

Annexure - I

Specifications for Drive & PLC package for Craven Planner 2/A/22 of WTM

1) General:

Craven Planner 2/A/22 is a multi-purpose planning and milling machine having following specifications:

Table Length: 9200 mm, Max. Weight of Job: 100 Ton

It is proposed to upgrade the machine by retrofitting DC Drive, AC Drive & PLC system. The work will broadly comprise of following:

- Removal of old & obsolete MG set based control system and in its place, design & retrofitting of DC Drive, AC Drive & PLC based control system.
- Replacement of complete power & control wiring, Conduits for routing these cables, Terminals at various junction boxes and other wiring accessories.
- Replacement of front fascia plate of machine Control Desk, Left Planning head pendant, Right Milling head pendant These pendants are to be supplied with devices like, Push buttons, Selector switches, & Indicating lamps etctogether with devices like, Push buttons, Selector switches, Indicating lamps, Meters etc.

2) Scope of Supply:

Sl.No	Description	Qty.
a)	400 Amps, 440VDC, Four Quadrant, Digital DC Drive for control of Table Motor.	1 Nos
b)	18.5 KW, 3-phase, 415V, AC Vector Drive along with encoder feedback option for control of Front Milling Head cutter motor.	1 Nos
c)	15 KW, 3-phase, 415V, AC Vector Drive along with encoder feedback option for control of Side Milling Head cutter motor.	1 Nos
d)	50 Amps, 440VDC, Four Quadrant, Digital DC Drive for control of Feed Motor.	1 Nos
e)	1024 pulse Digital Encoder for speed feedback from Table Motor, Front Milling Head cutter motor, Side Milling Head cutter motor.	3 Nos
f)	Twin 1024 pulse Digital Encoder in a single housing for Feed Motor. One shall be used for closed loop speed control of DC drive and the other will be wired to PLC for tool feed control during planning operation.	1 Nos.
g)	10 Amps, 180 VDC Four Quadrant, 1phase 220 VAC Input, DC Drive for control of side-head tool feed motor.	1 Nos
h)	Programmable Logic Controller comprising of: i) Control panel mounted main PLC rack having CPU and following modules: - Digital inputs : 80 Nos. (24VDC) - High Speed Digital inputs: 2 Nos pulse inputs for connecting encoder. - Digital outputs: 48 Nos. (24VDC) - Analog inputs: 8 Nos (0 to +/- 10VDC). - Analog outputs: 4 Nos (0 to +/- 10VDC)	1 Set.

	ii) Control Desk mounted remote I/O rack having PLC remote interface and following modules: <ul style="list-style-type: none"> - Digital inputs : 48 Nos. (24VDC) - Digital outputs: 32 Nos. (24VDC) - Analog inputs: 8 Nos (0 to +/- 10VDC). - Analog outputs: 8 Nos (0 to +/- 10VDC) - 5.7" MMI Monochrome MMI for indicating the operating parameters and fault messages. { Detailed specs as per point (4)(c) below}	
i)	Isolation relay with contact rating of 220VAC/ 5Amps for 48 Digital Outputs at Control Panel and 32 Digital Outputs at Control Desk. These relays shall be DIN Rail mounted PLC relays of PHOENIX CONTACT only.	1 Set.
j)	A control panel of RITTAL make and IP42 grade housing the above DC Drives, AC Drives, PLC, Output Isolation Relays and following accessories: <ul style="list-style-type: none"> i) Incomer Switch fuse unit (SFU). ii) Cubicle ventilation fan, Louvers with dust cover for ventilation. iii) Emergency stop scheme to isolate all machine outgoing supplies during emergency conditions. iv) 3-phase AC Line choke for DC Drives, AC Drives. v) Semiconductor fuses for AC Input & DC Output, Field Input, AC Line contactor for each DC drive. vi) Semiconductor fuses for AC Input, AC Line contactor for each AC drive vii) 24VDC SMPS Power Supply for PLC Inputs/Outputs, Relays, Indicating lamps etc. viii) Protection fuses boards for all PLC cards, Inputs & outputs ix) Indicator lamps for Mains On, Control On, Group Fault, Drive Run & Drive Fault etc. x) Analog meters for displaying AC Mains Voltage, (Voltage, Current & speed) of all the four drives etc. xi) Push buttons for Control on, Control off, Emergency Stop, Fault reset etc. xii) Hooter for fault annunciation, 20" tube light for each section of panel for illumination & 5 amps socket for 220V AC supply xiii) 3-phase AC feeders each comprising of MPCB's and contactor for the following AC Motors. xiv) 2HP (reversible) for cross slide locking/ unlocking. xv) 1HP for forced ventilation of table motor. xvi) 0.5HP for Table oil pump. xvii) 0.5HP for Gearbox Oil Pump. xviii) 0.5 HP Tool Lifting Motors (4 Nos) xix) 30Volts, 20Amps, Transformer & rectifier set for DC Supply of clutches, solenoid etc. xx) RC Surge Suppressors for each contactor, Free-wheeling diode for all clutches, solenoids etc. 	1 Set.

