Annexure I

SCOPE OF SUPPLY FOR RECONDITIONING, UPGRADATION AND RETROFITTING OF SKODA RAM BORER, PLAN 1-112 (MODEL: W250H), S.No. Ob22605 & ITS ROTARY TABLE (MODEL: S80B), S.No. Ob 22725

A. SCOPE OF SUPPLY (W250H AND TABLE S80B):

A.1 X-AXIS:

1. New Biplast lining and glue for X -axis guideways; wedges with adjusting screws
2. Parts for reconditioning and modification of X-axis feed gear box without electromagnetic clutches
3. Bearings of the X-axis feed gear box
4. Seals of the X-axis feed gear box
5. Adaptation flange, coupling etc for installation of Siemens AC servomotor
6. Brackets for installation of Heidenhain linear scale and transducer
7. New hydrostatic system for X-axis guideways comprising of
    - Hydrostatic unit
    - Oil tank
    - Hydrostatic manifolds
    - Set of capillaries
    - Interconnection of hydraulic system
    - Sealing of front (face) surfaces of bed sections

A.2 Y-AXIS:

1. New Biplast lining and glue for Y -axis guideways; wedges with adjusting screws
2. New feed gearbox for Y-axis to replace the existing gear box (with electromagnetic clutches which provide 1:10, 1:1, and Rapid selections). After the installation of new feed box, Y-Axis shall be steplessly driven by Siemens AC servomotor. *Party shall ensure minimum and maximum speeds presently available on the machine. The same shall be stated in the offer.*
3. New ball lead screw and nut for Y-axis
4. Brackets for installation of Y-axis ball lead screw and nut
5. Parts for adaptation of ball screw to new feed gear box of Y-axis
6. Adaptation flange, coupling etc for installation of Siemens AC servomotor
7. Safety brake for Y-axis ball screw locking comprising of brake, bevel gears and necessary brackets to fasten the brake to the gear box.
8. Brackets for installation of Heidenhain linear scale and transducer
9. New bellow covers for the protection of Y-axis ball lead screw

A.3 Z- AND W-AXES (Spindle and ram)

1. New Biplast lining and glue for Z- and W-axis guideways; wedges with adjusting screws

2. Seals for Z-and W-feed shifting system and gearbox.
3. Parts for reconditioning and modification of Z-and W-axes gear box (without electro-magnetic clutches)
4. Adaptation flange, coupling etc for installation of Siemens AC servomotor for Z-and W-axes
5. Assembly for fitting and installation of Heidenhain rotary encoder for Z-and W-axes
6. Blocking attachment of boring feeds
7. New chain and sprocket assembly for blocking system of boring feeds

A.4 <u>SPINDLE:</u>

1. All the bearings of main spindle seat
2. Rear spindle guiding bearings
3. Bearings of the main spindle drive gear box
4. All gears of main spindle gear box
5. All shafts of main spindle gear box
6. Seals for hollow spindle sealing
7. Seals for main spindle
8. Seals for the spindle speed shifting system
9. New front panel with seals/wipers for quill
10. Boring spindle wiper and lubricating sponge

A.5 <u>V-AXIS OF TABLE:</u>

1. New Biplast lining and glue for V -axis guideways; wedges with adjusting screws
2. New ball screw and nut for the V-axis; (*V-axis traverse is about 1600 mm*).
3. Brackets for installation of V-axis ball lead screw
4. Bracket for installation of V-axis ball screw nut
5. Bearings for mounting of V-axis ball screw in housings
6. New planetary gear box for V-axis feed system
7. Adaptation parts for the installation of the planetary gear box
8. Flange, coupling for installation of V-axis AC servomotor
9. New lubrication system for V-axis ball screw
10. New lubrication system for V-axis guideways
11. New hydraulic system for V-axis clamping unit
12. Parts required for repair of V-axis clamping unit
13. Set of seals for the V-axis clamping unit
14. New set of wipers for V-axis guideways
15. Brackets for installation of Heidenhain V-axis measuring system
16. Assembly for blocking of V-axis

