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Contents

THE SEA CHANGE – 300 FATHOMS DEEP, 3 YEARS LATER

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Abstract

The sea change experienced in a large underwater acoustic energy source, placed on the ocean floor at a 300-fathom depth, is discussed as it is examined from the surface three years later by reactivation of an installed closed-circuit video link. The author recapitulates an earlier paper on this subject that was presented at the SPIE Seminar of February 1968 (published in the Seminar Proceedings, vol. 12, pp. 73-80), updates the background of the initial ocean emplacement, and discusses the sea changes in the submerged structure and instrumentation. He illustrates the various areas of interest by videotape recordings. Many questions have arisen concerning the effects of long-term deep submergence on various parts of the video apparatus including the camera, camera viewport, the camera pan and tilt unit, the lighting unit, and the long cable. This paper discusses some of these questions.

• • • •

"Full fathom five thy father lies;
Of his bones are coral made;
Those are pearls that were his eyes:
Nothing of him that doth fade
But doth suffer a sea-change
Into something rich and strange."

William Shakespeare
The Tempest
Act I, Scene 2, Line 389

Introduction

This paper is a sequel to a previous paper presented at the SPIE Seminar of February 1968, in San Diego, and published in the Seminar Proceedings, vol. 12 (pp. 73 to 80).

A few aspects of the previous paper will be reviewed for clarification. That paper described the successful utilization of a closed-circuit video system as an aid in emplanting an underwater acoustic source at a precise location on the ocean floor at a depth of 300 fathoms. The video system operated properly throughout the emplantment and assisted in positioning the acoustic source safely and properly on a relatively small plateau of about 200 by 400 yards in its subsurface location.

The recovery and reactivation of the video system three years after the emplantment will be described and the effects of the long-term submergence will be reviewed.

Description of Video System

Figure 1 shows the Deep Ocean Basin Acoustic Source. Its emplantment was successfully accomplished during June 1966. It is 25 feet in diameter and 50 feet high and weighs 35,000 pounds in air.

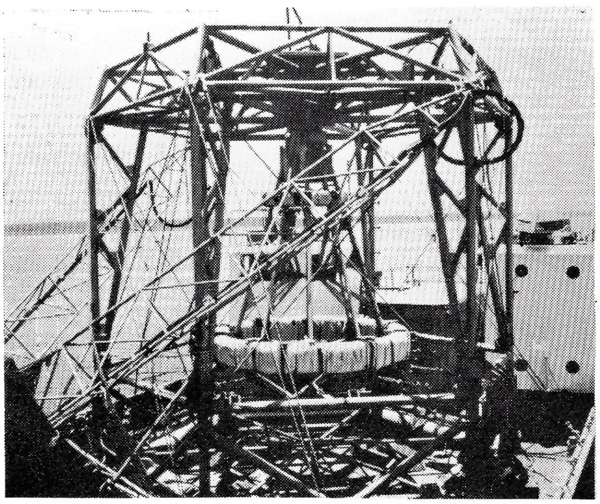


Fig. 1. Deep Ocean Basin Acoustic Cabled Source

Figure 2 indicates the location of various items of the video system that were installed on the sound source to augment the acoustic methods of observing the descent and bottom emplacement.

The complete video system consisted of a camera, lighting, a pan and tilt unit, a control unit, a power

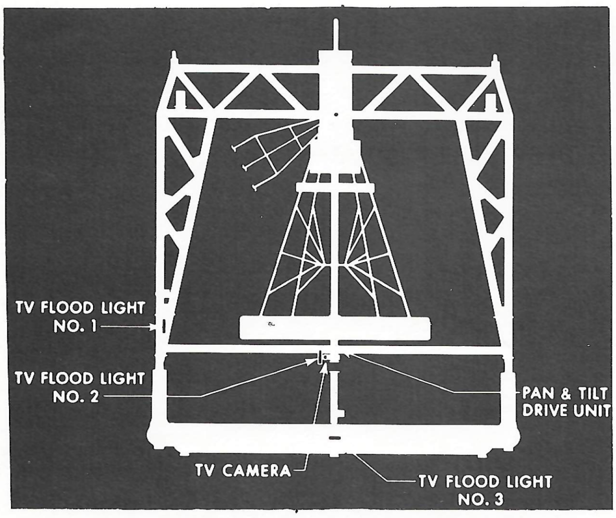


Fig. 2. Location of Video System Components Attached to the Unit Cage

supply, three video monitors, a video film recorder, 5000 feet of cable on a special cable reel, and a slip ring assembly.

