Annexure-1 **SCOPE OF WORK**

Name of work:-Reconditioning & Retrofitting of Horizontal boring machine make-USSR Model-2657, Plan No. 0-204 of Block-2 (Spindle dia 150 mm)

NIT No. : 03/WEX/MCR/0-204/Bl.2/ 2010-11/ Dt.20.10.2010

1. MACHINE SPECIFICATIONS:

1.1 Make : Russian STANKOIMPORT
1.2 Model: Horizontal Borer 2657
1.3 Overall dimensions: L =10900 mm
W= 7100 mm
H = 6000 mm
1.4 Boring Spindle Dia: 150mm
1.5 Spindle motor: 14kw,1450 rpm
1.6 Axial spindle travel(Z-Axis): 1240mm
Traverse rate: 2.4-3200mm/min
1.7 Head stock vertical travel (Y-Axis): 2000mm
Traverse rate: 1.2-1600mm/min
1.8 Column travel (X-Axis): 3200mm
Traverse rate: 1.2-1600mm/min
1.9 Facing head radial tool slide maximum traverse:240mm
1.10 Feed drive motors for headstock, column and spindle feed and table carriage: 4.2 kW, 1600/3600 rpm
1.11 Feed drive motors for radial tool slide: 1.3kw,1500rpm
1.12 Head stock clamp drive motor: 1 kw,1300 rpm
1.13 Head stock column carriage clamp drive motor: 1 kw,1300 rpm
1.14 Total no. of spindle rpm steps: 22 (7.5 to 950 rpm)
1.15 Total no. of facing head rpm steps: 18 (3.75 to 192 rpm)
1.16 Weight: 52200 kgs.

2. MECHANICAL WORK :

2.1. GENERAL WORK:

2.1.1 Complete reconditioning and accuracy restoration as per original test charts of the machine.
2.1.2 Dismantling of all units, cleaning, and identification of damaged parts for rebuilding / replacement.
2.1.3 Machining and grinding of guide ways of bed, column and their matching slides etc.
2.1.4 Pasting of Turcite on slides if needed.
2.1.5 Scraping of sliding parts for desired surface contact and accuracy.
2.1.6 To carry out the modification of the lubrication system on all guideways, lead screw and nut, Head stock etc.
2.1.7 Main spindle should be checked after dismantling and shall be repaired to the extent feasible to achieve the accuracies.
2.1.8 Replacement of Nitrided bushes of spindle.

2.1.9 Checking of all lead screws and their rectification if possible. The nuts shall be replaced in all cases matching the rectified lead screws.
2.1.10 Reconditioning of gear boxes.
2.1.11 Reconditioning of table.
2.1.12 Reconditioning of clamping systems of X, Y & Z axes and table.
2.1.13 Replacement of all bearings of the machine.(Except Spindle bearings)
2.1.14 Replacement of all oil seals, O-rings, fasteners and other 'C' class items.
2.1.15 Rebuilding of the machine, replacements/repair of worn out parts.
2.1.16 The existing pulley of headstock gearbox shall be rectified to suit the new gear box.

2.2 MODIFICATION OF HEAD STOCK:

2.2.1 Head stock shall be modified to suit new requirement with AC spindle motor with gear box (as per clause 3.1 of annexure-1) and hydraulic gear shifting. After modification, there shall be only four steps covering all the speed ranges. Cutting power and torque at the spindle as per original capacity shall be ensured by the vendors.
2.2.2 Counterweight wire ropes will be replaced and system shall be overhauled.
2.2.3 New drive belts for spindle drive of Fenner/Dunlop/Yule/Goodyear make shall be fitted.
2.2.4 All hydraulic elements like pump, valves etc. shall be of latest version of Vickers/ Rexroth/Yuken make.

2.3 MODIFICATION OF LUBRICATION SYSTEM:

2.3.1 Centralized lubrication system of adequate capacity of Cenlub /Parker/ Rexroth/ Hydac make shall be provided for X and Y axis & mounted at suitable place.
2.3.2 Lubrication system for head stock shall be modified by installing suitable pump, motor, valves and other required accessories to meet the requirements.
2.3.3 There should be no leakage from the lubrication system.

