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Subject: Program Development for ROV Inspection and Security System with MSST 91102

Sir:

As per the request made by GM1 Jason Stewart, attached please find a proposal for SeaTrepid services with regards to program development for ROV deployment.

The proposal is divided into 4 levels based upon your required degree of program development:

- 1) List and test mission scenarios for optimum deployment techniques, develop SOP's for deployment categories, and develop PQS's as well as ongoing training requirements.
- 2) Documentation of 1) above to MILSPEC guidelines.
- 3) Perform testing in 1) above on other vehicle platforms.
- 4) Draw up test program then perform independent evaluation of ROV platforms under consideration.

This proposal is designed in "Layers" starting/continuing from the training received previously on the VideoRay ROV equipment currently in your possession, to development of techniques/SOP's with equipment in inventory, to documentation, through to opening the field to testing of other ROV equipment. It is reasonable to have the first layer performed at the unit level. For all subsequent layers, other commands within the USCG may require consultation.

The proposed end product of this process is a developed and mature ROV capability within the USCG. The initial phase, herein proposed to you, is the implementation to your unit. Please advise if you desire a scope change for this operation.

Sincerely,

Robert D. Christ

## **Narrative**

This narrative discusses issues surrounding the implementation of the ROV system with the USCG. At the end of this narrative, the specific proposal lists means and methods for achieving the conditions stated in this narrative.

### **A. Deployment Concepts**

With any new operational system employing a new technology, new methods of operation are required in order to fully take advantage of the enhanced capabilities and inherent limitations. An example of this is the advent of the aircraft. It took the development of new methods, techniques and training upon introduction of this new system in order to branch this technology to weapons delivery, aerial observation and passenger transport. Later came the development of instrument navigation technologies and procedures for all-weather capabilities. During each phase of development, a team tested techniques and worked out the best procedures for deployment from the concept stage through to the user level implementation.

With the expansion of the USCG's underwater mission requirements, new methods and means must be developed in order to take full advantage of this new technology while limiting the need to "recreate the wheel" through trial and error methodology.

### **B. Defining Mission Requirements**

With the expansion of the traditional USCG surface mission to now include below water responsibilities, matching the proper technology to the mission is essential to achieving mission objectives. It is the understanding of this author that the initial mission of the ROV technology is for security threats. This technology is also adaptable to some of the more traditional roles of the USCG including environmental monitoring, safety/regulatory enforcement and facilities/vessel maintenance chores.

Underwater ROV/Camera technology runs from pole camera all the way to fully integrated autonomous robotic vehicles. The VideoRay system deployed with USCG is somewhere in the middle of these extremes as a basic "Flying Eyeball" with basic mechanical intervention and integrated acoustical positioning.

### **C. Integrating currently deployed ROV systems with current infrastructure**

#### **MSST Boat Geo-Referenced Positioning**

One of the requirements for the initial deployment of the VideoRay system onto the MSST boats was that the system fit aboard the standardized RB-HS boat design without modification. Due to this, some equipment redundancy was necessary in order to obviate the necessity to tap into the RB-HS's electronic or power package. Specifically, the acoustical positioning system needs some data feeds as well as power in order to deploy off of the RB-HS boat with geo-referenced short baseline acoustical positioning.

Short baseline acoustical positioning involves the deployment of a 3-transducer array over the side of the vessel/location of opportunity to derive basic range and bearing location for the submersible from the transducer array. That can either be derived relative to the transducer array or can be derived geo-referenced. The system ordered by USCG can be operated in either mode.

Real-time magnetic vessel heading information is needed in order to snap the submersible's relative bearing from the transducer array [mounted at known locations on the boat] to magnetic

bearing. A real-time GPS feed is needed in order to geo-reference the transducer array. Once the GPS origin and distance/magnetic bearing are obtained, the submersible location is easily resolved.