The video camera and the pan and tilt unit are shown in Fig. 3.

Emplantment

The ship used for the emplantment was the Motor Ship SALERNUM (Fig. 4). Figure 5 shows the cable reel mount used for paying out the 5000 feet of 3/4-inch cable. Attached to the cable reel was a type SR-15 ring connector assembly (Fig. 6), with a coaxial rotary joint for video return, to enable continuous viewing during the descent of the apparatus.

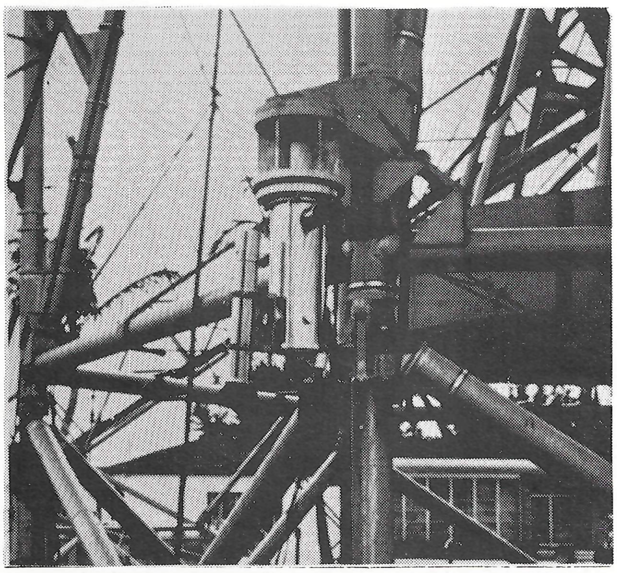


Fig. 3. Camera Pan and Tilt Unit

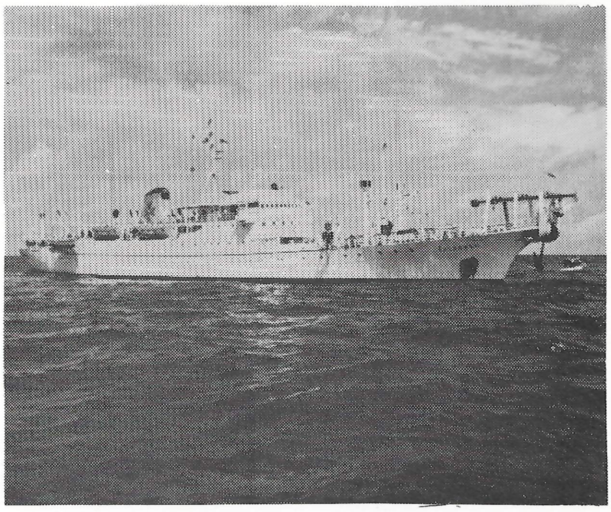


Fig. 4. MS SALERNUM

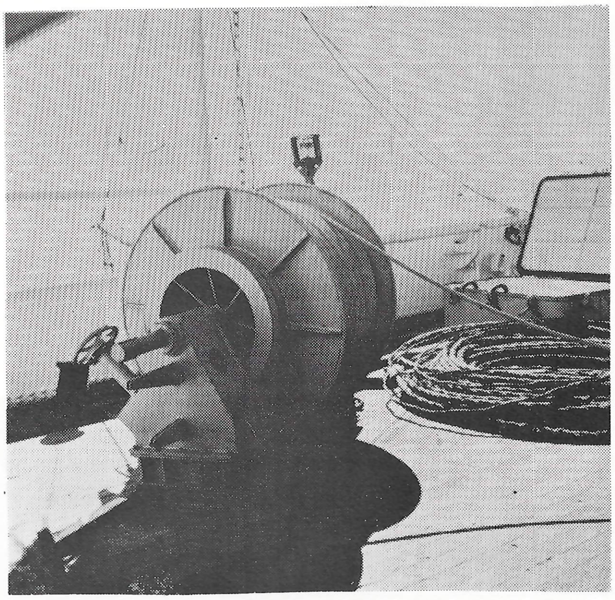


Fig. 5. Cable Reel Deck Mount

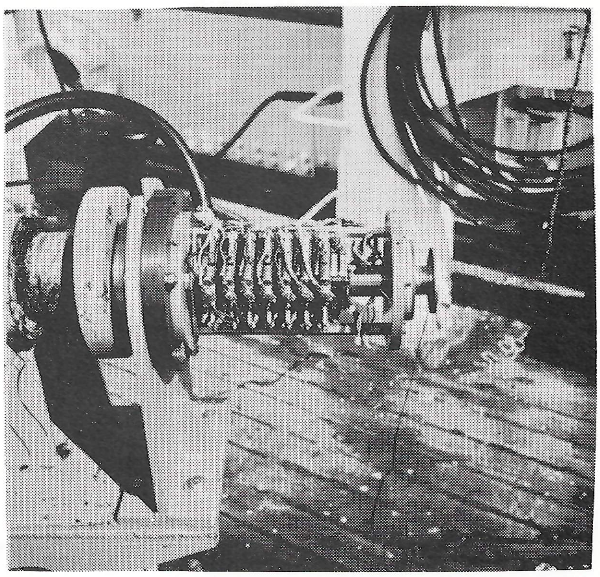


Fig. 6. Slip Ring Assembly

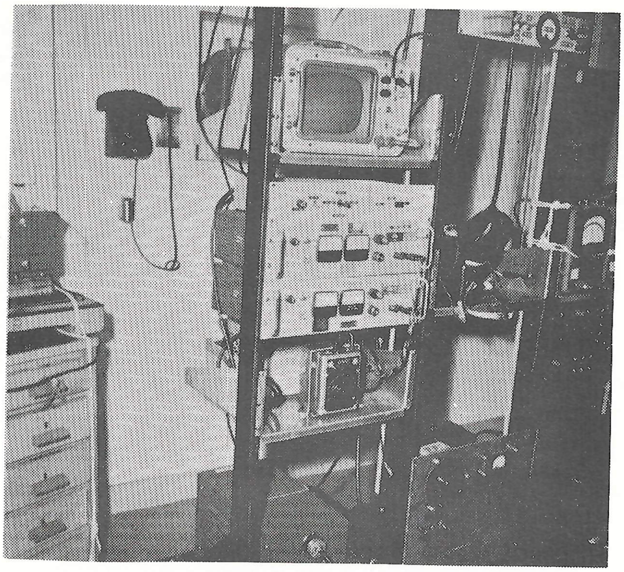


Fig. 7. Laboratory Test Space

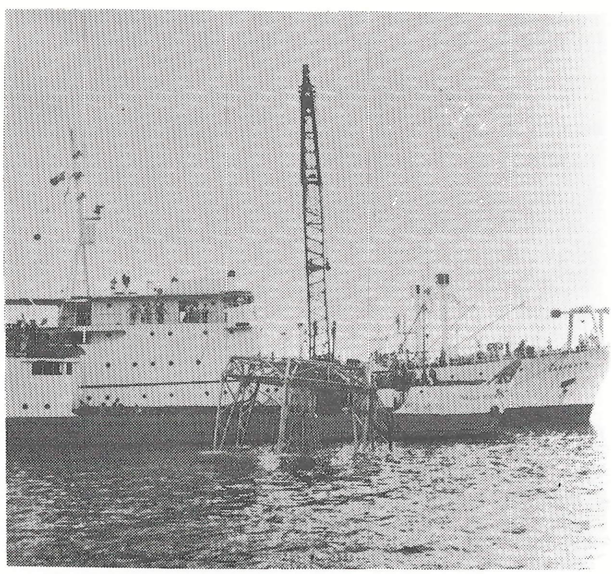


Fig. 8. Lowering of Acoustic Source

