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Remotely Operated Vehicle/Assessment and Response (ROVAR)

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ADMINISTRATIVE INFORMATION

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RBT

EXECUTIVE SUMMARY

OBJECTIVE

The objective of the Remotely Operated Vehicle/Assessment and Response (ROVAR) project was to demonstrate the feasibility of using a remotely operated vehicle (ROV) to provide an appropriate response to underwater threats. The ROVAR effort demonstrated the use of several currently available, nonlethal response techniques on the Underwater Security Vchicle (USV) under simulated operating conditions.

We found a wide variety of response methods during our extensive literature search on swimmer/diver countermeasures. These methods were classed as warning, position marking, target marking, and target capture. Candidate methods were evaluated according to their operational capabilities, system impact, vulnerabilities, human factors, and logistics considerations.

To verify that a ROV system could be used effectively as a response vehicle, several different response methods were tested on the USV. Methods tested included diver warnings, floodlighting, target marking, and target capture.

RESULTS

The ROV successfully tracked targets and can be used as an effective response device against underwater diver targets. All response methods worked with the system to varying degrees, particularly those not requiring direct contact with the diver target. For example, the best results were accomplished using noncontact response devices such as an underwater speaker and floodlighting.

RECOMMENDATIONS

Recommendations include (1) adapting the existing target-marking and capture hardware for more effective vehicle operation and (2) investigating other noncontact means of response. In addition, ROVAR's ability to track a target and effectively apply a response demonstrated the feasibility of combining assessment and response functions on a single platform.

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1.0 INTRODUCTION

1.1 OBJECTIVE

The objective of the Remotely Operated Vehicle/Assessment and Response (ROVAR) project was to demonstrate the feasibility of using a commercially available remotely operated vehicle (ROV) to provide an appropriate, nonlethal response to previously detected underwater threats.

1.2 APPROACH

The ROVAR project was a small-scale effort to demonstrate the response capability of the Underwater Security Vehicle (Fletcher, 1992). A literature survey and vendor discussions were performed to determine possible response techniques such as underwater lighting, in-water communication, target marking, and target capture. Candidate techniques were evaluated on the vehicle using existing hardware wherever possible. The effectiveness of each method was evaluated, and recommendations were made for future development.

1.3 NEED

Representatives of CINCPACFLT, SUBPAC, WESTCOM, and the USPACOM Joint Antiterrorism Working Group have indicated a need for a response capability in addition to the detection and assessment capabilities defined by the Waterside Security System and Underwater Security Vehicle programs. This need is reflected in the Tentative Operational Requirement (TOR) for the Waterside Advanced Security Program (WASP) that calls for a nonlethal, cost-effective means of responding to an underwater threat.

1.4 BACKGROUND

The Waterside Security System (WSS) is currently being developed under Operational Requirement OR-214-09-87 to provide a shore-based, permanent security system for critical installations. To fully serve the Navy's security needs, WSS may be enhanced in several ways; for example, by adding ROVs to the tools and sensors already available. The Underwater Security Vehicle (USV) demonstrates one approach to incorporating ROVs with the WSS.

The USV will accommodate assessing contacts previously detected by the WSS or other security systems (figure 1). The USV would be at the site of the threat for the assessment phase; therefore, a response capability is a logical next step in USV system development. An effective response is defined as one that deters or delays a potential threat, without excessive force. For example, an effective response would be making a submerged swimmer come to the surface for apprehension. Figure 2 shows the proposed operating sequence of a response-equipped USV. The ROVAR effort demonstrated the use of currently available nonlethal response techniques on the USV under simulated operating conditions. The vehicle's ability to track a target and effectively apply a response demonstrated the feasibility of combining assessment and response functions on a single platform.

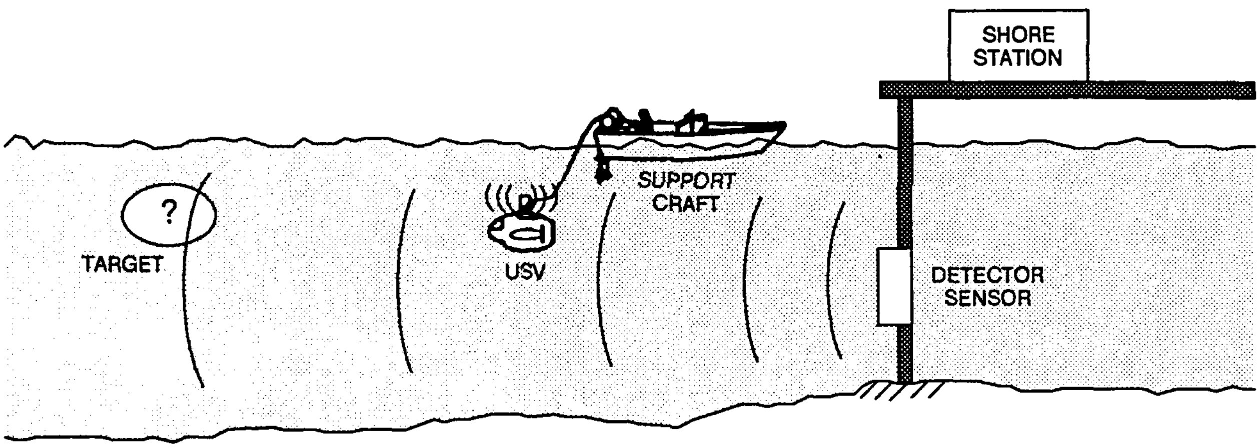

Figure 1. USV/ROVAR system concept.

