HINDUSTAN PREFAB LIMITED

(A Govt. of India Enterprise)
Jangpura, New Delhi-110014

CONSTRUCTION OF 150 BEDDED ESIC SUPER SPECIALTY HOSPITAL AT PANDEYPUR, VARANASI.

TECHNICAL SPECIFICATIONS OF MEDICAL GAS PIPING

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TECHNICAL SPECIFICATIONS

Technical specification of Centralized Medical Gas Pipeline System (MGPS) and manifold Room for ESIC Hospital, Varanasi Uttar Pradesh

SPECIFICATIONS OF MGPS SYSTEM (Medical Gases + Manifold & Vacuum System)

DISTRIBUTION PIPING

1. **Copper Pipe**

Copper pipe should be as per BS:EN 13348:2008/ASTM B819 standard, solid drawn, seamless, deoxidized, non arsenical, half hard, tempered and degreased copper pipe confirming to the standard. All copper pipes should be degreased & delivered capped at both ends. The supply of pipes be further accompany with inspection certificates from manufacturers as well as from third part inspection like Lloyds/SGS/TUV etc.

Pipe sizes to be used should be as under:

Outer Dia.	Thickness(Min.)
12mm	0.6mm
15mm	0.9mm
22mm	0.9mm
28mm	0.9mm
42mm	1.2mm
54mm	1.2mm
76.1mm	1.5mm

1.1 Copper Fittings

Copper fittings shall be made of Copper and suitable of working pressure of 17 bar and especially made for brazed socket type connections. Copper fittings should meets and as per EN 1254 standards.

1.2 Installation & testing

Installation: Installation of piping shall be carried out with utmost cleanliness. Only pipes, fittings and valves which have been degreased and brought in polythene sealed bags shall be used at site. Pipe fixing clamps shall be of non ferrous or non-deteriorating plastic suitable for the diameter of the pipe. All pipe joints shall be made using flux less brazing method. All joints should be made of copper to copper. Adequate supports shall be provided while laying pipelines to ensure that the pipes do not sag. The spacing of supports shall not exceed 1.5 meter for any size of pipe. Suitable sleeves shall be provided wherever pipes cross through wall/slabs. All pipe clamps shall be non-reactive to copper.

1.3 Test

After erection, all the new pipes cleaned or purged with the help of dry nitrogen gas and complete existing and new system will be tested with dry nitrogen at 1.5 times of working pressure for 48 hours.

1.4 Painting & Supporting

Painting: All existing and proposed exposed pipes/should be painted with two coats of synthetic enamel paint & color codification as per **IS 2379:1990**. All concealed pipes to have gas identification bands/labels. At appropriate distance.

1.5 Support

Supports should be provided to ensure that the pipes do not sag. The spacing supports should not exceed. 1.5m for any size of pipe suitable sleeves shall be provided wherever pipe cross through walls/slabs. All pipe clamps shall be non-reactive to copper.

2.0 Oxygen Cylinder Manifold System

Oxygen Manifold System 10+10 size comprising high pressure copper pipe size with high pressure brass fitting made of high tensile brass. NRV and high pressure copper tail pipes. Manifold must be supplied with thirty two numbers each of high NRV and pig tail pipes. The manifold should be so designed that it shall suit easy cylinder changing and positioning. The system should have non-return valves for easy changing of Cylinders and without closing the bank. The cylinder should be place with the help of cylinders brackets and fixing chains which should be zinc plated. Cylinders may or may not be in scope of gas pipe line supplier (please quote the prices/charges of the cylinders separately).

Oxygen Manifold of 2 x 10 cylinders. The manifold should be hydraulically tested to 3500 psig. The high pressure header bar shall be designed in such a manner that it can be extended to facilitate additional cylinder connections.
The manifold should be so deigned that it shall suit easy cylinder changing and positioning. The system should have non-return valves for easy changing of cylinders without closing the bank.

The cylinder should be placed with the help of cylinder brackets and fixing chains which zinc plated.

2.1 Change Over Reduction Box (Oxygen) (IMPORTED)
The Oxygen change over reduction box will be of Digital fully Automatic and shall switch from "Bank in Use" to "Reserve Bank" without fluctuation in delivery line pressure and without the need for external electrical power. After the switch – over, the "Reserve Bank" shall become the "Bank in Use" and the "Bank in Use" shall become the "Reserve Bank". The Change Over Reduction Box will have Power Supply & Signaling Module. The power supply module supplies electric power to alarm system of the reduction box. The signaling module for monitoring the pressure status & will trigger an alarm, if the set limit values are exceed.