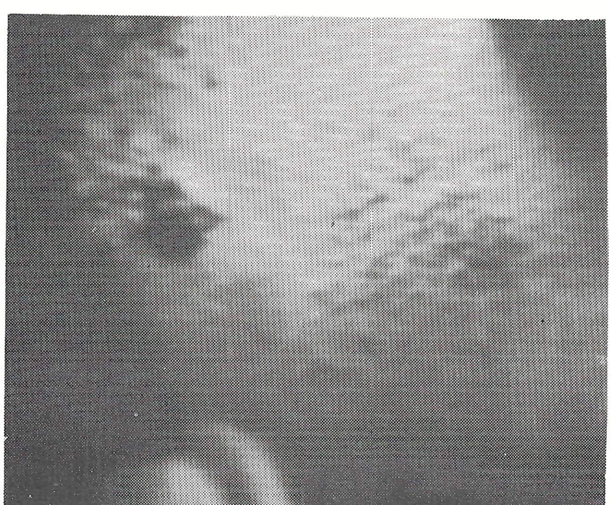


Fig. 9. Ocean Bottom View

Shown in Fig. 7 is one of three monitors that were installed in strategic locations throughout the ship in such areas as the Chart Room, Control Room, and this Test Room. Also shown installed in this equipment rack are all controls and power supplies for the video camera, lights, and the pan and tilt unit. All monitors displayed the same view simultaneously.

The MS INAGUA ROVER, a support vessel, hoisted the cage over the side with its 60-ton crane (Fig. 8) and, upon disengagement of the crane hitch, full control of the cage was transferred to the SALERNUM.

As the cage approached the ocean floor, a view of the bottom came on the monitor screen (Fig. 9). Moments later, bottom contact!