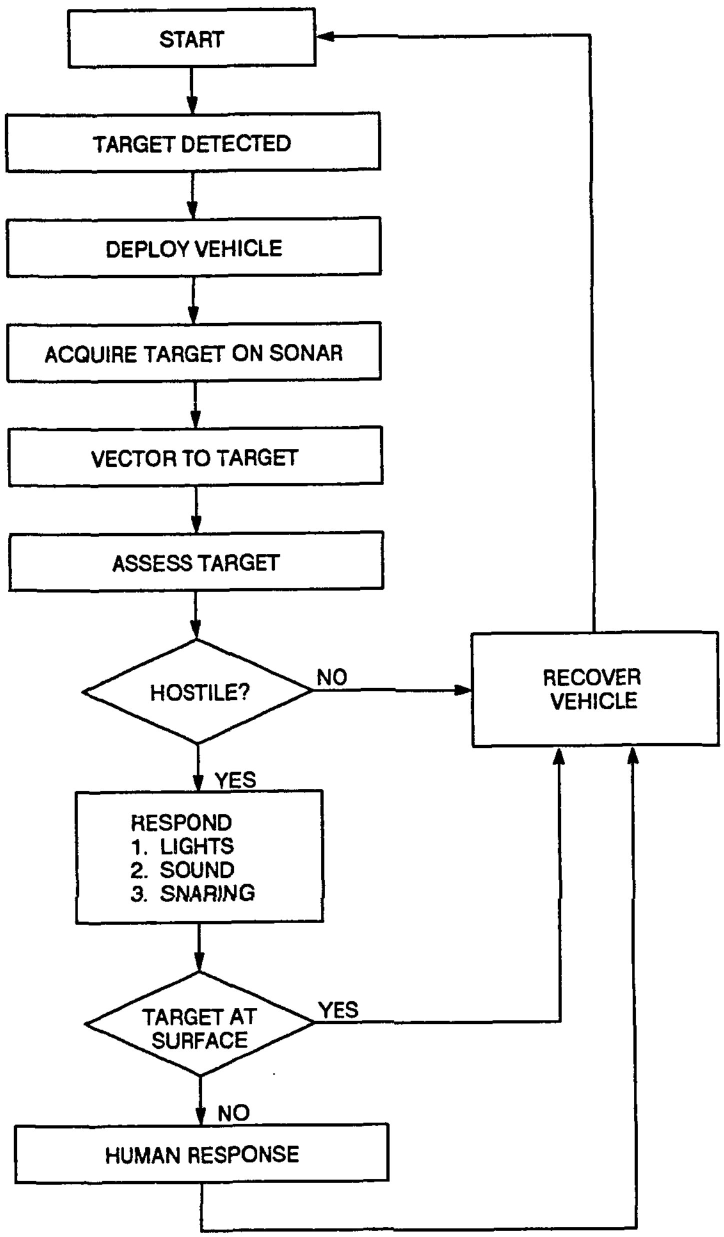

Figure 2. ROVAR operational sequence.

2.0 RESPONSE TECHNIQUES

2.1 MEANS OF RESPONSE

A wide variety of response methods was found during the extensive literature search on swimmer/diver countermeasures. While many of these are adaptable for use on a ROV, the limited scope of the ROVAR major bid and proposal (MB&P) effort did not permit an all-inclusive in-depth evaluation. Instead, a few of the simpler methods were chosen just to demonstrate the vehicle's capability to perform a meaningful response function. These are a small representative sampling of the types of responses available for use on a ROV. The ROVAR effort was intended to show only that a vehicle can be used this way and not to determine the optimum system.

2.1.1 Warning

The simplest method of response is simply that of just **warning**. This may be accomplished by a simple hydrophone arrangement on the ROV, permitting an announcement to be made that the target has entered a forbidden area. For the ROVAR demonstration, this function was demonstrated using a diver recall device adjacent to the vehicle.

2.1.2 Disorientation/Irritation

The next step beyond warning is providing a noncontact impediment to distract the target from its mission. This may be accomplished by visual, auditory, or tactile means. At its simplest, an obscurant may be emitted into the water to block the visual orientation cues. A flashing strobe light may also be disorienting, further confusing the target. Depending upon the host platform, audible sonar pings or intermittently turning the propellers may also deter an underwater approach or attack. More active deterrent measures include detonating grenades and mortars in the water or using electrical fields and discharging capacitances.