k)	<p>The Control Desk mounted PLC remote I/O rack. All the components here shall be mounted on GI sheet, wired in properly laid conduits and terminated on terminal blocks. This plate shall be fitted in existing control desk and other end of terminal blocks to be wired to respective devices of desk. It shall comprise of following.</p> <ol style="list-style-type: none"> PLC remote I/O rack having I/O's as mentioned at (8)(b) above. Protection fuse boards for PLC cards, Inputs & outputs. Sitop 24V DC, power supply for PLC remote I/O rack, Inputs/Outputs. Sitop 10V DC power supply for analog input card. 	1 Set.
l)	<p>New front fascia plate with approximate size as given below:</p> <ol style="list-style-type: none"> Left Planning Head (Size 250mm X 300mm) Right Milling Head (Size 250mm X 300mm). Control Desk bottom (Size 1100mm X 700mm) Control Desk Front (Size 1100mm X 250mm). <p>These plates shall be of 5mm thick aluminium, with cutouts as per requirement and engraving as per specific function.</p>	1 Set
m)	<p>All the devices for two pendants and one control desk like pushbuttons, indicating lamps, selector switches, and display meters are also to be supplied. The tentative estimates for total quantity of these devices required at three locations are as follows</p> <ol style="list-style-type: none"> 24VDC LED type pilot light (Green, Red, Yellow, Amber, White color): 10 Nos. Normal push button assembly (Green, Red, Amber, Black color): 10 Nos. Illuminated (24VDC LED type) raised push button assembly (Red color): 10 Nos. Illuminated (24VDC LED type) normal push button assembly (Green, Yellow, Amber, Red, White color): 30 Nos. 2-position selector switch assembly (Black color): 10 Nos. 3-position selector switch assembly (Black color): 5 Nos. Mushroom type latched emergency stop push button assembly (Red color): 4 Nos. Panel meters of size 96 X 96 mm as follows: <ul style="list-style-type: none"> 500-0-500 Amps Analog DC Ammeter for Table Motor: 1 Nos. 0-60 Amps Analog Ammeter for Front Milling Head cutter Motor: 1 Nos. 0-60 Amps Analog Ammeter for Side Milling Head cutter: 1 Nos 60-0-60 Amps Analog Ammeter for Feed Motor: 1 Nos 3.5 digits DPM for Table speed: 1 Nos 3.5 digits DPM for Front Milling Head cutter: 1 Nos 3.5 digits DPM for Side Milling Head cutter: 1 Nos 3.5 digits DPM for Feed rate: 1 Nos. 	1 Set

n)	<p>All the machine power & control wiring is to be replaced. All the flexible cables and conduits shall be of LAPP make only. The tentative estimate based on our assessment are as follows:</p> <ul style="list-style-type: none"> i) 3-core, 120 Sq.MM, armored, Cu. cable for incomer: 30 m. ii) Single core, 120 Sq.MM, armored Cu. cable for DC Motor armature: 40 m. iii) 3-core, 16 Sq.MM, Cu., flexible & shielded cable for AC Motors: 100m. iv) Single Core, 16 Sq.MM, Cu, multi-strand flexible cable for feed motor: 50 m v) 3X(2X0.14)+2X(0.5) flexible shielded cable for encoder of all the four motors: 200 m. vi) Circular threaded connectors for encoders: 5 Nos. vii) 24-core, 1.5 Sq.MM, multi-strand flexible cable for control wiring: 100 m. viii) 3-core, 2.5 Sq.MM. multi-strand flexible cable for auxiliary motors: 100m. ix) Single-core 1.50 Sq.mm, multi-strand flexible cable for control wiring: 200 m x) Single-core 0.50 Sq.mm, multi-strand flexible cable for PLC wiring: 200 m. xi) Data cable for connecting of remote I/O rack (size as per manufacturer's recommendations): 25 m. xii) LAPP make SILVYN RILL PA6 type polyamide grooved conduit of diameter 30mm: 100m xiii) End conduit glands for 30mm conduit: 25 Nos. xiv) LAPP make SILVYN RILL PA6 type polyamide grooved conduit of diameter 16mm: 100m. xv) End conduit glands for 16mm conduit: 25 Nos. 	1 Set.
o)	Igus make cable drag chain suitable for two cable of dia. 30mm, length of traverse 4m.	1 nos