All components inside the Change Over Reduction Box like Pressure Regulators, piping and control switching equipment shall be cleaned for Oxygen Service and installed inside the cabinet to minimize tampering with the regulators or switch settings.

The Change Over Reduction Box will be made to provide Heavy Duty and have a Flow meter with measuring range 0 – 1700 Nm^3/min. The safety cover of reduction box is lifted with the help of two dampers. The capacity of reduction box at 4 bar outlet pressure is 175 m^3/h and it have two working reduction valve.

The change over box is equipped with a modern LCD display, LEDs & buttons for easy menu cycling which enable a great overview & easy information monitoring. On display the following parameters can be monitored:-

Visual Light Signaling:- The light of the light emitting diodes can be seen from the distance of 4m, if the illumination of the room is between 1000 & 1500 Lx. In case of an error the LEDs blink with the frequency of 1Hz (0.5s ON – 0.5s OFF). The parameter for the blinking is adjustable.
Buttons :- The buttons are touch – sensitive.
Pressure Transmitter: - Installed in each change – over reduction box is an adjustable pressure transmitter (4 – 20 mA) with ON/OFF switching capability.
Flow Meter: - The alarm system display, with the help of a flow meter, enables or shows :

- Overview of the flow rate statistics
- Current flow rate
- Current consumption
- Monthly consumption
- Setting of the critical flow limit – THE ALARM GOES OFF
- All the values remain stored, even in case of an electrical outage

Unit must have UL Listing/CE notified number on it. System Comply HTM 02-01/NFPA 99C/ ISO 7396. It must be come with serial number, warranty and test certificate from European / American manufacture only

2.2 Oxygen Emergency Cylinder Manifold System
A separate Bank consisting of 4+4 cylinders which shall be connected to the main line through double stage high flow regulators after isolating the control panel to ensure uninterrupted supply of medical oxygen in case of manifold/control panel is in operative. The regulators will have gauge to show the status of standby cylinders and delivered line pressure and have safety valve set to blow at pressure above 70 PSIG.

3.0 Medical Vacuum Plant

Reciprocating Medical Vacuum System
Reciprocating Medical Vacuum System should comply with HTM 02-01/ NFPA 99 C/EN/DIN. The unit shall consist of electric motor driven pumps vacuum receiver, electrical control system and interconnection piping and wiring. The components shall be modularly assembled for easy service.

Vacuum Pump Module

- It should fully comply and meets with the requirements of the standard.
- Designed flow capacity should be minimum 4200 LPM ± 5% variation in Triplex configuration.
- It should be European CE marked/UL listed. The medical vacuum plant shall **comprise Triplex, Reciprocating vacuum pumps** to provide a flow rate of at least **4200 l/min ± 5%as per the relevant standard (i.e. as per HTM 02- 01/NFPA99C/DIN/EN/ISO 7396 standard) to provide the desired flow of the hospital** to maintain a vacuum level of 450 mmHg at the plant connection point.

- The vacuum plant shall comprise Two/four air-cooled; oil lubricated reciprocating vacuum pumps suitable for both continuous and frequent start/stop operation at inlet vacuum levels between 500mmHg and 660 mmHg.
- The control system should normally employ automatic rotation of the lead pump to maximize pump life and ensure even wear.
- Vacuum pump inlets shall include a wire mesh filter and integral non-return valve to prevent oil suck back and pressure increases in the vacuum system.
- Each vacuum pump shall be fitted with anti-vibration pads between the pump foot and mounting frame. The plant shall be fitted with duplex bacteria filter system. Each individual filter shall have the capacity to deliver full design flow such that one set is designated duty and the other will be standby.
- Each bacteria filter shall be provided with a transparent sterilizable collection jar to collect condensate. The total water capacity of the pressure vessels shall be at least 100% of the design flow rate of the plant in 1 minute in terms of free air aspired. The plant control and power management system shall monitor the safe operation of the plant, providing signaling into the alarm system as per the requirements of HTM 02-01/NFPA 99C. Vacuum pump exhaust shall be piped out of the plant room and discharged outside the building at high level away from windows and any other air intakes.

Vacuum Receiver

The vacuum receiver shall be made of rust free corrosion resistant steel and fabricated as per IS:2825 for a vacuum pressure of 760mmHg. It should include bypass valves, manual drain valves, vacuum gauge. Vacuum reservoir shall have total volume of at least 100 % of plant output in one minute in terms of free air aspired at normal working pressure.