2.1.3 Position Marking

A third method of response is that of **position marking**, marking the last-known position of the target as opposed to marking the target itself. This may be accomplished by releasing a fluorescent dye into the water, lighting the target area, or dropping marker buoys where a target contact was made. In the ROVAR demonstrations, the USV used its lights for this, silhouetting the target by lighting it from below. This was accomplished by moving the orientation of the top lights of the USV to a vertical, rather than a horizontal, position.

2.1.4 Target Marking

Target marking is among the most direct means of response, but also among the most difficult. It entails close contact with the target to attach a marker buoy or other distinguishing tag to it. This operation requires high maneuverability and places the vehicle in a vulnerable position. Hardware from other response systems was tested on the USV system for the ROVAR demonstration.

2.1.5 Capture

Finally, the most difficult response is actually **capturing** a target. As with target marking, the vehicle must be extremely capable. Methods of capturing a diver target include—but are not limited to—snaring with a line, netting, or grappling hook. For the ROVAR demonstration, a Happy Hooker™ snaring device was used to attempt to wrap a line around a target for its capture and recovery to the surface.

2.2 EVALUATION CRITERIA

Each method of response has its particular strengths and weaknesses. These can be evaluated in several categories, including operational capabilities, impact on the vehicle system, vulnerabilities, human factors, and logistics. Table 1 summarizes these factors for the response methods discussed under paragraph 2.1.

Table 1. Evaluation of response techniques.

Response \ Evaluation	Operational Capabilities	System Impact	Vulnerability	Human Factors	Logistics
Warning	Deter	Low	Low	Good	Good
Disorientation/ Irritation	Deter Delay	Moderate	Low	Fair	Fair
Position Marking	Aid to Assessment Apprehension	Low	Moderate	Good	Fair
Target Marking	Deter Delay Aid to Apprehension	Moderate	High	Fair	Poor
Capture	Deter Delay Apprehension	High	High	Poor	Poor

2.2.1 Operational Capabilities

The first criteria by which a response method should be judged are its operational capabilities. First and foremost is its effectiveness: its ability to deter, delay, or facilitate target capture. Additional desirable features of a response method include aiding in target assessment, allowing evaluation of the response, handling multiple targets, and having a graduated force level available.

Additional considerations in evaluating the operational capabilities of a response are those involved in applying the response. Factors such as the range to the target for effective operation, the degree of required target localization, and the requisite reaction/deployment time all affect the overall effectiveness of a response technique.

2.2.2 System Impact

When working with a size-constrained system such as a ROV, the overall system impact of added equipment must be carefully considered. Ideally, any response system would be small, light, and balanced to maintain the trim of the vehicle. The power needs from the vehicle should be minimal, or better yet, the system should be entirely modular and self-contained. Vehicle system such as sonar, video, and control systems should not be adversely affected. On a broader scale, the response method used should only minimally affect the environment around the vehicle, with no permanent effects to either the system or its environs.

2.2.3 Vulnerabilities

Ideally, adding a response method to a ROV system would not only increase its utility, but would also reduce the system's vulnerability to hostile targets. A ROV system has a major inherent vulnerability due to its dependence on the tether cable; therefore, any system that can deter a target at a distance would have great potential value. In addition, any response system should also be hardened to possible countermeasures and environmental effects.

2.2.4 Human Factors

The use of any response device must consider the human factors involved, both from the viewpoint of the user and the target. Clearly, the techniques should pose minimal risk to the user and equipment, with adequate safety precautions taken in both the system's design and use. A system should be straightforward and easy to use, requiring minimum training for effective application.

From the target's perspective, the purpose of response as discussed here is to deter, delay, and/or capture the target without physically damaging it. Risk of injury to the target should be minimized without sacrificing operational effectiveness. In peacetime applications, this is also a prime consideration for ensuring political acceptability of the system.

2.2.5 Logistic Considerations

Logistically, the response system should be a simple addition to the USV or other vehicle system in use. It should be highly reliable, easy to maintain, and require no additional personnel beyond those involved with the vehicle system. Both the purchase and the per-use cost should be kept to a minimum to permit effective deployment of the system.

3.0 PROOF OF CONCEPT DEMONSTRATION

To demonstrate that a ROV system can be used effectively as a response vehicle, several different response methods were tested at the NOSC test pool and were video taped both internally (from the vehicle point of view) and externally. Methods tested included diver warnings, position marking, and target marking. All performed with the system, and those not requiring direct contact with the diver target functioned particularly well.

3.1 DIVER WARNINGS

A diver-recall communication device (figure 3) was borrowed from the dive locker and was operated close to the vehicle. Surface personnel used the system to communicate with the diver targets.

Figure 3. Diver communication system.

3.1.1 Capabilities

The diver-recall device was used adjacent to the vehicle running at full thrust. This simulated the effects of communicating to a diver while operating the vehicle in his vicinity. The divers clearly understood the directions given over the device and experienced no interference from the vehicle system. They could also clearly understand instructions across the test pool, a distance of 100 feet. In other unrelated use, the diver-recall device has been found effective at distances of one-quarter mile or more. This is a very straightforward method of response showing the utility of the ROV in approaching the target.