High-quality heading and GPS information is currently available from the RayMarine SeaTalk software currently standard on the RB-HS boats. Further, with an easy software update, the geo-referenced position of the submersible can be displayed on the RayMarine LCD display mounted next to the helm. This would eliminate the need for the separate VideoRay flux-gate heading sensor [and time-consuming separate calibration of same] as well as the [non-differential] GPS receiver included with the USCG purchase. The outputs are all NMEA standard - meaning they are non-proprietary format which are portable between different vendor positioning systems.

Currently, a separate ac power source is needed to power the VideoRay system along with its accessories. There are 3 separate high-capacity battery systems aboard the MSST RB-HS boats. By either integrating a 12 vdc to 110 vac inverter or specifying a pure 12 vdc powered VideoRay system, the bulky space-consuming generator can be eliminated from the boat. There is currently excess breaker capacity from the onboard 12-volt bus.

During the deployment training at the MSST's it was noted that an approximate 1.5 hour setup time was required in order to temporarily rig the MSST boat for VideoRay Geo-Referenced SBL acoustical positioning.

*To summarize*, a small modification to the standardized design of the MSST boat could yield cost, time and space savings in further ROV system implementations.

#### **Ship Hull Vessel-Referenced Acoustical Positioning**

Vessel-Referenced long baseline acoustical positioning involves deployment of a 4-transponder (battery operated) array over the side of a vessel of interest at measured locations along the hull attached to the lifelines of the vessel. The VideoRay is then operated independent of the transponders with acoustical communication for accurate triangulation to locations on the vessel. A side and top view drawing of the vessel is necessary in digital format (.bmp) in order to navigate the VideoRay submersible along and to that scaled drawing.

This system performed as designed at all MSST locations. By far the largest challenge faced during the deployment of this system has been obtaining drawings for the vessel under examination. Once the drawings were located, a learning curve to register these drawings was noted at each location. However, the drawings were easily loaded and activated once registered.

*To summarize*, in order to fully make use of the Ship Hull inspection system a centralized location/depository for ship drawings database will need to be established. If this procedure is not established, this system, capability and project may languish.

#### **D. Defining and Writing SOP's for ROV Operational Deployments**

In order to fully take advantage of the operational capabilities of this new technology, techniques are required so as to make optimal deployments with minimal time, equipment resources and manpower. A program can be established whereby each foreseen operation be tested in a realistic environment so that operational data may be gathered and SOP's defined.

Some possible steps to implementation of this program are as follows:

1. Establish a list of foreseen mission requirements/operational tasks

2. Define the completion objectives
3. Test conceivable means of achieving these objectives
4. Write and Implement SOP's to the unit level allowing for leeway in the field based upon the situation at hand.

#### **E. Data/Intel Availability in Support of ROV Operational Deployments**

Making available data based upon Intel could assist in deployment of ROV systems. Currently, large vessels are required to transmit AIS information via VHF as well as to give advance notification of arrival into US Ports. An example of Intel assisting ROV operations would be the procedural pairing of AIS information with a generated/registered ship hull drawing transferred to the operational level for possible physical investigation. Headquarters could update its database of drawings on an ongoing basis sending periodic updates into the field. An extensive ship hull database could be generated from various sources. Once Port Operations is notified of a ship arrival, class of vessel information could be gathered along with drawings of that class for on-site hull inspection while still at sea.

#### **F. Equipment Staging Area**

Currently, all equipment is stored in equipment storage areas of the various MSST's. One recommendation for an easy additional deployment location is to outfit a van with a table, chair and power source so as to easily and quickly drive up to a dock location to drop the system in the water with minimal (<2 minutes) deployment time. This would be in keeping with the rapid-response and multi-role nature of the MSST units as well as allow for vessel-borne, land-based and RB-HS-deployment of the ROV camera systems. In either case, the equipment as well as trained operators should be as close to the "Action" (i.e. ports/waterway/traffic) as is possible.

