Annexure A
Technical Specifications

Introduction

The 9000T Press & 32/65mT Manipulator in Forge Shop are working from last 35 years. The 9000T Press, Hydraulic Duisberg make & 32/65mT Manipulator, Sack Make was firstly installed around 1950's in Germany and after operating for more than 30 years, shifted to BHEL, CFFP and erected and commissioned in 1992.

This 32/65mT Manipulator has served for many years and availability of is on the decreasing trend due to heavy deterioration of moving parts and control system. The quantum of forgings depends on the performance of this manipulator whose major functions is to hold the ingots and perform various functions as and when required during forging operation of 9000T Press. The major functions performed by Manipulator are listed below:

Functions performed:

- Rotation of Jaw of manipulator (Both clockwise and anti-clockwise with speed regulation)
- Clamping and de-clamping of Jaw of manipulator
- Side shifting of Jaw (Parallel and Angular)
- Travel of manipulator (to and fro on rail mounted track with speed regulation)
- Lifting of jaw (up and down motion)

To perform these functions the hydraulic circuit which consists of high pressure Hydraulic Pumps with motors, various type of valves with mountings, accumulator stations, hydro-motors and manifold blocks, is functioning whose drawing is also attached for reference and its details is as follows :

1.1) Axial piston pumps with Electric Motor

Scope includes:

(i). Supply of Pumps P1,P2 & P3, P4 along with Motor M1, M2 respectively with all its hydraulic control system including all valves & pilot pump as shown in the drawing. Specification of Pumps and motors is given as under :-

Suitable Pump P1- Pressure- 250bars, Discharge - 340l/min, for cylinder functions of Manipulator along with Double acting Motor M1 of Power-132KW, Freq.-50Hz, Voltage-500V, No. of Rev.- 750 RPM,

Suitable Pump P2- Pressure- 250bars, Discharge - 290l/min, for Hydromotor functions of Manipulator suitable for Double acting Motor M1 as shown in drawing.

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Suitable Pump P3- Pressure- 250bars, Discharge - 290l/min, for Hydromotor functions of Manipulator along with Double acting Motor M2 of Power-132KW, Freq.-50Hz, Voltage- 500V, No. of Rev.- 750 RPM,

Suitable Pump P4- Pressure- 250bars, Discharge - 340l/min, for cylinder functions of Manipulator suitable for Double acting Motor M2 Power-132KW, Freq.-50Hz, Voltage- 500V, No. of Rev.- 750RPM.

(ii). 03 Nos. of **Loading unloading valve 38.1, 38.2, 38.3** as shown in Drawing.

1.2) Control System for Cylinder operations

Scope includes:

(i). Supply of Valves for all cylinder operations which includes all directional control valves, Check valves, pilot operated check valves, pressure relief valves, throttle valves etc as shown in the hydraulic circuit drawing.

S.No	Type of Valve	Part No.	Size	Quantity
1	Direction Control Valve	19.1	NW 10	01
2	Direction Control Valve	20.1,20.2, 20.3	Nw10	03
3	Direction Control Valve	22.1, 22.2	NW20	02
4	Direction Control Valve	23.1, 23.2, 23.3, 23.4,	NW30	04
5	Check Valve	27.1, 27.2	NW40	02
6	Pilot Operated Check Valve	31.1, 31.2, 31.3	NW50	03
7	Pilot Operated Check Valve	30	NW 30	01
8	Pilot Operated Check Valve	28	NW10	02
9	Check Valve	26.2	NW30	01
10	Pressure Relief Valve	36.1	NW 50	01
11	Pressure Relief Valve	34	NW 30	01
12	Pressure Relief Valve	33	NW 10	01
13	Throttle valve	46.1, 46.2	NW15	02
14	Throttle valve	47.1, 47.2, 47.3, 47.4	NW20	04
15	Throttle valve	48.1,48.4	NW 30	02
16	Throttle valve	49	NW50	01
17	Throttle valve	129	NW 30	01
18	Isolating valve	50	NW 15	01
19	Isolating valve	54.1	NW6	01
20	Pressure Reducing valve	130	NW20	01
21	Check Valve	136	NW20	01

1.3) Control System for Rotation & Travel operations

Scope includes:

(i) Supply of Valves for all hydromotor operations which includes all directional control valves, Check valves, pilot operated check valves, pressure relief valves, throttle valves etc as shown in the hydraulic circuit drawing.

