OPTICAL TECHNOLOGY DIVISION
OPTO-MECHANICAL DESIGN ENGINEERING

Memorandum ME 74

TO: B. Malin DATE: December 20, 1971

FROM: L.B. Molaskey ✓

SUBJECT: Improved Viewing Capability for Bathyscaph Trieste II

During my recent experience with the Trieste II operation off Hawaii, it was very apparent that one of the most serious operational limitations is the pilot's viewing range out of the ball when operating on the ocean bottom. Although the Trieste is equipped with a window, lights, viewing optics, television, and sonar, its ability to search the bottom is limited to a range of less than 30 feet from the ball in a 120° cone along the vehicle axis.

The search method currently employed is to maneuver the bathyscaph along the ocean floor with the trail ball (a 250 pound ball tethered on a light cable) extended about 35 feet. This places the pilots about 30 feet from the bottom. Sonar is used to locate large solid targets up to a range of about 3,000 feet. The scaph is then maneuvered toward the target until visual contact is made (30 feet) or until the sonar reflection disappears because the target is outside the inner edge of the viewing cone of the sonar (inside the minimum range). At that point a visual search is conducted. Recognition of a target, as compared to rocks, other debris, or physical contours of the ocean bottom is very difficult with sonar. The result is that each potential target must be investigated visually. The improvement achieved by increasing the visual capability so that target discrimination can be achieved at a greater range is therefore an area function.

I have recently reviewed Engineering Report #10706, "Undersea Laser Sensor", prepared for the U.S. Navy in May 1971 and think that the principal described therein could be applied to the Trieste. I also understand that some recent work in solid state detectors at OTD could be used to improve the reliability of such a system.

I don't know if the Trieste has any development money to use for such an item but I do know that they would be very receptive to an unsolicited proposal and would help pursue the funds required if convinced that the improvement is feasible. I have discussed this matter with Lt. Cdr. Bartels, Officer in Charge of Trieste, and Cdr. Mooney and Capt. Packer of Submarine Development Group I, all of whom expressed interest in any device which would improve their viewing range.

Recognizing that the best proposals address specific problems with detailed solutions that are tailored to the hardware involved I requested and

obtained the following details of the Trieste and its equipment:

NOTE: Assume that one or two sensor systems, composed of a sensor head which is external to the pressurized ball, mounted to the "pan and tilt platforms" which are located on both sides and just forward of the ball and a viewing and control station which is located in the ball.

Sensor Head Design Requirements

Form Factor - 10 inch dia. x 36 inches long.

Mounting - Clamped to 10" dia. via quick coupling device capable of activation underwater by divers at a depth of 30 feet.

Weight - No firm requirement but should be minimized as consistent with application and maintenance.

Vibration - Not known - should be consistent with environment - handling, test, and operation on surface and below.

Shock - Same as vibration.

Temperature - a. Operating 30 to 110°F
b. Storage 0 to 140°F

Pressures - Operation at P = 13,500 PSI external water pressure

- Test - Must be capable of withstanding 10 cycles of pressure change. Nine cycles from one atmosphere to 13.5K PSI held for 10 minutes. Final cycle from one atmosphere to 13.5 K PSI held for one hour - no leaks or permanent deformation. Must operate at both pressures.

Wave Motion - 10,000 pounds per square feet of exposed area.

Power Available - $24\ ^{+4}_{-2}$ VDC

- $120\ ^{+29}_{-5}$ VDC

* - 115 V 60 cycle single phase

* - 115 V 400 cycle single phase

*This power is available from a converter but is in limited supply.

(All power is from two battery sets aboard the Trieste. The 24V system has a total mission capacity of 5,000 amp hr. The 120V system has a total capacity of 952 amp hr. These batteries operate all systems aboard. Propulsion system 120V. Life support and instrumentation 24V.)

Connectors - Electro Oceanic heavy duty series. Maximum of two leads per connector pin - as many pins as required.

Diagnostics - None on present equipment but can be considered if useful.