A.6 <u>B-AXIS OF TABLE:</u>

1. New Biplast lining, glue and adjusting screws for B -axis guideways
2. Parts for modification of B-axis feed system

3. New planetary angle feed gearbox for B-axis feed
4. Structure for installation of new planetary angle gearbox
5. Mounting for installation of B-axis AC servomotor
6. New lubrication system for B-axis guideways
7. Parts and seals required for repair of B-axis clamping units
8. New hydraulic system for B-axis clamping units
9. New hydraulic system for control of B-axis locking device
10. Parts including seals required for repair of B-axis locking device
11. Assembly including brackets for installation of Heidenhain B-axis rotary encoder
12. Set of bearings for central seating of the clamping plate of the table
13. New feed pinion
14. Set of new feed gears
15. Assembly for blocking of B-axis

A.7 LUBRICATION SYSTEM OF THE MACHINE:

1. Lubrication system of the machine shall be overhauled as specified in paras 42-46 of Scope of Work. Parts required for overhauling shall be supplied by the party.
2. New system for collecting and recirculating of lubrication oil

A.8 DRO System

1. New Heidenhain DRO for 6 axes display
2. New Heidenhain linear measuring scale for X-axis to meet full axis traverse
3. New Heidenhain linear measuring scale for Y-axis to meet full axis traverse
4. New Heidenhain Rotary encoder for Z and W-axes
5. New Heidenhain linear measuring scale for V-axis of rotary table to meet full axis traverse
6. New Heidenhain Rotary Encoder (18000/ 36000 PPR) for B-axis of the rotary table
7. Pre-assembled shielded signal (feedback) cables for Heidenhain linear and rotary Devices of X, Y, Z+W, V-and B-axes of required length.
   Lengths of the signal cables should be evaluated based on Heidenhain installation instructions and should be within the maximum limits prescribed by Heidenhain.
   There should not be any loss of signal to affect and disturb the measurement.
8. Power supply cable for the DRO

A.9 OPERATOR'S PENDANT AND AUXILLIARY PORTABLE OPERATOR PANEL:

1. New operator's pendant shall be supplied equipped with all necessary operating devices such as Potentiometers, Push buttons, selector switches and indicating lamps.
2. Pendant shall have sufficient space for mounting of the Heidenhain 6-axis DRO
3. New Panel hose
4. Machine load indication shall be provided on pendant.

5. Spindle speed indication shall be provided on pendant.
6. Potentiometers for control of speed of various axes of the machine and table should have ***anti-log characteristic*** (*The existing Potentiometers on the pendant are also of this type*).
7. Pendant shall be so designed as to give similar functionality and features to the operator as are available presently.
8. An auxilliary portable operator panel shall be supplied and commissioned for operator's use on difficult locations of the job to be machined.

A.10 ELECTRICALS AND DRIVES AND PLC:

1. Siemens AC Servomotors 1FT6 for X, Y, Z+W, V, and B-axes
2. Simodrive 611U drive system including HF reactor, filter, I/R module, LT and closed loop control modules for X, Y, Z+W, V, and B-axes
3. Set of Pre-assembled power cables of required length for X, Y, Z+W, V and B-axes servomotors
4. Set of Pre-assembled power cables of required length for X, Y, Z+W, V, and B-axes servomotors
5. Profibus Fast Connect Bus cable, type 6XV1830-0EH10 of required length
6. Profibus Connectors with PG interface as per requirement
7. Profibus Connectors with without PG interface as per requirement
8. Operator Panel OP77 DP
9. Distributed I/O modules **ET 200 L or Phoenix equivalent–**as per machine inputs and outputs requirement
10. New Rittal Electrical cabinet(s) having sections for drives, PLC and other switchgear and fitted with
    - Complete Simodrive 611U system as per Point A.10/2. above
    - Siemens 4-Quadrant DC drive SIMOREG 6RA70 for controlling 80 kW Main motor of the machine
    - Siemens S7-300 Central Processing Unit **CPU 314C-2DP** Compact CPU, 48 KB RAM, 24 V DC Supply Voltage 24 DI/16 DO/4AI/2AO integrated, integrated functions, MPI, Profibus DP master/slave interface, with Micro Memory Card 6ES7 314-6CF01-0AB0
    - Required S7-300 digital and analog input and output cards to meet the requirement of the machine
    - Distributed I/O modules for installation in the pendant, column and table(if possible) for connection to machine inputs and outputs
    - All required electrical switchgear such as fuses, contactors, MPCBs, MCBs for induction motors of the machine, 8-channel Relay boards (2 Amps)-Phoenix-make
    - SMPS SITOP DC 24 V power supply, 20 Amps
    - MCCB for the machine
    - Panel-type Airconditioner(s) (*should preferably be sourced from Indian market)*