3.1.2 System Impact

Installing a speaker hydrophone on the vehicle will have little effect on the vehicle system, because the spare conductors in the tether can be used to power and operate the system.

3.1.3 Vulnerabilities

Adding a speaker on the vehicle will not make the system any more vulnerable. Tests with the vehicle have demonstrated that while a target can hear the vehicle system, ascertaining the direction from which the sound is coming is extremely difficult. Since no physical contact is made with the target, the vehicle can maintain a safe standoff distance.

3.1.4 Human Factors

Use of a diver communication device is the least complex of the response methods investigated. It is simple to use and may be operated by either the vehicle operator or additional security personnel as available. Since this method requires no physical contact with the target, inadvertent injury is minimized.

3.1.5 Logistics

The diver communication device is a straightforward system used as a routine part of Navy diving operations. No particular care is required for the system beyond the routine maintenance given to the rest of the USV system. Being a simple and rugged system, it requires minimum training for use and maintenance.

3.2 FLOODLIGHTING

Floodlighting was used to demonstrate the utility of position marking a target.

3.2.1 Capabilities

Underwater floodlighting is a method commonly used for underwater security around submarines and other high-value assets. By lighting the water volume from below, any swimmer or diver target may be clearly silhouetted for a surface sentry to easily detect. This was clearly demonstrated during the Coast Guard MDZ/PIDR OPS 91 harbor defense exercises in August 1991, where the USV vehicle was used to light up the swimmer targets from below, alerting surface sentries to their presence (Fletcher, 1992). While very effective at night, the floodlighting was generally ineffective during full daylight conditions.

3.2.2 System Impact

To bottom light a target, either additional lights may be added to the vehicle system or the existing lights can bc rotated. For the ROVAR demonstration, the two top lights of the USV were rotated 90 degrees to point upward. This was a minor modification to the vehicle that did not adversely affect the overall lighting capability of the system. As a side benefit, the upward-pointing lights allowed the vehicle to be easily seen while operating at night.

3.2.3 Vulnerabilities

As with the diver communication system, no target contact is required for floodlighting to be an effective response system. Using the lights will alert the target to the location and direction of the vehicle system, but since covertness is not a requirement, this is not considered a major difficulty.

3.2.4 Human Factors

Floodlighting is by far the simplest response method available for use on a ROV system. It may be operated directly with the vehicle lighting controls and will not threaten the operator, equipment, nor target.

3.2.5 Logistics

As with the human factors, floodlighting is the simplest response system logistically. No additional equipment is required, no training beyond that of the vehicle operator, and no maintenance beyond the standard vehicle maintenance.

3.3 TARGET MARKING

To demonstrate a ROV's ability to mark a diver target, the USV was outfitted with a mockup of a leg grabber obtained from an alternate response system (figure 4).