Wrapup operations required that the ship head toward shore to run off the remaining cable. The end of this cable was sealed by dipping it in neoprene cement and then taping (Fig. 10). A rubber hose, plugged at one end, was cemented, inserted over the cable, and secured in place with an aero-clamp. A grappling line was attached to the video cable for planned future recovery and subsequent video reconnect for visual inspection of the unit, when and if needed.

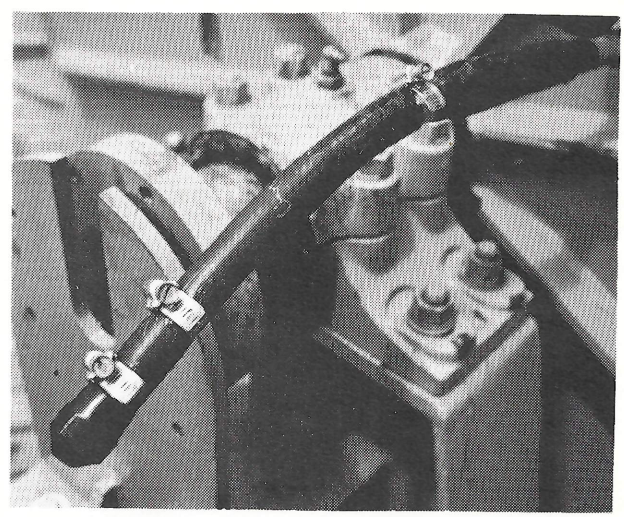


Fig. 10. Video Cable End Sealed

Recovery and Reactivation

In early February 1969, intermittent operation of the sound source unit resulted in plans for reactivating the video system, to provide for a visual inspection of key points on the unit, as well as a possible shift in position or angle. The Research Vessel PATRICK KILEY, of Hydrophone Research Corp., shown in Fig. 11, was used for the subsequent video cable recovery operations. Shortly after, the ship steamed to the anchorage point.