(ii) Supply of one Hydro motor for Rotation Function.

(ii). Supply of two hydro motors for travel function as shown in hydraulic circuit drawing.

Vendor should either supply hydro motor similar to existing hydro motor so as to fit in the existing mounting or equivalent hydro motor with all adaptors/modifications to fit in the existing mounting(all modifications to be done by the vendor))

Specifications of suitable Hydro Motors for Travel Function of Manipulator is **Torque- 375Nm, No. of Rev.- 400RPM, Pressure- 250bars** as shown in drawing (TP No. 73.1&73.2)

Valves for Rotation and Travel Operations

S.No	Type of Valve	Part No.	Size	Quantity
1	Direction Control Valve	18		01
2	Check valve	26.1	NW 30	01
3	Direction Control Valve	23.6	NW 30	01
4	Pilot Operated Check Valve	119.1, 119.2	NW 50	02
5	Throttle valve	118.1, 118.2	NW 50	02
6	Pressure relief valve	121	NW 30	02
7	Pressure relief valve	66	NW 30	02
8	Check Valve	27	NW 40	08
9	Pressure relief valve	35.1,35.2,35.3	NW50	03
10	Check valve	44	Nw40	01

1.4. Recirculation Unit pumping station

Scope includes:

(i) Supply of circulation pump with motor as shown in hydraulic circuit drawing. Specification of Suitable Vane Pump P5 is Pressure -25bars, Discharge- 260l/min alongwith Motor of Power-11KW, Freq.- 50Hz, Voltage- 500V, No. of Rev.- 1500RPM for circulation Unit.

(ii) Suitable Pumps P6 and P7 along with Motor M4 as shown in drawing.

1.5 Accumulator stations

S.no	Item Description	Part No	Size	Quantity
1	bladder	62	32 ltrs	01
2	Safety block	52	Nw 30	01
3	Throttle valve	129	Nw30	01
4	Isolating valve	50	Nw 15	01
5	Isolating valve	54	Nw 6	01
6	bladder	88	32 ltrs	02
7	Safety block	84	Nw 30	02
8	Pressure reducing valve	130	Nw 20	01
9	Check valve	136	Nw 20	01
10	Throttle valve	85	Nw40	01
11	Piston Cylinder arrangement	77	32 ltrs	01
12	Safety block	84	Nw 30	01
13	Ball valve	83	Nw 15	01
14	Check valve	83	Nw 15	01
15	bladder	63	20 ltrs	02
16	Safety block	52	Nw 30	02
17	Throttle valve	48	Nw 30	02

1.6 Electrical & Electronics

1. All motors compatible with respective pumps rated at 50Hz, 500V AC ± 5%

2. All control cables.

3. All power cables from Starter Panel to respective motors if the power rating of motors is more than the existing power rating of motors.

4. Motor starter panel in case the rating of respective motors is more than the existing motors.

5. PLC (SIEMENS SEMATIC S7 300/400 or above only), Profibus, control and / or amplifier cards, relays, contactors, sensors, limit switches, feedback encoders, potentiometers, field input devices, etc. and other switch gear items required for normal operation of required operational features are to be provided by the vendor.

6. Manipulator Control Panel: Located in press control room

PLC Panel having SIEMENS SEMATIC S7-300/400 or higher CPU with distributed /remote I/O's. Fully wired with relays, contactors, MCB, regulated power supply and other switch gear items. This panel will interface with the field devices mounted on operator's desk through hard wiring. This panel will interface with Remote Manipulator Panel through profibus. This panel will interface with MCC Panel for starting of various motors through hard wire.

7. Manipulator Remote Panel: Located on Manipulator.

This panel will have communication, Input & Output cards, and Power Supply unit, fully wired with terminal blocks, Solid state relays, contactors, MCB and other Switch gear items. Through

this panel switching of analog and digital valves and operation of various manipulator operational features will be established.

