



MBARI

TECHNICAL COMMENTS & COMPLIANCE

TIBURON II ROV SYSTEM

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TABLE OF CONTENTS

CONFIDENTIALITY	1
TABLE OF CONTENTS	2
1.0 INTRODUCTION	3
2.0 MBARI ROV REQUIREMENT - TECHNICAL COMMENTS & COMPLIANCE	1

1.0 INTRODUCTION

The following comments on technical compliance are based on the MBARI document entitled 'Request for Rough Order of Magnitude (ROM) Quotation' for 'MBARI'S 4000 METRE SCIENCE ROV'. The item and title in the table of section 2 of this document reflects the sections of the MBARI document and the table should therefore be read in conjunction with the MBARI document. The replacement ROV will be configured to be compatible with existing ROV equipment built into the RV Western Flyer.

The Tiburon II ROV system offered to meet the MBARI requirement will be a variation of the Quantum ROV which is the flagship workclass ROV offered by SMD Hydrovision. The dimensions of Quantum are very similar to the dimensions specified for Tiburon II and this size of ROV will be necessary to carry the significant quantity of sensors and accessories specified by MBARI. Although based on the Quantum frame, the layout of equipment and buoyancy will be completely reconfigured to create the Tiburon II ROV.

The Quantum ROV is typically a 125-200shp ROV when configured for the Oil & Gas industry but due to umbilical diameter constraints it is proposed that a 50shp ROV HPU is fitted for Tiburon II. It may be possible to increase this power to nearer 75shp if the umbilical storage drum can be water cooled and the final power and configuration will be decided in conjunction with MBARI engineers.

A variation of the 380mm diameter Curvetech thrusters normally fitted to Quantum will be used. These thrusters will be fitted with a lower displacement hydraulic motor which reduces the maximum thrust of the thruster at the operating pressure of the hydraulic system to match the 50shp power source. To maximise the thrust of the ROV a software controlled power sharing system will be developed based on the operational experience of Tiburon operators and thrust will exceed the 400lbs per thruster specified. Another thruster control scenario will also be developed in conjunction with MBARI to minimise the disturbance of the front viewing area due to thruster operation during scientific observation. Hydraulic power available for tooling will also be considerably more than specified.

With the accessories and payload specified, an initial weight estimate indicates the overall in air weight of Tiburon II will exceed the 10,000lbs specified if conventional 4000m rated buoyancy is used. A low density syntactic foam rated for 4000msw is therefore proposed which will reduce the in air weight of the ROV to approximately the specified 10,000lbs. Unfortunately this buoyancy is considerably more expensive and this selection should be reviewed again during the final weight analysis.

The existing power source on the vessel will be used for the proposed Tiburon II ROV system. A new 20kVA power converter will be used to provide a 'clean' supply at 60Hz for the 14kW of ROV instrument power and the ROV HPU power will be taken directly from the 'noisy' vessel power. The ROV power distribution system will be configured for separate main power incoming supplies. If in the final analysis in air weight is greater than acceptable, reduction of the weight of the 14kW of instrument power transformers on the ROV can be considered by the use of a higher frequency supply from the power converter.

All Tiburon equipment and parts considered to be reusable by MBARI will be included where it is practical on the assumption they do not reduce the reliability of the system.

2.0 MBARI ROV REQUIREMENT - TECHNICAL COMMENTS & COMPLIANCE

Item	Title	Comments	Tiburon II Compliant
1	Introduction	SMD Hydrovision offer to provide a bespoke configuration of ROV to match the requirement of MBARI based on the SMDH Quantum ROV system. The Quantum ROV system uses a modern control system configured for maximum flexibility and ease of maintenance using PC computing systems to guard against obsolescence. A distributed control network is used to control and sense the various equipment mounted on the ROV to minimise the use of high density connector systems. The Curvtech brand of ROV hydraulic control and propulsion assemblies which are designed and manufactured by SMDH are used throughout the ROV system. These tried and tested electrical and hydraulic assemblies will be mounted in a bespoke frame to create the Tiburon II ROV. The frame will be based on the bolted construction frame used for the Quantum ROV. SMDH look forward to working with MBARI engineers to produce a fully compliant scientific ROV.	Yes
2	Requirements		
2.1	High Level Requirements	All the requirements of items 1 to 7 can be achieved or exceeded using the proposed solution by SMDH	Yes
2.2	Power		
2.2.1	Umbilical	A specification of the proposed umbilical is included in the proposal and it meets or exceeds the requirement. It is compatible with the existing deployment equipment.	Yes
2.2.2	Source Power	It is proposed that a new 20kVA power converter be utilised to provide the 'clean' instrument power for the ROV at 60Hz. A separate incoming supply directly from the vessel 'noisy' supply will be used to power the ROV HPU. The power distribution equipment supplied will be configured for separate incoming supplies for the ROV instruments and the ROV HPU. In air weight of the ROV will be close to the specified maximum and after detailed design review it may be considered necessary to use a higher frequency ROV instrument supply to reduce the size and weight of the instrument power transformer boxes on the ROV.	Yes
2.2.3	Auxiliary Instrument Power	A separate auxiliary instrument transformer junction box will contain the 8.5kw transformer group for the auxiliary power sources specified. Power will be unregulated wherever possible and the switching functions and addition of serial data will be included. The type of high power supplies and whether they can be	Yes