Bacterial Filters

The filters should be designed for removal of solid, liquid and bacterial contamination from the suction side of vacuum pump systems, preventing damage to the pump and the potential biological infection of the surrounding environment. The dryer should be particulate filter dryer with ability to remove particles as small as 1micron.

4.0 COMPRESSED MEDICAL AIR SYSTEM

FEATURE

- Breathing air package incl. absorption dryer, pre- and after filter and automatic level controlled condensate drain.
- Guaranteed and validated separation efficiency according to international standards.
- Optimal adaptation and generous dimensioning of the components.

4.1 Air Compressor

- Specifications:

- Air Compressors	:	4 Nos.
- Type	:	Reciprocating,Non-lubricated Double stage.
- Capacity	:	58.00 cfm at 8.5 Kg/Cm2.
- Cooling	:	Air cooled.
- Drive		
- Electric Motor	:	4 Nos.
- Motor	:	15 HP
- Type	:	Induction Motor, TEFC.
- Drive	:	Belt drive.
- Electricity supply	:	440 Volt, 50 Hz. 3 phase.
- Starter	:	Star/Delta Control & Switchgear/L&T Technical with over load protection.
- Air Receiver	:	4000 Ltrs.
- Air Dryer	:	60 cfm
- Filters	:	Three stage

Air Compressors are mounted on base frame. The Compressor shall discharge into the after cooler, moisture separator and then to the air receiver. The Air Receiver is connected to inlet of the Air Dryer and outlet is connected to the hospital pipeline system through pressure regulator-cum-filter. The compressors are air cooled.

4.2 filtration and dryer system

In the case of oil injected compressor, each compressed air system shall be fitted with a multistage air/oil separator, capable of limiting oil carry over to a maximum of 3 ppm to minimize contamination and maintenance.

Duplex desiccant dryer and filtration modules shall be provided with three individual stages of filtration as follows:
Stage 1: Coalescing filter upstream of the desiccant dryer for removing liquid water, oil and oil aerosol down to 0.1mg/cum (0.1 ppm) and particles down to 1micron.
Stage 2: Particulate filter after the desiccant dryer for dust protection and removing particles down to 1 micron.
Stage 3: filter for removing particles down to 0.01 micron.
Bacteria filter:- Duplex bacteria filter system for removing particles down to 0.01 micron and preventing bacterial contamination.

4.3 Air Receiver

Total air receiver capacity shall be at least 3000 Ltr as per the plant capacity in terms of free air delivered at normal working pressure. Each air receiver shall be protected by a pressure relief valve, a fusible plug and include a pressure gauge with isolating valve and a drain cock. It should comply with relevant **IS-2825** Standard.

The plant control and power management system shall monitor the safe operation of the plant, providing signal into the alarm system as per the requirement of the standard and hospital.

4.4 Air Pressure Reducing Station

Pressure Reducing Station for 4 bar and 7 bar should fully comply and meet with the requirements of the standard. Simplex pressure reducing station shall comprise as in-line pressure regulator, with downstream pressure gauge. Isolation valves and pressure release valves should be provided as per the standard.
Duplex pressure reducing station to have two branches, connected to the MGPS in parallel in order to allow maintenance on the components of one branch, while the gas flow is maintained in the other branch.
Ball Valves - Full bore which operate from fully open to fully closed position with a quarter turn of the handle.
Complete pressure reducing station with base plate mounted for ease of installation.
Padlocks available to allow locking of the valves in both open and closed positions and must have easy to read pressure gauges. Base plate mounted and supplied with copper stub pipes for ease of installation using inert Jointing procedures.

The compressor system should have-
Intake filter Check Valve Delivery pipe, Mounting on air tank along with all standard fittings viz. safety valve, pressure gauge, delivery valve, drain valve etc.

Bidder shall provide all electric control panels, starters etc required for proper functioning of motor.
Desiccant Air Dryer – 2 nos.
Twin 3-Stage Breathing Air Filters – 2 sets
Outlet pressures for drills/equipment and ventilators should be a minimum of 7 bar and 4 bar respectively.
The compressor should be heavy duty, reliable with long MTBF. Each compressor cylinder is to be protected by a temperature switch, which will stop the drive motor and provide an alarm signal in the event of abnormal discharge air temperature. Each compressor module should include an inline filter with particle retention of 10 microns, inlet isolation valve, discharge isolation valve, and pressure relief valve. The capacity should be capable to take care of total load of all the outlets.