11. New wiring, conduits and cables for the machine and table

A.11 MISCELLANEOUS ITEMS:

1. Flexible cable carrier for carrying the cables from the machine to the electrical cabinet
2. New Air Distribution system for the machine including set of new ISO valves for replacing the existing pneumatic valves
3. New coolant pump with flow control having discharge of 30 LPM and 10 m pressure head along with VFD (*preferably Siemens MM440/Fuji/Yaskawa-make*) for speed control of the coolant pump motor.
4. New hose pipes for coolant system connections
5. Electronic flow switches to replace the existing mercury switches for monitoring of lubrication of main gear box and feed gear box of Z-and W-axes
6. New set of wipers
7. New limit switches preferably of Euchner-make for limitation of all axis movements
8. Parts for modification of the counterweight such as assembly for reinforcement of counterweight's guiding ; Spring cushion for counterweight
9. New wire ropes for the counter weight system
10. New telescopic covers (roof type) of Hennig/Sur Hennig-make for both sides of X-axis bed guideways
11. Flexible cable carrier for carrying the cables of the Rotary cable including all fixing parts

A.12 SPARES:

1. Electronic Flow Control Switches -10 nos.
2. Potentiometers of anti-log characteristic -10 nos.
3. Limit switches-Euchner-make - 05 nos.
4. Heidenhain DRO 6-axes - 01 no.
5. Heidenhain scale scanning head for X-axis - 01 no.
6. Heidenhain scale scanning head for Y-axis - 01 no.
7. Heidenhain scale scanning head for table V-axis - 01 no.

A.13 DOCUMENTATION:

1. New Kinematic diagrams for all axes including table shall be supplied.
2. New hydraulic schematic of the machine and table
3. New lubrication schematic of the machine and table
4. Assembly drawings of table V-and B-axes
5. New electrical schematic of the machine and table
6. New PLC program print out with Cross Reference List and comments in English
7. PLC program on CD/DVD
8. List of all bought-out items, their part nos., name of manufacturer and operation

and maintenance instructions

9. Operation Manual of Heidenhain DRO, Heidenhain Product technical sheets of all linear measuring scales and Rotary encoders

B. WARRANTY:

Warranty period shall be 18 months from the date of successful commissioning. Replacement of parts will be within 15 days from the date of intimation by BHEL.

C. SPECIAL INSTRUCTIONS:

1. Party shall mention in the offer the ***new feed range*** of each axis viz. X-axis, Y-axis, Z+W axis, table V-axis axis and table B-axis achievable after the reconditioning and upgradation.
2. Following details shall be submitted by the vendor along with the offer:

2.1 Name plate details of all the AC servomotors axis-wise
2.2 Complete Siemens part nos. of Simodrive 611U system incl. HF choke, Filter, Infeed/Regenerative feedback module, all LT modules, and 611U closed loop control modules.
2.3 Lengths of servo power and signal cables for each axis
2.4 Siemens part no. of 6RA70 drive for the main motor including the current rating
2.5 Details of the Heidenhain DRO incl model and size
2.6 Details such as Model, length, type of output (11 uA/1 V pp/5 V TTL) of Heidenhain linear measuring scales for X, Y, and V-axes
2.7 Details such as Model, type of output (11 uA/1 V pp/5 V TTL), no. of pulses per revolution of Heidenhain rotary encoders for Z+W axis and table B-axis
2.8 Lengths of DRO feedback cables for each axis
2.9 Details of Siemens S7-300 PLC CPU along with total no of digital and analog inputs and outputs
2.10 Details of decentralised Distributed I/O units and their proposed location on the machine
2.11 Size, length, make and the accuracy grade of the ball lead screw of Y-axis.
2.12 Size, length, make and the accuracy grade of the ball lead screw of V-axis.
2.13 List of bearings to be replaced in X-axis feedbox
2.14 Quantity, numbers, sizes and make of bearings of the central seating of the clamping plate of the table
2.15 Details of all the parts proposed to be supplied for reconditioning of the B-axis gearbox such as gears, wormgears, wheels and bearings
2.14 Details of new feed gear box of Y-axis shall be submitted by the vendor.
2.15 Details of bearings of the main spindle seat
2.16 Details of bearings of the rear spindle guiding
2.17 Details of bearings of main spindle drive gear box
2.18 Details of all spindle gears and shafts
2.19 Details of new lubrication system of V-axis guideways with lubrication schematic

