

TECHNICAL SPECIFICATION FOR 2000T HYDRAULIC PRESS

1. INTRODUCTION

This specification covers the general requirements of two numbers of 2000T hydraulic presses which include design, manufacturing, supply, erection, commissioning and testing of the presses at NFC Kota, Rawatbhata, Rajasthan.

The 2000T hydraulic presses are required to compact the zirconium metal sponge of various sizes and shapes (As per specifications given below).

2. SCOPE OF SUPPLY

The scope of supply include design, manufacturing, supply, erection, commissioning and testing of two (2) numbers of down-stroking hydraulic presses used for making compacts of zirconium sponge.

Any additional items or sub systems which are not mentioned in the specifications but required or identified for the completeness and trouble-free performance of the system shall be included in the scope without additional price and time implications.

3. JOB DESCRIPTION

Dimensions of various zirconium sponge compacts to be produced are as following:

1. Cylindrical compact of 180 mm diameter and 135 mm height.
- 2 . Cylindrical compact of 150 mm diameter and 140 mm height.
- 3 . Cubical compact of dimension: 500 x 50 x 75 mm (L x W x H)

4. PROCESS DESCRIPTION

Zirconium metal sponge along with alloying elements shall be filled in the die and by pressing the metal sponge in its respective die as per production schedule, compacts shall be obtained. The height of compact shall be dependent on the oil pressure limit.

• OPERATION SEQUENCE

- I. Initially die rests on the press bed and punch in top most position.

- II. Zirconium sponge and alloying element is fed into the die in three parts such that alloying elements assumes approximately a central position in the compact (Manually by operator./Automatically by Auto dosing system)
- III. The main ram moves downward first with high speed and then slowly to press the sponge filled in the die.
- IV. The oil pressure in the main cylinder reaches the set pressure and then holds for about 10 seconds.
- V. Decompression : The oil pressure in the cylinder & lines are reduced to an acceptable level.
- VI. The main ram now retracts back slowly.
- VII. The die also lifts up along with compacted sponge in it.
- VIII. Un-loader block slides & positions beneath the die cavity.
- IX. Die rests on un-loader block and then the ram starts coming down.
- X. The Punch moves down to eject the pressed zirconium sponge (compact) out from bottom of die in to the cavity of the un-loader block.
- XI. The punch is now quickly retracted back to top most position.
- XII. The die lifts upwards and the un-loader block is retracted back along with the ejected compact and slides it down to the stacking tray. Suitable arrangement shall be made so that compact does not get damaged while it slides down to stacking tray.
- XIII. The die again sits over the bed & the press is ready for next cycle.

5. MAJOR COMPONENTS

5.1. Press Frame

The major components of press frame like Bed, Top Head, Slide, Uprights shall be fabricated using ISO 2062 Grade 2 plates and by welding them as per standard welding procedures. The plates should be as per BIS specifications & Material Test Certificate (MTC) of the plates issued by steel plant should be submitted to inspecting officials of NFC. All critical welds shall be tested for weld defects. Method of testing weld defects and method of stress relieving shall be explained in the bid. The fabricated structure shall be duly stress relieved. The records of stress relieving should be furnished during the inspection of the machine. The detailed

design calculations for the suitability of the critical sections or the FEM analysis should be furnished after placement of order. A cross sectional schematic diagram for major assemblies shall be furnished in the bid to indicate the constructional features. The slide should have 8 point guiding with in-situ adjustable & replaceable Ph. Bronze liners for long life.

Note: The frame of the press shall have openings from all four sides such that the pressing area is accessible from all four sides. Minimum 1000 x 1500mm for sides opening and 1500 x 1500mm for front and back openings(W x H)

Noise levels shall not exceed 85 dB, when measured at a distance of 1 meter from the machine in the free field conditions.

5.2. Main ram and cylinder

Main ram of the press shall be made of forged block. The main cylinder shall be forged out of single block and then machined. Relevant certificates for ram and cylinder shall be provided during PDI.

5.3. Die and Punch assembly

- a) Die assembly with cavity height of 430mm shall be provided for 150mm and 180mm diameter compacts.
- b) For rectangular compacts, the punch shall be 50 mm wide and 500 mm long. The cavity shall be 400 mm deep(approx.)
- c) The gap between bottom of punch and the top surface of die shall be 320mm.
- d) Ram shall be chrome plated and surface finish certificate shall be provided. Chrome plating thickness shall be clearly indicated in the offer.
- e) Moving bed of the press and die inner liner etc. shall be forged components

Note: Die and punch for all three type of compacts is in the scope of bidder. Die liner has to be sink fitted in the die housing.

