" HYDAS " AND " HYSURCH "

THE PRESENT AND FUTURE IN HYDROGRAPHIC SURVEY SYSTEMS AT THE U.S. NAVAL OCEANOGRAPHIC OFFICE

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Good afternoon, ladies, gentlemen and fellow hydrographers. For many years I've looked forward to attendance at the Hydrographic Conference here in Monaco and the wonderful opportunity it provides for free and open discussion with one's contemporaries. Today, I hope I can stimulate some thought and discussion on the subject of coastal charting requirements and capabilities by describing some of our development efforts at the U.S. Naval Oceanographic Office.

Charting the coastal and ocean areas of the world to satisfy the ever-increasing accuracy requirements of both commercial and Naval users is a real challenge which faces us all. A modern, accurate hydrographic survey provides the basic ingredient for chart production. And yet how many of us would say, at this point in time, that we have completely adequate surveys of our coastal waters ? I, personally, would not, because what was completely adequate a few years ago may be inadequate now in terms of satisfying the new requirements of deepdraft ships, off shore geophysical exploration and environmental studies.

In the United States, our Naval Oceanographic Office (*) is charged with the responsibility of providing charts and navigational information required for safe navigation by U.S. vessels in foreign waters worldwide. As all of you recognize, there is no single country capable of assuming

(*) As of 1 July 1972 the portions of the Oceanographic Office charged with this responsibility were separated and redesignated as the Hydrographic Center, Defense Mapping Agency — part of a Department of Defense re-organization of all mapping, charting and geodesy functions. The Hydrographic Surveying function remains with NAVOCEANO but under the management control of the Director, Defense Mapping Agency, Washington, D. C.

such a responsibility and carrying it out without the cooperation and assistance of other maritime countries.

The free exchange of nautical charts and information through the medium of the IHO, cooperative joint surveys such as those in the North Sea and Malacca Strait previously discussed by RADM RITCHIE, special exchange and reproduction agreements such as we enjoy with some of you — all are essential to the accomplishment of such a task. Much remains to be done, both in improving our technical capability to acquire necessary graphic data and in improving our human ability to apply these technical resources more effectively for the benefit of all.

I will leave the subject of closer cooperative survey and charting endeavors for the new directorship of the IHB to consider and, hopefully, to foster. My remarks this evening will be restricted to the technical improvements in data collection capability, in being or under development, at the U.S. Naval Oceanographic Office.

As most of you know I'm sure, we in the U.S. Navy rely on our National Ocean Survey, formerly called our Coast and Geodetic Survey in the Department of Commerce, for the charts of our own coastal waters. This arrangement has permitted us to concentrate on ways and means of acquiring hydrographic data in foreign waters by cooperative surveys with friendly governments whose resources for charting their own coastal waters were recognized as insufficient for timely completion of essential, modern survey or re-survey operations.

Until 1970, survey ships assigned to such operations were regular Fleet auxiliaries — transports, mine-sweepers, tenders, tugs, etc, which were modified for survey work. Later modifications were effective and productive units. Several of you will remember our sister-ships, USS TANNER and USS MAURY, since they have worked on joint survey operations with some of your own ships and personnel during the past quarter century. Now we have a new pair of sisters — USNS CHAUVENET

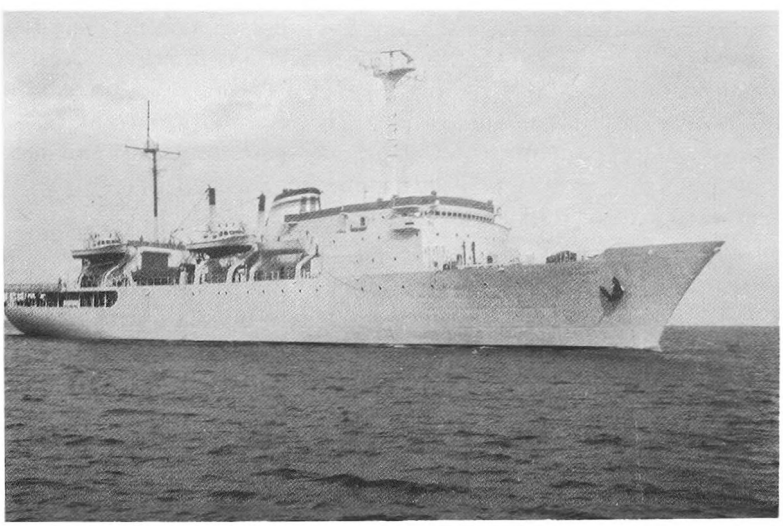

FIG. 1. — USNS CHAUVENET (T-AGS-29).

and USNS HARKNESS (Figure 1) as replacements. It is these ships, their sounding boats and related survey equipment I will describe as our present coastal survey system. (For those who might not hear my remarks tonight or who wish to see for themselves — the USNS HARKNESS is here in Monaco now and will welcome your inspection).