#### **G. Personnel Profile for Equipment Operators**

The largest single industry operator of ROV equipment in the world is the Offshore Oil & Gas Industry. The best possible profile of an ROV "Pilot" is an electronics engineer who is also an aircraft pilot as well as an experienced commercial scuba diver. The reason for the aircraft pilot/scuba diver profile is the ability to think in 3-dimensions along with a divers knowledge of the underwater environment. The reason for the electronics background is the degree of technical knowledge (i.e proficiency in working with applied electronics and industrial computer equipment) needed in the field.

Since the optimal profile for this specific task may not be available in the line duty seaman, a team comprising members with an operations discipline, an electronics discipline and perhaps a law enforcement discipline would be preferable.

#### **H. On-Going Training Program**

Let us address training requirements for the VideoRay ROV's currently deployed:

- a. Initial – Either develop an internal ROV training facility to train currently deployed personnel or appoint a contractor to regularly visit specific deployment locations using currently developed or enhanced manufacturer's training materials.
- b. Recurrent – Establish qualification performance guidelines for proficient ROV operators using a series of establish piloting tasks using the model for pilot training as specified in standard aviation training materials.
- c. Differences – At this time, this capability would not be necessary unless a new line of ROV systems were to be deployed with USCG. If/when a new system is

deployed, currently-qualified ROV pilots would require differences training between ROV platforms.

## **I. Documentation and Maintenance Program**

- a. Command Responsibility – A unit or department should be assigned with overall fleet-wide responsibility for maintenance and support of the system. This would simply be an experienced person somewhere within the USCG that tracks the usage of ROV systems establishing a spares depot, expertise (a sort of “technical help line” in computer terms) in operations, operations planning and support on a 24-hour basis. Individual unit responsibility and accountability should initially be given to a single individual at each location so as to maintain control over the operations and maintenance of each operational system. From there, integration into the USCG maintenance tracking system can be established, mean time between failures (MTBF) on critical components can be computed and further developmental feedback communications can be accomplished.
- b. Conformity with Existing Standards – Once experience is gained with the systems (as per a. above), the fleet-wide systems can then be integrated into the USCG’s vessel tracking and maintenance systems [or some other equipment-specific tracking program].
- c. Maintenance Requirements and Scheduling – Scheduled maintenance and system down time can also be intelligently administered within the already-established procedures. This would lower the need for direct backups in each location by keeping in centralized spares store as well as high-usage backups where needed.
- d. Unit/Division/Headquarters Reporting – Centralized reporting will allow for service bulletin and fleet-wide informational distribution for items relating to common usage issues for systems in the field.

## **Proposal**

- A. **List and test** mission scenarios for optimum deployment techniques, develop SOP’s for deployment categories, and develop PQS’s as well as ongoing training requirements. The objective of this process is the live testing of each anticipated scenario so as to develop optimum techniques for deployment. This program should be conducted in direct conjunction with unit operational personnel using unit equipment. This section will be divided into a series of tasks accompanied by a time budget for the task with documentation.
  - a. Task #1 – Test plumb a RB-HS boat for quick setup of ROV system by tapping into RayMarine electronics system, pre-routing transducers and testing best locations for deployment. Test deploy the equipment and document all findings. Equipment needed: one ROV system, one RB-HS boat dedicated for testing, wiring, cable ties, serial connectors and mounting hardware. Personnel needed – one ET and one BM. Proposed time budget: 8 hours for plumbing and wiring testing, 2 hours for operational testing and 2 hours documentation.
  - b. Task #2 – Test plumb a van for quick setup of ROV system. Equipment needed: one ROV system, one rental (or USCG) van, table, chair, VHF hands-free radio equipment, and one Imagenex 881 tri-pod mounted sonar (SeaTrepid will provide). Personnel needed – one ET and one BM. Proposed time budget: 4 hours for wiring testing, 2 hours for operational testing and 2 hours documentation.
  - c. Task #3 – Deployment exercise of the ROV in van. All scenarios are using simulated conditions. Scenario 1 is contraband dropped onto bottom from vessel at dockside. Scenario 2 is contraband hidden in bow thruster of vessel at dockside. Scenario 3 is