Details of die and punch shall be discussed during detailed engineering and the approved drawings shall be used for manufacturing.

5.4. Hydraulic System

Positive displacement hydraulic pumps shall be provided for the hydraulic system of the press. Oil flow shall be pulsation free. Detailed hydraulic circuit shall be provided along with the bid. Number of pumps provided,

their type, make, model no. and capacity shall be clearly indicated in the bid.

The tank(s) of hydraulic system shall be as per the latest applicable standard. It shall be provided with an air breather(s), suitable baffle plates, filler breather, temperature indicator gauge, oil level gauge, inspection cover(s), provisions for addition of lines in future, over flow and drainage connections.

Main ram shall be actuated by variable flow positive displacement pump.

The maximum temperature of hydraulic oil should not exceed 55 deg.C during operation.

Hydraulic Power pack shall be installed on ground

The return line filter shall have clogging indicator. Type, make and model no. of each filter element shall be indicated in the bid. Cold bent, solid drawn, seamless steel tubes should confirm to DIN 2391/C, used in the hydraulic circuit. The hydraulic system shall be provided with ports for measuring pressure during troubleshooting or maintenance. Four sets of minimess couplings with pressure gauges shall be provided, which are used for measuring pressure at various points in the hydraulic circuit.

The hydraulic system shall include/incorporate an online oil filtration unit mounted on mobile trolley. The filtration unit should employ twin filters with provision for continuous measurement & display of oil cleanliness level in NAS & ISO scale and water percentage. This mobile filtration unit shall take oil from the main oil tank of the press, filter it & pump it back to the main oil tank. The filtration unit shall be of adequate capacity to handle the volume of oil in the main tank and shall be suitable for continuous operation.

6. TECHNICAL DETAILS

S No	Description	Specification
1.	Type of press	Down-stroking, Vertical
2.	Type of frame	Tie rod (pre-stressed at 3000Ton)
3.	Pressing capacity	2000 T
4.	Return capacity	~ 80 T

5.	Ram Stroke	~ 800 mm
6.	Daylight	~ 1500 mm
7.	Bolster size	~ 1200 x 1100 mm
8.	No. of Main cylinder	1
9.	Type of main cylinder	Double acting or Single Acting
10.	Working pressure	315 kg/cm ² (max)
11.	Bolster type	Fixed, 1 No.
12.	Speed of Ram	
	a) Fast approach	50 mm/sec
	b) Pressing(Variable)	(2-30mm)
	c) Fast return	60 mm/sec
13.	Height of Bolster top face from the floor level	600mm - 800mm
14.	Die block cylinder stroke	To be indicated by bidder
15.	Bed sliding cylinder stroke	800 approx
16.	Bed Sliding Cylinder speed	
	a) Forward	120 mm/sec or higher
	b) Return	150 mm/sec or higher
17.	Electrical System	
	a) Power Supply	3 Phase / 415V \pm 10% 50 Hz \pm 3%
	b) Control Voltage	24V D.C.
	c) Main Pump Motor	To be given by bidder (Siemens/ABB make/CG)
18.	Operation Modes	Inching / auto / semi-auto

19.	Slide guiding	Eight point adjustable guides with replaceable Phosphor Bronze liners
20.	Lubrication System	Centralized grease lubrication System, Make: Cenlub
21.	Oil Cooling	By suitably selected plate type water cooled heat exchanger.
22.	MAKES:	
	a) Make of hydraulic pumps	Rexroth / Oilgear / Eaton / Vickers
	b) Photoelectric guards (wherever used)	Orbital / Keyence
	c) Makes of Hydraulic valves	Rexroth / Oilgear / Eaton / Vickers
	d) Makes of hydraulic fittings	Swagelok, Parker
	e) Hydraulic hoses.	Parker, Merkel
	f) Seals	Merkel / Spareage
	g) PLC system	SIEMENS/Schneider of latest series/models.
	h) HMI	Same as that of PLC
	i) Shielded Cables	Helu / Lapp
	j) Pressure sensor	WIKA/HYDAC/IFM
	k) UPS	Emerson/APC/Eaton
23.	Tooling required for Die and punch changing.	
24.	Press accuracies for Parallelism, perpendicularity & flatness	JIS-6403-Grade I
25.	Deflection of slide & bolster	0.17mm/m.
26.	Online oil filtration unit with mobile trolley	Make: Hydac

The values given in above table (up to point no.-16) are indicative and to be discussed during detailed engineering before finalizing.