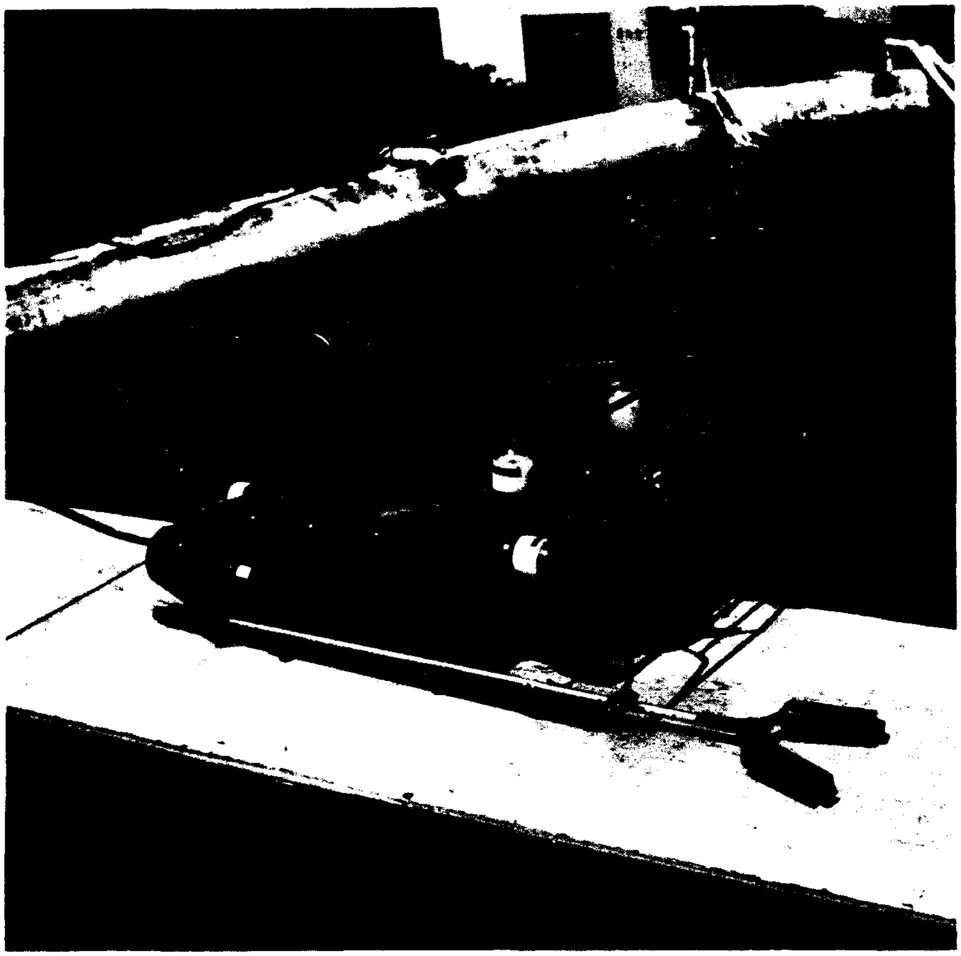

Figure 4. USV equipped with a mockup of a leg grabber.

3.3.1 Capabilities

To effectively mark a target, a line or hook must be attached to it so that it is not readily detached. In the ROVAR demonstration, a mockup of a leg-grabbing marking device from an alternate response system was used to test the vehicle's capabilities. The device was mounted on a pole that was in turn attached to the right vehicle skid. The USV maneuvered to effectively use this device on a still or cooperative target. Generally speaking, however, the vehicle was not effective in reaching evasive targets. Whether the operational difficulties were inherent in the mockup device or in the vehicle deployment was difficult to determine, since the mockup grabber was not a functional device.

With further development, this technique could best be adapted for use on a ROV. Additional mobility, such as a small manipulator, would aid in placing the device on a target. This could be accomplished by using the Articulator™ or other minimanipulator system. Also noted was the difficultly in aligning the device when it was on the right side of the vehicle. Final placement might be facilitated if the device were placed directly in front of the vehicle, so that the maneuvers would be straightforward.

3.3.2 System Impact

Adding the tagging devices significantly affected the vehicle system. The system tested in the ROVAR demonstration was a mockup of the actual hardware that would be used. To fully evaluate the impact on the system, the actual hardware would have to be fabricated and integrated with the USV system.

3.3.3 Vulnerabilities

Target marking exposes the vehicle to direct contact with the target—its most vulnerable state. Extending the response device subjects the vehicle to snagging or catching on items in the environment; in addition, this provides a convenient handhold for a potential target. Nonetheless, with appropriate design and integration, these or similar devices may be developed for effective use on a ROV.

3.3.4 Human Factors

Devices requiring direct contact with the target must be handled very carefully to minimize the risk of serious injury to the target. During the USV testing, the divers stated that simply ramming the vehicle into a target would be an effective response.

3.3.5 Logistics

In general, the more involved the marking and capture devices are, the higher the degree of skill that is required in their operation and maintenance. However, any system that was to be used routinely on the USV or other ROV system would be designed to facilitate operation and maintenance.

3.4 TARGET CAPTURE

To demonstrate how a ROV is used for capturing a diver target, the USV was outfitted with a Happy Hooker™ line looper (figure 5).

3.4.1 Capabilities

As with marking, to effectively capture a target, a line or hook must be securely attached. In the ROVAR demonstration, a Happy Hooker™ line looper was used to demonstrate a target-capture capability. The device was mounted on a pole attached to the right vehicle skid, similar to the rigging used for the target-marking device. The USV maneuvered to effectively use this device on a still or cooperative target. The small radius of the line looper prevented a diver from being snared. Instead, the divers held out poles, simulating equipment that might be snared in an actual operation. Due to this limitation, the vehicle could not effectively capture evasive targets.