Fig. 11. Video Cable Recovery Ship

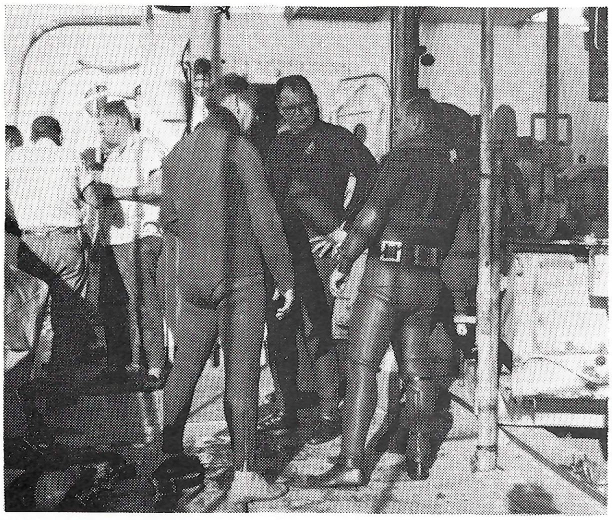


Fig. 12. Divers Prepare for Grapnel Line Search

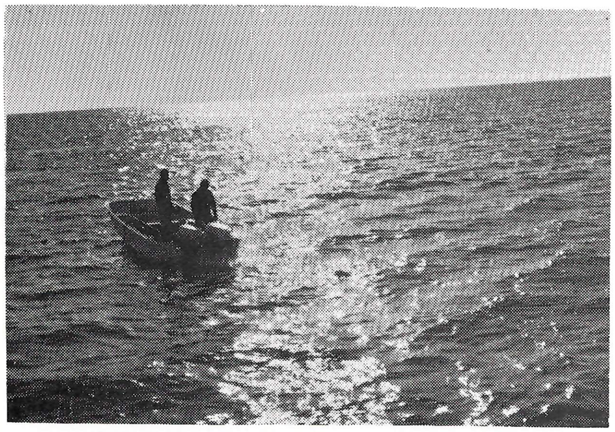


Fig. 13. Awaiting Divers

The divers (Fig. 12) then prepared to go over the side to search for the grapnel line attached to the video cable. A small boat (Fig. 13) stood vigil while the divers made their underwater search at a depth of about 75 feet.

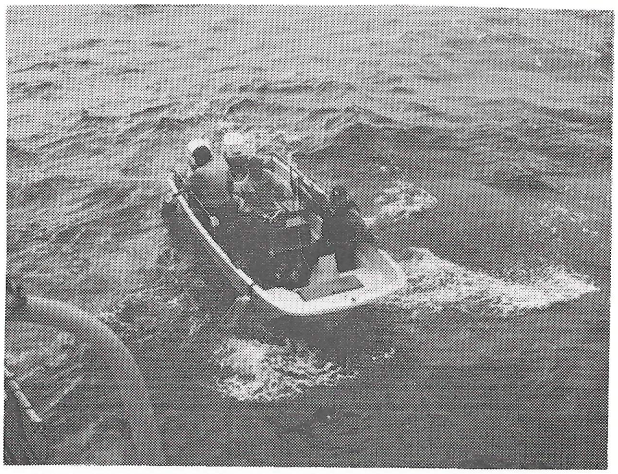


Fig. 14. Return of Divers

The divers and the small boat crew returned after locating the grapnel line (Fig. 14).

A hauling line brought the grapnel line aboard the ship for underrunning (Fig. 15).

The grapnel and cable end were then pulled aboard the PATRICK KILEY (Fig. 16).