4.5 Accessories

Accessories including for job site installation such as inlet and discharge flexible connectors,vibration mounting pads, and source isolation valve should be supplied.

5.0 Nitrous Oxide Cylinder Manifold System

N_2O manifold system 3 x 3 size comprising of high pressure copper size with high pressure brass fittings made of high tensile brass, NRV and high pressure copper tail pipes. Manifold must be supplied with four numbers of high quality NRV and pig tail pipes. The manifold should be so designed that it shall suit easy cylinder changing and positioning. The system should have non-return valves for easy changing of cylinders without closing the bank. The cylinder should be place with the help of brackets and fixing chains which should be zinc plated. Cylinders will not in scope of gas pipe line supplier.

5.1 Automatic Control Panel (Nitrous Oxide)

Same as specification of oxygen reduction box.
The capacity of reduction box at 4 bar outlet pressure is 50 m^3/h and should have two working reduction valve.

The Control Panel will be made to provide Heavy Duty with gas heater and have a Flow meter with measuring range 0 – 1700 Nm^3/min. The safety cover of reduction box is lifted with the help of two dampers.

Unit must have UL Listing/CE notified number on it. System Comply HTM 02-01/NFPA 99C/ ISO 7396. It must be come with serial number, warranty and test certificate from European / American manufacture only

5.2 N_2O Emergency Cylinder Manifold System

A separate Bank consisting of two (2) cylinders which shall be connected to the main line through double stage high flow regulators after isolating the control panel to ensure uninterrupted supply of medical gas in case manifold/control panel is in-operative. The regulators will have gauge to show the status of standby cylinders and delivered line pressure and have safety valve set to blow at pressure above 70 PSIG.

6.0 AVSU/Control-Closing Valve Boxes (Integrated Area Alarm)

The purpose of **Control-Closing Valve Boxes** for medical gases is permanent status control of medical gases within the network system installed in a certain building. The boxes are installed in individual floors/area which allows for status control of medical gases throughout the building/floors/area, and shutting-off the supply to individual parts of the building. Also, in case of a central supply outage, they enable emergency supply to individual installation branches.

A detailed view of what is going on with an individual media is enabled by the LCD alarm system display of a rather trendy design. User-friendly menus show the decrease or increase of pressure and the flow rate of an individual medium. The temperature is monitored, as well. The REED switch detects, if the box was opened by force. The REED sensor may also be installed on the valve, giving the valve status OPEN/CLOSED. Any potential fault is accompanied by an acoustic warning and signaled by red LEDs. These errors can also be monitored remotely using the GSS system (CAN-BUS technology) or potential-free contacts. Each box has the capacity to house 1-5 different gases, and may be either surface-mounted or sunken-mounted.

The block of the control-closing box is a connection unit for copper pipes, shut-off valve, emergency supply, pressure transmitter, pressure gauge, flow meter (optional). The box casing should be made of stainless steel sheet metal for long durability for smooth functioning & operation, the entry of inlet & outlet connection of each services should be from top side of the box.

The inlet/outlet pipes are made of copper, with a max. diameter of Ø22 mm. The slotted nut enables visual inspection to determine, if the blocking or the run-through element is installed. The red coin is installed into the block of the control-closing box when performing the installation pressure test. The green coin is installed into the block of the control-closing box when the latter is in operation. Upstream from each individual block there is a shut-off valve which enables the operator to cut-off the supply to a specific section / floor of the building. The emergency supply connection port may be used in case the central supply fails. The port is installed at buyer's option. (NIST, DISS), The pressure transmitter translates the gas pressure into an electrical signal which is then relayed to the block connection module. The installed pressure gauge enables visual pressure monitoring. The flow meter measures the quantity of the gas flow within the gas installation system.

The valve box should have a lockable door (hinged on top) of valve box with a 4mm thick tempered glass installed on door should be opened upwards for easy maintenance access. In case of an emergency the door can be opened by force (**hit the lock**) without damaging the glass.

In the lower section of a control-closing box there is a power supply module which connects to: MAINS SUPPLY,CONNECTION OF PRESSURE TRANSMITTERS (4-20mA), CONNECTION OF FLOW METERS, CONNECTION OF REED CONTACTS,CONNECTION OF POTENTIAL-FREE CONTACTS,CAN – BUS.

