electro-magnetic and electro-static interference.

7.5 The device should be wall mountable; Each device should be equipped with state-of-art maintenance free gear drive mechanism & self

adjusting optical seals for moving parts for noise-less operations.

7.6 Stations should be equipped with RFID readers for various functions such as Carrier ID and inventory, Carrier ID with properties, permitted addresses or groups, prohibited addresses or groups, automatic destination, reject items not identifiable etc..

7.7 The device should be front loading with integrated carrier damping arrangement; no air waste while sending or receiving a carrier; Automatic energy-saving mode; Juddering circuit; with modular replaceable control cards

7.8 Each device should be supplied with upholstery and carrier holding rack.

7.9 Stations should have built in security features to limit access to authorized users

7.10 List of approved makes attached

7.11 Should be connected to the network with control cable of high grade composite with grounding, power and data-com all three in one and should be fully screen and use grounded system concept to minimize electromagnetic and radio-frequency interference for LVDC 36V using RS232 to RS485 platform using unicore cable based on RS485 connectivity which provides composite LV power supply and communication.

7.12 Construction with PVC, PMMA for Fire- and smoke-resistant & Smooth shapes enhance easy cleaning and disinfection; 30% quieter than typical free-standing stations, due to optimal acoustics

7.13 Illumination and status lighting support calm setting and easy messaging

7.14 Ergonomically adapted sending and receiving heights Carrier sending port at Ergonomic height with Protection against moving parts & illumination concept with Translucent door out of acryl (PMMA)

7.15 Station front housing with Curved shape front housing out of plastic (PS) with inner reinforcement of steel

8.0 Standard or Compact Stations:

8.1 The Station screens have the capability to show all send and receive log of their own stations.

8.2 This equipment Station is constructed using steel & standards minimizing electro-magnetic and electro- static interference

8.3 The device is wall mountable; each device is equipped with state-of-art maintenance free gear drive mechanism & self adjusting optical seals for moving parts for noise-less operations.

8.4 Stations are equipped with RFID readers for various functions such as Carrier ID and inventory, Carrier ID with properties, permitted addresses or groups, prohibited addresses or groups, automatic destination, reject items not identifiable etc..

8.5 Each station has capability / option for unlimited remote arrival messaging via (optional) NetClient on to user's PC.

8.6 integrated carrier damping arrangement; no air waste while sending or receiving a carrier;

8.7 LEDs for notice;

8.8 Automatic energy-saving mode;

8.9 Juddering circuit; with modular replaceable control cards

8.10 Configurable; Comfortable read of the digital LCD screen with Graphic Monitor 240 x 64 pixel & 4 lines – 30 or with Touch Screen Panel

8.11 Characters each line with Clear text in station display for various messages & servicing and backlit; Option for a 7"-10" Touch Screen Control Panel should also be available.

8.12 Possibility to enter pin-codes / access code; Speed-dial button for direct dialing of the receiver;

8.13 Telephone type soft membrane key pad.

8.14 Each device is supplied with receiving basket with upholstery and carrier holding rack.

8.15 Each station device is provided with four carriers. These special carriers are with caps for secure use; fully integrated rubber seal; payload up to 2 kg; Impact resistant and crystal clear polycarbonate middle body;

8.16 The device is with integrated radio-frequency identification system

9.0 Horizontal lab receiving Station:

9.1 The station Device for installation in laboratories with much reduced space capacity and always taking in consideration the ergonomically aspect.

9.2 Should conform to EU Director for Electromagnetic tolerance 2004/108/EC; EEC directive for low voltage devices 93/68/EEC; EEC machines directors 98/37/EEC.

9.3 With built-in special turn-around function, the carriers slow down, turn from a vertical position in the station to a horizontal position and roll horizontally in the arrival area.

9.4 Receiving area at 93degrees with 2000mmL; the device should compact size and connected to dedicated and independent powerlines List of approved makes attached

9.5 The device should be wall / table top mountable; Each device should be equipped with state-of-art maintenance free gear drive mechanism & self adjusting optical seals for moving parts for noise-less operations.

9.6 Stations should be equipped with RFID readers for various functions such as Carrier ID and inventory, Carrier ID with properties, permitted addresses or groups, prohibited addresses or groups, automatic destination, reject items not identifiable etc..

9.7 List of approved makes attached

9.8 Should be connected to the network with control cable of high grade composite with grounding, power and data-com all three in one and should be fully screen and use grounded system concept to minimize electromagnetic and radio-frequency interference for LVDC 36V using RS232 to RS485 platform using unicore cable based on RS485

connectivity which provides composite LV power supply and communication.

10.0 Automatic Multi receiving Station:

10.1 The Auto receiving station enables carriers to arrive at the destination from the origin, keeping the sending station free for loading and dispatching the carriers. This station is most suitable for auto receiving in Pharmacy where during peak hours there is heavy inward and outward traffic flow of carriers.

10.2 Should conform to EU Director for Electromagnetic tolerance 2004/108/EC; EEC directive for low voltage devices 93/68/EEC; EEC machines directors 98/37/EEC.

