

SURVEY INFORMATION PROCESSING SYSTEMS IN THE ROYAL NAVY

by the United Kingdom Hydrographic Department (*)

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BACKGROUND

The first Automatic Data Logging System to be used at sea by the Royal Navy was installed in HMS HECATE in 1967. Systems were installed into the three other ships of the Class, and a training system was supplied to the Royal Naval Hydrographic School. Upgraded by various software and hardware modifications over the years, the system remains in service, still meeting Hydrographer's data logging requirements for ocean surveys. However until HMS ROEBUCK was accepted into service in 1986, the use of automation to assist in the progress of coastal surveys was restricted to computation of position, track guidance, and the plotting of the ship's track.

INTRODUCTION

The Royal Navy's first automated data logging and processing system for bathymetric surveys was installed in HMS ROEBUCK during her construction. Designated the Survey Information Processing System (SIPS), it was developed to suit Hydrographer's particular needs in association with Qubit UK Ltd., as Ministry of Defence contractor. This system is hereafter referred to as SIPS 1. The requirement for similar systems to be fitted to the other coastal survey vessels during their major refits was recognized. The normal procurement procedures of competitive tender were followed, and eventually the contract for SIPS Mark II (SIPS 2) was awarded to Qubit in July 1988. Meanwhile another

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less powerful system, the Small Ships Surveying System (S4), had been developed for Hydrographer by Qubit after competitive tender. In early 1988 this was fitted into two chartered vessels, manned by Naval Parties surveying in coastal waters, and into the 15-metre launch, HMSML GLEANER.

AIM

The aim of this paper is to outline the performance of the original SIPS 1 system, the development of the SIPS 2 and S4 systems, and the future enhancements planned for all three.

PHILOSOPHY

Throughout the procurement of SIPS 1 and related systems, the main objectives in using such computer-based surveying systems were:

- a. The achievement of an overall increase in survey accuracy and thoroughness;
- b. The provision of improved quality control over survey data at all stages;
- c. The speeding-up of the data processing task, thereby reducing the time taken to render surveys to the Hydrographic Department.

In general, it was considered that data logging and processing systems should:

- a. Collect and record all raw data;
- b. Allow the surveyor to maintain full control over all stages of automatic processing;
- c. Improve the quality of survey records.

Also it was considered that wherever possible, without significantly constraining their capabilities, new equipments should have the highest level of compatibility with existing systems.

SIPS 1

Descriptions of SIPS 1 may be found in various papers, including those of the Second International Hydrographic Technical Conference 1984 (Ref. 1), Autocarto '86 (Ref. 2), and in the International Hydrographic Review, January 1988 (Ref. 3). Figure 1 illustrates its component parts. First of class trials for HMS ROEBUCK and her various systems continued until mid-1987 in various areas from Gibraltar to the west coast of Scotland. These included a survey in the Outer Hebrides without contractor assistance, where a new surveyor, unfamiliar with SIPS 1, was used as a 'guinea pig', operating the system with