7. INSTRUMENTATION & CONTROLS

7.1 Machine shall have a PLC & HMI based control system.

7.2 Specifications of PLC system:

- a. Programming Package: Programming package for editing control logic shall be in scope of supply.
- b. Controller: shall have at least two communication ports, one to be utilized for programming and another for networking.
- c. All input and output modules utilized shall have optical isolation and have control voltage of 24 V DC only.
- d. Rack power supply shall be of the type as recommended by PLC manufacturer.
- e. All the outputs shall drive final control elements like solenoids, contactors etc through interpose relay modules.
- f. Control supply to final control elements shall be through connectors with fuse and fuse blown indication.
- g. CPU and memory loading shall not be more than 50%.
- h. CPU supply shall not be utilized for interrogation supply of the inputs, for which separate supply shall be provided.
- i. At least 30% inputs and 30% outputs of I/O modules shall be left unused/spare.
- j. All the cables required for operation of press shall be in scope of supply of vendor. Cables for integrating all sensors with PLC shall be shielded type.
- k. I/O cards shall be fully wired and brought to terminals both in case of used and unused.
- l. Communication: all the control system components, like Controller, HMI and Electronic Drives (if any) shall be networked on digital communication

7.3 Specifications of electronic drives system (if any):

- a. All the drives shall be sized to have minimum 20% higher rated current than that of respective motors.
- b. These drives shall be networked with HMI and all critical parameters like speed, current etc. shall be displayed on HMI.
- c. All the drives wherever used shall have sufficiently rated input chokes.
- d. Drives selected shall have all latest control modes.
- e. Configuration/Commissioning software for Drives and related specialized connecting cables/adaptors for connecting drives with Computer shall be in scope of supply.
- f. If any proprietary control card is utilized detailed diagnostic manuals/circuits with necessary test points shall be supplied.

7.4 Specifications of Operator Console

- a. Minimum following screens to be developed:
 - Press mimics showing operations and status of various sensors.
 - Alarm configuration.
 - I/O status with communication
 - Any other screen needed for easy operation and diagnosis.
- b. Swiveling type operator console, housing the HMI shall be provided.
- c. Operations repetitive in nature shall be in hardware form (Push Buttons, Selector switches etc). All other operations shall be provided via HMI.
- d. HMI specs:
 - i. Size of screen : 19" +/- 0.5" diagonal acceptable
 - ii. Type : Touch screen (analog type)
 - iii. Memory card slot : at least one slot for CF card
 - iv. USB slots : at least 2 slots
 - v. Backlighting : LED based.
 - vi. Interfaces : at least one Ethernet based port in addition to the port used for connecting with PLC
 - vii. License for nos. of tags shall atleast be 50% more than all the tags used in the system.

viii. Software :Licensed Programming software for configuration/editing of PLC and HMI screens and other parameters shall be in scope of supply.

e. Portable programming device: It shall be used for programming configuration, transfer, storage of recipe, user configuration data.(1TB Hard disk, 16GB RAM, i7 processor)

7.5 Functions:

- i. The control system shall be programmed for press specific operations like automatic, manual & maintenance modes.
- ii. The control system shall have all required recipes for automatic pressure control based on different compact sizes.
- iii. All important process parameters like pressure, compaction diameter, oil temperature etc. shall be logged and displayed in trend form.
- iv. Facility of report generation of logged process data along with operator/shift in charge details, lot numbers, number of compactions etc. along with time stamp shall be available. It should be possible to print reports into a pen drive in pdf and csv formats. Also, necessary functions for transporting recorded data to central computer shall be available in chosen HMI as explained below..

7.6 Sensors: Electronic sensors shall be used for measurement of process parameters like pressure, oil level and temperature etc. and integrated with PLC system.

7.7 Provision for networking: A communication port in control system shall be made available to integrate the control system with centralized computer, and depicting all process status in that.

7.8 It is proposed to have separate alloying addition system with separate bins and weight monitoring system so that alloys can be filled in to the die cavity at suitable time and position. Similarly for metal sponge addition, separate drum lifting and feeding system to feed metal sponge into the die will be envisaged. It may be noted that these systems are not the part of hydraulic press.

However vendors are encouraged to give there offer separately. The control systems envisaged for the press shall be able to configure and integrate these alloy and sponge addition system.

7.9 UPS: One online UPS for at least 30 minutes back-up for control system components like PLC, HMI, sensors' supply shall be supplied.