10.3 The device should be wall mountable; Each device should be equipped with state-of-art maintenance free gear drive mechanism & self-adjusting optical seals for moving parts for noise-less operations.

10.4 Stations should be equipped with RFID readers for various functions such as Carrier ID and inventory, Carrier ID with properties, permitted addresses or groups, prohibited addresses or groups, automatic destination, reject items not identifiable etc.

10.5 List of approved makes attached

10.6 Should be connected to the network with control cable of high grade composite with grounding, power and data-com all three in one and should be fully screen and use grounded system concept to minimize electromagnetic and radio-frequency interference for LVDC 36V using RS232 to RS485 platform using unicore cable based on RS485 connectivity which provides composite LV power supply and communication.

11.0 Diverter Units

11.1 The diverter units are switching device used at branching points in

the system to direct the path of the carrier from a single tube at one end to three selectable tubes at the other end. The ends of the diverters should be attached with forwarding tube network using steel clamps that are easily removable during servicing.

11.2 Should conform to EU Director for Electromagnetic tolerance 2004/108/EC; EEC directive for low voltage devices 93/68/EEC; EEC machines directors 98/37/EEC.

11.3 Should be fitted with optical sensor to detect passage of the carrier.

11.4 Should be fitted with moveable tube that gently guides the carrier through the diverter in pre and auto- selected direction. The tube is positioned precisely at the selected port using proximity sensor built-in.

11.5 The divert is enclosed in rigid metal box frame with removable side covers for services with minimized electrostatic interference.

11.6 The device should be wall/ceiling mountable; Each device should be equipped with state-of-art maintenance free gear drive mechanism & self-adjusting optical seals for moving parts for noise-less operations.

11.7 The units should be equipped with state-of-art maintenance free linear gear drive mechanism & self- adjusting proximity digital sensors & noise-less operations.

11.8 Should be fitted with wear resistant gear driven s-section for switching lines; and the diverter unit

11.9 List of approved makes attached

11.10 The unit should have automatic operations as well as via Centralized control centre for smooth receipt of material

11.11 Should be connected to the network with control cable of high grade composite with grounding, power and data-com all three in one and should be fully screen and use grounded system concept to minimize electromagnetic and radio-frequency interference for LVDC 36V using RS232 to RS485 platform using unicore cable based on RS485 connectivity which provides composite LV power supply and communication.

12.0 System Tube Network:

12.1 The network should be of special Imported U-PVC forwarding tubes and bends conforming to DIN6660 for characteristics; Tubes and bends should be smoothly connected with PVC sleeves welded together with special PVC welding glue after cleaning with PVC cleaner. The Tubes and bends should be mounted at site using thread rods & tube clips at every 2 to 3 meter distance.

12.2 Should be touch with low elastic distortion, high abrasive resistance,

12.3 Should be difficult to inflame in accordance to DIN4102 – should only burn when it is decomposed by very high temperatures constantly of more than 180 degrees Celsius – once removed from source of fire the polyvinylchloride extinguishes again.

12.4 The tubes and bends in the network should conform to following specifications:

a.	Physical tensile strength:	55N/mm3
b.	E-module:	3000N/mm3
c.	Resistance to impact:	High resistance at 20 degrees Celsius without breaking
d.	Thermal Coefficient of Linea Expansion:	80 x 10^{-6} K^{-1}

e.	Heat conductivity:	0.16 W/mk
f.	Inherent stability up to:	60 degrees Celsius
g.	Electric surface resistance:	-10^{12}
h.	General average density:	1.38 g/cm3
i.	Absorption of water during 24 hours:	0.03%
j.	Combustability:	Self extuinigishing B1: Difficult to inflame
k.	Tolerance of Diameter:	+0.35 – 0.50mm

13.0 System Control Cable

13.1 The system should have single control cable of high grade composite with grounding, power and data-com all three in one and should be fully screen and use grounded system concept to minimize electromagnetic and radio-frequency interference. Instrumentation wire type 2 x 2 x 0,22 x 1,9², Compatible with system on low voltage supply of 36V for human protection.

13.2 All devices should be connected with LVDC 36V using RS232 to RS485 platform using unicore cable based on RS485 connectivity which provides composite LV power supply and communication to all stations and devices in the network and hence are digital in nature and maintaining a real time live connectivity speed of minimum 70 – 120 devices per second which can be constantly monitored Live and Real Time on the PC monitor. The control cable of high grade composite with grounding, power and data-com all three in one and should be fully screen and use grounded system concept to minimize electromagnetic and radio- frequency interference. Instrumentation wire type 2x2x0.22 x 1.9^2 conforming to CE or EN standards

13.3 List of approved makes attached

13.4 Specifications:

- 4 Core (0.22 SQ MM ABC PE Insulated, polyester taped Cu-Braid & PVC Sheathed)
- +2 core (2.0 SQMM ABC, PVC Insulated)

•Drain Wire (1.50 SQMM)