2.20 Details of new lubrication system of V-axis ball screw with lubrication schematic
2.21 Details of new lubrication system of B-axis guideways with lubrication schematic
2.22 Details of new hydraulic system for V-axis clamping units with schematic
2.23 Details of new hydraulic system for B-axis clamping units with schematic
2.24 Details of new hydraulic system for B-axis locking device with schematic

D. GENERAL CONDITIONS:

1. Delivery period for the material shall be intimated by the vendor.
2. Vendor shall also intimate the total downtime of the machine for completion of retrofitting and reconditioning work.
3. Any other work/material required for successful reconditioning and commissioning of the machine may be offered by the vendor. *However no such offer shall be accepted by BHEL after placement of the P.O. and supply of such material and work associated with its installation shall be the responsibility of the vendor.*
4. Party shall quote the prices of material and labour separately in the budgetary offer.

E. QUALIFYING CONDITIONS:

1. Only those vendors, who have done mechanical reconditioning/ accuracy restoration/complete overhauling of at least 1 no. Skoda Ram Borer of spindle dia 250 mm as per Skoda test protocols in the past five years (on the date of opening of tender) and such machine is presently working satisfactorily for more than six months after commissioning (on the date of opening of tender), shall quote.

   OR

   Only those vendors, who have manufactured, supplied, and commissioned at least 1 no. Ram Borer of min. spindle dia 200 mm in the past five years (on the date of opening of tender) and such machine is presently working satisfactorily for more than six months after commissioning (on the date of opening of tender), shall quote.

2. Following information should be submitted by the vendor about the companies where similar machines have been supplied or reconditioning work has been carried out. This is required from the vendor for qualification of the offer.

i.) Name of the customer(s) / company(s) where the machine(s) is/are installed.
ii.) Complete postal address of the customer.
iii.) Name, designation, Phone, FAX no. and e-mail id of the contact person of the customer.
iv.) Month & Year of commissioning.
v.) Broad specifications of the machine(s) supplied/reconditioned and application.

vi.) Performance certificate from the customers regarding satisfactory performance of machine (Original Certificate or through E-mail directly from the customer). The original performance certificate may be returned after verification by BHEL, if required.

3. BHEL reserves the right to verify information submitted by the vendor. Vendor shall agree to arrange a visit of BHEL expert(s) to the customer's premises for verification purposes, should BHEL so desire. In case, the information is found to be false/incorrect, the offer shall be rejected.

4. M/S Skoda MT, Czech Republic being OEM of the subject machines are technically qualified to bid for the tenders.

Annexure II

A. SCOPE OF WORK

The machine will be inspected at the beginning of reconditioning job and measured as per its standard inspection chart and all accuracy deviations will be recorded as per existing state. All existing major troubles will be noted.

A.1 X-AXIS:

1. Guideways shall be repaired, levelled, scraped and matched with the column saddle.
2. Guideways shall be lined with Biplast using glue. New wedges shall be fitted with adjusting screws.
3. Feed gear box shall be suitably modified so as to replace the existing electromagnetic clutches which provide 1:10, 1:1, and Rapid selections. After the modification of the feed box, X-axis shall be steplessly driven by Siemens AC servomotor. Party shall ensure minimum and maximum speeds presently available on the machine. The same shall be stated and confirmed in the offer *Details of feed gear box modification shall be submitted by the vendor.*
4. Feed box bearings shall be replaced.
5. Seals of feed box shall be replaced.
6. New telescopic covers shall be installed on both sides of the column on X-axis.
7. Heidenhain linear measuring scale shall be installed and commissioned after replacing the existing Philips scale
8. New Siemens 1FT6 AC servomotor shall be fitted to the modified X-axis feed box.
9. New Euchner-make limit switches shall be installed and wired along with dogs (cams) for traverse limitation
10. New hydrostatic system shall be installed and commissioned for X-axis guideways