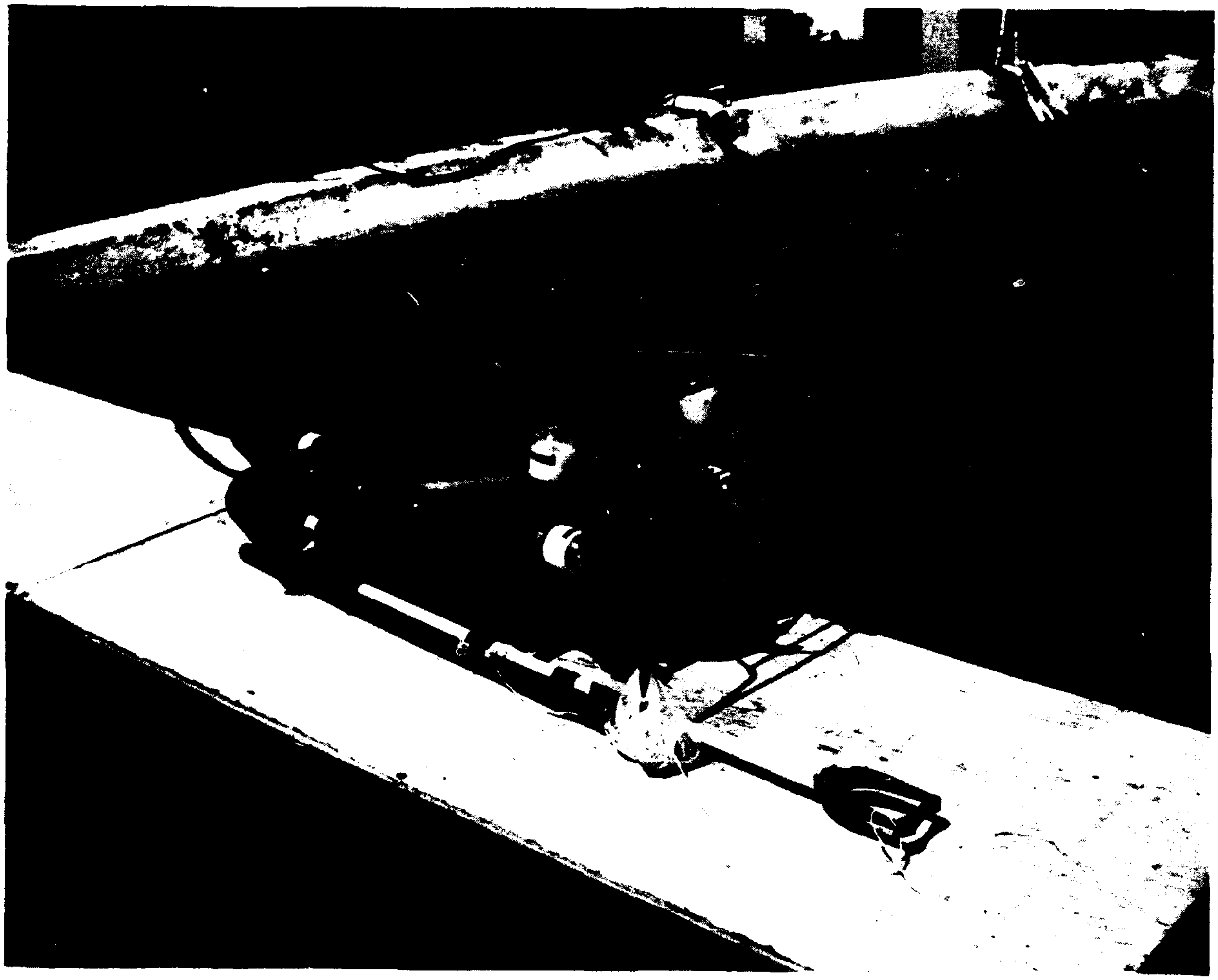

Figure 5. USV equipped with a Happy Hooker™ line looper.

As with the marking device, with further development, this technique could be adapted for use on a ROV. A wider jaw on the snare would enable the vehicle to snare larger sections such as a diver's leg or torso. The additional mobility provided by a small manipulator would aid in placing the snare on a target. This could be accomplished by using the Articulator™ or other minimanipulator system. As with the target marker, aligning the device was difficult, since it was not centered with the viewing area. Deployment of the snare might be facilitated if the device were placed directly in front of the vehicle, allowing straightforward maneuvers.

3.4.2 System Impact

Of all the methods investigated, adding capture devices most significantly affects the vehicle system. The Happy Hooker™ system tested in the ROVAR demonstration was an example of the type of hardware that might be used and not particularly the specific item intended for an actual response device. Actual response hardware would have to be fabricated and integrated with the USV system to fully evaluate its effect on the system.

3.4.3 Vulnerabilities

Target capture exposes the vehicle to prolonged direct contact with the target, thus leaving the vehicle in its most vulnerable state. Extending the device subjects the vehicle to snagging or catching on items in the environment, as well as providing a convenient handhold for a potential target. Nonetheless, with appropriate design and integration, capture devices may be developed for effective use on a ROV.

3.4.4 Human Factors

As with the marking device, the target-capture procedure must be performed very carefully to minimize the risk of serious injury. In an operational scenario requiring target capture, one must determine what level of risk is acceptable to both the target and the hardware.

3.4.5 Logistics

The more complex the marking and capture device the higher degree of vehicle-operator skill is needed in their operation and maintenance (figure 6). However, any system to be used routinely on the USV or other ROV system would be designed to meet the need for simplicity in operation and maintenance.

Figure 6. Operation of USV with Happy Hooker™ line looper.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

4.1.1 Feasibility

The ROVAR test results and demonstrations verified that a ROV can be used as an effective response device against underwater diver targets. The best results were obtained by using noncontact response devices such as an underwater speaker and floodlighting. The limited scope of the ROVAR testing prevented us from determining an optimal response system at this time.

4.1.2 Preferred System

Based on the ROVAR tests, the preferred response system for a ROV would be a noncontact system that would be effective at a safe standoff distance. Where actual target marking or capture is desired, a robust, self-adjusting grabber or snare, mounted front and center of the vehicle, would be preferable.

4.2 RECOMMENDATIONS

4.2.1 ROVAR System

Additional testing and development remains to be done on the ROVAR system. Incorporating a speaker hydrophone directly onto the vehicle would enable an in-situ demonstration of its communication ability. Using actual capture hardware with additional adaptation for vehicle use would allow a more valid evaluation of the vehicle. A larger snaring device, rather than the more constrained method demonstrated during the ROVAR tests, would enable the divers to be actually captured.

