

Encl. to Tender No. EKM/Q/002916/10-11, Dt19.07.2010
ENCLOSURE - 1

**WORK PACKAGE (SCOPE OF WORK) FOR INSUTU ASSEMBLY,
MACHINING / BORING, INSTALLATION, COMMISSIONING AND
TEST & TRIALS OF "VERTICAL RUDDER" ON INS SINDHUKIRTI**

A) TECHNICAL SPECIFICATIONS

1. **Activity**: Carry out assembly, Installation, Trials and Commissioning of Vertical Rudder as per drawing/ repair manual. Manufacturing of shims and fit bolts as required including machining/ borings, bedding, reaming holes, alignment, clearances of mating components, assembly and Pressure testing. The assembly and installation drawings and repair manuals are to be guide lines for assembly and installation of Vertical Rudder is enclosed in Appendix-1.

2. **Spares and materials**: All raw materials required for manufacturing the shims and fit bolts, electrodes, consumables like gaskets, gas, compressed air, oil, Paint etc. will be supplied by HSL at HSL Stores. All fasteners and spares required for assembly the components in situ will be supplied by HSL. and other fasteners, gaskets etc required for testing will be under HSL scope. Contractor should make arrangements to cut the materials from Rounds/ Plates as required for manufacturing the jigs and fixture. All cleaning and working materials like rag, Kerosene, wire brush, Persian blue, hand pump (Hand pump for pre. Testing can be supplied by HSL) for pressure testing of the components etc. will have to be arranged by the contractor. The contractor should submit detailed list of spares/ raw materials required for manufacturing the shims and fit bolts within 10 days of placement of order. The list of materials required for installation and testing should be submitted within 20 days of placement of order.

3. **Checks, Testing and Inspections**:- All the checks and tests are mentioned in the drawing/ repair manual/ approved QAP by WOT, are to be offered for inspection by the team of HSL and WOT as required and the data to be recorded. The Inspection Report recorded data are to be bound and submit in triplicate to HSL-QC.

4. **Description**: The following main components of Vertical Rudder are as follows:

- | | |
|-----------------------------------|-----------|
| (i) Blades. | - 01 Nos. |
| (ii) Rudder Stock. | - 01 Nos. |
| (iii) Rudder Stock Top bearing. | - 01 Nos. |
| (iv) Rudder Blade Pintle bearing. | - 01 Nos. |
| (v) Rudder Blade Pivot. | - 01 Nos. |

(vi) Tiller.	- 01 Nos.
(vii) Tie Rods.	- 02 Nos.
(viii) Drive Rods.	- 02 Nos.
(ix) Slider housings assembly.	- 02 Nos.
(x) Hull gland assembly.	- 02 Nos.
(xi) Couplings assembly.	- 02 Nos.
(xii) Indicators assembly.	- 02 Nos.
(xiii) Hydraulic machine/ Cylinders.	- 02 Nos.

5. Technical Data:

- (i) Working pressure of Hydraulic Drives : 100 Kg/cm².
(ii) Hard over angle of Vertical Rudder from amidships : $\pm 30^{\circ}$
(iii) Angle of Vertical Rudder limited by bracket. : $\pm 31.5^{\circ}$.
(iv) Time taken to put Vertical Rudder from hard over to hard over.: 20 \pm 2Sec.

6. Description of work: - On completion of medium repair all equipments/ components will be handed over to the contractor for installation. All equipment/ components are to be inspected for its completeness and condition by contractor before installation. All bolts, nuts and washer are to be cadmium coating/ phosphotize before installation the equipment/ components. During installation all clearances/fits limits are to be maintained as per related documents/ drawings. De-preservation and preservations of equipment are to be carried out by contractor till its installation onboard. Total work can be sub divided into following activities:

- a) Hydraulic Cylinders:- Preparation of foundation beds and shims of hydraulic cylinders are to be done before installation the hydraulic cylinders by eliminate nicks, notches, scores by means of scrapping, then check with a testing plate by Persian blue. Foundations holes, shims and hydraulic cylinders bed holes are to be ream in situ after alignment the hydraulic cylinders. Fit bolts are to be manufacture 08 nos. for fitment. Operating the hydraulic cylinders first hydraulic pipes are to be connected by the contractor. After final fitment of fit bolts 0.05mm. feeler gauge no go are to be check between the shims and foundation beds/ Hydraulic Cylinders beds.
- b) Couplings:- Couplings assembly are to be carried out as per coupling drawing of Vertical Rudder drives 238-03.006c6 (17/5013).
- c) Hull gland assembly: Hull gland assembly to be carried out as per Hull gland drawing of Vertical Rudder Rams assembly drawing.- 238-32.1230 c6 (17/5263) and - 238-32.1230cb (17/6283). Hull gland bush fitment is in contractor scope. Gland assembly pressure testing are to be carried out as per drawings.