• laid up collectively Aluminum Polyester tapped and overall PVC Sheathed

Specification		Core		Core Colour	Sheath Colour	Marking Method
Control Cable		7/0.200 mm ABC (Insulation PE)		Red Pink Black Blue	Blue	Ink Black / White
		19/0.36 mm ABC (Insulation-PVC)		Red Blue		
Conductor		Insulation (PVC/PE)			PVC Sheath	
Area mm^2 (Nom)	No./mm	Insulation Diameter (mm)	Nom Thickness (mm)	Min. thickness at any point (mm)	Nom. Thickness (mm)	Min. Thickness at any point (mm)	Overall Diameter (mm)
0.22	7/0.200 mm	1.30+/-0.05 (4C-PE)	0.35	0.25	1.35	0.85	10.0 ± 0.25
		4.80±0.20 (outer Sheath-Grey)	0.60	0.42			
1.80	19/0.36 mm	2.90+/-0.10 (2C-PVC)	0.50	0.35			
Conductor Bunching Lay :7/0.200 ABC - 20 mm (max.), 19/0.36 ABC-60 mm (Max)							
Lay Length : 4C- 100 mm (Max), Over all Laid up Lay-150 mm (Max)							
Polyester Tape : 10X0.025 mm							
Cu-Braiding : 16X5X0.12 mm ATC , Coverage : 75% (Approx)							
Polyester Tape over Braid : 10X0.025 mm							
Drain Wire : 30/0.250 ABC							
Over all laid up lay: 150 mm (Approx)							

Aluminum Polyester Tape : 20X0.050 mm
Polyester Tape : 20X0.025 mm
PVC Grade : Insulation Type 'A' , Sheathing Type ' ST1' to IS: 5831-84
Insulation PE : HDPE

Electrical Properties:

Conductor Resistance at 20°C	7/0.200 mm – 87.6 Max. Ohm / KM 19/0.36 mm ABC - Max. 9.7 Ohm / KM
Wire Elongation	0.200 - 9% (Min) 0.36 - 13.50(Min)
Wire Diameter	0.200 ± 0.01mm 0.36 ± 0.01 mm
High Voltage Test	All specimens to withstand AC 1500V / 1 Minutes
Spark Test	All specimens to withstand 3.0 KV for 0.15 seconds without breakdown.
Insulation Resistance Test At 27°C At 70°C	36.70 Mega Ohm -KM (Min.) 0.037 Mega Ohm-Km(Min)
Volume Resistivity	$1X10^{16}$ Ohm-Cm (Min)

Physical Properties:

T.S and Elongation of PVC Insulation	Before Ageing	Tensile Strength	12.5 N / mm^2, Min.
		Elongation	150% Min.
	After Ageing at 80°± 2° / 168 hours (7 days)	Tensile Strength	12.5 N/mm^2 Min, Variation ± 20% Max.
& Sheath		Elongation	150% Min, Variation = +/- 20% Max.
T.S & Elongation of PE Insulation	Before ageing	Tensile Strength	10.0 N / mm^2, Min.
		Elongation	300% Min.
Loss of Mass Test of PVC	Temp. : 80 +/- 2°C / 168 Hours (7 Days)	2 mg/ cm^2 Max.	
Heat Shock Test for insulation & sheath	Temp.: 150 +/- 2°C / 1hr Mandrel Diameter = 2 to 2.5	The sample shall not show any crack or scale on the surface.	

	times of average diameter of specimen	
Hot Deformation Test for insulation & sheath	Temp.: 80+/-2°C / 4 hr Wt. for Insulation = 100g Wt. for Sheath = 210g	The thickness of sample shall not decrease more than 50%.
Heat Shrinkage Test	Oven Temp.: 150°C +/- 2°C / 15 Minutes.	Max. 4%

14.0 Optical sensor

Switch should be modular and provided built-in various devices. Should be portable in nature, easily replaceable. Should be com-connectable to various devices through the system should have single control cable of high grade composite with grounding, power and data-com all three in one and should be fully screen and use grounded system concept to minimize electromagnetic and radio-frequency interference. Instrumentation wire type 2 x 2 x 0,22 x 1,9^2, Compatible with system on low voltage supply of 36V for human protection.

15.0 Power booster pack:

The system should be with integrated power pack at strategic points; made of plastic case as per IP66/67 rating; 200Va. The power pack should be compatible for activation & de-activation of slave power packs through centralized built-in switch and L/ connection. Each Power pack should be supplied with a separate UPS backup of 500va (power point of 6A with supply will be provided by the institute).

16.0 Carriers or Capsules

These special carriers are with caps for secure use; fully integrated rubber seal; payload up to 3 kg; Impact resistant and crystal clear polycarbonate middle body; With Loading Dimensions of 330mmH x 120mm ID [List of approved makes attached]; with Unique

flip-top or Swivel caps for secure use; Metal-free design through rotation welding procedure; payload up to 3kg; Impact resistant and crystal clear polycarbonate middle body, with integrated radio-frequency identification system. Approx. Fifty percent of the total carriers supplied should be supplied with special design vacuholders for safe holding of sample tubes and approx. twenty percent carriers should be supplied with foam inserts. There should be 4 carriers supplied per station.