8. ELECTRICAL

1. Complete electrical including motor control panel, operator station, process mimic panel displaying indications for energized control devices like limit switch, solenoid etc, necessary complete cabling, earthing shall be supplied.
2. Energy efficient motors of category IE4 as per IEC /EN 600034-30-1:2014. shall be employed for all pumps.
3. Motors shall be protected against Over load, phase unbalance, short circuit. MPCB and fuses shall be provided.
4. Panel A.C. shall be provided with power panel, instrumentation panel considering ambient temperature range 10-50 Degree Celsius)
5. Electronic controller shall be employed to reduce idling power loss of main pump motor.
6. Visible double earthing shall be provided for all the panels, motors.
7. Mushroom headed latchable emergency Push buttons shall be provided on operator desk, at four side columns and control panel.
8. Minimum no of switch operations on operator desk shall be ensured for inching operation. All push buttons used shall be LED lit type.
9. Control supply shall be taken from phase to phase supply by employing ultra isolation transformer.
10. The power panel shall be of dead front design (except for indication), made of sheet steel construction, free standing.
11. All electrical power panels shall have door interlocks, 3 phase LED light indication for incoming power.
12. Main incoming panel and Motor Control Centre (MCC) shall have multifunction digital meter along with necessary CT, PT for measuring and displaying voltage, current, pf, kW, kVA, etc with networking facility
13. Panel height shall be within 6 feet. However if the height increases, suitable arrangements shall be given for approach.
14. All the interiors of panels shall be accessible from front and there shall not be any need to open backside.
15. Double earthing points terminating GI flats shall be provided at both side of panels.
16. The panels shall be spacious enough and well ventilated
17. Detachable cable gland plates shall be provided for cable entry.
18. Panel door earthing, panel lighting with door interlocks shall be provided
19. Cable size of control wiring: 1.5 sq-mm minimum
20. Wiring shall be well dressed and fixed properly with cable ties and identified with ferrules and tags.

21. Panels shall be painted in Siemens gray color (shade- RAL 7032)
22. Power Panel ingress protection : IP (dust proof: IP 55)
23. Panel ACs shall be provided of sufficient capacity to cool complete power panel and control panel.(Ambient temperature: 10-50 Degree Celsius)
24. Make - Switchgear, Relay : Siemens/Sceider
Panel : Rittal, Siemens
Limit Switch: BCH, Scheider, Siemens
Control switches:AE, Keycee, Siemens, Teknic
Connector: Connectwell, Dowells,

9. SAFETY SYSTEMS

1. Photo electric guard curtain shall be provided. This will stop the press if any thing enters the pressing zone during operation.
2. Ram locking at Top Dead Centre to ensure safe position of rm during maintenance.
3. Two mushroom headed start push button shall be provided to avoid accidental pressing of start button.
4. Barricading from all sides
5. Oil level display and low level interlock for auto filling and for stop operation shall be provided.
6. Oil temperature display and interlocking to stop press operation in case of over temperature shall be provided.

10. UTILITIES

- 10.1 Ambient temperature: 10 degree to 50 degree Celsius
- 10.2 The equipment shall be designed for supply voltage of 415V \pm 10%, 50 Hz \pm 3%, 3-phase power supply.
- 10.3 At incoming supply isolation transformer for control system shall be provided by the vendor where ever required.
- 10.4 Cooling Water temperature: 30 degree Celsius, 3 bar.
- 10.5 Instrument Air: 6 bar
- 10.6 All utilities like cooling water, Power supply and instrument air will be provided in range of 10m from the equipment by NFC. A distribution board as required shall be provided by bidder.

11. General Conditions:

- A. The above specification are the minimum requirement for proper and safe operation of 2000T Hydraulic press. The responsibility of Safe and satisfactory functioning of Hydraulic press lies with the bidder and any

- additional component/ sub component/ software/ hardware which may not be the part of tender but is essential for satisfactory and safe operation of Hydraulic press shall be provided by the bidder without any price implication.
- B. All cables shall be properly tagged before commissioning trials are started.
 - C. The equipment and all its field components shall be designed for ambient temperature range of 2 to 50 degree Celsius.
 - D. All consumables and commissioning spares required during trial runs shall be supplied by the bidder along with foundation bolts etc.
 - E. Break up of all electrical load shall be provided by the bidder
 - F. Technical offer shall be submitted in soft copies also.
 - G. The design may be made considering provision for incorporating auto feeding system
 - H. Cable testing and ferruling philosophy shall be finalized in consultation with NFC.