8. The control should be selected for digital operation of clamp/unclamp, tongue lift up/down, tongue shift parallel left/right, tongue shift transverse left/right. The operations Jaw rotation (clock /anti clock wise) and travel (forward/backward) should be closed loop speed regulated.

9. **Making of panel and Field wiring**

S.No.	Specification
9.1	Indicators of incandescent lamp type not to be used.
9.2	Current density less than or equal to 2.5A/SQMM for power conductor of tinned copper only. Aluminium conductors not to be used.
9.3	PLC Wiring by 0.75mm/1sq-mm flexible multi strand annealed copper wire.
9.4	Panel Power wire not less than 4sq-mm flexible multi strand annealed copper wire
9.5	Separate 415/230V to 24V DC Power supply in each Panel. (Main & Remote)
9.6	Separate 10V DC Power supply for Each Main Panel for joysticks.
9.7	415/220V Transformer in each main panel with tapping for voltage correction
9.8	Digital outputs of PLC for all purposes except digital signals to control cards to be realized only through Relays. No direct PLC output to be used except for the purpose of interfacing with control cards.
9.9	Red colour wire to be used for 220V Ac wiring inside panel, Neutral to be black colour.
9.10	Blue colour wire to be used for PLC wiring and/or for 24 V DC and /or 10V DC.
9.11	All relays used for Valves should be Solid State Relays.
9.12	All Terminal Blocks used for control circuit must have in Built fuses. There should be at least 10% terminals provided as spare in each terminal block.
9.13	Buses should not be used to connect PLC with Relay board.
9.14	For feedback of 220V AC, Input to PLC should be realized through Relays.
9.15	All Cards used for Siemens Sematic PLC must belong to same family. Mixing should not be done.
9.16	All PLC programming should be in LAD. All networks/blocks should be supported with comments. Customized programs with redundancy not to be used.
9.17	At least 10% Inputs/Outputs and relays should be spare.
9.18	Proper laying of cables & wires their arrangement/dressing, marking/numbering/feruling, proper termination of wires and cables with lugs/thimble is to be ensured during the erection process.
9.19	All wires and cables should be protected with proper metallic conduits with PVC coating/Stainless steel conduits and should be rust free. Flexible conduits should also be used if so required specially at termination ends.
9.20	All profibus cables to be covered through flexible metallic conduits.
9.21	All logics, design, interlocks as per existing electrical drawing and/or proven and engineered system by vendor subject to agreement/approval by BHEL
9.22	Manufacturing Drawings to be approved before manufacturing by BHEL.
9.23	All Power contactors selected must be 150% of design calculated current rating. All starters must have run, stop and trip LED indications. All Star/Delta starters must have digital Ammeters. Aluminum Bus bar current density 1A/Sq-mm or less

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	Copper Bus bar current density 1.6A/Sq-mm or less. Copper wires for power wiring current density 2.5A/Sqmm or less. Copper wires for Control wiring 1Sqmm or more Control Transformer 415/220 with tappings, minimum 3KVA for control supply. All CTs (Current Transformers) to have 1Amp as secondary rating. Incomer to be provided with Digital Energy Meter
9.24	All these field cables to be water, oil, and chemical resistant and fire retardant The field cables should be properly protected with metallic conduits

2.1 Scope of work: Hydraulics

In the above defined circuit the major problems associated with the Manipulator are the worn out Pumps, Hydro-Motors, cylinders, packings which results in the slow operations of the manipulator and these problems have significant role in the amount of forgings carried out.

It is decided to recondition the existing Hydraulic System of 32/65mT Manipulator on the existing structure. This reconditioning work requires replacement of all the existing Pumps with motors, Hydro motors, all types of Valves, Accumulators stations for clamping, damping and lifting functions with accumulators stand and Manifold blocks. All these have to be dismantled and replaced with the new upgraded hydraulic system.

Vendor can replace the existing hydraulic items or they can provide the equivalent items which can perform all the functions (given in Point No. 02) of the existing manipulator within the range given in the Testing parameters (given below in point No 6). No deviation in the testing parameters shall be acceptable.

