THE PRODUCT

**First: General**

The V:'or hall include \he design, installation, supply, erection, setting to work, testing and ommIs\_sIonIng, and handing over of the Pneumatic Tube Conveyor System to form **a** complete In tallat1on as scheduled and in accordance with the Subcontract documents and in full compliance with all relevant standard:; and the acceptance of the Jordanian Civil Defence Codes.

Second: **MATERIALS**

1. Pneumatic Tubework
	1. All tubework shall be 160mm bore, polished self-extinguishing hard PVC to specification DIN 8061/ 62 Group B1 materials, with minimum wall thickness of3mm.
		1. Pneumatic tube minimum centerline bend radius shall be800mm.
		2. Tubework shall be suitably supported by hangers attached to concrete slabs.
		3. The maximum distance of hangers shall not exceed 3m, bends to be supported on both ends.
2. Transportation Carriers
	1. Carriers shall be clear view, both sides and opening with swivel topseals.
	2. RFID tags to be integrated on both ends for bi-directional operation. The carriers with a nominal 150mm external diameter and internal length 400mm shall be capable of being cleaned at least weekly by the following means.
		1. Washing in cold water containing disinfectant.
		2. Irradiation by gamma-rays of 2.5 mega rads (maximum 20 minutes) Gassing with eU1ylene oxide.
		3. Carriers shall be provided per each station, each carrier to be furnished with 2 RFID based identification tags.
	3. Nominal carrier size shall be 400mm long x 115mm diameter. To enable cleaning or disinfecting of the total system internal surfaces.
	4. Provide 1No. swab carrier complete with replaceable internal sponge.
3. Turbine Vacuum/ Blower Units
	1. Blowing or sucking of carriers shall be propelled by adequately sized 3 phase AC motor driven turbines operated by frequency converter for software adjustable air flow. Starting, direction of travel of air, overload and transmission of basic fault signal shall be connected to the main system controllers. ·
	2. Each turbine if the system needs more than one shall be fitted with a 3 way reversing valve to implement the three vacuum, pressure and air cushion modes of operation. The design shall permit immediate air reversal for each mode and shall automatically zero position for pneumatic deceleration. ·
	3. The turbine impellers shall operate within an airtight alloy housing free of casting defects. The drive motor shall be directed coupled to the turbine shaft. Bearings shall be of the sealed for life type adequately sized for the load imposed.
	4. The turbine shall contain a built-in silencer along with a connection socket for fresh air suction. Provide filters to the inlet and outlets of each turbinesystem.
		1. The minimum blower size allowed shall be2kW.
		2. Slow speed reduction via active air flow control by frequency converter device shall be incorporated into the turbine system for each zone.
4. Carrier Diverting Stations
	1. The diverting stations shall be fully automatic and shall have dedicated electronic control cards lo allow information transfer between the station and the main controlunit.
	2. The control cards shall provide diverter motor overload protection. Power supply voltage boosting shall be provided as part of this Subcontract.
	3. Diverter motors sha:I be of the industrial type selected for heavy-duty operation. Durabel Teflon

bushing and mounts shall be incorporated in the units. Operation shall be virtually noiseless to persons in immedia:e vicinity.

4, Diverter units shall be positioned such that easy access is available for routine maintenance and repair without the necessity of undue removal of building elements.

1. Local Terminals (Stations)
	1. The local terminals shall be for surface installation to the wall.
	2. To provide a user-friendly operation. This device must be design in such that the user can load the carrier directly in an opening on the front of the station without the need to open any doors or similar. It is acceptable that a carrier for send has to be loaded via a storage device (similar to tube funnel) on the top or bottom side of the station housing.
	3. Only stations which provide a user friendly load entry height of approximately notlesthan 100cm above floor level are acceptable and stations shall be capable of transporting carriers within a

 nominal 160mm diameter tube.