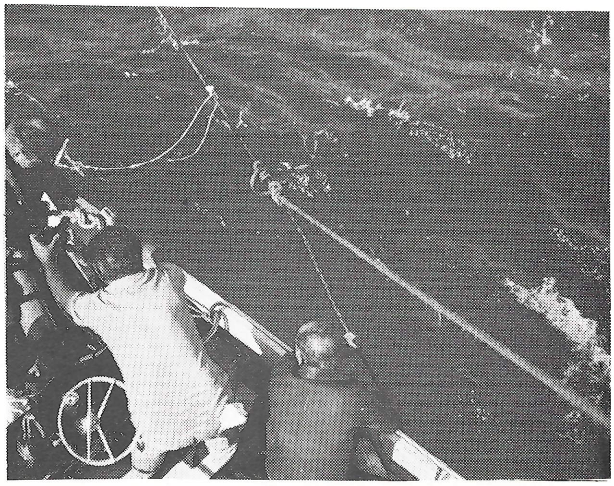


Fig. 15. Grapnel Line Brought to the Boat

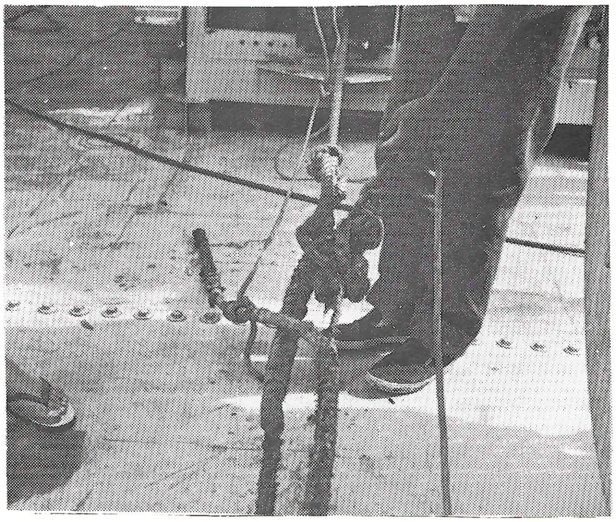


Fig. 16. Grapnel and Cable End On Board

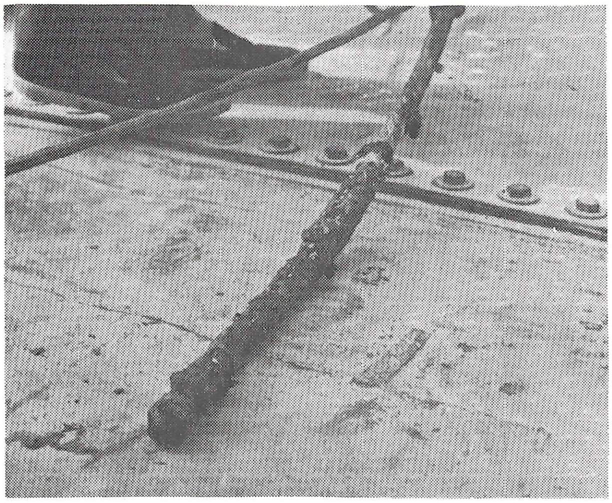


Fig. 17. Video Cable End Seal

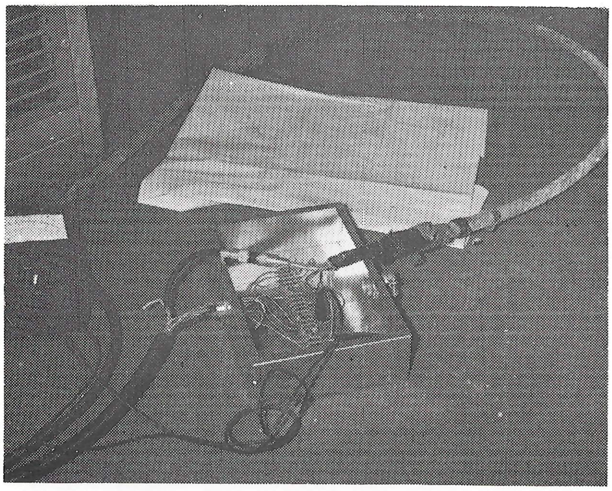


Fig. 18. Junction Box

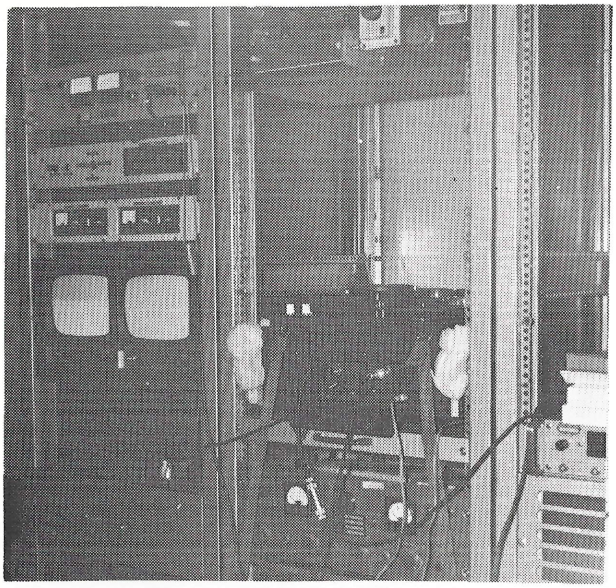


Fig. 19. Equipment Rack

With the end of the video cable on board and the cable stoppers attached, approximately 30 feet of cable was routed into the dry laboratory space and secured to a suitable work area (Fig. 17). Here the video cable end seal was removed and the conductors were prepared for application of spade lug connectors and a VHF coaxial connector.

The sea cable was checked for continunity and connected to a junction box (Fig. 18), which had been prewired and assembled at the Laboratory, with Jones-type terminal boards and pigtail connectors.

Connections were then made to the camera, the pan and tilt unit, and the lights. Power supplies and monitoring equipment were mounted into the equipment rack (Fig. 19). As power was applied to the light source, it was monitored. The results indicated that the lamp was functioning properly. Power was then applied to the camera, and indications were also favorable. No video was present on the monitor at this time, because of the characteristics of the mercury vapor lamp (i.e., ionization of mercury vapor, which usually takes 5 to 7 minutes to come up to full light output). When the lamp did come up to its full operating condition, the scroll of the unit came into view.

Motion Picture Commentary

The following commentary accompanied a 7-minute motion picture film transferred from video tape recordings made over 5000 feet of cable during the emplantment and subsequent reactivation. These films showed the results of the use of video in the emplantment and the effects of 3 years of continuous submergence on all video components.

Emplantment Task

The first section you are now seeing is the sound source as it was lowered just below the water surface to approximately 30 feet. Divers are shown removing all extraneous connections.