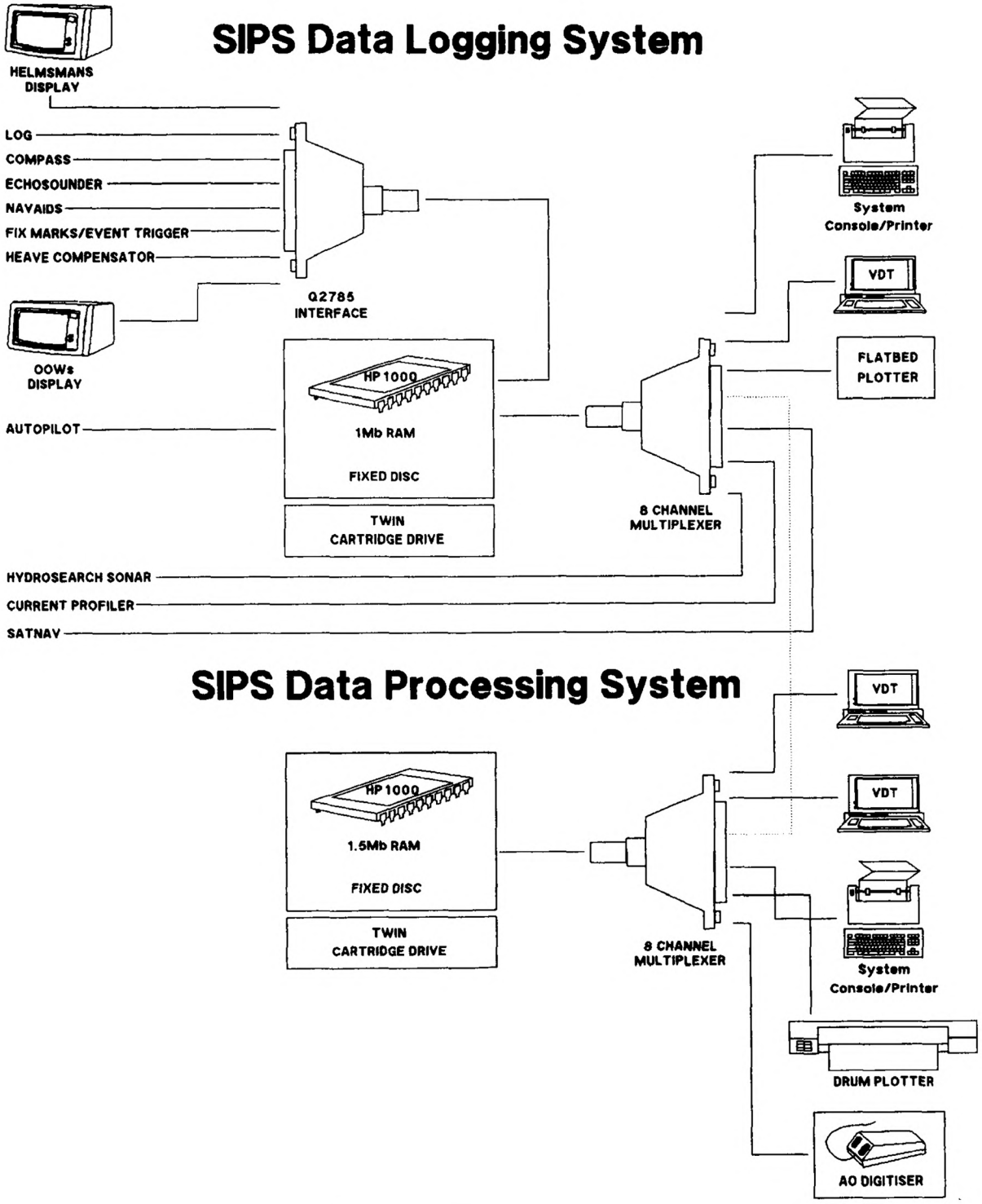


FIG. 1.— SIPS 1.

guidance only from the handbooks. Although shortcomings in the documentation were identified, it was found that the Data Logging System (DLS) generally performed well. The operation of the Data Processing System, (DPS), however, was found to be slow, but, nevertheless, the reduction of a day's data could be achieved within 24 hours. A certificate of clearance for use for SIPS 1, initially with software version 1.2, was issued in September 1987. Since then surveys in the Dover Straits, the Sea of the Hebrides and Gibraltar, and various wreck investigations have been undertaken using software versions 1.2 and 1.3. In July 1989 software version 1.5 was issued and has been used for surveying the Approaches to Barrow, and to calibrate various Hyperfix chains.

Performance

Time elapsed meters were fitted to SIPS 1 and used together with Availability, Reliability and Maintainability (ARM) log books to assess the performance of the system since its clearance for use. Hardware defects have been few, and have not presented any major losses of surveying time, partly due to a comprehensive outfit of onboard spares. The fibre optic link, which provides a reversionary mode of operation by swapping equivalent DLS/DPS hardware items, has not been needed, only being used in trials. System freezes were at first quite frequent, but greater operator familiarity leading to fewer keying errors, and modifications to software incorporated in version 1.3 resulted in far fewer entries in the ARM log in 1989. The lengthening mean time between failures indicated a satisfactory growth in system reliability. One major problem was the inability to read tape cartridges on the DPS and process data simultaneously, resulting in a daily loss of about 6 hours processing time while the logged data was read into the DPS. The cause was eventually traced to the mode of operation of the VDUs and corrected, providing an appreciable amount of extra time each day for processing.

The full acceptance of SIPS 1 into naval service is expected shortly, and a new issue of software, clearing the remaining minor defects, is expected to be ready for issue in March 1990 as version 2.0. This should also incorporate some major extra facilities, as detailed later.