		immersed in oil and pressure balanced requires careful review during the design phase to configure the most practical solution.	
2.2.4	Ground Fault Interruption	Bender Line Insulation Monitoring (LIM) units will be fitted within the HV power distribution equipment. Separate LIM systems will be fitted for the single phase instrument power and the 3 phase HPU power. The LIM system will be coupled to the HV side of the HV transformers and will continually measure the line insulation of the umbilical conductors. If insulation falls below a preset level an alarm will sound and if it falls below a lower preset level the HV power to the ROV is shut off. There is a keyed override facility on the LIM control unit.	Yes
2.3	Payload	Payload in excess of 273kg (600lbs) including 68kg (150lbs) of variable buoyancy will be provided with the tool sled and core instruments mounted on the ROV	Yes
2.3.1	Syntactic Foam	4000m syntactic foam will meet the specification and accommodate a 91kg (200lbs) front payload. Due to in air weight constraints it is expected low density high cost buoyancy units will be necessary. This will be reviewed during the preliminary design.	Yes
2.3.2	Fixed Ballast	Location of lead maximises stability	Yes
2.3.3	Variable Ballast	It is assumed the equipment for the variable buoyancy will be free issued for integration in the ROV. Equipment dimensions and weights are required for the design and layout of the variable buoyancy will be done in association with MBARI engineers. Adequate hydraulic power is available	Yes
2.4	Vehicle Propulsion		Yes
2.4.1	Thrust Capabilities	The system will be designed to draw the maximum power through the umbilical while maintaining reliable operation. The electro hydraulic ROV will use a special version of the Curvtech thruster type HTE 380-32 powered from a 50shp HPU with 71cc/rev pump. This is an appropriate diameter of thruster for the physical size of the ROV and will provide over 20% more thrust (due to its greater efficiency) for the same power when compared with the 300mm thruster. With a constant power pump control the 3 vertical thrusters can be designed to take up to full power and the 4 horizontal thrusters can also take full power. The assumption is that full power vertically and horizontally is not required at the same time. The power sharing algorithms for priority of vertical or horizontal thrusters will be created based on input from MBARI operational knowledge. Open water thrust from each thruster is estimated at 250kg (550lbs) and when mounted within the structure of the ROV it is expected each horizontal thruster gives about 210kg (460lbs) and each vertical thruster gives about 175kg (385lbs). This provides up to 600kg (1320lbs) of horizontal thrust and 500kg (1100lbs) of vertical thrust for the ROV. This can only be achieved if either the vertical or horizontal thrusters are operated and not both sets together. These thrust figures will allow the speed specification to be exceeded.	Yes
2.4.2	Thruster Placement	A number of options for thruster layout can be considered to minimise turbulence in the viewing area due	Yes

		to thruster wash. It is assumed the vertical position of the ROV will be controlled using the variable buoyancy when scientific observation is in progress. The 3 vertical thrusters will be positioned one port and one starboard about 25% back from the front of the ROV and the third thruster mounted aft central. The horizontal thrusters will be in a conventional vectored configuration but when performing scientific observations a special thrust control algorithm will be selected. Only the rear thrusters will perform fore/aft propulsion and only one set of fore aft thrusters will be used to move the ROV laterally. During lateral movement water will only be drawn from the front viewing area not pushed into the area by the front thruster which should minimise disturbance. If this compromise is considered inadequate by MBARI and if space allows, it may be possible to fit a single lateral thruster in the centre of the ROV which is only selected for lateral movement during scientific observation. These options can be reviewed/decided upon jointly with MBARI engineers and they assume the current will be low in the area of scientific observation.	
2.5	Software, Control, Telemetry & Video	User configurable input and output data will be accommodated.	Yes
2.5.1	Pilots GUI	The GUI will be field configurable and will provide all the display data required by the Pilot and Observer. Where appropriate, sensor and accessory data will also be integrated into the control system along with data from the ROV power distribution system and if available, data from the existing deployment system. Video and sonar data will also be displayed on the flat screen display system.	Yes
2.5.2	Control System	All available ROV control functions will be provided and access to the control system software will also be provided. AUTOROV functions available are auto heading, depth, altitude, hold, step, home and track.	Yes
2.5.3	Sliprings	The existing slipring specified will provide the power and communications required by the ROV	Yes
2.5.4	Video Overlay	A suitable video over lay will be provided or supplied by MBARI	Yes
2.5.5	Video Requirements	The HDTV camera communications will be configured with a dedicated fibre optic cable. The 3 chip camera and other cameras video will be transmitted via the existing fibre optic multiplexer.	Yes
2.5.6	Auxiliary Data Requirements	The specified auxiliary data channels will be provided in the auxiliary sensor junction box and will be transmitted via the fibre optic multiplexer. At least 2 spare fibres will be provided in the umbilical and made available for use on the ROV and surface control system.	Yes
2.5.7	Auxiliary Hydraulic Valves	A tooling port supplied from a spare servo valve in the thruster control unit will provide flow control and total flow in excess of the flow specified. A standard 10 function HCU fitted with 4usgpm 4way 3 position solenoid or proportional valves is included. Pilot check and cross over relief valves can also be fitted to any of the 10 valves and external manual adjustable flow control can be provided for the solenoid valves. If space and weight dictates a 4F unit is necessary this can be provided.	Yes
2.6	Dimensions, Weight and Frame		