While you are looking at this I would like to explain about an additional technique for detecting the remaining depth to the bottom. This technique employed a glass ball depth monitor which was suspended 50 feet below the cage. This ball broke on contact with the bottom, causing an explosion that was picked up by an operator monitoring the hydrophone, thereby confirming the remaining depth at about 50 feet. I mention this because you will see this object in the film; immediately after the explosion the bottom came into view. The lowering action of the cage was then slowed down for a gentle bottom contact. The object you see in the center left of the picture is the glass ball depth monitor. The actual bottom contact shown here raised excessive sediment, a condition which lasted about 3 hours, during which time video was shut off.

When reactivated and directed from topside, the camera scanned the cage structure and bail, revealing visually that all was well and that the cage was as hoped, less tilted than the maximum acceptable tilt angle of about 30 degrees, with the acoustic sources approximately horizontal as planned.

Reactivation Task

This film shows the images seen through several small areas of growth which we believe to be bacterial. This growth obscured the view to quite an extent as you can see. It was disturbing until we learned to operate the pan and tilt unit in such a way as to see the object of interest through the clear areas.

Results

The operational requirements were fully met. Visual observations of possible damage to several key points on the sound source and cage, in addition to its angle change, position shift, etc., were made.

However, many more questions have been asked concerning the sea change and long-term deep submergence effects on the camera electronics, camera lens viewport, deep submergence lights, pan and tilt unit operation, and cable performance after such a long period of nonuse. All of these will be discussed individually.

Camera and Electronics

The camera was a model TC-100 with a built-in long-line amplifier. The only problem here was that the lens focus was locked in the infinity focus position, and therefore, all items closer than 6 feet were not sharp; beyond this, the depth of field and clarity were considered to be good.

No problems were encountered with the electronics in the camera. A check for mositure or leakage was made with the camera placed in a vertical position with the lens down. A close inspection of the lensport was made, but no sign of condensation or moisture from within was observed.

Camera Lens Viewport

The camera lens viewport showed several small areas of growth which we believe to be bacterial. This growth obscured the view to quite an extent as you have seen but, because of our ability to pan and tilt, we were able to look through the clear areas.