HYDAS

The ship system :

The Ship System is called HYDAS — an acronym for Hydrographic Data Acquisition System. It is an automated data collecting, processing, display and recording system designed primarily for installation in these ships. Basically, it is a two computer system. One PDP-9 computer operates in a real-time mode to perform the basic HYDAS functions; the 2nd identical computer serves either as a back-up for the ship's real-time computer or as a free-standing computer for processing data collected by the ship's four survey boats. (Figure 2).

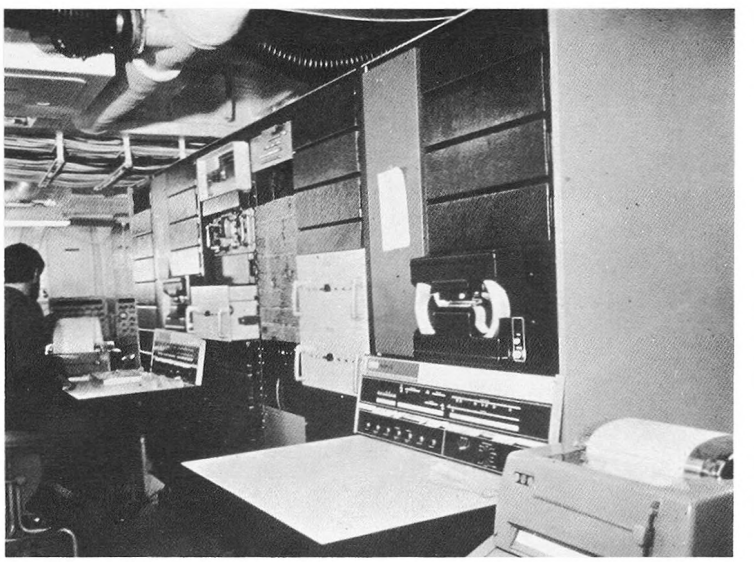

Fig. 2. — PDP-9 Computer Installation.

A Storage Drum, with a capacity of 131 thousand 18-bit words is accessible to either computer on a first come, first served basis.

Recording and Display Devices include : (1) An incremental magnetic tape recorder to record identification, raw survey and some computed data, (2) A teletype printer for each computer to display necessary monitoring data, i.e., time, depth, speed, heading, etc., (3) A cathode ray tube display at the computer and on the ship's bridge shows progress relative to a

pre-plotted track, and (4) Flat bed plotters, which plot ship and survey-boat tracks and depths, and drum plotters which plot profiles of magnetic and gravity data.

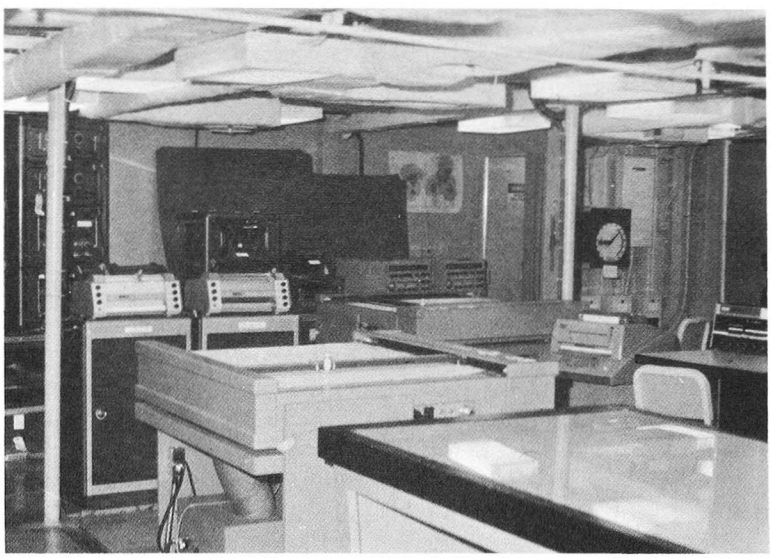

Fig. 3. — Flat-bed Plotter — Survey Control Center.