2.6.1	Vehicle Dimensions	Tiburon II will be within the maximum dimensions specified. These dimensions are similar to the Quantum ROV which will be used as the basis for Tiburon II. With the quantity of accessories specified the vehicle will require to be close to the maximum allowed dimensions if easy access to equipment for maintenance is to be provided.	Yes
2.6.2	Weight	An initial weight estimate showed the Tiburon II would exceed the specified weight of 10,000lbs and high cost low density syntactic foam is proposed to reduce the weight to approximately the specified weight. This should be reviewed again after a final detailed weight analysis is completed during the design phase.	Yes
2.6.3	Frame	The frame design will be based on the bolted aluminium design used for the Quantum ROV. The front area will be modified to maximise the open area at the front of the ROV and the multi point lift box will be modified to utilise the MBARI lift latch for deployment and recovery . An umbilical termination point will also be provided. Existing or similar manipulator mounting plates and a forward mounted instrument protection frame will be included. The conventional position for the thrusters shown on the Quantum will be reviewed to ensure the thrust path is in the optimum position for stable propulsion of the vehicle.	Yes
3	Core Instrumentation	The core instruments listed will be free issued by MBARI for fitting to the ROV and testing of the ROV interfaces. A 4 pole HPU motor is proposed to minimise acoustic noise although a 2 pole could be offered to minimise size and weight of the HPU and pump. Curvetech 4 pole motor power packs and valve packs have been used extensively on survey ROV systems without acoustic interference problems. If this is considered a main point of concern we can discuss methods of reducing the effect and testing the vehicles acoustic signature but this would be in addition to the current proposal . The positioning of the accessories on the ROV will be done in conjunction with MBARI engineers requirement	Yes
3.1	Manipulators	Mechanical, electrical and hydraulic interfaces will be provided for the specified manipulators. It is assumed all cables and equipment will be provided with the manipulators	Yes
3.2	Navigation	Mechanical and electrical interfaces will be provided for the equipment listed. It is assumed cables and bracketry will be provided with the equipment.	Yes
3.3	Viewing	CAMERAS: Mechanical and electrical interfaces will be provided for the camera equipment listed. It is assumed cables and bracketry will be provided with the equipment and it is planned for the cameras to be connected directly to the electronic pressure vessel to minimise cabling. PAN & TILTS: Mechanical and electrical interfaces will be provided for the 4 x P&T's listed. It is assumed cables and bracketry will be provided with the equipment. P&T angle feedback will be available for display. Control will be from the touch screen PC or panel mounted joystick as preferred. LIGHTING: Mechanical and electrical interfaces will be provided for the incandescent and HMI/MSR lights specified. It is assumed cables and bracketry will be provided with the equipment. .A lighting control junction box will provide power and control for the specified lights.	Yes

3.4	Science Tools	Mechanical and electrical interfaces will be provided for the CTD to be specified. It is assumed cables and bracketry will be provided with the equipment.	Yes
3.5	Tool Sled	Mechanical, hydraulic and electrical interfaces will be provided for the Tool Sled as specified. It is assumed cables, hoses and mounting accessories will be provided by MBARI. The base of the Quantum frame is configured to provide mounting of an under slung tooling package so it is expected these four mounting points will be suitable for the MBARI sled. A suitable tooling port will provide up to more than the specified hydraulic flow and the electrical power will be supplied from the auxiliary instrument power transformer junction box.	Yes
3.6	Existing Equipment	The system will be designed to interface with the existing deployment equipment. It is assumed the slip ring has adequate passes and capacity for the fibre and HV power cables. The surface control equipment and power distribution system will be configured to fit within the existing control room. The existing fibre optic multiplexer system will be used. The existing termination box and cables and connectors will be reviewed and it will be agreed with MBARI what if any of the items are used in the new system It is assumed the existing vehicle lock latch will be used.	Yes
4	Launch & Recovery and Umbilical handling System	A new 5000m x 0.68" diameter umbilical cable will be supplied for fitting to the existing deployment equipment. The Tiburon II vehicle will be configured to be compatible with the existing deployment equipment and the same launch and recovery procedure will be used.	Yes
5	Design Review and Acceptance testing	As part of the design process MBARI will participate in a minimum of a preliminary and a critical design review at the offices of SMDH. MBARI will witness the FAT and will sign off against each of the agreed tests during the FAT.	Yes