Signalling: The light of the light emitting diodes can be seen from the distance of 4 m, if the illumination of the room is between 1000 and 1500 Lx. In case of an error the LEDs blink with the frequency of 1 Hz (0.5 s ON – 0.5s OFF). The parameter for blinking is adjustable. The LEDs give the following warnings:

- ALARM SYSTEM DISPLAY CONNECTION FAILURE/
- ON/ OFF ALARM DISPLAY FAULT
- PRESSURE TOO LOW
- PRESSURE TOO HIGH
- NORMAL PRESSURE

The alarm system incorporates a touch sensitive display which enables easy “Menu cycling”, and with the help of a flow meter (**optional**), enables or shows: Overview of the flow rate statistics, Current flow rate, Current consumption, Monthly consumption, and at the time of setting of the critical flow limit – THE ALARM GOES OFF and all the values remain stored, even in case of an electrical outage.

Unit must have UL Listing/CE notified number on it. System Comply HTM 02-01/NFPA 99C/ ISO 7396. It must be come with serial number, warranty and test certificate from European / American manufacture only

7.0 Gas Terminal Unit

The medical gas terminal unit HTM compliance (should conform to ISO 9170-1:2006 or above and accept probes to BS 5682) or NFPA99 Compliance. The wall mounted first fix assembly should consist of brass pipeline termination

block with copper stub pipe permanently secured between a back plate and a gas specific plate which allows limited radial movement of the copper stub to align with the pipeline.

Terminal units should be gas specific and only accept the correct medical gas probe. Gas specific components should be pin-indexed or geometric indexed to ensure that a correct gas specific assembly is achieved so that in normal course of dismantling for repair or maintenance, parts from other gases cannot inadvertently be used. Wall mounted terminal units should incorporate an anti-rotation system to engage with connected downstream medical equipment ensuring correct orientation. Terminal units installed in booms or pendants should be attached to their respective flexible gas hose by a gas specific NIST fitting and anti-rotation pins should not be fitted. Terminal units located in a rigid installation should be capable of single-handed insertion and removal of the correct medical gas probe.

Main feature of Gas outlet are as:-

- Main constituent parts made of metal
- Less components used
- Smooth connection and disconnection

The above specifications are in general, however as mentioned above each part should strictly meet either of the HTM 02-01/EN737/NFPA 99C/ISO 7396 (Latest Version)

Unit must have UL Listing/CE notified number on it. System Comply HTM 02-01/NFPA 99C/ ISO 7396. It must be come with serial number, warranty and test certificate from European / American manufacture only

8.0 Ward Vacuum Unit

The ward vacuum unit should be designed for minimum servicing and high efficiency. Vacuum unit should have capacity of 600 ml wall mounted jar. Some of the features of the product include:

- Regulator body, which houses an on/off switch, regulation knob, vacuum gauge graduated in mbar.
- The on/off switch allows the operator to start or stop suction by turning the switch.
- With regulation knob operation, knob operator can set the necessary vacuum amount.
- The jar is made of polycarbonate transparent and unbreakable autoclave up to 121 *C.
- Well proven fluid control trap (safety) fitted on the unit automatically and efficiently shut off vacuum fully, while preventing the transfer of liquid to the vacuum regulator, pipeline and pump.
- Unit should be equipped with an additional minimum **120 ml polycarbonate safety jar** with safety trap filtration system of hydrophobic filter.

9.0 Oxygen Flow meter with Humidifier Bottle

Back Pressure Compensated flow meter should be of accurate gas flow measurement with following features:

A) Control within a range of 0-15 LPM.
B) It should meet strict precision and durability standard.
C) The flow meter body should be made of brass chrome plated materials.
D) The flow tube and shroud components should be made of clear, impact resistant polycarbonate.
E) Flow tube should have large and expanded 0-15 LPM range for improved readability at low flows.
F) Inlet filter of stainless steel wire mesh to prevent entry of foreign particles
G) The humidifier bottle is made of unbreakable & reusable polycarbonate material autoclavable at 121 °C.
H) Humidifier Bottle should be covered under warranty.
I) Unit must be manufactured under ISO – 13485 compliance and also compliance of CE accordance.

10.0 Bead Head unit

It should provide a safe efficient means of delivering services to patients staff in both general and special care applications, it is modular design made of high strength extruded Aluminum with anodized finish, and ability to house medical gas terminal units (as per Requirement) and electrical socket , smooth curved surfaces, no visible screws and choice of colored décor stripe, ease of installation via separate rail-bracket or wall mounting plates, easy removal of covers for maintenance and pipeline connection, with integral medical rail as part of the modular extrusion design. Unit must be manufactured under ISO – 13485 compliance and also compliance of CE accordance. It has segregation of services i.e. extra low voltage, normal voltage and medical gases should be maintained throughout. It has separate compartment (dual compartment) for both electrical and gases services according to medical conformity.
Its aluminum extrusions have a polyester coating finish on all external surfaces before installation. It have provision for nurse call, data or monitoring sockets, should be made at the point of manufacture .It should be supplied duly prepiped , prewired and fully tested or in carcass form.
Each Horizontal Bed Head Panel shall be having-

- Provision of gas outlet as distribution list.