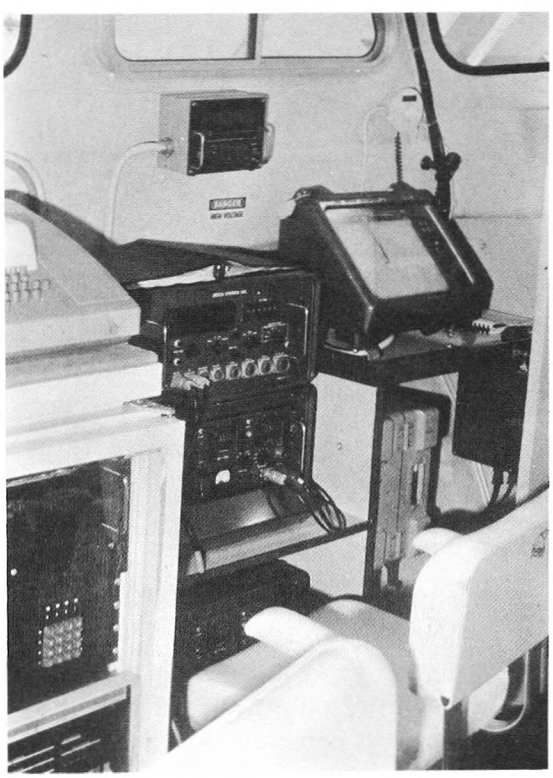

Fig. 4. — HYDAS Installation.

Sensor interfaces, such as analog to digital converters, and real-time hardware, such as a clock and power-fail detector, complete the system. Data collection is correlated by the oscillator clock. Any source can be used — computer resolution of time is accurate to 1/10 000 of a second!

The boat system :

The Boat System — installed in each of the four 36-foot survey launches carried aboard CHAUVENET and HARKNESS consists of (1) a small computer with a 4 000 word (4k) core memory of 16-bit words, (2) a 16-character input keyboard, (3) a magnetic tape recorder, (4) an electronic positioning system receiver, (5) an echo-sounder with digitized output as well as visual echogram, (6) a drum plotter, and (7) an oscillator clock. (Figure 4 — Boat computer and electronic positioning system receiver).

Data gathering and processing are done periodically under control of the oscillator-clock. Output is to incremental magtape recorder and drum plotter. The drum plotter is mounted forward in clear view of the helmsman.

Depths are not normally plotted but are recorded on the magtape, along with time, identification, position coordinates, and any other type of raw data. The standard echo-sounder recorder, plus a digital read-out dial, provide the boat officer and the helmsman with necessary, real-time depth information.

A few months ago I made a quick one-day visit from Washington to HARKNESS, at sea off Cape Hatteras, by plane and ship's helo to see for myself how the HYDAS system was working. At that time, there were still a few " bugs " to be worked out. Subsequently, the survey launches have been competing among themselves and several have logged over 100 n.m. a day of good taped data. The ship and boat systems will get their first real operational test this summer — CHAUVENET in the Pacific, HARKNESS in the Atlantic and Mediterranean.

I hope that all of you will take the opportunity to visit the USNS HARKNESS during her stay in Monaco this week and see for yourselves the HYDAS equipment I have just described.

HYSURCH

Now, I'll discuss briefly how we're still trying to improve the speed and efficiency of future coastal hydrographic surveys.

Our coastal hydrographic survey and charting system, acronym " HYSURCH " (Figure 5) is a research and development effort now underway. As a follow-on to HYDAS, its major objectives are to accelerate data collection rates, and to improve techniques for on-site compilation