2.4 GUIDEWAYS PROTECTION SYSTEM :

2.4.1 Polyurethane guide ways wipers shall be fitted on all guide ways of machine.
2.4.2 Sturdy steel telescopic covers walk on type and having polyurethane wipers, shall be provided on both sides of saddle to protect the guide ways of bed of machine.
2.4.3 Bellows shall be provided on both sides of head stock to protect the guide ways of column of machine.

2.5 WORK TO BE DECIDED DURING JOINT INSPECTION (IF REQUIRED) :

Replacement of following items shall be decided at the time of joint inspection at vendor's works. Vendors have to quote separately for these items.
2.5.1 Column Lead Screw replacement
2.5.2 Spindle Lead Screw replacement
2.5.3 Spindle replacement.
2.5.4 Spindle sleeve complete with all parts.
2.5.5 Spindle Bearings.
2.5.6 Pulley of Head Stock Gear box
2.5.7 Casting repair (if any)

3. ELECTRICAL WORK :

3.1 Retrofitting with AC spindle motor 17 KW IPH7 along with suitable signal and power cables, 1000 rpm to 8000 rpm in place of existing induction motor, with a two speed planetary gear box of ZF make (2LG4315) to provide speed reduction 1:1 and 1:4.

3.2 Siemens AC Servo Motors 1FT6 of suitable rating along with suitable signal and power cables for X,Y,Z Axes & table carriage shall be installed.

3.3 Siemens AC Servo Motors 1FT6 of suitable rating along with suitable signal and power Cables for facing head radial tool slide shall be installed.

3.4 Siemens AC Servo Motors 1FT6 of suitable rating along with suitable signal and power Cables for Head stock clamp shall be installed.

3.5 Siemens AC Servo Motors 1FT6 of suitable rating along with suitable signal and power Cables for Head stock column carriage clamp shall be installed.

3.6 Complete rewiring of machine & replacement of electrical items.

3.7 Testing of all electrical motors and their repair by revarnishing, vacuum impregnation and replacement of bearings if required.

3.8 Heidenhain DRO system comprising of linear scales, scanning heads, signal cables,3-Axis DRO unit for X,Y,Z Axes shall be provided.DRO shall accept 5V TTL/ 1V pp signals. Linear scales must have accuracy no lesser than +/- 10 µm per meter.

3.9 New metallic cable drag chain /caterpillar type cable carrier covered on both sides , make KABELSCHLEPP/ELEKTROMAG with guiding tray shall be provided for electrical cables.

3.10 New operator panel to be mounted on machine platform incorporating all required machine controls including those of tables, heidenhain DRO, spindle load meter etc.

Operator panel should have following features-

- Axes selection for X, Y, Z, radial tool slide and table through a selector switch.
- Directional PBs + & - for axis movement.
- Rapid traverse operation in Jog.
- Setting/inching operation in Jog
- Continuous Feed with spindle running for actual machining on the machine
- Illuminated Pushbuttons one for each gear step with LED lamps to command gear change
- Provision to operate the Table from the operator pendant in inch & continuous mode in direction CW/CCW.
- Emergency stop.
- Alarm Reset Push button.
- Hydraulic pump ON push-button/key.
- Main motor ON push-button/key.
- Coolant ON / OFF push-button/key.
- Indicators for main motor ON, Oil pump ON, Axes slides clamped/unclamped.
- RPM meter & load meter for spindle.
- DRO display shall be installed on operator panel.

3.11 Siemens AC Servo drive system 611U complete with Mains filter, HF Commutator Reactor, Infeed /Regenerative Feedback module, Over Voltage Limitation module, LT and control modules and radial built-on fan for supply and control of spindle, all the feed and table carriage motors. All 300 mm drive modules should have radial built-on fan.

Ratings of various modules shall be in accordance with Siemens selection tables and shall be mentioned in the offer.

3.12 Siemens/ABB/GE Fanuc PLC system having 64 inputs and 64 outputs for the machine.

3.13 A dust-and vermin proof Electrical cabinet incorporating the drive system , PLC, all the switchgear shall be provided. All compartments should be illuminated for ease of maintenance. Two nos. ebm/nadi make exhaust fans of suitable rating shall be mounted on the cabinet. The switchgear (MCBs, MPCBs, Contactors, Relays etc) should be of Siemens/ Schneider/ Fuji/Mitsubishi/ABB make.Cabinet shall have a 220V, 5 Amp socket and switch for service purposes.