The details of the new required system is given below:-

- Main Pumping station with electric motor and Axial piston Pumps
- Manifold block for cylinder functions with all valves and mountings
- Accumulator station for clamping function, damping function, lifting function
- Manifold block for travel function with two numbers of Hydro motors , all valves and mountings
- Manifold block for rotation function with one number of Hydro Motor, all valves and mountings
- Accumulator station for travel function
- Recirculation pump unit station (In case the vendor is modifying the circuit of P2 and P3 Pump for rotation and Travel operations, then this pumping station may be excluded)

The new parts have to be assembled on the existing structure of the manipulator. If any additional manifold block/ Valves required by the vendor, it has to be accommodated on the same structure. The testing of safety interlocks, functionality tests and no load and load trials shall be in the scope of vendor. The new system has to run at an operating pressure of 200 bars with maximum pressure of 250 bar. The same pressure shall be tested on the pipe line and manifolds with the aid of pressure points given on each pressure line going for individual cylinder functions.

The details of the existing hydraulic system is given above for reference and its hydraulic drawing is also attached.

All pressure sensors and all hydraulic control pipes, hose pipes and accumulator in vendor scope. Scope also includes all piping & fitting materials, couplings including flanges with nuts, bolts and washers required for interconnecting joints and mounting pipes on Manifolds, valves etc.

Calibration and scaling of new sensors like Oil temperature sensor, Pump Pressure sensor and Oil level sensor shall be in the scope of vendor.

2.2 **Scope of work: Electrical and electronics**

1) Dismantling of all existing control panels, Junction Boxes, control and power cables along with operator desk of existing system.
2) Erection of new Manipulator PLC panel in control room and remote panel on Manipulator.
3) Erection of new Starter panel.
4) Lying of profibus cable along with conduits and clamps from Main PLC panels to Remote panels.
5) Laying of complete control cables along with conduits from Remote panel to field devices on manipulator. Screened cables along with conduits from remote panel to EMG and Encoders.
6) Lying of complete control cables with conduits from Main Manipulator Panel to Field devices mounted on Operators desk and on MCC.
7) Laying of Power cables from Starter Panel to Manipulator & on the moving trolley system.
8) Installation and erection of new hardware and software.
9) Calibration and scaling of new sensors and encoders.
10) Testing of safety interlocks, functionality tests and no load trials.
11) Start-up including hot trials.

3. Operating conditions:

- Pressure: Working pressure 200 bar with maximum pressure of 250 bar.
- Temperature: Ambient
- Operating Fluid: Hydraulic Oil SS 68/SS 100
- Operating Voltage: 500 V AC ± 5%.
- All solenoid valves to operate on 24 V DC

4. General features:

- The scope is limited to Hydraulics and associated electrical and electronics only, necessary to obtain the desired features.

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- Any other item required other than that mentioned above and necessarily required to obtain the desired performance may also be included.
- Structural parts of the manipulator are not in scope.

Note:

1. Hydraulic circuit drawing of the manipulator is attached for reference.
2. The provided scope is only indicative in nature and the applicants are invited to provide comments on the same.
3. Interested vendors are **strongly advised to visit CFFP** and study the subject hydraulic system hands-on.

5. Acceptance criteria: End Result of the Renovated System: Testing parameters

a) The new system has to run at an operating pressure of 200 bars with maximum pressure of 250 bar. The same pressure shall be tested on the pipe line and manifolds with the aid of pressure points given on each pressure line going for individual cylinder functions.

b) The system should run satisfactorily performing all the functions of given below conforming to the value of its specific function.