- Provision for 6 nos.multipin 6-16 Amps, switch socket outlet combine, 1no. appropriate MCB or as directed by user/client.
- Equipped with One. No. of each – SS utility basket, IV Pole, Infusion Rod.
- It should be 1200-1500 mm long as required to fulfill user requirement.
- provision for nurse call as required

Electrical connection from main supply to Bed head unit in not part of contractor scope. It will be dine by user department by its own resources. Only internal wiring within unit is in scope of contractor.

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11.0 Theatre Suction unit

A sturdy trolley with castor base complete with angled high suction controller. The unit should be powered from the medical vacuum supply and with 3 meter of vacuum hose and matching probe suitable for vacuum outlet. It should have two secretion jars with below mentioned specifications.

Suction Jars should have the following:

The 2000 ml + 2000ml. Suction Jar made of polycarbonate should be capable to autoclave up to 121 *C. All seals and splatter tube should be designed for long life. The overflow trap in the jar should be designed to ensure maximum efficiency in preventing overflow.

12.0 Isolation valve

All valves are to be ball valves, with stainless steel balls and PTFE or Teflon seals.

They shall be suitable for a working pressure of 10.2 Kg/cm² gauge. Pipelines must be properly secured by holder bats in close proximity to the and on either side of each valve.

Valves tendered for shall be submitted for approval to the Department prior to installation

13.0 Master Alarm (Imported)

Master gas alarm should be able to communicate with **all gases plant equipment** in manifold room/plant room. Should able to connect with LAN network as directed by EIC.(cost for LAN networking connection paid extra as required after approval). Alarm should have this main function/indication for alarming.

RIGHT – the right side is empty or full.
LEFT – the left side is empty or full.
HIGH – the working pressure is too high – red light
LOW – the working pressure is too low – red light
OK – the working pressure is – green light
OK – green light
RESET – is used to discontinue the sound alarm
TEST – is used to control & Check the alarm

Unit must have UL Listing/CE notified number on it. System Comply HTM 02-01/NFPA 99C/ ISO 7396. It must be come with serial number, warranty and test certificate from European / American manufacture only

14. AGSS (Anesthetic Gas Scavenging System) Plant –2000 LPM)

Duplex Anesthetic Gas Scavenging System (AGSS) of 2000 l/min. should be confirmed to HTM 2022/02-01/ NFPA 99 C/EN/DIN.

Duplex AGSS System with twin stand alone AGSS pumps of 3 phase 2000 l/min capacity each with built in flow indication and pressure regulation valve. It should be mounted on single frame with control panel and separate warning label. One pump working and one stand by and vice versa. The package should consist of two rotary vane vacuum pumps, a control panel, and mounted on a common base frame.

AGSS pump: AGSS pump shall operate completely dry permanently lubricated and sealed. Each pump should be completely air cooled and have absolutely no water requirements.

Control System: The duplex control system should conform to International Standards. The control system should 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 and audible reserve unit alarm with isolated contacts for remote alarm. Should be in duplex format and must be chassis mounted ready for installation. Duplex system in-line non-return values should allow individual pump servicing. Active anesthetic gas scavenging systems should be designed to safely remove exhaled anesthetic 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. AGSS design should be dependent upon flow rate and pressure drop characteristics of the individual components of a systems, it is essential that terminal units, remote controls and pump units. AGSS Remote Control indicator must be provided for each OT with the system

15. Electrical Control Panel for Air and Vacuum Plant System

Electrical control panel is made of MS Sheet having thickness 16 SWG and should be epoxy powder coated. The electrical control panel would be equipped with auto manual selector, 4 no. Star-Delta starters each compatible to 15 HP motors for compressors and 3 nos. DOL starters compatible to 10 HP each electric motor for Vacuum pumps.

The electrical control panel would be further equipped for duplex/cascade system for vacuum pumps & Air Compressors and also equipped with safety equipment for the air compressors & vacuum Pump like Phase preventer, Phase correcting relays additional MCB for operating other general equipment.