d) Indicators assembly, Tie Rods and Drive Rods installation are to be carried out as per drawing 877ЭKM-215-9005Э(17/1152) and 877Э-215-006Э(17/1153).

e) Slider housings assembly:- Preparation of faces and shims of slider housings to be carried out before installation the Slider housings assembly by eliminate nicks, notches, scores by means of scrapping, then check with a testing plate by Persian blue. Slider housings fwd. face holes/ shims and Slider housings aft face holes are to be ream in situ after alignment the Slider housings assembly. Fit bolts are to be manufacture 08 nos. for fitment. After final fitment of fit bolts 0.05 mm. feeler gauge no go are to be check between the shims and slider hosing face / hosing face.

f) Tiller:- Tiller assembly and pressure testing 0.5 kg/ cm^2 to be carried out as per drawing 877ЭKM-215-9005Э (17/1152).

g) Top and bottom bearing and Bossing bushes:- The Top and Bottom bearing Bossing bushes housing repairs, machining/ borings and alignment in situ in contractor scope. The bearings installation is to be carried out as per the fit mentioned in drawing -877ЭKM-215-9003ЭC∩Э (17/1150).

h) Blade and Tilting shaft/ Stock:- Blade and Stock installation are to be carried out as per the drawing 877ЭKM-215-9005Э (17/1152). Installation of Stock hydraulic jack will be provided by HSL. Before installation the Stock and Blade blue contact test are to be carried out with blade Hub with Stock. The blue contact test, if not within the permissible limits as per reference Documents, bedding is to be carried out by contractor till WOT satisfaction.

i) Vertical Rudder components lubrication grease pipelines are to be manufactured by contractor. Total length of the pipes is 50 Mts. Approx, pipe dia. 14x2.5, material of pipe M3P (Gost. 617-90) copper, material of end fitting Bronze. All pipe lines are to be test and installed/grease proving as per repair manual. Two in numbers grease distributors and one in number central lubricator devices are to be installed by the contractor. All raw materials for manufacturing the pipes and end fittings are in contractor scope. Pipeline tests are to be conducted together with pipelines as per the drawing 877EP2-507-003.

j) Installation & Integration checks.

k) Final installation of the system.

l) HATs and SATs as per Methodica.

7. (i) **HATs:** Hats are to be carried out as per Hats Methodica which is enclosed at an Annexure- 2 to this Work Package. During HATs all parameters should be satisfied as per HATs Methodica. No additional payment will be made for during trials fault finding and defect rectification. During HATs all consumable are at HSL scope.

(ii) **SATs**: SATs will be carried out by Ship Staff. Any defects observed during SATs and remarks given by Ship Staff are to be rectified by the contractor. No additional payment will be made.

8. Miscellaneous:

a) Repeated works: No additional amount will be paid for repeated jobs. till completion of guarantee period.

b) Tool and appliances: All tools , instruments and appliances required for manufacture, assembly/installation, trials and inspection are to be arranged by the contractor. Instruments must be of high precession quality procured from branded company and acceptable to inspection agency, calibration when ever required must be carried out.

c) Work Standards: General Engineering practices and special instructions laid down the reference documents are to be strictly adhered by the contractor during the execution of the contract. Clearance standards as laid down in the reference documents are to be achieved during manufacturing, assembly/ installation, trails and defect rectification.

d) Drawing / Documents: All reference documents! drawings will be available for reference in document section or with the engineer-in-charge which is enclosed at an Annexure-1 to this Work Package . However, the contractor may take Xerox copies at his cost for reference, on completion of work the Xerox copies are to be returned to HSL.

e) Contractor should have past experience in similar type of work and employ professionally qualified site Engineer for supervising the work.

f) Contractor should employ highly skilled technicians who have previous experience, should be able to read the drawings and well acquainted with measuring instruments.

g) In side and out side the submarine there will be so many contractors working parallel for different systems. You should co-operate with each other and maintain healthy atmosphere.

h) It is a challenging project linked with so many agencies including foreign countries. Contractor has no right to ask any explanation or claim against time delay.

- i) Installation of Hydraulic manipulators, valves, Hydraulic pipes concerning to Vertical Rudder at HSL scope. But its sequence of operation, adjustment of throttles, timing, interlocks etc. at contractor scope during installation and trials.
- j) All the technical requirements indicated in the relevant drawings technical operating and repair instructions are to be strictly adhered.
- k) During installation crane facility / schofling is in HSL scope.
- l) Shifting of components/ spares for small items is in contractor scope but shifting of heavy components crane facility will be provided by HSL .
- m) Installation/ pressure testing the components & equipments manufacturing the jigs and fixture are in contractor scope. Manufacturing the jigs and fixture raw materials will be provided by HSL.