A.2 Y-AXIS:

1. Guideways shall be repaired and matched with headstock.
2. Guideways shall be lined with Biplast using glue. New wedges shall be fitted with adjusting screws.
3. Existing leadscrew shall be removed. New ball screw shall be installed using appropriate brackets.
   Safety brake assembly shall be fitted onto the ball screw using appropriate brackets and bevel gears .
4. Existing gear box shall be replaced by a new feed gear box. New Y-axis AC servomotor shall be fitted to the new gear box.

5. New bellow covers shall be installed for the safety of the guideways and ball screw.

A.3 Z- AND W- AXES: (Spindle and ram)

1. Guideways shall be lined with Biplast using glue. New wedges shall be fitted with adjusting screws.
2. Gear box of Z-and W-axes shall be suitably modified so as to replace the existing electromagnetic clutches which provide 1:10, 1:1, and Rapid selections. After the modification of the gear box, Z-and W-axes shall be steplessly driven by a Siemens AC servomotor.
   Party shall ensure minimum and maximum speeds presently available on the machine. The same shall be stated in the offer.
   Details of feed gear box modification shall be submitted by the vendor.
3. Replacement of seals of Z-and W-feed shifting system and the gear box.
4. Fitting of new Siemens AC servomotor to the feedbox
5. Replacement of the blocking system of the boring feeds.

A.4 SPINDLE:

1. Bearings of main spindle seat shall be replaced.
2. Rear spindle guiding bearings shall be replaced.
3. Bearings of the main spindle drive gear box shall be replaced.
4. All gears of the main spindle gearbox shall be replaced.
5. All the shafts of the main spindle gearbox shall be replaced.
6. Seals of main spindle shall be replaced.
7. Replacement of seals for hollow spindle sealing
8. Seals of the spindle speed shifting system shall be replaced

A.5 V-AXIS OF TABLE:

The table will be inspected at the beginning of reconditioning job and measured as per its standard inspection chart and all accuracy deviation will be recorded to inspection chart as to the existing state. All existing major troubles will be noted and Vendor's engineers will work out the plan to remedy the same to the best condition possible.

1. Existing combined feed gear box of V-B-axes shall be dismantled along with the feed system of V-axis.
2. Machining and scraping will be done for mounting new Heidenhain linear scale and new ball screw for V-axis and installation of plastic lining (Biplast) of the guiding in V- axis.
3. Guideways shall be lined with Biplast using glue. New wedges shall be fitted with adjusting screws.

4. For V-axis drive, a new ball screw along with the nut shall be installed using new bearings and brackets and a new planetary gearbox.
5. New Siemens AC servomotor shall be fitted for V-axis drive.
6. New system for lubrication of ball screw and guideways shall be installed and commissioned.
7. Repair of V-axis clamping units shall be carried out.
8. All the seals of V-axis clamping units shall be replaced
9. New hydraulic system for V-axis clamping unit shall be installed.
10. New wipers for V-axis guideways shall be fitted

A.6 B-AXIS OF TABLE:

1. Guideways shall be lined with Biplast using glue and adjusting screws.
2. Existing B-axis feed system shall be modified to accommodate drive for new AC servomotor.
3. New B-axis servomotor shall be mounted.
4. Repair of B-axis clamping units shall be carried out and all the seals shall be replaced
5. Repair of B-axis locking device shall be carried out and all the seals shall be replaced
6. New hydraulic control for B-axis locking device shall be installed and commissioned.
7. New lubrication system for B-axis guideways shall be installed and commissioned.

A.7 LUBRICATION SYSTEM OF THE MACHINE:

1. X-axis guideways lubrication system shall be overhauled.
2. Y-axis guideways and ball screw lubrication system shall be overhauled.
3. Lubrication system of Z-axis guideways shall be overhauled.
4. Lubrication system of main spindle gear box shall be overhauled.
5. New lubrication system for the machine shall ensure that lubrication oil is collected and recirculated back to the lubrication tank and should not seep into the machine foundation.