SIPS 2 AND S4

Procurement

During 1987 a Cardinal Point Specification was prepared for SIPS 2. This detailed the requirement for the systems for each 'Bulldog' class coastal survey vessel (SIPS-H), a training system (SIPS-T) and a processing and development system for Hydrographer (SIPS-HD). This went out to competitive tender. The tender responses were assessed and Qubit selected as the contractor.

Meanwhile that autumn, a technical requirement for S4 was prepared by Hydrographer, and also put out to competitive tender. The requirement was for

three systems, one for each of two Naval Parties, and the third for HMSML GLEANER, together with a training system. The responses were received and assessed in early 1988. The contract was awarded to Qubit, based on their TRAC IVS/CHART IVS systems, for delivery in April. No training system was included, due to expected compatibility with SIPS 2.

SIPS-H

The development of SIPS 2 has proceeded in parallel with the Royal Australian Navy's HYDLAPS project, and is based on the same hardware, and much of the same software. The SIPS-H DLS, based on a TRAC V work station, is linked by fibre optic cable to the DPS to permit on-line transfer of data for processing. It is presented diagrammatically in Figure 2.

The main features of the DLS in SIPS-H are:

- a. The logging of raw navigational data, and computation of position from up to 20 lines of position, using weighted least squares and allowing for antenna motion;
- b. The availability of a (C-O) model to apply varying corrections to each line of position automatically;
- c. A navaid calibration routine which caters for Trisponder and includes baseline crossing;
- d. The logging of depth data, corrected for heave, together with the heave value provided in real time by a TSS 320 compensator;
- e. The automatic creation of individual line files, ready for transfer to the DPS;
- f. The transfer of raw logged data and line files by fibre optic link to the DPS, where it is archived to tape cartridge;
- g. The automatic cessation of logging, file closing and saving to disc in the event of a power failure of more than three minutes to the uninterrupted power supply, thereby safeguarding the data and leaving the surveyor free to deal with any emergency;
- h. The provision of track guidance information to the autopilot and helmsman, and quality control or positional data to the Officer of the Watch;
- i. The plotting of track information on a A0 plotter.

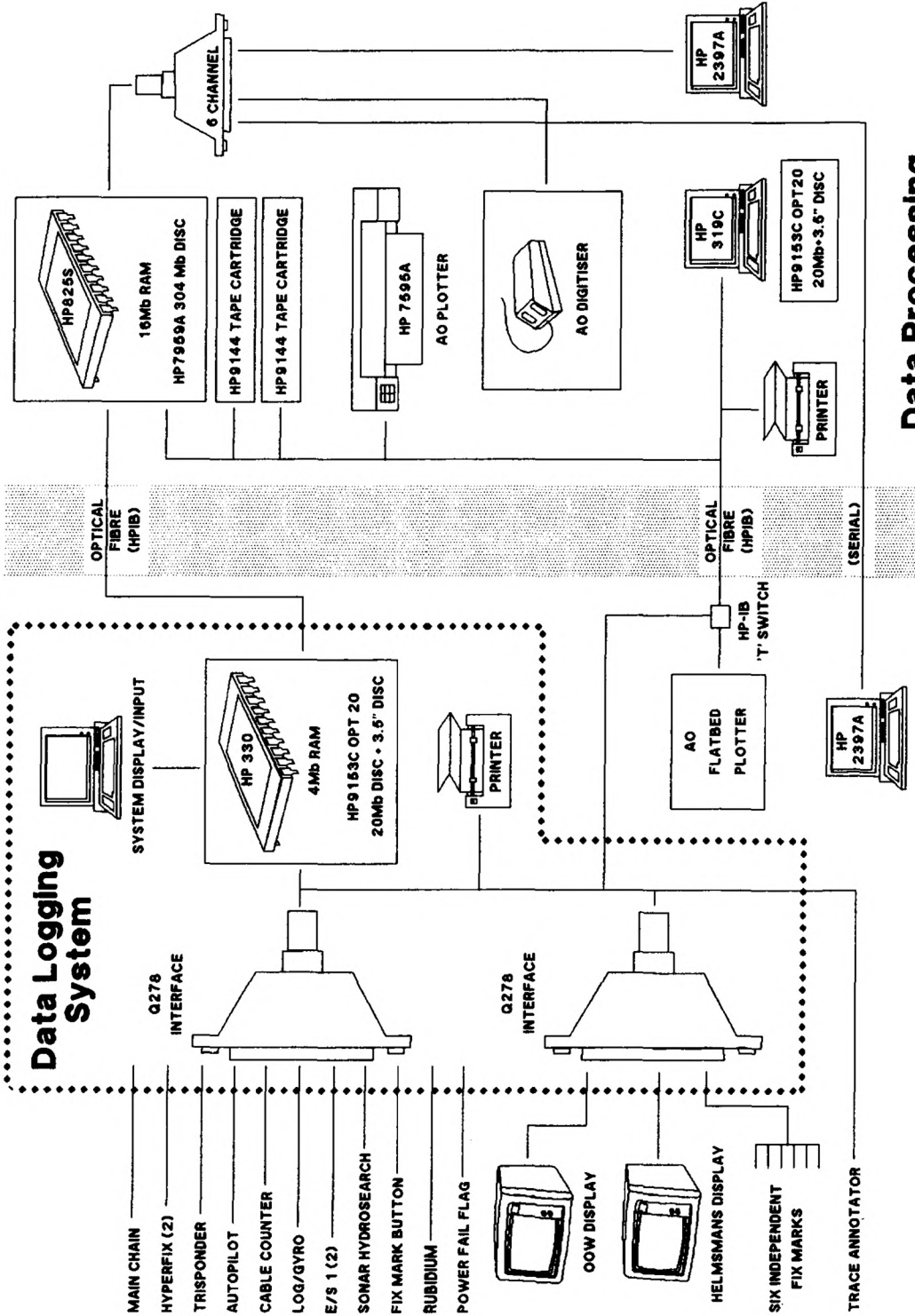
The DPS is centred on a powerful mini-computer, which is connected to three work stations. Using RISC technology and the HP-UX version of UNIX as its operating system, it is fully capable of multi-user, multi-tasking operation without significant time penalties. With the ready access to data from the DLS, there will be a significant saving of time in the processing of each day's work, and also in the production of fair records, both digital and the traditional graphical. The main features of the DPS are:

- a. The ability to process data efficiently while tasked by all three work stations.

CHARTROOM

SIPS 2

BRIDGE



Data Processing System

FIG. 2.— SIPS 2.

- b. Immediate access to individual line files, with no wait for data cartridge tapes to be read;
- c. The ability to recompute navigational data using different parameters.
- d. Semi-automatic depth processing and sounding selection, with interactive editing;
- e. The use of co-tidal models for automatic adjustment of the height of tide from tide gauge to position of sounding;
- f. Database generation, including the digitisation of analogue records and plots;
- g. Plotting of survey information as working or fair sheets, with colour banding, crossline comparison, digital elevation model, weeding of overlapping soundings, survey comparison and 3-D views available.

SIPS-T

The training system at the Royal Naval Hydrographic School was installed in September 1989. It is almost a complete SIPS-H system, scaled down by the exclusion of the second plotter, the second printer, and one DPS workstation. The instructor may use an external simulator to provide the input data through the various interfaces to the DLS side of SIPS-T, and it is planned to use smaller surveys from SIPS-based systems for DPS training. Training in the use of SIPS-based systems will be included in career courses from January 1990.

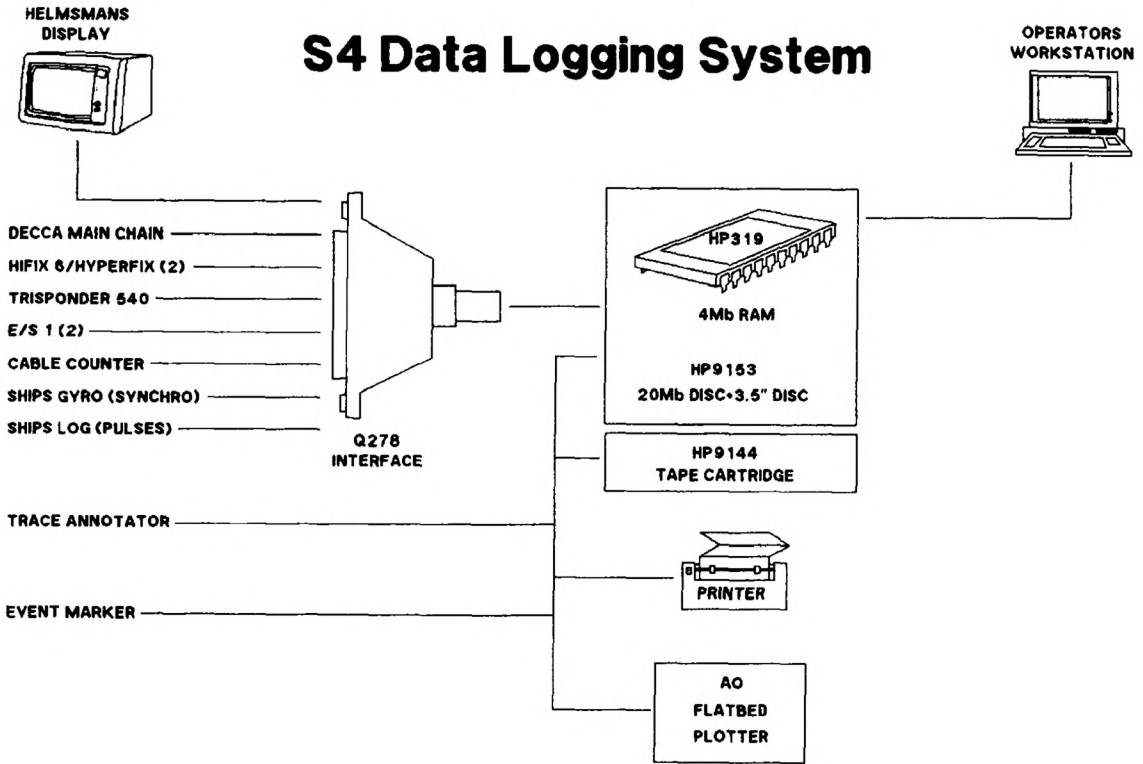
SIPS-HD

SIPS-HD comprises the DPS side of a system, together with extra software installed for translation of SIPS 1 and S4 data into SIPS 2 format, thereby allowing it to handle all SIPS related systems' data. It was installed at the Hydrographic Department in early December 1989. The main uses for the system are envisaged as:

- a. The checking, cataloguing and archiving of data;
- b. The recomputation of survey positioning data in the event of the discovery of major problems in the rendered products;
- c. The production of reduced-scale plots for chart compilation;
- d. The development in-house of further processing and databasing facilities.

S4

S4 comprises a separate DLS and DPS, using data cartridge tapes for transfer of logged data to the DPS as in the original SIPS 1. The DLS and DPS are both based on Qubit TRAC V hardware, with the addition of cartridge tape drives. With the exception of a digitising table, its configuration is very similar to SIPS 1 as can be seen in its diagrammatic representation in Figure 3. The system is reasonably transportable and compact, an important consideration for the Naval Parties as they need their systems ashore for processing each winter.



S4 Data Processing System

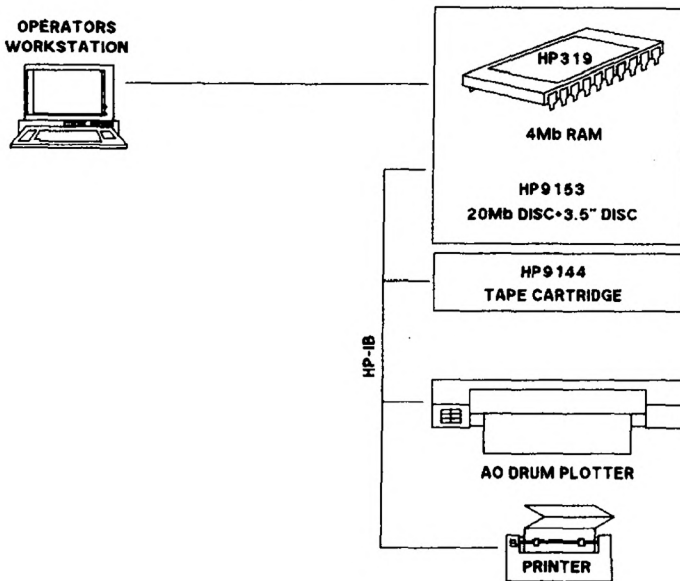


FIG. 3.— S4.

This is also important for GLEANER as she has limited space onboard, and has to set up her DLS ashore in the vicinity of her survey area.

Performance

No information is yet available on SIPS 2, as the first SIPS-H (in HMS BULLDOG) is not programmed for sea trials until March 1990. Factory acceptance trials have demonstrated all the functions under simulated conditions, and provided some indication of the inherent speed of the DPS. As with SIPS 1 in HMS ROEBUCK, time elapsed meters and ARM logbooks will be used on SIPS-H for about two years to study the overall reliability of the hardware and software.