Appendix - 1.**The assembly and installation drawings of Vertical Rudder.**

- (i) Vertical Rudder - 877ЭKM-211-9007Э. -17/1145.
- (ii) Installation of Vertical Rudder . - 877Э-215-006Э. -17/1144.
- (iii) Boss Boring and installation of Vertical Rudder. - 877ЭKM-211-.
9006ЭCПЭ - 17/1150.
- (iv) Hydraulic steering engine medium repair specifications.- 238-32.1222 .
YC. Vol.1&2 -17/960.
- (v) Steering gears specifications for medium repair.- 877ЭKM-200- 004YPЭ.-
17/1061.
- (vi) Steering and planes Description & operating instructions.- 877ЭKM-
902-.3016TO.
- (vii) Drawing of coupling of rudder drives. -238-03.006сб. - 17/5013.
- (viii) Drawing of guide rod of rudder/aft plane. - 239.32.3788 сб-17/5011.
- (ix) Drawing of rudder/aft plane hull gland assembly. - 238-32.1034сб. - 17/5006.
- (x) Hull gland of rudder and aft plane Rams. assembly drawing.- 238-32.1230
сб. - 17/5263.
- (xi) Hull gland Dia.80mm of rams of rudder and aft planes.-238-32.1230сб.
- 17/6283.
- (xii) Hydraulic steering engine B.P & KГP - 877
Technical Description & Operating Instruction.- 238-32.1222TO, Stage - 447.
- (xiii) Centralized lubrication of rudder and aft plane.- 08405/ 08313-507-.003.
-17/5841.
- (xiv) Pipe of centralized lubrication in 6 compartment(AP&VR)-.08405/08313-507-
015 -17/5843.
- (xv) Principle diagram of Vertical Rudder lubrication. - 877ЭP2-507-015M
Stage-1-874.
- (xvi) Device for C.L. in compt.-6 Installation drawing.- 877ЭP2-507-008M.
- Stage-1-866.

RESTRICTEDHARBOUR ACCEPTANCE TRILS**10. VERTICAL RUDDER**1001. Instruments Required.

- (a) Stop Watch.
- (b) Megger

1002. Systems Required.

- (a) Hydraulic Systems
- (b) Pirit
- (c) Centralised lubricating system.

Checks in Dry- dock

1003. Installation. Carried out installation check of the rudder gear as per technical description and operating instructions 238-32. 1222 TO.

1004 Carry out lubrication of rudder and prove grease at all the points.

1005 Pressure Test. Carry out pressure testing of the system by working fluid in accordance with technical description and operating instruction at a pressure of 125 kg/cm².

1006 Insulation. Check insulation resistance of circuits and repeaters and record in table A.

Trials

1007. Check the proper adjustment of the safety valves of the rudder- moving hydraulic cylinders at a pressure of 120 kg/cm².

1008 Operate the rudder, check and record the following in the table **B**:

(a) Matching of electrical and mechanical indicator of rudder angles for each 5° of change during operation from the control post.

(b) Difference in the values of angles should not be more than $\pm 2^\circ$ on shifting from 20° to 30°.

(c) Testing duration should be 2 cycles of checking from each control post for each value of angle shifting.

1009. Operate rudder blade five times at maximum angles slowly without any jerk, from P12 G manual control in aft ends, and check shifting time, hydraulic cylinder pressure and average speed of shifting and record in table C.

Note:- While checking give maximum rudder angle $\pm 31.5^\circ$. Pressure drop during operation of one cylinder and two cylinders should not be more than 10 ± 5 Kg/cm² and 5 ± 2 Kg/cm² respectively.

1010. Check the operation of the light signaling on changing the operation modes of steering gear and operation of different components.

1011. Check the operation of manual shifting and locking mechanism of rudder blade by $\pm 5^\circ$. Connect the mechanism with the pipelines by hoses; open the valves of the mechanism and rudder. Close the by-pass valves of the valve box. Supply working fluid to the hydraulic cylinder cavity by hand pump for shifting the rudder to the right or left from the zero position to 5° .

1012. Check the operation of light signaling on the console of system during change in the operating mode of rudder, by two cylinders to one cylinder and vice versa.

1013. Check the time for shifting of control from panel 3PI of system Pirit to the control from the emergency control devices P-13B. The time for switching over to the emergency control device should not exceed 3 sec, from the start of rotation of the handle on the device to the start of movement to the blade.