12. AUTO ALLOY AND SPONGE DOSING SYSTEM(Optional)

Zirconium metal sponge and alloying element are required to be filled in the die cavity of the press automatically during auto cycle of the press. The dosing of the alloys which has to be accurately weighed independently shall be poured in the press die such that it assumes central position in the output compact.

Details of all the alloys and Zr Sponge is as follows:

- 1. Zr-Sponge : 3 to 16 mm size
- 2. Tin (Sn) pallets : 3-5 mm
- 3. Iron (Fe) Powder : 100 mesh size
- 4. Chromium (Cr) Powder : 60 mesh powder
- 5. ZrO₂ : 350 mesh size
- 6. Zirconium fines : 1 to 3 mm
- 7. Niobium granules : 1 to 5 mm

Quantity (gms)required to make 15/20kg compact

- 1 Tin (Sn) : 180-340gms
- 2 Chromium (Cr) powder : 11-26gms
- 3. Iron (Fe) powder : 27-48gms
- 4. Fe + Cr : 42-74gms
- 5. Zirconium Oxide (ZrO₂) powder: 53-76gms
- 6. Zirconium fines : 300-1500 gms
- 7. Niobium granules : 250-550gms

Zirconium metal sponge will be stored in drums of 200kgs, with 10 drums making one lot. Design of auto dosing system shall be able to handle one complete lot of sponge for making compacts.

Technical offer shall be submitted along with technical offer of Hydraulic press. Detailing of the system shall be done during detail engineering.

13. DRAWINGS AND DOCUMENTS TO BE SUBMITTED AT DIFFERENT STAGES:

.With offer

1. PO copy of successfully executed project minimum 2000 ton or higher capacity press.
2. GA drawing of proposed Hydraulic press shall be provided.
3. Make/ datasheet of all bought out items.
4. Technical details regarding safety features.
5. List of all the components which shall be forged, stress relieved shall be provided.
6. Compliance statement to the specifications.
7. List of utility requirement for the press.
8. Control system architecture with make and models of major components viz PLC, electronic drives (if any), HMI, servo motors (if any) and automation bus.
9. Technical Document covering features of control system, different sub systems of the equipment being controlled, integration details of various subsystems, etc.,.

13.1. After PO placement

1. Quality Assurance Plan (shall be made mutually within one month from order placement)
2. Basic foot print of equipment
3. Basic Foundation Drawing
4. Technical Details regarding major components and detailed 3-D model of total unit
5. Manufacturing drawings for approval from NFC
6. Basic mechanical Drawings
7. Electrical and electronics drawings for approval from NFC
8. Design analysis of all the critical components like bolster, tie rods etc..
9. Total cooling water requirement shall be provided

10. Details of Hydraulics: make, circuit etc.
11. General Arrangement drawing, Foundation drawing, Electrical & Hydraulic circuit should be furnished to NFC after PO for approval.

13.2. During PDI

1. Video recording of assembly of critical components of press.
2. Preliminary drawing of all mechanical components.
3. MTC, Forging certificate and stress relieving certificate of all critical components.
4. Surface finish test certificate for main ram.
5. Electrical and electronics drawings

13.3. During trial Runs

As build documentation

The following documentation shall be provided in English language:

- Safety Instructions
- Maintenance manuals
- Maintenance schedules
- Drawings

Brochures and descriptions from sub-suppliers shall be provided in English

For all changes on the supplied equipment which may have been implemented during acceptance testing the "As-built" documentation will be delivered eight (8) weeks after formal acceptance.

The "As built" documentation shall contain the following documents:

- General lay-out drawings
- General arrangement drawings
- Assembly drawing of all the major sub-assemblies to be supplied
- Set of detailed subassembly drawings with bills of material
- Set of foundation drawings
- Set of Flow diagrams for power, water and compressed air
- Hardcopy and Editable softcopy of PLC program, HMI project and servo drive configuration parameters (if any) along with required licensed software's.
- If any proprietary control card is utilized detailed diagnostic manuals/circuits with necessary test points shall be supplied.

- Hardcopy and Editable softcopy of Drawings for Control System Cabinets, I/O racks, Marshalling cabinets, Control desks & Power distribution boards and electrical drawings
- List of all the Mechanical/ Electrical/ Electronics/ Instrumentation bought out items along with there Make, Model no and other details. If possible, attach catalogue for the same.
- Set of operation and maintenance manuals

All the above documents shall be submitted in 3 nos. of hard copy. Additionally, 1no of soft copy shall also be submitted, comprising of all the above mentioned items

14. PERFORMANCE GUARENTEE TEST/ACCEPTANCE TEST:

To be demonstrated at site. Necessary inputs like raw material, skilled / unskilled manpower to be provided by NFC. Performance guarantee test will be conducted at NFC, Kota site for 2 shifts of 8 hours continuously producing no less then 160 compacts in the presence of firm's engineers and NFC team. During the performance guarantee test, the machine should work without any breakdown after which it will be treated as commissioned.