3.14 220V AC,5A plug points shall be provided in electrical cabinet(s) and the operator panel.

3.15 Machine work light with halogen lamp and magnetic base for illumination of work area.

3.16 All push buttons, selectors, switches, indicators , contractors, MCB's cable , lugs, ferrules , terminal plug, socket and relay modules etc. shall be replaced with new version of reputed make.

3.17 All power cables/signal cables should be of Siemens make only.

4. MONITORING:

4.1 Any abnormality on the machine should be indicated by indicating lamps, PLC alarms & message prompts.

4.2 PLC alarms & messages should include the device number and/or the operand.

5. SAFETY FEATURES SHOULD INCLUDE:

5.1 Fuses & Overloads of appropriate ratings for all primary & auxiliary circuits.

5.2 Limit switches & sensors to avoid over-travel & collision of any part of the machine.

5.3 Float & pressure switches to ensure proper functioning of hydraulic & lubrication systems.

6. DISMANTLING OF MACHINE FOR DESPATCH TO VENDOR'S WORKS:

6.1 Vendor shall carry out and record all the accuracy tests as per test chart before dismantling of machine.

6.2 Vendor shall dismantle the machine at BHEL, Haridwar.

7. PAINTING OF THE MACHINE AFTER RECONDITIONING:

7.1 Moving units/parts of the machine shall be painted in Satin Blue shade

7.2 Non-moving units shall be painted in Phirozi Blue shade after reconditioning.

8. PRE-DESPATCH INSPECTION:

Inspection of the machine after reconditioning shall be carried out by BHEL at vendor`s works to check functioning of machine and to check geometrical accuracies as per para no. 9.1 of acceptance criteria. Only after the clearance given by BHEL, shall the machine be dispatched to BHEL, Hardwar.

9. ERECTION AND COMMISSIONING:

Erection and commissioning shall be done by the vendor at BHEL, Haridwar.

10. ACCEPTANCE CRITERIA:

10.1. Accuracy test as per manufacturer's test chart for geometrical accuracies of Bed, Saddle, Column, Headstock, Face Plate and Spindle shall be demonstrated at vendor's works before dispatch of machine to BHEL, Hardwar. Mandrel test will also be shown at vendor's works before dispatch of machine.

10.2. All accuracy tests of the machine including tests under point 9.1 as per manufacturer's test chart shall be demonstrated at BHEL, Hardwar at the time of Erection & commissioning.

10.3. Machine shall be accepted after performance test on one test piece at BHEL Hardwar by representatives of the vendor. BHEL shall provide all necessary jobs, tooling, material handling facilities and operator and inspection aid for the same.

11 . PERIOD OF RECONDITIONING:

11.1. Period of reconditioning of the machine as per the scope of work at vendor's works shall be six (6) months maximum from the date of receipt of machine at their works.(period between receipt and dispatch)

11.2. Vendor shall intimate date of receipt of the machine at their works to BHEL, Hardwar.

11.3. Vendor shall depute their manpower within 7 days of intimation for erection and commissioning of the machine at BHEL, Hardwar.

11.4. The erection and commissioning work should be completed within 30 days from the date of start of erection and commissioning at BHEL, Haridwar.

12. LATE DELIVERY:

LD of 0.5% of the total cost of works per week, subject to a maximum of 5% shall be imposed on delay in delivery from scheduled delivery date and delay in commissioning from scheduled commissioning date.

13. OTHER TERMS & CONDITIONS:

13.1. List of all parts repaired or replaced to be furnished to BHEL along with reconditioned machine.

13.2. Old parts, which would be replaced by new ones, should be returned to BHEL Hardwar properly tagged.

13.3. Vendor shall arrange insurance of the machine during reconditioning at their works.

13.4. Any material or any activity if not covered in the scope of supply and scope of work but necessary for proper reconditioning of the machine should be offered and quoted by the vendor.

No price additions shall be allowed after placement of the Work Order and the supply of all such material and activities shall be the responsibility of the vendor.

13.5. Vendor shall bring all tools and manpower for dismantling, erection & commissioning of the machine at BHEL, Hardwar.

13.6. Further off-loading of work either in part or full is not permitted in any case without prior permission of AGM (WEX-MCR), BHEL, Hardwar.