A.8 DRO SYSTEM:

1. DRO system supplied as per points A.8/1. to 8. of the scope of supply shall be commissioned on the machine. It is to be ensured that DRO readings are in conformity with readings taken by instruments such as screw gauge, measuring rods which is a usual practice with BHEL's production and quality departments.

2. DRO shall be mounted on the operator's pendant for convenient display of all machine axes and table readings to the machine operator.

A.9 ELECTRICALS ,DRIVES AND PLC:

1. New Servodrive system comprising of Siemens 1FT6 AC servomotors and Simodrive 611U shall be commissioned on all the axes of machine and the table to give smooth traverse and steplessly variable minimum to maximum speed.
2. PLC system shall be installed and all machine and table inputs and outputs shall be connected to the new PLC system using new wiring with proper labeling. All machine and table inputs and outputs shall be terminated on distributed I/O modules located at the site itself and not to be brought to the main electrical cabinet. All the operator panel inputs and outputs should be connected to distributed I/O modules to be mounted inside the Operator Pendant. All distributed I/O modules shall be inter-connected with Profibus cable which shall finally be connected to S7-330 CPU and Siemens Operator Panel OP 77 in the main electrical cabinet.
3. PLC program shall be developed to meet all the functional requirements of the machine.
4. All necessary messages and alarms shall be generated. All the alarms should appear on Siemens Operator Panel OP77 to be mounted on the electrical cabinet door. Critical alarms/messages regarding lubrication, operation of limit switches, status of gear step of main spindle etc. should also be provided through illumination of LED-type indicating lamps on the cabinet door.
5. Siemens Operator Panel OP77 shall be programmed by the vendor so that all PLC inputs, outputs and flags can be seen by maintenance personnel on the panel display.

A.10 MISCELLANEOUS WORKS:

1. New wipers shall be fitted on all axes.
2. New air distribution system with modern pneumatic ISO valves shall be installed in place of the system
3. New coolant pump shall be commissioned and will be controlled by the VFD drive. New hose connections shall be installed.
4. Air distribution system of the machine shall be modified.
5. All mercury flow switches shall be replaced with electronic flow switches
6. Necessary repairs/adjustment of the machine jib crane shall be carried out.
7. New flexible cable carrier shall be fitted after removing existing carrier.
8. New wire ropes for counter weight shall be pulled in place of the existing ropes. Necessary repair and adjustment of the counterweight system shall be carried out. Spring cushion and counterweight's guiding shall be reinforced.

9. Machine jib crane (cap. 750 kg) shall be repaired by the vendor.
10. Machine shall be painted afresh after application of putty on required surfaces.

B. MACHINE ACCEPTANCE:

1. Vendor shall perform all the activities as mentioned in the scope of work to commission the machine.
2. Vendor shall carry out testing of geometrical accuracies of the machine as per Skoda standard test charts Ob1122T & Ob1298 T
3. One job to be decided by BHEL shall be successfully machined in the presence of vendor's experts.

C. VENDOR'S OBLIGATIONS:

- WORKING TOOLS AND MANDRELS: Vendor shall bring working tools and mandrels required for dismantling, reassembly with modifications, commissioning and performing accuracy tests of the upgraded reconditioned m/c.
- Vendor will prepare the drawing of defective parts to be repaired or to be manufactured at BHEL Workshop.
- Vendor shall intimate the ISO grade and quantity required of hydraulic and lubrication oil for first filling of tanks.
- All manpower required shall be the responsibility of the Vendor

D. BHEL'S OBLIGATIONS:

BHEL will provide following assistance: -

- All possible machining help will be provided by BHEL. It is limited to machining on machine tools installed at BHEL, Hardwar only.
- Crane, lifting tackles, gas cutting sets with gas, welding machines, transportation of material inside the plant, jacks etc.
- Consumables like cotton waste, welding rods, emery papers, oil, etc. Party shall intimate the requirement of the types of machine along with machining time required.
- Transportation of supplied material within factory premises shall be in BHEL scope.