



REPUBLIC OF KENYA

**DIRECTORATE OF PUBLIC WORKS**

**PROPOSED MEDICAL OXYGEN PRODUCTION PLANT FOR  
GARBATULLA SUB- COUNTY REFERRAL HOSPITAL**

**TENDER DOCUMENT**

ICG/019/2017-2018

ISSUED BY:  
COUNTY WORKS OFFICER,  
MINISTRY OF PUBLIC WORKS  
P.O BOX 38,  
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ISIOLO COUNTY GOVERNMENT  
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**23<sup>RD</sup> February, 2018**

## MEDICAL OXYGEN PRODUCTION PLANT

### 1.00: DESIGN CONDITIONS

Oxygen residual in product Gas	Approx. 95 Vol.% +2%
Design production capacity	Approx 5.0 Nm <sup>3</sup> /h
Product delivery pressure	Approx 6.1 bar (g)
Design air feed pressure: (At PSA feed skid boundary)	Approx 7.5 BAR (G)
Atmospheric dew point product	≤-40 <sup>0</sup> C
<b>CUSTOMERS OXYGEN CONSUMPTION PROFILE</b>	
Average oxygen consumption	N/A
Peak consumption	N/A
Duration peak consumption	N/A
<b>DESIGN AMBIENT CONDITIONS</b>	
Air temperature	At least 20 <sup>0</sup> C
Working ambient temperature	+5 <sup>0</sup> C-+40 <sup>0</sup> C
Elevation	300m above sea level
Relative humidity	65%
<b>FEED AIR REQUIREMENT</b>	
Consumption	55,9Nm <sup>3</sup> /h
Pressure	10bar (g)
temperature	20 <sup>0</sup> C
Hydrocarbon content	<5ppm
Particles	<5mg/m <sup>3</sup> @max.3
Dew point	<-20 <sup>0</sup> C@1 bar(a)
<b>UTILITIES / SITE CONDITIONS</b>	
Power supply	240v/50Hz, 3-phase 415v/50Hz
Area rating	Unclassified areas
Location	Indoors
Max Noise level LEQ	61, dB (A)
Air compression equipment	Yes
Oxygen and air storage tank	Yes
O <sub>2</sub> Compression	Yes

## **PLANT CONFIGURATION**

### **2.1 SYSTEM COMPONENTS**

In order to operate the medical oxygen plant automatically, the following utilities and components will be installed for good operation and long life cycle:

#### **2.1.1 Air compressor (1)**

Fixed speed screw compressor.

- Oil injected, air cooled, CE approved.
- Ready for connection and operation.
- Vibration – isolated mounted on base frame for foundation free installation.
- Hinged and removable enclosure side doors to allow complete access to all service points.
- Energy efficient integrated compression element assembly.
- Air / oil cooler combination.
- Discharge pressure relief valve
- Air intake filter and suction regulator.
- Lubrication system oil filter
- Microprocessor based control and monitoring system
- Star delta starter incorporating main, star and delta contactors
- Compressor should be self-resetting after power failure

#### **2.1.2 Air receiver (1)**

Vertical carbon steel pressure vessel with approx 500 liters capacity, including security safety valve, electronic manual drain valve and pressure gauge.

#### **2.1.3: Air filters (1set)**

In order to guarantee the good working and low degradation of the PSA, include a set of high efficiency and appropriate filters. These filters should have a very low pressure drop and prepare the oxygen generator to receive air with very high quality.

#### **2.1.4 Air dryer (1)**

In order to supply dry air to oxygen concentrator, a high efficiency fridge must be included with automatic drain of condensates. The dryer should be able to work up to 70<sup>0</sup>c inlet air temperature.

### **2.1.5 Oxygen generating machine (1)**

The oxygen concentrator typically contains process components including

- Applied technology PSA

**Applied system: Modular Adsorption towers, with possibility to add modules at installation site in order to increase plant capacity.**

- Adsorption towers to be made of aluminum
- All piping to be made of stainless steel or galvanized steel.
- Total height of plant not to exceed 1,750mm

**Oxygen outlet pressure to be 6 bar**

- Air inlet and oxygen outlet connection to be located on same side of the plant to allow corner installation.