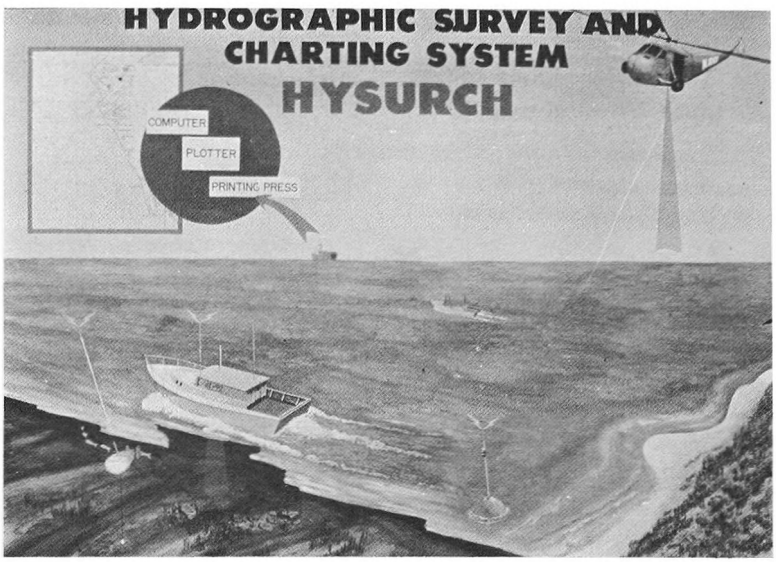

FIG. 5

and evaluation of data. An advanced development model of the system is in the final stages of hardware and software integration, in preparation for field testing this summer.

The development model, based upon a total system concept, is made up of the following elements:

a. Two soundboats,
b. One data buoy,
c. An electronic positioning net,
d. A data link, and,
e. A data collection and compilation center.

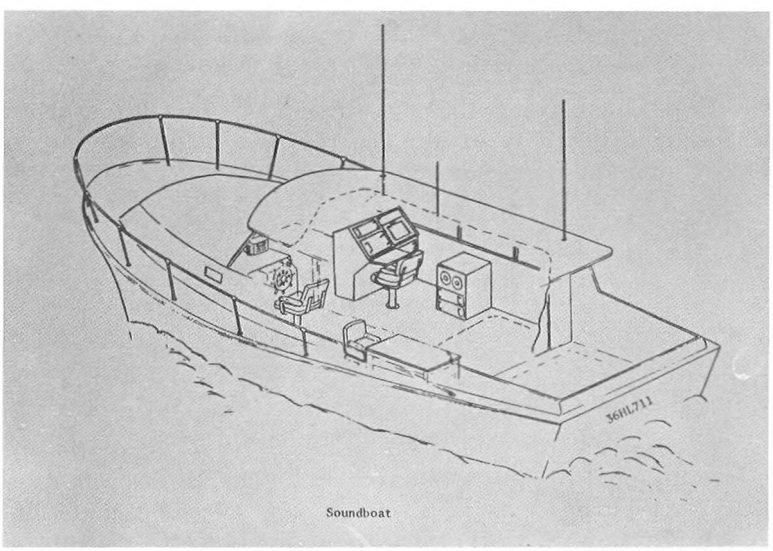

FIG. 6. — HYSURCH Survey Launch.

The *soundboats* (Figure 6) are 36-foot sport sedans modified for survey operations. The fiber glass hulled boats are diesel powered, and are capable of speeds of 30 knots in smooth waters. Acceptance trials have been completed and the boats are now being outfitted with their survey equipment which includes a dual frequency sounder, a position receiver, a small computer, data recording, and data link equipment. These boats are interim units, to prove the system. In the long run we may very well be using air cushion or other advanced type, high-speed platforms.

The *data buoy* is a 31-inch spherical buoy containing a battery power supply, a cassette tape recorder and a data transceiver. A pressure transducer, attached to the anchor, detects the tidal variations. These are recorded on tape with latest reading transmitted via data link on command from the collection/compilation center aboard ship.

The *electronic positioning net* is a master — two slave hyperbolic net: The transmitters are capable of buoy installations. Two taut wire, shallow moored buoys (Figure 7) are included to allow shallow water mooring of two stations. The buoys are moored submerged with only the antenna and its support structure piercing the surface.

The collection/compilation center, to be housed in a van for the test configuration, has been assembled. It contains the equipment that will be installed later in the mother ship. These equipments are:

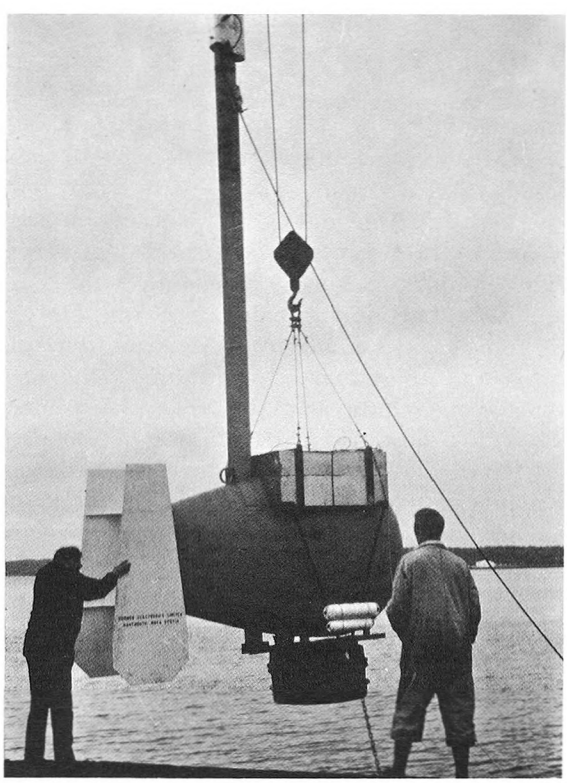

FIG. 7. — Positioning System Buoy.

A collection computer interfaced to a cathode ray tube (CRT) for real-time display of data.

A compilation computer interfaced to a drum plotter for graphic output.

A teletype, magnetic tape units, and a disk memory shared by the two computers.

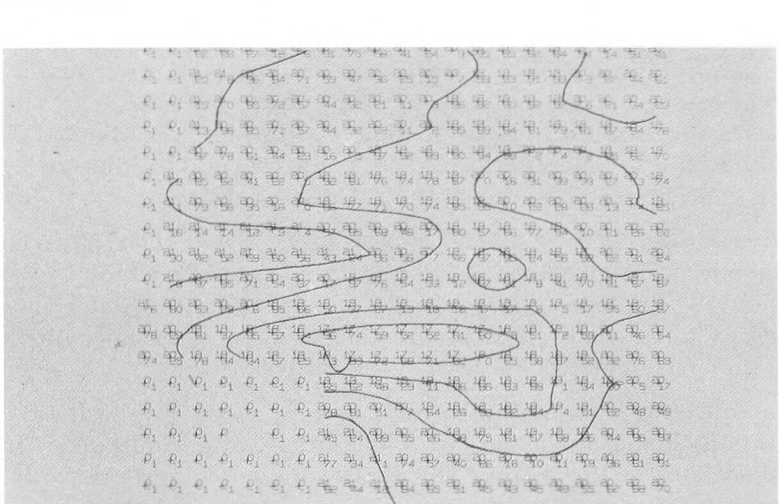

FIG. 8. — Computer Generated Smooth Plot.

All the hardware is now available and the system elements are being integrated to provide a full coastal survey and chart compilation capability. Depth, position, and tide data are recorded on magnetic tape and returned to the compilation center for processing. During the survey operations the data link provides real-time data sampling from the boats and tide buoy under control of the collection computer. Survey progress will be monitored and changes made to the survey, if required, during the operation. Corrected and smoothed information is then used to computer-generate an equally spaced data grid (matrix) which forms the basis for the smooth sheets. This data grid with contour overprint is output by the plotter (Figure 8). The computer will compare track lines against the grid base to identify points not recoverable within specified depth tolerances. Cross check lines are similarly compared to evaluate the validity of the survey and compilation processes.

The hydrographic data depicted as selected spot depths plus contour lines redrawn at the desired chart scale and combined with land detail can, if necessary, be output aboard ship as interim field charts of the area. The standard final products will continue to be made at the Washington Headquarters.

This all sounds very nice, but how does it check out ? Early tests have acquired data for developing and testing the computer program and the boat performance. Survey lines were run at ten lane intervals to

simulate a reconnaissance survey operation and at one lane intervals to simulate the fine survey. Cross check lines were run. Soundings and positions were recorded at a rate of five points per second. Magnetic tape records of the operation were excellent with 99 % of the data accurately recorded in depths varying from 10 metres to 127 metres. The boats were able to satisfactorily operate and record data at speeds of 20 knots in state 2 seas and 16 knots in state 3 seas. I consider these results encouraging.

In summary, HYSURCH is nearing a full system testing stage. Our R&D (*) efforts should show us the way to improve the speed and quality of coastal surveys and at the same time reduce manpower and associated high costs of present collection efforts. I know we are not alone in our concern to accomplish these objectives. We are watching with interest other efforts in our own and in other countries. Hopefully, we all can achieve a giant step forward in the near future. Environmental requirements have added new urgency to long-existing navigational requirements for accurate knowledge of the bathymetry of our relatively shallow harbor, coastal and continental shelf areas. Those of us here today represent the expert nucleus of the team required to do the job. We must get on with it — together!

(*) Research and Development.