1014 Pressure difference in the hydraulic cylinder during the rudder movement should be 14-16 kg/cm².

1015. Rectify the following if observed during the trials.

- (a) Leakage through the rod seals in the hydraulic cylinders due to damage of cups.
- (b) Leakage from the slide valves due to damage of sealing rings.
- (c) Decrease of the rudder speed due to failure or damage of the piston-cups.

TABLE - A**INSULATION RESISTANCE OF ELECTRICAL CIRCUITS**

<u>Sl.No.</u>	<u>Electrical circuit</u>	<u>Insulation in Meg. Ohms</u>		
		<u>Normal</u>	<u>Before Trials</u>	<u>After Trials</u>
1.	<u>Pirit drive</u>	1.0		
2.	<u>Repeaters</u>	1.0		

TABLE - B**TEST RESULT OF VERTICAL RUDDER STEERING GEAR****MATCHING READING OF RUDDER INDICATOR**

<u>Type of indicator</u>		<u>Indicator Reading (Deg)</u>												
<u>Mechanical in A/E</u>		<u>Port</u>						<u>0</u>	<u>Stbd</u>					
		<u>30</u>	<u>25</u>	<u>20</u>	<u>15</u>	<u>10</u>	<u>05</u>		<u>05</u>	<u>10</u>	<u>15</u>	<u>20</u>	<u>25</u>	<u>30</u>
<u>Electrical</u>	<u>A/E</u>	1												
		2												
	<u>C/R</u>	1												
		2												
	<u>Bridge</u>	1												
		2												

TABLE - C**TEST RESULT OF VERTICAL RUDDER
AT MAX. ANGLE 30°**

<u>Operating Mode</u>	<u>Pr. In The System Kg/Cm²</u>	<u>Shifting time during control from</u>			<u>Shifting Speed</u>	<u>Pressure in Hydraulic Cylinder Kg/Cm²</u>			
		<u>C/R</u>	<u>A/E</u>	<u>Bridge</u>		<u>Main</u>		<u>Add.</u>	
						<u>Head</u>	<u>Dis.</u>	<u>Head</u>	<u>Dis.</u>
By two cylinder from Steering hydraulic system	1								
	2								
	3								
	4								
	5								
By one cylinder from steering system	1								
	2								
	3								
	4								
	5								
By one hydraulic cylinder Ships hydraulic system	1								
	2								
	3								
	4								
	5								

Max angle shifting

Port
Stbd

Representative of HSL production Department

Representative of Quality Control Department

Representative of WOT

Representative of Ship's Staff

B - COMMERCIAL TERMS & CONDITIONS

1. **TIME SCHEDULE:** The completion time schedule is for **90 days** from 01.10.2010.
 2. **PAYMENT TERMS:**
 - 2.1 **Stage –I :-** 30% Payment shall be made after completion of **assembling insitu and machining / boring work** against the submission of the satisfactory work done certificate duly certified by the concerned production department.
 - 2.2 **Stage –II :-** 30% Payment shall be made after completion of **installation onboard** against the submission of the satisfactory work done certificate duly certified by the concerned production department.
 - 2.3 **Stage –III :-** 20% Payment shall be made after completion of **Commissioning** against the submission of the satisfactory work done certificate duly certified by the concerned production department.
 - 2.4 **Stage –IV :-** 10% Payment shall be made after completion of **HATs & SATs (Test & Trials)** against the submission of the satisfactory work done certificate duly certified by the concerned production department.
 - 2.5 **Stage- V :-** Balance 10% payment shall be made after completion of guarantee Period.
 3. **GUARANTEE PERIOD** : The guarantee period is 12 Months from the date of HATs & SATs of the Vertical Rudder onboard. Any defects arising are to be attended to promptly and rectified at free of cost.
 4. **PERFORMANCE BANK GUARANTEE** : 10% Performance Bank Guarantee to be submitted upto the period of satisfactory completion of the work within 15 days of issuing LOI / Confirmatory Work Order.
 5. **DELAY IN COMPLETION OF WORK** : 0.5% per week subject to a maximum of 10% of the Work Order Value.
 6. **GENERAL TERMS & CONDITIONS** : As per Enclosure – 2
 7. **EMD** : Rs.20,000/- Demand Draft / Bankers Cheque on the Name of M/s Hindustan Shipyard Ltd., Visakhapatnam-530 005 towards Earnest Money Deposit to be submitted along with Technical Bid. (Returnable)
- Note:-** Vendors registered with HSL are also to submit EMD.
8. **TENDER FEE** : Rs.500/- Vide State Bank of India Challan /Bankers Cheque on the Name of Hindustan Shipyard Ltd., Visakhapatnam - 530 005 (Branch No.9082), Cr. HSL Current A/c No. 10299596073 towards tender fee to be submitted along with Technical Bid. (Non returnable)

Chief Manager (SBO)