**External inlet process air filters for removal of particles oil vapor and condensate.**

**No process piping inside electrical box admitted.**

**Oxygen analyzer to interface with PLC in case of low O<sub>2</sub> purity.**

- Series of PSA banks, made of aluminium each existing of two filled with molecular sieve.
- Waste gas silencers, sized to muffle vent gas to design noise levels.
- Control cabinet, including process controller (PLC, Allen Bradley or Siemens)
- Set of electro-pneumatic valves and throttles
- Interconnecting piping electrical and instrumentation
- Safety valves set at appropriate pressure level.
- All piping, valves and instrumentation to be mounted in a carbon steel cabinet.
- Performance test and report prior to shipment.
- Zirconium cell base oxygen analyzer with digital display(0-95%)
- Electronic product flow meter (0-12NM<sup>3</sup>/h)
- 93/42/EEC certification for production of medical oxygen

### **2.16 oxygen buffer tank (1)**

Oxygen buffer tank 1500 liters with internal special treatment for oxygen use.

External coating with epoxy end painting, including oxygen security valve and pressure gauge

- Vertical carbon steel pressure vessel.
- Safety valves set at appropriate pressure level
- Volume 500 liter

- Working pressure 11 bar (g)

### **2.1.7 High pressure oxygen compressor (1)**

One high pressure oxygen compressors combined for filling up to 16 cylinder of 40l or 12 cylinders of 50l at 120 bar (g). The high pressure oxygen compressors operates fully automatically

- Max flow rate per unit 0.8-3.2Nm<sup>3</sup>/h
- Max discharge pressure 120 bar (g)

### **2.1.8 Cylinder filling manifolds (1)**

The oxygen plant should include one oxygen cylinder filling manifold, capable to fill cylinders from the standard 50 litres (or small size 40l) (other sizes as option)

- Number of seats: 6

## **3.1 MEDICAL DEVICE CERTIFICATION**

The complete plant pursues a medical device certification that guarantee to the end users that it produces medical oxygen according to ISO 10083: 2006 and international pharmacopoeia. The plant should be classified as a medical device class IIb according to MEDDEV and comply with the essential requirements of the European Directive.

93/42/CEE and is designed to provide oxygen with medial quality not industrial quality.

The complete package is labeled with CE medial Mark, CE- 0120 by SGS-UKASA – England.

## **3.2 Engineering services.**

- Provide startup, operating and maintenance procedures in English.

## **Training services on site.**

The supplier should provide training for technical personal for normal period of not less than (2)days on site at no additional charge. Training will consist of operation of the unit as well as maintenance of the system.

## **CUSTOMER SCOPE OF STUDY**

**3.33** phase and 1 phase power should be readily available on site

#### **4. MAINTENANCE PLAN**

The manufacturer must provide maintenance plan for:-

##### **4.1 Basic replacements**

##### **4.1.1 Oxygen concentrator**

##### **4.1.2 Air compressor**

##### **4.1.3 High oxygen compressor**

##### **4.1.4 Gas alarm is required to be at:**

- Theater – master
- Engineering – slave
- New born – master

N.B: Installation of 3 phases to the site (4core – 10mm<sup>2</sup> cable)