4.2.2 Additional Capabilities

In addition to further developing the capabilities demonstrated during the ROVAR tests, other response methods may also be easily incorporated into the USV vehicle. Of particular interest would be adding items, such as stroboscopic lights and water obscurants, to disorient the divers. The capability to drop buoy markers at the noted target positions could also be easily incorporated.

4.2.3 Future Efforts

In addition to adding the capabilities just discussed, future efforts in nonlethal response should investigate more exotic methods of nonlethal response such as ultrasound, electrical fields, and capacitance discharge. These and other methods may well serve to put the "bite" into the current capabilities of the USV.

5.0 REFERENCES

Fletcher, B. 1992. "Underwater Security Vehicle Final Report." NOSC TR 1472 (Jan). Naval Ocean Systems Center, San Diego, CA.

APPENDIX A

ROVAR PROOF OF CONCEPT TEST PLAN

A.1 INTRODUCTION

A.1.1 OBJECTIVE

The objective of this series of tests is to demonstrate the feasibility of using a commercially available remotely operated vehicle (ROV) for a nonlethal response to previously detected underwater contacts.

A.1.2 APPROACH

A series of tests are planned to demonstrate the capabilities of a ROV for the cost-effective, nonlethal response to a previously detected and assessed target.

A.1.3 BACKGROUND

The current Underwater Security Vehicle (USV) will assess contacts previously detected by the Waterside Security System (WSS) or other security systems. Because the USV would be at the site of the threat for the assessment phase, a response capability is a logical next step in USV system development. An effective response is defined as one that deters or delays a potential threat, without excessive force. For example, an effective response would force a submerged swimmer to come to the surface where he can be apprehended. Under simulated operating conditions, ROVAR will demonstrate the use of a currently available nonlethal response technique on the USV vehicle. The vehicle's ability to track a target and effectively apply a response will show the efficiency of combining assessment and response functions on a single platform.

A.1.4 SCOPE

The ROVAR demonstration tests will be limited to a basic Proof of Concept demonstration, due to time and funding constraints. Given the range and bearing of a target, the operator will aim for sonar contact with the vehicle. Then, upon making sonar contact, the vehicle will be driven to intercept the target until the vehicle can visually assess it or provide a noncontact response.

A.2 LOCATION AND SCHEDULE

A.2.1 LOCATIONS

Tests are planned for August 1991 at the NOSC Hawaii Test pool, the KMCAS fuel pier, and the Barber's Point Deep-Draft harbor.

A.2.2 SCHEDULE

Task	Location	Time
Coast Guard Exercise	MARISCO Facility	9–10 August
Hardware Demonstrations	NOSC test pool	21 August
Sponsor Demonstration	Fuel Pier	27 August

A.3 SUPPORT REQUIREMENTS

A.3.1 FACILITIES

The facilities required at each site include 220-V single-phase power, weather protection for the control consoles, and a crane or davit for handling the vehicle.

A.3.2 PERSONNEL

Barbara Fletcher—Test director

Brian Nobunaga—Vehicle operator

Roy Yumori—Vehicle operator

Military divers will be used as targets for the operational sections of the tests.

A.3.3 LOGISTICS

Arrangements will be made with KMCAS and SSP *Kaimalino* personnel to ensure no conflict exists in using the Fuel pier. SSP *Kaimalino* facilities may be used to support the testing.

A.3.4 EQUIPMENT

In addition to the basic vehicle system equipment, some means must be available for launching and recovering the vehicle. A small hoist would be appropriate or possibly existing cranes aboard the SSP *Kaimalino*.

A.4 TEST SETUP

A.4.1 TEST AREAS

The test pool will provide the primary area for evaluating the response hardware and the vehicle integration characteristics. The objective is to demonstrate and document the capabilities of the ROVAR system. Demonstrations under more natural operating conditions will be held at the Coast Guard harbor defense exercise and off the fuel pier.

A.4.2 ENVIRONMENTAL CONDITIONS

The test pool is being used to evaluate system operation under a convenient and controlled environment. In order to document system performance, the water must be clear—a condition that is best found in the pool.

A.4.3 SAFETY REQUIREMENTS

Standard safety precautions will be observed for using high-voltage equipment around water. Proper procedures will be used for handling overweight and bulky items. Divers will be warned to avoid the vehicle thrusters, when active. The vehicle will be kept away from ship propellers, pontoons, pilings, and other areas where the tether could become tangled.

A.5 TEST PROCEDURES

A.5.1 DIVER COMMUNICATIONS

A.5.1.1 Objective

This test determines whether a verbal warning system is understandable by a diver when used in conjunction with the USV.

A.5.1.2 Equipment

Vehicle

Diver Communication Device (borrowed from the dive locker)

A.5.1.3 Procedure

1. Tie wrap speaker to vehicle.
2. Tape cable to tether, ensuring there are no free loops of cable that may become tangled.
3. Initiate and launch vehicle.
4. Locate and approach divers from a midwater (3 meter) position.
5. Verbally give divers instructions and observe their reactions.
6. Get maximum communication range by reversing until targets no longer respond.
7. Record maximum range.