3) Scope of Work:

The work involved includes the following:

a)	All the existing panels, cables, conduits, machine wiring etc has to be removed. A non-functional drilling head is also mounted on the left head which is also to be dismantled and removed	1 Set.
b)	Erection of supplied control panel, remote I/O racks, and accessories are to be mounted at respective locations as envisaged above	1 Set.
c)	Mounting of encoders on Main Motor, Front Head Milling Motor, Side Head Milling Motor. All the modifications, fixtures, flexible coupling shall be provided by party.	1 Set.
d)	The complete machine wiring as per the new scheme. All the material like cables, conduits, end connectors, mounting adapters, terminal blocks, and accessories for wiring like lugs, ferules, cable ties, pads etc is to be supplied by party.	1 Set.

	Tentative estimation for cables required are mentioned at (2)(12) above. However supplier has to arrange for any material not covered above but required for completion of the job.	
e)	Tuning & parameterization of AC/DC Drives, Application software development for PLC & MMI as per requirement	1 Set.
f)	Commissioning and prove out	1 Set.

4) Detailed Specifications:

a) DC Drive:

- a.1) The specifications of existing DC machine to be controlled by the drive are as follows:

Sl.No	Description	Rating
i)	Make	AEI
ii)	Power	120/120/30 kW
iii)	Rated Voltage	440/230/73 VDC
iv)	Rated Current	220 Amps DC
v)	Field: Voltage	220 Volts

- a.2) The drive is intended for controlling the above DC machine in four-quadrant region. The detailed specifications shall be as follows:

Sl.No	Description	Rating
i)	Quantity	1 Nos.
ii)	Input supply	415V \pm 20%, 3 phase, 3 wire, 50 Hz
iii)	DC Output	440VDC, 400 Amps, continuous
iv)	Field Output	320 VDC, 25 Amps
v)	Mode of operation	Continuous duty, 4-quadrant
vi)	Field Weakening	Required
vii)	Speed regulation	0.1% of base speed through digital tacho feedback
viii)	Braking	Regenerative
ix)	Digital Inputs	Minimum four, fully configurable
x)	Digital Outputs	Minimum two, fully configurable, potential free
xi)	Analog Inputs	Minimum two, (+/- 10V DC or 4-20MA selectable)
xii)	Analog Outputs	Minimum two, (+/-10VDC)
xiii)	Ambient Conditions	0-45 degrees, RH 95%

a.3) Features of D.C, Digital Drive:

- The controller must be compact and modular in construction.
- It shall be microprocessor based digitally controlled, Three-phase fully controlled reversible bridge configuration, capable of bi-directional operation with regenerative braking.
- The field controller and field bridge shall be integrated in the drive module and capable of field weakening operation. The plotting of field characteristics for field weakening operation shall be automatic during auto-tuning procedure.

- iv) It shall have an inbuilt/detachable programmer for parameterization & display.
 - v) It must have all standard protections like stall protection, instantaneous power failure, single phasing, phase rotation, over voltage, under voltage, over current, thermal overload etc. All faults and operating conditions must be displayed on suitable seven segments /alpha-numeric display.
 - vi) It must have auto tuning facility. This must enable perfect matching of motor coupled to load with regards to optimum acceleration time, deceleration time, speed amplifier, current amplifier, output torque control etc. All parameters for drive control should be programmable type.
- b) **AC Vector Drive:** The drive is intended for controlling AC motor in four-quadrant region. It must be a compact, modular, digital with an inbuilt/detachable programmer for parameterization & display. The drive must have an auto-tuning feature for adaptation of drive with any motor. All the motor data, various loops, inputs, outputs shall be easily configurable. The detailed features are as follows:

Sl.No	Description	Requirements
i)	Power Supply	415V/ 3 phase/ 3 wire/ 50Hz/ +/- 15%
ii)	Control Method	Flux vector control with PG, Open loop vector control, V/f control, V/f control with PG.
iii)	Speed Control Range	1: 200 (open loop vector control), 1:1000 (flux vector control)
iv)	Speed Control Accuracy	+/- 0.02% (open loop vector control), +/- 0.002% (flux vector control)
v)	Frequency Control Range	0.01 Hz to 400 Hz
vi)	Starting Torque	150% at 0.3 Hz (open loop vector control), 150% at 0 Hz (flux vector control)
vii)	Overload Capacity	150 % for 60 sec.
viii)	Braking Torque	Min. 50% with internal/external chopper & resistance
ix)	Digital Inputs	Min. six (fully configurable)
x)	Digital Outputs	Min. four(fully configurable)
xi)	Analog Inputs	Two Nos. (+/- 10V DC or 4-20MA selectable)
xii)	Analog Outputs	Two Nos. (+/-10VDC)
xiii)	Motor Protection	Electronic thermal overload, PTC thermistor
xiv)	Important functions	Power loss ride through, speed search, acceleration/deceleration time, auto-tuning, motor slip compensation, jump frequencies, energy saving function, PID controller, and two switch able set of motor parameters.
xv)	Ambient Conditions	0-45 degrees, RH 95%

- c) **Programmable Logic Controller(PLC):** The PLC shall be a compact, modular, DIN rail mounted type with easily accessible connection points as per the following details:

Sl.No	Description	Requirements
i)	Quantity	1 No.
ii)	Inputs/outputs	As per details given in scope of supply
iii)	Program memory	Sufficient memory to program I/O as mentioned above.
iv)	Backup memory	EEPROM submodule
v)	Processing time	0.6ms/1024 statements(Max.)
vi)	No. of flags	256 (minimum)
vii)	No. of timers	32 (minimum)
viii)	No. of counters	16 (minimum)
ix)	Program processing	Cyclic, Interrupt driven
x)	Instruction type	Binary logic, bracketed operation, Result assignment, bit memories, counting, timing, transfer, comparison, jump, block call, special function, word logic, arithmetic etc
xi)	Power supply	24VDC/230VAC
xii)	Ambient temperature	0-45 ⁰ C, 95% RH
xiii)	Communication	RS 232 serial port or USB for programming,

5) **Make of Major Components:**

Sl.No	Component	Manufacturers
a)	DC Drive	Siemens/Allen-Bradley/ABB/Baldor
b)	AC Drive	Siemens/Allen-Bradley/ABB/Baldor/Schneider
c)	PLC	Siemens/Allen-Bradley/ABB/Schneider
d)	MMI	Siemens/Allen-Bradley/ABB/Schneider
e)	Switchgear	Siemens/Allen-Bradley/ABB/Schneider
f)	Power Supplies	Siemens/Phoenix/Omron
g)	Encoder	Hubner/Heidenhain/Siemens/Allen-Bradley

6) **Control Scheme:**

The party has to prepare the control scheme and submit to BHEL for approval within two week of receipt of order.

7) **Literature:**

Four copies of literature containing complete O & M manual and electrical & electronic circuit diagrams are to be supplied along with the equipment.

8) **Training:**

Supplier should arrange for training of two BHEL engineers free of cost for the offered drive systems/PLC at their works/training center after placement of order.

9) **Test & Guarantee:**

The supplied equipment including the bought out items should be guaranteed for a period of one year after commissioning for any fault in material / workmanship. Test certificates of the various supplied items are to be furnished alongwith supply of material.

10) **Evaluation Criteria:**

Equipment should meet all our above specifications. The bidders must furnish point-to-point replies against all the points of our specification failing which their offer may not be considered. The following details shall be submitted along with the offer

- a) Point wise confirmation to our specification.
- b) Clear scope of supply
- c) Detailed catalogues of the offered major items.
- d) Make and rating of major components in conformance to our specification.

11) **Qualifying Requirement:**

Only those vendors, who have supplied and commissioned at least two retrofitting work having Drives (50KW or above) & PLC (100 I/O's or above) on a large machine tool in the past five years and such system is presently working satisfactorily for more than one year (more than six months if supplied to BHEL) after commissioning, would be eligible for participating in the tender. The following information is to be submitted by the vendor.

- a) Name of the customer / company where such system is installed.
- b) Complete postal address of the customer.
- c) Year of commissioning.
- d) Machine for which the system is supplied with details of work undertaken.
- e) Name and designation of the contact person of the customer.
- f) Phone, FAX no. and email address of the contact person of the customer.