Field of View -

a. Low power - must provide wide area coverage (present viewing optics is 120° FOV.) for search.

b. High power - at least 2 times low power - consistent with other parameters to aid in discrimination of underwater targets at maximum range.

The mount on which the sensor head is fixed provides azimuth pointing of 360° and elevation of ±90°. Both motions require twisting of electrical cable. The mount is #RP-3 Pan and Tilt Unit manufactured by Hydroproducts Division of Dillingham Corp., Serranto Valley, California.

Focus Adjustment - 3 feet to infinity.

Viewing and Control Station

Form Factor - 6 x 10 x 12 rack mounted box.

Mounting - hard mounted to structure of sphere.

Weight - No limit.

Vibration - Not known - consistent with application - environment is not severe.

Shock - Not known - same as vibration.

Temperature - 60 to 110°F operating
0 to 140°F storage

Relative Humidity - 35 to 95%

Pressure - Sea level minus 2" hg.

Environmental Gas - O_2 content 20% $^{-2\%}_{+5\%}$

remainder - air constituents

Generation of Toxic Compounds - The unit shall not generate any compounds, elements or other materials that are toxic or otherwise harmful to the pilots when exposed to the equipment operating in the sealed environment for periods of up to 24 hours.

Explosion Proof - The equipment must be explosion proof per mil specs.

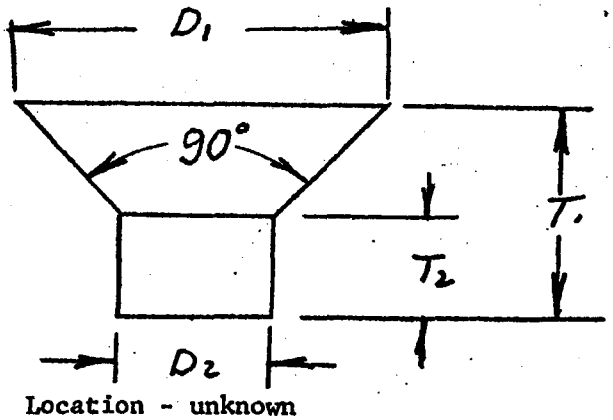
Display - Conrac, 8 inch diagonal, 500 TV lines or equivalent.

Controls - T.V. as required
Standby - if required
System On
System Off
High Power
Low Power
etc.

The following data is provided to give an idea of the Trieste's present capability:

Viewing Port - Cone shaped $D_1 = 17.062$, $D_2 = 4.782$, $T = 6.14$ inches; material Plexiglass G (Thermoplastic acrylic resin) No optical coatings located on forward centerline of the ball.

Peep Holes (4) - $D_1 = 4.008$, $D_2 = 1.00$, $T_1 = 4.3$, $T_2 = 2.8$ inches



Location - unknown

Viewing Optics - Binocular viewing system (manufactured by Kolmorgan) - approximately 3 inch diameter objective - coated lenses. Eyepiece can be separated to provide two monocular systems (for two pilots simultaneously.) Each eyepiece has diopeter adjustment +1 to -3. Power changer by mechanical lever. Field of view through window -

high power 72° field

low power 120° field

NOTE: Pilots can not look out the view port except through the viewing optical system.

TV Viewing Systems - There are provisions for mounting four TV cameras outside the ball on the pan and tilt mounts or hard mounted. Any three T.V. can be viewed inside on 8 inch television sets (Conrac).

Typical TV Camera - Zoom TV Model TC-150-MIL-ST-2-T manufactured by: Systems Division of Dillingham Oceanographic Engineering Co., San Diego, Calif.

Horizontal resolution - 500 TV lines

Lens - focal length in air 13 mm to 52 mm with maximum aperture of f/2.0

Focus range - 3 feet to infinity

Horizontal field of view - 38° to 10.5°

Vertical field of view - 30° to 8°

Both in water.

or

Underwater TV Camera Model II - same manufacturer

Lens - 12 mm, 60° field of view

Focus range - 3 feet to infinity

Horizontal resolution 600 TV lines

Present TV's operate on 24 VDC supplied from main battery on 2 leads of #16 wire (power and return) - Signal leads are coax except through ball penetration where they are on separate pins.