chemical spill from sunken barge at dockside. Scenario 4 is oil leak from running gear of vessel along dockside. Scenario 5 is drowning victim recovery from harbor area next to shore. Scenario 6 is pier security sweep for suspicious items. All subsequent scenarios should be listed at the beginning of the training day and should take less than 1 hour each due to learning curve adjustments. Personnel needed – one GM and one LE. Proposed time budget: 16 hours for 2 full day’s testing and 4 hours documentation.

- d. Task #3 – Test scenarios on a RB-HS boat for various mission situations. Scenario 1 is simulated contraband dropped overboard from high-speed boat while in pursuit and recovery of contraband. Scenario 2 is hull inspection for contraband or suspicious items from RB-HS while live-boating standing off in harbor. Scenario 3 is chemical spill from sunken barge in channel. Scenario 4 is unidentified item on bottom in slip area. All subsequent test scenarios should take approximately one hour depending upon the task due to learning curve adjustments. Equipment needed: one ROV system, one RB-HS boat, one fabricated pole for mounting ROV during stand-off ship hull inspection (SeaTrepid will provide specifications). Personnel needed – one GM and one BM. Proposed time budget: 16 hours for 2 full days testing scenarios and 4 hours documentation.
- e. Task #4 – Test boarding of vessel then hull sweep. Build a small database of ship’s drawings from various sources and register drawings for use in Ship Hull software. Personnel needed – one GM and one BM. Proposed time budget: 8 hours for testing on as many vessels as is possible, 8 hours building database and 4 hours documentation.
- f. Task #5 – Writing SOP’s for deployment will take approximately 40 hours for documentation with minimal illustrations.
- g. Task #6 – Writing training manuals as well as PQS’s for unit personnel will take approximately 40 hours with minimum illustrations.
- h. Pricing for proposal:

Task	Time Budget
Task #1	12 hours
Task #2	8 hours
Task #3	20 hours
Task #4	20 hours
Task #5	40 hours
Task #6	40 hours
Total Time	140 hours
	8 hours/day
Total Days	18 days
Billing Rate	\$980/day
Total Billings	\$17,640
Estimated Travel Expenses	\$5,040
Total Proposal	\$22,680

**B. Documentation** of 1) above to MILSPEC guidelines.

Since this will, in all likelihood, be accomplished through headquarters, a separate proposal will be generated once specific completion guidelines are submitted.

**C. Perform testing** in 1) above on other vehicle platforms.

SeaTrepid proposes doing testing of other vehicle platforms in parallel with testing of the equipment on-hand on an informal basis. This can be accomplished quite inexpensively through simply renting (or borrowing) the equipment from the manufacturer for the 3-week period needed for testing. The strengths/weaknesses will become quickly apparent once the systems are compared in real environments during operational scenarios. This should not constitute a comparative vehicle analysis for procurement purposes (which may require substantial additional documentation). This real-time analysis will supplement and append the testing conducted by NAVSEA at the Portsmouth Naval Shipyard (Kittering, ME) in January, 2002. This testing will also be USCG-specific since USCG operational personnel will be conducting the actual test with consultation from SeaTrepid. A performance chart matrix should be constructed based upon these tests. Pricing for this additional process will depend upon the level of testing as well as the number of additional platforms requiring tests. The SeaTrepid billing rate is \$980/day.

**D. Draw up test program then perform** independent evaluation of ROV platforms under consideration.

Once testing is performed as per C. above, a formal testing program can be conducted based upon a series of objective tests specific to USCG needs. A separate proposal will be generated once the performance guidelines are established based upon feedback from testing in C. above.