This performance has to be demonstrated 6 times in a week.

15. TRAINING:

Training shall be imparted by supplier's qualified engineers for 5 working days during installation and commissioning of the press at Kota site. The training should cover operation, mechanical maintenance, electrical maintenance and electronics maintenance. The training should include classroom training and on the job training as per the firm's recommendation. A video recording of critical component mounting and dismounting shall provided

16. BIDDER QUALIFICATION CRITERIA:

- A. Bidders should be established manufacturer of hydraulic presses of 2000T and above capacities and should have supplied at-least 3 presses in the last ten years. The machines should be in working condition
- B. The critical manufacturing operations of press like fabrication, stress relieving, machining and assembly should be done under strict quality control

at manufacturer's works. Bidder should submit manufacturing facility details along with the bid.

17. INSPECTION:

- A. Stage wise inspection of the press components shall be done after placement of order. The different stages of inspection shall be put in QAP after mutual agreement with NFC (Material inspection, welding inspection and deflection test etc.).
- B. During Pre-dispatch inspection, the complete press structure shall be assembled and shown without pre-stressing of tie rods. All the test certificates shall be explained and handed over to the NFC engineers.

18. ERECTION AND COMMISSIONING

- 15.1 Complete erection and commissioning is under the bidders scope. All necessary material handling equipment, cranes, special tools and tackles are in bidders scope.
- 15.2 First fill of oil for Press and other consumables, etc required complete for erection & commissioning and performance trial shall be provided by bidder without any extra charge.
- 15.3 Establishing common control room for both the presses, which includes all the instrumentation hardware, operation panels, etc., lies within the scope of the vendor.

19. GUARANTEE/ WARRANTEE

Bidder shall give warrantee of complete replacement of component or system for 12 months after successful commissioning at M/s NFC, Kota. The supplier should furnish bank guarantee.

During the warrantee period, the supplier shall replace any component / sub-assembly that may fail or show symptoms of failure at free of cost at site.

20. COST BREAKUP

Price quoted for the tender shall be quoted in the format available on NFC website.

Price of Auto alloy and sponge dosing system for 2000T hydraulic press and recommended spares shall also be quoted. These are optional items and NFC reserves right to purchase this item at the time of placing order for presses. Basic presses along with cost of erection and commissioning and mandatory spares shall be considered for price evaluation. Auto alloy and sponge dosing system

and recommended spares for 2 years shall not be considered for price evaluation. The un-priced table of recommended spares shall be provided in part 1 of the bid.

21. MANDATORY SPARES FOR 2 EQUIPMENTS

S.No	SPARES	
1.	Die, housing and punch for 150, 180 mm diameter compacts and for rectangular (50x75x500) compacts, un-loader bed & mounting plates	1 Set
2.	Complete set of filter elements/cartridges for return line filters & oil filtration unit.	2 Sets
3.	Complete set of hydraulic flexible hoses with connectors (Total number installed)	2 Sets
4.	Set of Pipe clamps	1 Sets
5.	Flexible connectors / bellows used in hydraulic lines. (Total number installed)	1 Set
6.	Complete set of seal kits for valves & auxiliary cylinders.	2 Sets
7.	Seals like 'O' rings, metallic re-enforced seals or metallic washers used in hydraulic lines (Total number installed)	2 Sets
8.	PLC CPU	1 no
9.	Input and output modules (each type utilized)	1 no
10.	24 V DC power supply	3 nos.
11.	Spare kit for hydraulic pump	1 set for each pump.
12.	Pressure gauges	1 set installed
13.	Pressure switches	1 set installed

14.	Minimesh coupling with gauges	1 set
15.	Pneumatic / hydraulic actuator used for side lock of main ram	1 no

22. RECOMMENDED SPARES:

Bidder may supply list of spares recommended for 2 years of safe and trouble free operation with price in Part-2 of bid.

An Un-priced list of recommended spares shall be supplied with the Part-1 of offer.

NFC reserves the right to purchase any of the recommended spare at the time of placing order for equipment.

- **Please note that no price shall be indicated in Part-1 of the bid.**