* 1. Each loca\_l terminai shall be fu\ly equipped with all accessories, e.g., basket & carrier storage rack. required for·ncr.n.:il operation of the system.
	2. Power supply voltage boosting shall be provided as part of thisSubcontract.
	3. Each terminal shail have a processor to control system operation. The user interface shall incorporate a keypcd with background lighted graphic LCD display for operator guidance, warning and sta:u:; rr..::ssages.
	4. The loading and disc arging of carriers shall be automatic.
	5. The sy tem shall be capable of transporting multiple carriers gently discharged into a basket for convenient collect,on:
	6. Each station must be furnished with a minimum of 2 separate RFID readers, one in the send compartment to ,ead carrier ID a second in the keyboard to read Smart Cards within approximately 15cr. distance limit.
	7. The station user inte: face must indicate the arrival and retention of such secured carriers at the station.
	8. Arrival of a carrier .at a local terminal will be signified by an audio/ visual alarm/ indication light. Up to eight personal identifiers shall be provided for each local terminal to enable specific alarms for individua l users.
	9. Operating instruc!ior.s in Graphical and Typeset form shall be displayed at each station. Such instructions shall be permanently attached in durable material in an easily readable location.
1. Electrical Wiring - General
	1. All wiring shall be carried out using PVC insulated cabling. Cables shall be or sufficient size to prevent excessive voltage drop and shall terminate in plugs or terminalclips.
		1. Turbine Plant Room Wiring
			1. All plant *room* wiring shall be run in heavy duty conduit or ducting systems installed to ensure rigidity and located to avoid damage.
			2. Plant room.duct shall be located overhead.
			3. Connection between ductwork and other equipment where vibration may occur or adjustmer.t is required shall be by flexing piping or conduit.
		2. General Wiring
			1. Where e>1:po1:.ed to damage, cables shall be enclosed in metal or heavy duty plastic conduit er duc:ing systems in accordance with local statutory authority requirements.
			2. Provisions shall be made to accommodate building shrinkage without distorting/ buckling of conduits/ ducting.
			3. Wher e cMduits are used, separate inspection type draw-in boxes shall be provided at maximum 15m centers.
			4. The number of cores used in each multicore cable shall be such that at least 10% spare cores are provided. Cables shall be individually shielded and/ or co-axial type as required.
			5. Cables shall be free of twists or kinks and be installed to avoid strain being placed on conduclcr.s. or terminals.
			6. Appropriate means shall be taken to avoid abrasion or damage.
		3. Equipment Prctection
			1. Adequate protection shall be provided for comprehensive overload, under voltage, and phase failure as appropriate for the specified turbine drive and control system.
			2. Protection shall be arranged such that turbines return to normal operation upon restorati: n·oi correct supply.
		4. Electrical Interference
			1. General: All equipment and/ or appliances provided under this Specification shall not cause electrical interference to any other equipment within the building. If the inherent characteri:;t;cs of the equipment are such that interference is possib,le provide efficient devices capable of suppressing the interference.
		5. Electromagnetic Interference
			1. Power and/ or control systems shall not create electromagnetic energy, either radiated or through electrical wiring, that interferes with other apparatus. Static suppression shall be a:,pl;ed to stations, diverters and other tube fittings as necessary.
			2. All equi;:,r..snt shall comply with the relevant standards for "Limitation of Harmonics caused *t:.'i* Industrial Equipment" and "Limitation of Voltage Fluctuations caused by Industrial t:quipment".

**THE EXECUTION**

FIRST: **EXAMINATION**

Verification of Conditions: Examine areas for compliance with requirements for installation and conditions affecting performance of the Work. Identify conditions detrimental to a proper and timely completion and notify the Engineer of thP. um,atisfactory conditions. Proceed with installation only after unsatisfactory

conditions have been corrected.

SECOND: INSTALLATION

1. General
	1. Assemble and install system in accordance with the Contract Documents, applicable codes and regulations and according to the Shop Drawings.
	2. Anchor and fasten the system and components to the building construction to provide stable and secure installation.
	3. Closely fit and join all parts of the system and finished components exposed to view, provide a neat uniform appearance.
2. Controls
	1. The specified pneumatic tube system, will provide a hospital wide automatic small material transport system must include security means to prevent accidentally or willful disoperation.
	2. The system shall include an electronically based Risk Management system to prevent unauthorized access to VIP sections, must include a full reporting system to verify who sends what from where and prevent unauthorized to get access to rated emergency medication sent by the system.
	3. The central processor controller shallbe located adjacent to turbines. A bi-directional working two line tube arrangement connects the station locations to a system network, which to provide the possibility to send between any of the stations within thesystem.
	4. Fire Alarm interface signals will be provided to the turbine controller location. Upon receipt of a fire signal, the pneumatic tube system shall shut down when the carrier in each zone has arrived at its programmed destination. No further carriers shall be accepted into any zone in the system for transmission until the fire signal is cleared at the firepanel.
	5. The system shall be capable of:
		1. Transferring a carrier weighing up to 3kg at an average speed of *6ml* s software adjustable blower units (frequency converter) for slow mode on special transactions range 3 to *6ml* s.
		2. Providing a means to redistribute unused carriers to origin (home) locationsautomaticallyby reading RFID coded address from carriers.
		3. Operating multiple carriers simultaneously within two connected zone 160mm dia. System.
		4. Each zone to be operated by separate blower, each blower to be equipped with frequency converter for adjustable speed if yore designs is multi zones.
		5. Purging lost carriers to a designated terminal.
		6. System to incorporate a risk management, operation of the system electronically limited to authorized staff, featured by electronic user identification with RFID proximity ID card (smart card) transaction may only be started by authorized user who to identify himself to the system with proximity RFID card (smart card), reading distance 10 to 15cm to prevent misinterpretat\_ion while more users are present in front of a station.
		7. Transport of pharmaceuticals to selected locations provided under the special considerations cf safety and security by automatic transport of drugs and other restricted medical goods, regarding access to the received carrier in the receiving station (secured

transmit).