Lamps

The lamps were 1000-watt Underwater Mercury Light Model 2. Although there were three lights installed and used in the emplantment, only one light, the one installed on the camera, was wired and powered through the video cable that was recovered for the visual inspection project. No problems were encountered in the operation and use of this light during its total 9 hours of operating time. The wiring and power for the other two lights had been provided through the main cable of the sound source during original emplantment. They were not used for the reactivation task.

Pan and Tilt Unit

The pan and tilt unit was a model RPS-3. This unit worked a little "jumpy" on the emplantment, which we previously attributed to the possibility that a cable might have twisted during descent and was resting on the outer housing, causing the unit to bind slightly. During the reactivation it again started off a little stiff, but after a few minutes this condition cleared up. I believe this latter case was due to the accumulation of fine sand particles between the revolving part of the pan unit (operating in azimuth) and the unit's base.

Underwater Video Cable

Five thousand feet of type C103P, 15-wire 3/4-inch cable with 2 double layers of armor was used. Although some bands of curlicues appeared on the

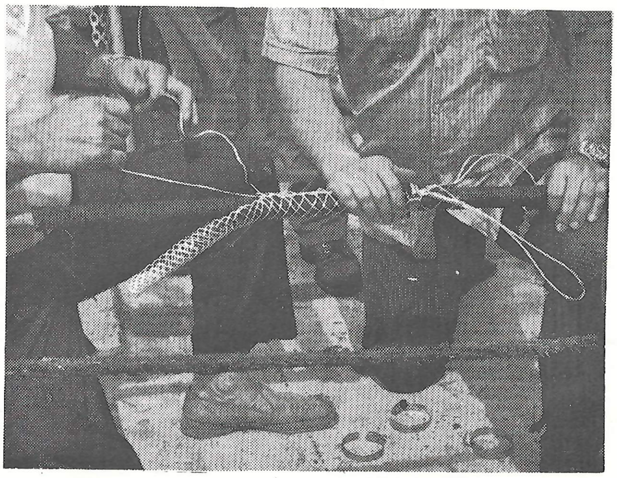


Fig. 20. New End Seal

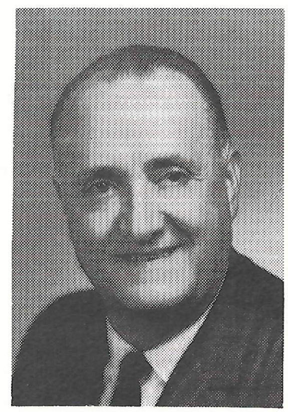
last 400 feet of cable and although at a few points the outer ring of double-lay armor was twisted, the overall cable performance both internal and external was exceptionally good. It must also be kept in mind that the images seen on the monitor were transmitted through 5000 feet of this cable with only one line amplifier in the camera electronics. It was found by this visual observation that the compass-current flow indicator was missing.

In the final wrapup of this operation a new end seal was made up (Fig. 20). The grapnel line was attached to the video cable by two Kellems grips plus rope stoppers and was again dropped over the side for a planned final recovery of the entire unit.

Conclusion

Although much was learned from this visual observation, ultimate detailed and critical inspection of components will have to await final recovery of the entire unit, which is planned for the not too distant future.

ABOUT THE AUTHOR



JAMES F. SELVIDIO is presently Head of the Photo-Optical Techniques Branch of the New London Laboratory, Naval Underwater Systems Center, Newport, R.I. He has been a member of the Laboratory Professional Staff for more than a quarter century, and has been Supervisor of Photography since 1945. His work has always been involved with the application of photographic science to the work of the Laboratory. Within his profession he is known country-wide for his personal contributions to the advancement of the state-of-the-art of his chosen field over the years. His current responsibility is to provide Photographic, Photo-Optical and Video Instrumentation of many kinds, together with well qualified technical personnel to operate such equipment for the acquisition of scientific and engineering data above, on, in and below the Sea in most ocean areas where the Navy operates.

Mr. Selvidio has been a frequent contributor to the technical literature of applied photography, in particular where the ocean environment is concerned.