In S4, the initial software contained many faults, due partly to the limited time available between the award of contract and the start of the surveying season of the Naval Parties. However with much perseverance on both the side of the Naval personnel and Qubit, together with close monitoring of defects by the Hydrographic Department's Information Systems Branch, the major problems were soon rectified, and S4 has developed into a reliable system which has been used by Naval Parties 1008 and 1016 for all their surveys since April 1988, and by GLEANER since August 1988. Whilst the processing speed of S4 has been adequate for timely progressing of surveying data, NP 1008, which operates 24 hours a day, thirteen days out of fourteen for six to seven months each year, found that there was insufficient time available to produce the fair records of previous surveys as well as processing current survey data. To rectify this problem, a second DPS, including a second drum plotter, was supplied for the 1989 season.

Maintenance

SIPS 1 is supported by a maintenance contract with Qubit which has been revised to include the subsequent systems. Apart from limited spares held on board HMS ROEBUCK, its reversionary mode of operation provides a short-term fallback position until an engineer is available. SIPS 2 is also supported by Naval Stores, with all items of equipment NATO codified. On board spares for SIPS-H are held at a 20% stock-out risk level, with some items already rack-mounted. Depot spares allow for a 5% stock-out risk, with a complete set held by Qubit for use as a reference system, for software development and emergency support. Limited reference systems have also been provided for SIPS 1 and S4 support.

FUTURE ENHANCEMENTS

SIPS 1

As mentioned earlier, some extra facilities should be incorporated in software version 2.0, due to be ready for issue in March 1990. A dedicated

hyperbolic navaid calibration program is being developed to Hydrographer's specification. Also under investigation is the use of the fibre optic link as a permanent data highway from DLS to DPS, permitting the direct transfer of data files from the one system to the other, without the use of cartridge tapes. This should speed the transfer of data to the DPS, working in a somewhat similar manner to SIPS 2.

SIPS 2 AND S4

Once the hyperbolic navaid calibration routine has been proven on SIPS 1, it will be incorporated in SIPS 2 and S4 software. Similarly some extra facilities in SIPS 2 will in due course be incorporated into the software for SIPS 1 and S4.

The software in S4 is presently being upgraded to operate much as in SIPS 2. Individual line files, ready for the editing of track, if required, and the selection of soundings, will be formed on the DLS while logging data, thereby saving valuable processing time on the DPS. The data files will also be compatible with SIPS 2. The first upgrade was supplied to NP 1016 in mid October so that some experience in its operation was gained before the new season, and shortcomings could be identified and modified.

OTHER SYSTEMS

In 1989 three TRAC V systems were purchased for use in the 9-metre survey motor boats carried by the coastal survey vessels. The systems are similar to those being supplied to the Royal Australian Navy for use in their boats as part of the HYDLAPS project. Each has an A3 plotter to display the track, a liquid crystal helmsman's display to provide track guidance, and a touch sensitive plasma display which replaces the monitor and keyboard for overall control of the system. It is contained in a rugged transit case to permit easy shipment, and is presently provided with interfaces for Trisponder and echo sounder digitisation. The data is logged onto a fixed disc and can be transferred to 3.5-inch floppy discs for subsequent processing in SIPS-H.

A CHART V system was also purchased in 1989 for use by the Survey Analysis section at the Hydrographic Department. As well as the standard DPS software, this outfit also includes a volumetric package which permits the monitoring of dredging projects and the study of sediment transportation in sandwave areas. It takes its data either from a BBC microcomputer running a software package used by some Port Authorities or from standard SIPS and S4 cartridge tapes.

CONCLUSIONS

SIPS 1 and S4 have been successfully used for two years, producing accurate records within weeks of completion of surveys, thereby meeting Hydrographer's main requirements of the systems.

All the systems have been obtained from the same supplier, thereby providing benefits in compatibility and software development. The use of an experienced contractor has proved to be advantageous.

Having successfully automated surveying procedures, attention is now shifting to the use of the data in the Hydrographic Department.

References

- [1] HERON-WATSON, C.F.. UK Hydrographic Department's Automated Hydrographic Survey Systems.
- [2] DIXEY, D.J., C.S. GOBEY and D.L. WARDLE. A Survey Information Processing System for Hydrographer.
- [3] HMS ROEBUCK — The Ship and Her Systems — UK Hydrographic Department.