* + 1. Carriers transferred by secured transmit may only be released from the receiving station by authorized through a personal proximity authorization card (smart card).
		2. Every station terminal for this to have internal storage compartment for secured items. Carrier to be hold inside the station can only be released to authorized verified by electronic RFID based user identification.
		3. System report to file all transactions with ID of operator and ID of carrier each terminal furnished with RFID based verification of carriers to prevent system to accept any but a carrier for transaction. This to be installed in any and each terminal storage device.
		4. Equip carriers both sides with unique coded RFID for verification and with home address for automatic empty redistribution.
			1. Operating mul!iplc carriers simultaneously within a nominal two 160mm dia. System zones.
1. Purging lost carriers to a designated terminal.
2. Providing a personal identification number system to enable multi-level access control over users.
3. Prohibiting sending carriers to unauthorized destinations.
4. Providing a back up destination to substitute for terminals that are not operational.
	1. Main Control Unit
		1. The control system based on an IBM compatible or equivalent PC shall be connected to a printer to enable printing of operational data. The controller shall be capable of being programmed to receive information from all local terminals and control the system so that the most efficient tube route is taken for a 9iven command. The system shall address all requests for transportation based on a first in/ first out basis but shall also accommodate

 urgent item's by sorting send/ receive priorities.

* + 1. The system shall be capable of logging all usage of the system on a user ID basis to allow analysis of operating trends.
		2. All pneumatic controls between sending and receiving stations shall be operated by the system after the optimum route is selected and checked.
		3. A summary of required Main Control Unit features are asfollows:
1. Up to 5 dlgit destination number system.
2. Data is to be protected by confidential codes and/ or key lockingsystem.
3. Interface shall be via serial current loop and parallel Centronics port and an RS-232 for terminal or host computer.
4. Data Program Mode for servicing procedures.
5. All system devices status shall be capable of being interrogated form the Main Control Unit.
6. All transactions shall be completed to original destination after restoration of power following loss of supply.
7. Upon receipt of a Fire or Smoke Alarm signal from the Fire Control Panel. all transactions i;hall be completed to programmed destinations and the system shall shut down without accepting any further carriers into the systems. The voltage free fire alarm interface signal will be supplied to the system turbine plant room from the campus fire panel by the Fire Services Subcontractor. This Subcontractor shall nominate the type of contacts required Absence mode shall divert carriers to an alternate location Selection of slow transport speed shall be available.
8. Stations shall be capable of being de-activated without disruption to the system.
9. Carrier progress through the system shall be capable of being monitored for transactions.
10. Sending and Receiving priorities shall be capable of being designated to every station destination.

**THIRD: TESTING AND COMMISSIONING**

1. Testing and Acceptance
2. Prior to a formal system performance test, the Contractor shall perform preliminary tests, to veri fy all components are fully operational to dispatch and receive carriers between all stations and all possible combinations.
3. The Contractor shall provide written notification to the Employer's representative.
4. The Contractor shall provide necessary procedures and all necessary equipment necessary to carry out test and examination to prove that the equipment is installed and functioning in accordance with the Specification requirements.
5. Acceptance shall be confirmed by a signed written statement, signed indicating that the system has been handed over and accepted; all in accordance with therequirements.
6. This statement also to list if applicable minor insufficient or other defects, which to be corrected within limited time to apply for finalacceptance.
7. Instructions
8. Training to customers technical staff.
9. Initial training of system users.
10. Assistance in developing policies for the customers use of system Assistance in integration of Risk Management system Information and standards for the transportation of rated items with secured transport (pharmacy function).
11. Decontamination control, clean out procedure and clean out kit with procedures Maintenance training.
12. Manuals
	1. The Contractor to provide operation and maintenance manuals in electronic format on CD-ROM plus a hardtopy, all in accordance with the requirements.
13. Final Cleandown
	1. Prior to commencement of final testing and commissioning, carry out a complete and thorough clean down of the entire installation to remove all construction debris anddust.
	2. After satisfactory completion of all tests, any damage to finished surfaces shall be made good. FORTH: **DEMONSTRATION**

a) General: Refer to Section 017900 Demonstration and Training for additional demonstration and training requirements.

* 1. Furnish the necessary trained personnel to perform the demonstration and instructions and arrange to have the manufacturer's representatives present to assist with the demonstrations.
		1. Allow a minimum of 2 sessions for performing the prescribed demonstration lasting 4 hours.
	2. Arrange with the Engineer the date and limes for performing the demonstrations.
		1. The Engineer will select date and time for demonstration.

Page5 of 5

* + 1. Training

5.

# 6.

7.

8.

Instruct the Employer and designated representatives in the proper operation and maintenance of the system.

Conduct **a** training course for members of the operating and maintenance staff as designated by the Engineer.

The training course will be given at the installation during normal working hours for a total of 2 hours and shall start after the system is functionally complete but prior to final acceptance tests.

The field instructions shall cover all of the items contained in the accepted operating and maintenance manuals, as well as demonstrations of rbutine maintenance operations.

End **of Section**