Lighting System - see attached sketch.

I believe there is real potential in this area. The Navy has several deep submersibles which all have the same visibility problems. They are interested in getting new improved equipment to extend their capability for search and rescue work on the bottom.

I was given two names of project people at NAV - SHIPS who have responsibility for developing this type of equipment. They are:

Dan Spadone and

Joe Cestone at PMS 395

Deep Submergence

Because of the security aspects of my association, my name should not be associated with Perkin-Elmer except with Lt. Cdr. Bartels, Lt. Taylor, Cdr. Mooney or Capt. Packer. I would be glad to set up introductions, etc. for any contact you feel could be used to further investigate this area of potential business.

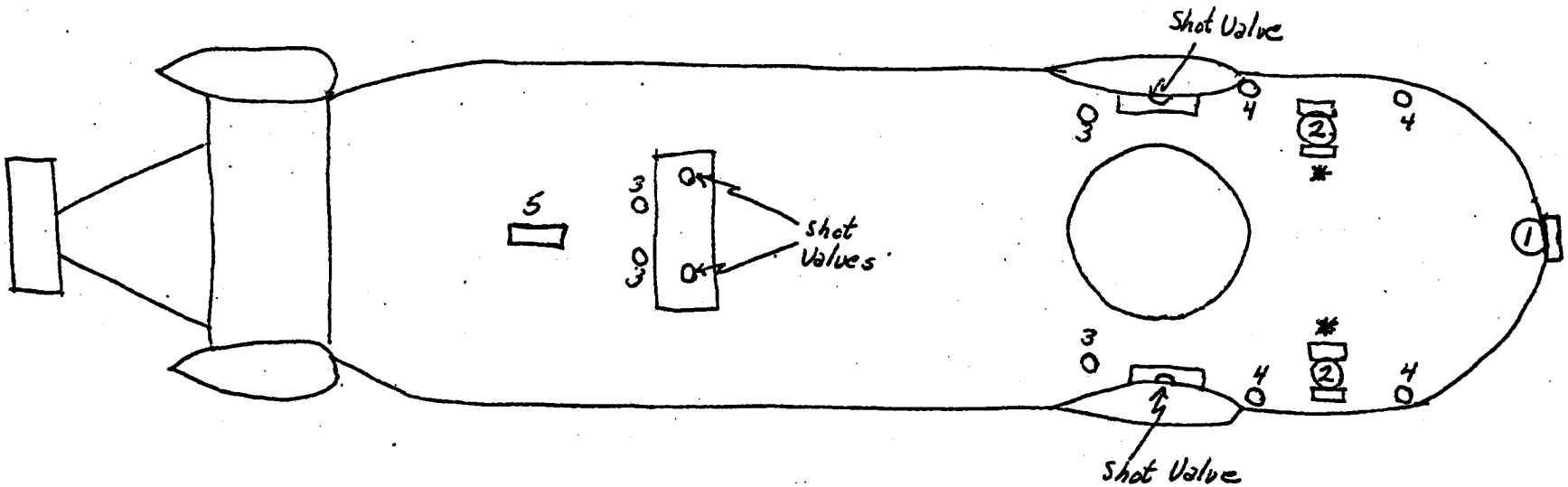
L.B. Molaskey

LBM/cj

cc: R.W. Jones
H.W. Robertson
M.F. Maguire

1. Four (4) Search lights on Pan & Tilt. 120 VDC, 750 W each
2. Two lights on each TV Pan & Tilt. 120 VDC, 250 W
   24 VDC T.I. (Thallium-Iodide) 250 watt
3. Four (4) Silo lights 24 VDC 400 W quartz-iodine
4. Four (4) Flood lights Same as Silo lights except 2 filaments for 800 watts eac
5. Aft TV Same as TV Pan & Tilts.

* TV PAN & TILTS each have a 24 VDC STROBE 500 watt-second



· Bottom View