S. No.	Description	Value
1	Tongs clamping moment	65 Mpm
2	Carrying capacity	32 Tons
3	Maximum tong opening	As per existing system
4	Minimum tong opening	As per existing system
5	Top most position of horizontal tongs axis above rail top	2000 mm
6	Bottom most position of horizontal tongs axis above rail top	1000 mm
7	Vertical lift of horizontal peel	1000 mm
8	Horizontal parallel side shifting of peel	± 250 mm
9	Tongs turning speed infinitely variable up to	Approx. 8 rpm
10	Travelling speed infinitely variable up to	Approx. 30 m/min
11	Maximum operating pressure	Approx. 250 bar

6 **Drawing and Documentation** (*In English Language only, to be submitted after Erection and commissioning)*

1. Complete Electrical drawing including layout, wiring diagram, bill of material, itemized product catalogue and details, interlocks and alarms hardcopy in leather bonded folders. The documents should not be photocopies but good quality printouts.- Five Sets
2. Complete Hydraulic drawing, layout, product catalogue, bill of material in leather bonded folders. The documents should not be photocopies but good quality printouts – Five Sets.
3. Operation and Maintenance Manual-Five Sets
4. Alarm list and fault diagnostic manual-Five Sets
5. A soft copy of above documents(1,2,3&4) in one Flash Drive- Five Sets
6. Copy of PLC Program & HMI Program in one Flash Drive.- Five Sets

7.0 Drawing Approval

Hydraulic circuit Layout/scheme, piping drawings, calculations, bill of material along with supporting data should be approved by BHEL before manufacturing.

Panel/electrical Layout/scheme, wiring drawings, calculations, bill of material along with supporting data should be approved by BHEL before manufacturing.
All the technical details, features & model of pump, motor, valves to be submitted with drawing for approval by BHEL before manufacturing.
All drawings with complete details and supporting data should be submitted in one lot.
Delay on account of incomplete drawing/data will be on vendors account.
Time of approval will be four weeks

8.0 Make of items to be used is as under.

S.No.	Item	Make	Remarks
8.1	Pump	Wepko, Rexroth, Parker	
8.2	Motor	Motors Siemens, ABB, Crompton Greaves, Bharat Bijlee, Marathon only	
8.3	Valves	Rexroth, Parker, Hydec	
8.4	PLC	Siemens, Europe	Preferably Germany
8.5	Relays	Phoenix	
8.6	Cables, Wires	Siemens, Lapp, Igus	Only Copper Core, tinned

8.7	Connectors, Terminal blocks	Phoenix, wago	Screw type. With fuse.
8.8	Pressure Sensors	HYDAC	
8.9	Temperature Sensors	HYDAC	
8.10	Limit Switches	Siemens, BCH	
8.11	Encoders	TWK	Absolute
8.12	Switches, Push Buttons	Siemens, Schneider	
8.13	LED indicators	Siemens, Schneider	
8.14	Joy stick	Spohn & Burkhardt	
8.15	Potentiometer/Variable Resistor	Siemens	
8.16	MCB,MCCB	Siemens, Schneider	
8.17	Contractors	Siemens	
8.18	Fuse Base and Fuse	Siemens	
8..19	Selector switch	Siemens, kaycee	
8.20	Profibus	Siemens	
8.21	Conduits	Reputed	Metallic PVC coated / Stainless Steel
8.22	Panel	Rittal	
8.23	Pressure/Level Sensor 300Bar	ABB/Reputed	
8.24	Proximity Switches	Reputed	

9.0 The project will be turnkey basis including Design, dismantling, erection, commissioning, cold trial and hot trial. All the man and material require for successful dismantling, erection and commissioning is to be arranged and supplied by vendor. Any other item/material require for the proper functioning or to attain desired features should be quoted and included in the scope of supply and will be on vendor account. Services like oxygen, water, air, cranes, and electrical supply only will be provided by CFFP/ BHEL.

10.0 Commissioning spares to be provided by vendor.

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11.0 PERFORMANCE GUARANTEE: The guarantee period of the system shall be 12 months from the date of successful commissioning and trial run (hot and cold) of the system at CFFP, BHEL Haridwar.

Udbhav Mukesh 20/10/17
Udbhav Mukesh
Sr. Engineer (Forge Maint.)

20/10/17
Anil Kr. Maurya
Dy. Mgr (Forge Maint.)

20/10/17
Narendra Kumar
Sr.DGM (Shop Maint. & Plg)

20/10/2017
Surendra Kumar
AGM (M&S, PMG &HSE)

20/10/17
K S Rana
AGM (Forge Production)