14. DEFECTS LIABILITY PERIOD –Guarantee

14.1 The vendor shall guarantee the executed work for satisfactory performance for one year on two-shift basis to the accuracies and performance excluding mal-operation and accidents. This period shall commence from the date of successful erection, commissioning and prove out of the machine at BHEL Hardwar.

14.2 Vendor shall attend the machine free of cost during the guarantee period.

14.3 Vendor shall replace/repair any defective part/item free of cost during the guarantee period.

15. TRANSPORTATION & INSURANCE:

15.1. Transportation & transit insurance will be on BHEL account.

15.2. Transportation by BHEL approved Transporters only.

15.3. Road permit, Form '31' & Form 'C' will be provided by BHEL.

16. BANK GUARANTEE:

Vendor has to submit a Bank guarantee of value Rs. 50 lakh against the estimated cost of machine before machine is dispatched from BHEL, Hardwar and till it is received back at BHEL, Hardwar.

17. DOCUMENTS:

- Electrical schematic of the machine: 3 sets
- PLC program in ladder form with symbols and comments in English: 3 sets.
- O&M manuals for PLC, drives, and Heidenhain measuring system: 3 sets.
- O&M manuals for ball screws and ball nuts: 3 sets.
- Modified kinematic and assembly diagrams of the main motion drive 3 sets
- Manual for the new Hydraulic system: 3 sets
- Manual for Lubrication system: 3 sets.
- A parts list of all new items/parts installed in the m/c 3 sets.
- Drawings and details of all mechanical modifications & fittings 3 sets.

18. PAYMENT TERMS :

No advance payment shall be made to the vendor.

Part payment will be made after completion of following milestones-

18.1. First payment of 15% of total work order value shall be made after dismantling and joint inspection at vendor's works.

18.2. Second payment of 75% of total work order value along with 100% Taxes and Duties will be made after dispatch of the machine to BHEL, Hardwar.

18.3. Final payment of 10% of total work order value will be made after erection, commissioning and acceptance of machine at BHEL, Hardwar.

18.4. Vendor shall submit performance bank guarantee of 10% of total work order value for the entire Warranty period before final payment.

18.5. All the payments shall be made through e-payment after submission of following documents along with first bill-

i. E-payment form duly filled.(form will be provided by BHEL)
ii. Bar chart of the machine showing the milestones
iii. Income tax exemption letter(if applicable)
iv. Receipt from the vendor that machine has been received by them at their works

19. OFFER:

The offer should be submitted in the following manner.

19.1 Techno-commercial bid containing technical details and commercial terms & conditions.

19.2 Price bid containing total price along with the price break-up for all the major items and for the items to be decided at the times of joint inspection . The price bid containing any terms & conditions are liable to be rejected.

19.3 Price bid shall be opened of only techno commercially accepted offers .

19.4 Point-wise compliance of this scope of work is to be given by vendors while submitting their offer.

20. QUALIFYING CRITERIA:

The vendors meeting any of the following criteria would only be considered:

20.1 Who are presently manufacturing or manufactured during last ten years Horizontal Boring Machines of spindle diameter 150mm or more.

20.2 Who have reconditioned and retrofitted a horizontal boring machine of spindle diameter 150 mm or more during last ten years.

The vendor must submit "Performance Certificate(s)" of the machine(s) from the end user along with the offer and should agree to arrange the visit of BHEL team for verification at the end user's works, if BHEL so desires.

21. EARNEST MONEY DEPOSIT (EMD)

21.1 Vendors have to deposit Rs. 2 lakh as the EMD. EMD may be deposited in cash, through pay order in favor of BHEL, Hardwar or through demand draft only.

21.2 EMD shall be converted to security deposit if the work is awarded.

21.3. EMD given by unsuccessful vendors shall be refunded back normally within fifteen days of acceptance of award of work by the successful vendors.

21.4 EMD shall not carry any interest.

22. **Vendors shall submit detailed scheme of modification in gear shifting system along with drawings and ketches for technical evaluation of BHEL. Functioning of modified system shall be the responsibility of the vendor.**

23. **Vendors are strongly advised to visit BHEL, Hardwar and study machine documents in detail on any working day between 8am to 5 pm before submitting their offer.(SUNDAY IS HOLIDAY)**

Technical Committee:

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