A.5.1.4 Data

Maximum range for effective communication ___100′ (POOL LIMIT)___

Operational notes

DIVER-RECALL DEVICE GOOD UP TO 1/4 MILE IN BAY, HARBOR, ETC.

NO INTERFERENCE NOTED FROM VEHICLE THRUSTERS, EVEN AT FULL THRUST.

A.5.2 FLOODLIGHTING

A.5.2.1 Objective

This test determines if the vehicle can be positioned so its lights may be used to floodlight a target from below, thus pinpointing its location to a surface observer.

A.5.2.2 Equipment

Vehicle

A.5.2.3 Procedure

1. Reposition top lights on vehicle to a vertical position.
2. Initiate and launch system.
3. Reacquire and intercept targets.
4. Turn on lights to illuminate targets.
5. If possible, maneuver vehicle underneath target.
6. Observe effect of light on an observer's ability to pinpoint the target location.

A.5.2.4 Data

NOSC Test Pool Observations

LIGHTING EFFECT GENERALLY NOT VISIBLE DUE TO HIGH AMBIENT LEVEL AND CLEAR WATER.

Barber's Point Deep-Draft Harbor Observations

ABLE TO LOCATE DIVER SILHOUETTES AND DIVERS ON SURFACE.

KMCAS Fuel Pier Observations

OCCASIONAL SILHOUETTES SEEN IF BOTH VEHICLE AND TARGET NEAR SURFACE.

GENERALLY OVERWHELMED BY HIGH AMBIENT LIGHT LEVEL.

A.5.3 TARGET MARKING

A.5.3.1 Objective

This test determines if the vehicle can maneuver to noninvasively attach a marking device to a target.

A.5.3.2 Equipment

Vehicle

Dummy target

Target-marking training fixture

A.5.3.3 Procedure

1. Attach target marker to vehicle skid. Ensure the camera has a clear view of the fixture.
2. Initiate and launch vehicle.
3. Set dummy target in a vertical position in midwater column in view of the fixed underwater camera.
4. Maneuver vehicle to "attach" marker to dummy. Determine best/workable techniques.
5. Repeat exercise with "real-diver" target. Build up to these behaviors:
   a. Stationary vertical diver position.
   b. Stationary prone diver position.
   c. Swimming diver, steady course.
   d. Swimming diver, evasive course.
6. Observe effectiveness of method.

A.5.3.4 Data

Dummy Target

NO PROBLEM, EXCEPT DUMMY FLOATS AWAY!

Stationary Vertical Diver

EASY PLACEMENT OF GRABBER

Stationary Prone Diver

WOULD HELP TO ROTATE GRABBER TO ACCOMMODATE DIFFERENT LEG/ARM ORIENTATION.

Steady Swimming Diver

SAME AS PRONE–ALSO DIFFICULT TO TELL IF EFFECTIVE CONTACT WAS MADE.

Evasive Swimming Diver

DIFFICULT TO IMPOSSIBLE TO MAKE CONTACT–NEED ACTIVE GRABBER TO DETERMINE EFFECTIVENESS.

A.5.4 TARGET CAPTURE

A.5.4.1 Objective

This test determines if the vehicle can maneuver to snare a target with a line carried by a Happy Hooker™ or other tool.

A.5.4.2 Equipment

Vehicle

Happy Hooker™ line looping device

Dummy target

A.5.4.3 Procedure

1. Attach Happy Hooker™ to vehicle skid. Ensure the camera has a clear view of the fixture.
2. Initiate and launch vehicle.
3. Set dummy target in a vertical position in mid-water column in view of the fixed underwater camera.
4. Maneuver vehicle to "snare" marker to dummy. Determine best/workable techniques.
5. Repeat exercise with "real-diver" target. Build up to these behaviors:
   a. Stationary vertical diver position.

b. Stationary prone diver position.

c. Swimming diver, steady course.

d. Swimming diver, evasive course.

6. Observe effectiveness of method.

A.5.4.4 Data

Dummy Target

HAPPY HOOKER™ JAWS TOO NARROW FOR ARM OR LEG—USE POLE OR ROD FOR TEST.

Stationary Vertical Rod

NO PROBLEM.

Stationary Prone Rod

NEED TWISTING ABILITY (I.E., MANIPULATOR) FOR EFFECT ORIENTATION.

Steady Swimming Diver

OK—ABILITY TO ADJUST POSITION OF "HOOKER" WOULD BE HELPFUL.

Evasive Swimming Diver

ARGH/SAME AS MARKER—NEED FUNCTIONAL, TAILORED HARDWARE TO DETERMINE EFFECTIVENESS.

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The Remotely Operated Vehicle/Assessment and Response (ROVAR) project demonstrated the feasibility of using a remotely operated vehicle (ROV) to provide an appropriate response to underwater threats. Several currently available, nonlethal response techniques were demonstrated on the Underwater Security Vehicle (USV) under simulated operating conditions. The ROV successfully tracked targets and can be used as an effective response device against underwater diver targets.

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