ITEM NO	DESCRIPTION BILL OF QUANTITY	UNIT	QTY	RATE	AMOUNT KSHS
1	<p>Medical oxygen plant and filling system.</p> <ul style="list-style-type: none"> <li>• OGP 6/50 90 LPM based on pressure saving adoption (PSA) technology producing oxygen at part of use with a purity of 95% + 3% with filling ramp fully compliant ISO 10083: 2006.</li> <li>• 90 litres / minute 3.2 CFM oxygen output capacity.</li> <li>• DD35 + pre filter</li> <li>• PD35+ after filter</li> <li>• QD45+activated carbon filter</li> <li>• With automatic start /stop</li> </ul>	NO	1		
2	<p>Cylinder filling ramp Semi automatic module consisting high pressure oxygen compressor flow 1.7 to 3.2 Nm<sup>3</sup>/h, discharge pressure 150 bar. Filing capacity of filling ramp for 6 cylinders at a go. NB: All components are bolted on the base frame / steel plate.</p> <p>Cooling: Air cooled pressure vessel approval CE/ASME Refrigerant: CFC free R134a, 500 litre 11 bar air receiver tank</p> <p>Air compressor</p> <ul style="list-style-type: none"> <li>• Air cooled – oil injected rotary screw air compressor, completewith integrated refrigerant air dryer.</li> <li>• Microprocessor based control and monitoring system</li> <li>• Enclosed in sound – insulated body work</li> <li>• Condensate trap with electronic water drain (EWD)</li> <li>• Noise level 61,db (A)</li> <li>• Cooling: air cooled</li> <li>• Self starting after power failure</li> <li>• Discharge pressure relief valve</li> <li>• Dew point + 3Deg C.</li> <li>• Compressor rating 9KW.</li> </ul> <p>Air drier. Refrigeration dryer with automatic condensate drainers</p> <p><b>Total carried to grand summary page</b></p>				

ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT KSHS
	<b>Copper pipes and fitting as follows</b>				
1	Copper pipe 22mm	LM	30		
2	Copper pipe 15mm	LM	1580		
3	Out let	NO	83		
4	Alarm	NO	3		
5	Line valve	NO	18		
6	Elbows 15mm	BO	1900		
7	Equal "T"	NO	906		
8	Coplars	NO	500		
9	Reducer 15x12mm	NO	95		
10	Pressure switch	NO	1		
11	Adaptor 'T'	NO	1		
12	Mounsem ring	NO	410		
13	Housing – kers	NO	390		
14	Thread rods 15/45m	NO	15		
15	Plastic lamps	NO	100		
16	Elbow 22mm	NO	6		
17	Equal 'T' 22mm	NO	1		
18	Reducer 22mm	NO	2		
19	Reducer 15mm	NO	2		
20	Supply of Oxygen twin flow metres complete set with humidifier	NO	41		
21	Copper pipe 12mm	LM	172		
22	Supply oxygen cylinders for emergency 3.6 cub m	NO	12		
	Total carried to grand summary				
	<b>Install, test and commission the plant and pipe works</b>				



ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT KSHS
	<b>PLANT HOUSING</b>				
	<b><u>ELEMENT NO.1</u></b>				
	<b><u>SUBSTRUCTURES</u></b>				
	<b><u>(ALL PROVISIONAL MEASURED)</u></b>				
	<b><u>Note: this element comprises all works up to including the concrete surface bed.</u></b>				
	<b><u>Earthworks &amp; excavations.</u></b>				
A	Excavate to remove clay soil	CM	67		
B	Excavate surface trench not exceeding 1.5meters deep starting from reduce level	CM	4		
C	Cary away surplus excavated materials away from site.	CM	67		
	Filings				
D	Approved hardcore fillings well watered rolled and compacted in layers not exceeding 150mm thick.	CM	44		
E	Selected earth filling.	CM	4		
F	50mm thick murrum blinding on surface for hardcore	SM	37		
G	Treat ground with approved anti-termite fluid in accordance with manufacturer instruments.	SM	42		
	<b>Total carried to collection .....</b>				

ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT KSHS
	<b><u>Substructures (continued)</u></b>				
	<b><u>Plain concrete (1:4;8) in:-</u></b>				
A	50mm thick blinding to foundation bases	SM	15		
	<b><u>Concrete (1:2:4) in:-</u></b>				
B	Foundation	CM	3		
C	100mm thick floor slab	SM	42		
	<b><u>Steel reinforcement</u></b>				
	<b><u>Supply and including all necessary tying wires and spacer blocks</u></b>				
D	10mm Ditto	KG	50		
E	8mm ditto	KG	35		
F	A142 – BRC fabric mesh reinforced	SM	42		
	Sawn formwork to:-				
G	75 to 150mm high	LM	26		
	<b><u>Damp proof courses</u></b>				
H	200mm wide horizontal bituminous laid and bedded in cement mortar 1:3	LM	15		
	<b>carried forward to page /2</b>				

ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT KSHS
	<b><u>ELEMENT NO.1 (CONTD)</u></b>				
	<b><u>DAMP PROOF MEMBRANE</u></b>				
	<b><u>VIBRATED REINFORCED CONCRETE (1:2:4) IN:</u></b>				
A	1000 gauge polythene	SM	42		
	<b><u>Quarry stone walling polythene sheet</u></b>				
B	200mm walling	SM	25		
	TOTAL				
	Brought forward from page / 1				
	Brought forward from page / 2				
	Brought down from above				
	Total carried to summary .....			<b>KSH.</b>	

ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT KSHS
	<b><u>ELEMENT NO. 2 WALLING</u></b>				
	<b><u>Vibrated reinforced concrete (1:22:4) in:-</u></b>				
A	Ring beam concrete	CM	1		
	Steel reinforcement including bending and tying wire				
B	12mm diameter high yield square twisted bars	KG	75		
C	8mm diameter mild round bar	KG	52		
	<b><u>Dressed quarry stone walling in cement sand mortar 1:4:-</u></b>				
D	150mm thick walling	SM	45		
E	Extra over walling for horizontal and vertical joints and keying	SM	45		
	<b><u>Sawn form works to:-</u></b>				
F	Sides and soffits of ring beam	SM	10		
G	150mm thick precast concrete vent block walling jointed in cement mortar 1:3	SM	12		
	<b><u>METAL CAGE</u></b>				
	<b><u>Mild steel metal frames all welded and smooth grounded</u></b>				
H	40x25x3mm rectangular hollow section rails	LM	20		
I	75x50x3mm RHS bearer	LM	12		
J	75x75x3mm SHS steel posts	LM	16		
K	Paint to steel members	SM	10		
	<b>TOTAL FOR CARRIED TO SUMMARY.....</b>			<b>KSH.</b>	

ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT KSHS
	<b><u>ELEMENT NO. 3</u></b>				
	<b><u>ROOFING</u></b>				
	<b><u>Covering</u></b>				
A	28gauge is prepainted G.C.I sheet fixed on timber purlins (measured separately) with two corrugated side laps 75mm end laps (measured net).	SM	73		
B	Ditto for ridge cap	LM	8		
	<b><u>Sawn celcuredcypressor other equal and approved.</u></b>				
C	100x50mm wall plate	LM	27		
D	100x50mm rafters	LM	60		
E	75x50mm purlins	LM	99		
F	10x50mm tie beam	LM	26		
G	75x50mm ties and starts	LM	43		
I	200x25mm fascia &berge board	LM	47		
	<b>TOTAL CARRIED TO COLLECTION PAGE .....</b>				

ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT KSHS
	<p><b><u>ELEMENT NO.4</u></b></p> <p><b><u>DOORS</u></b></p> <p><b><u>METAL DOORS</u></b></p>				
A	Door size 1200x2100 thigh metal door complete with framing and 5 lever union lock	NO	2		
B	Ditto size 900x2100 complete with framing and five lever union lock	NO	1		
	<b>TOTAL CARRIED TO SUMMARY .....</b>				

ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT KSHS
	<b><u>ELEMENT NO.7</u></b> <b><u>FINISHES</u></b>				
	<b><u>cement and sand 1:3</u></b> <b><u>finished smooth</u></b>				
A	25mm floor screed	SM	40		
B	25x100mm skirting.	LM	23		
	<b><u>Internal two coat cement and sand plaster (1:4)</u></b>				
C	12mm finish to walls.	SM	50		
D	Ditto externally to beams and walls	SM	55		
E	Plaster plinth	SM	13		
F	50mm thick precast concrete paving slab on 50mm thick sand	SM	17		

ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT KSHS
<b><u>ELEMNT NO. 6 PAINTING</u></b>					
A	Prepare and apply three coats plastic emulsion paint to walls internally	SM	50		
B	Ditto externally	S M	55		
C	Ditto vent block walling	SM	24		
D	Ditto gloss painted to wood and metal surfaces	SM	26		
E	Ditto bituminous paint to plinths	SM	13		
F	Provide a sum of shillings one hundred thirty four thousands				
<b>TOTAL CARRIED TO SUMMARY .....</b>					



ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT KSHS
	<b><u>PLANT HOUSING</u></b>				
1	FROM PAGE 3				
2	FROM PAGE 4				
3	FROM PAGE 5				
4	FROM PAGE 6				
5	FROM PAGE 7				
6	FROM PAGE 8				
7	FROM PAGE 9				
8	SUB – TOTAL				

**BILL OF QUANTITIES**

**ELECTRICAL INSTALLATION WORKS TO PROPOSED OXYGEN PLANT ROOM – GARBATULLA  
SUB-COUNTY HOSPITAL.**

ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT KSHS
	<b><u>SUPPLY, INSTALL, TEST AND COMMISSION THE FOLLOWING ITEMS</u></b>				
	<b><u>LIGHTNING POINT</u></b>				
A	Lightning points wired in 3x1.5mm <sup>2</sup> S.C/PVC cables (EA) drawn in concealed 20mm HG PVC conduit inside ceiling complete with all necessary accessories but excluding switches and fittings.	NO	9		
B	10 AM Molded ivory switch plate as mem or approved equivalent.				
	a) Two gang 2 way	NO	0		
	b) 1 gang one way	NO	0		
	c) 1 gang 2 way	NO	3		
	<b><u>LIGHTING FITTINGS</u></b>				
C	1200mm fluorescent fitting as thorn or approved equivalent complete with tube	NO	5		
D	100w bulkhead (metallic) as thorn or approved equivalent / w energy saver bulb.	NO	4		
	<b><u>SOCKET OUTLET AND POWER POINTS</u></b>				
E	Socket outlet point comprising wiring in 3x2.5mm SC cables (E.A) drawn in concealed 20mm HG Conduit.	NO	3		
F	13 A-2 Gang switch molded socket outlet plate as mem or it's approved equivalent.	NO	3		
	<b>SUB TOTAL</b>				

ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT KSHS
	<b><u>CONSUMER UNIT / DISTRIBUTION BOARDS</u></b>				
G	6 ways 3 phase distribution board as mem or its approved equivalent	NO	1		
H	6A SPMCB for above	NO	2		
I	32 SP MCB for above	NO	3		
J	60amps MCCB for above	NO	2		
	<b><u>SUB – MAIN CABLES</u></b>				
K	4x10.00m <sup>2</sup> single core copper cables drawn inside 32mm HG PVC conduits	M	20		
L	Allow for power supply from nearest power point using 10.0mm <sup>2</sup> x 4 core underground cable	M	30		
M	Allow for loop in box 16g complete with 3 cut-outs and one with neutral link	NO	1		
N	1500mm earth rod for above with earth lead	NO	1		
O	Allow for testing				
	<b>GRAND TOTAL FOR ELECTRICAL WORKS</b>				

ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT KSHS
	<b><u>PC AND PROVISIONAL SUMS</u></b>				
A	Allow a provision sum of Ksh. 1,000,000 for contingencies				1,000,000
B	Allow a sum of Ksh. 500,000 for project management				500,000
	<b>TOTAL P.C &amp; PROVISIONAL SUMS CARRIED TO GRAND SUMMARY .....</b>				

**PROPOSED MEDIAL OXYGEN PRODUCTION PLANT FOR GARBATULLA SUB- COUNTY REFERRAL HOSPITAL**

**GRAND SUMMARY**

ITEM	DESCRIPTION	FOR TENDERERS USE ONLY (KSHS)	OFFICIAL USE ONLY (KSHS)
1.	MEDIAL OXYGEN PLANT WITH FILLING RAMP		
2.	PIPE INSTALLATION		
3.	PLANT HOUSING		
4.	INSTALLATION AND COMMISSION		
5.	ELECTRICAL WORKS		
6.	PC AND PROVISION SUM		
7.	SUB – TOATL (A)		
8.	ADD 16% V.A.T OF SUB – TOTAL (A)		
9.	<b>GRAND TOTAL CARRIED TO FORM OF TENDERS</b>		

Amount in Words.....

Tenders signature and stump.....

Name.....

Name of witness.....

Signature.....

Address .....