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CSS 'FCG SMITH' HYDROGRAPHIC ACOUSTIC SWEEP VESSEL

by Adam J. KERR, Alan L. ADAMS and Robert G. BURKE (*)

THE SHIP

Principal Particulars

Length overall	34.8 m
Length waterline	32.8 m
Breadth overall	14.0 m
Breadth — single hull	4.0 m
Depth — moulded	3.4 m
Draft (design)	1.9 m
Displacement	328 tonnes
Trial speed	12 knots
Shaft horsepower @ 1800 rpm	2 × 400 HP
Crew	10
Classification	Lloyds + 100 A1 East coast of Canada Home Trade II.

Machinery

Main propulsion	2 Badouin 6P 15 SRC M propulsion systems with CP propellers and fixed nozzles.
Auxiliary power	2 Caterpillar 3306T auxiliary engines with MSC 334C Stamford generator to produce 270 kW of electric power.

(*) Canadian Hydrographic Service, Bedford Institute of Oceanography, P.O. Box 1006, Dartmouth, Nova Scotia, B2Y 4A2, Canada.

Electronic Equipment

Radars	2 Decca Gyro stabilized RM1290A X band radars.
Echo sounders	2 ELAC LAZ 72 50 kHz depth sounders.
Navigation	2 Racal 1028 Loran-C receivers. 2 Robertson SKR 82 gyro compasses.
Communications	2 Spillsbury FMX95 FM marine radios. 2 Daniels DE1400 SSB radios. 1 Collins 251 aircraft radio. Vilks integrated telephone and internal communications unit.
Miscellaneous	Taiyo TF733 weather facsimile receiver. Ginge-Kerr Fire Scope fire detection and control system.

The *FCG Smith* (Fig. 1) is named after Frank Clifford Goulding SMITH, who served as Dominion Hydrographer of the Canadian Hydrographic Service from

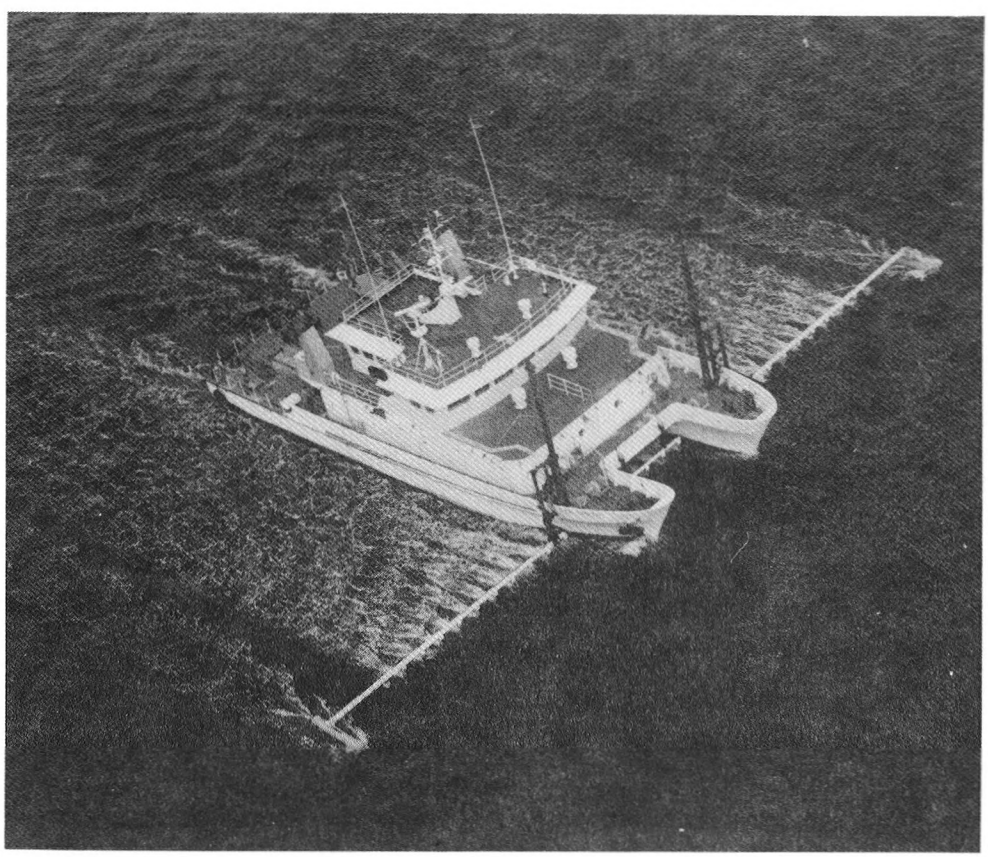

FIG. 1.— The *FCG Smith*.

1952 to 1957. The vessel is designed for the acoustic sweeping of harbours and fairways on the Atlantic coast of Canada.

The designers for the vessel were Evans, Yeatman and Endal (Associates) Limited of Dartmouth, Nova Scotia. After due consideration of the statement of requirements, they proposed a catamaran design in order to provide the high degree of stability required for the acoustic sweep gear. They were also asked to keep the draft minimal (less than 2 metres) and to provide good manœuvrability in order to work in the confined areas of harbours and fairways.

Navitronic Limited of Denmark was selected to provide the acoustic sweep system and electronics. The mechanical boom system for deploying the transducers was designed and fabricated by Canadian Dredge and Dock Co. Ltd., Toronto. The vessel is also designed to carry a paravane sweeping system.

FCG Smith was constructed by Georgetown Shipyard, Prince Edward Island, and commissioned on April 25, 1986. Since that time the vessel has gone into active service and is engaged in surveying channels into ports on the southwestern side of the Gulf of St. Lawrence. Apart from initial software and hydraulic problems the program is going ahead successfully.

Prior to letting the design contract, the Canadian Hydrographic Service had studied equipments available for acoustic sweeping. Several systems, both in Europe and North America, were observed in action. An independent study recommended the Navitronic equipment. Initially a portable system had been designed for the mechanical portion in order that it could be transported to, and deployed in the Arctic. In developing a system for the ship, a key issue was whether to deploy the transducers from submerged hydrofoil booms or from booms above the water surface with the transducers projecting downwards on spring-loaded 'break-away' struts. The former system is used extensively in Finland and the Federal Republic of Germany. It was decided that, in view of the difficulty and cost of making repairs to submerged booms, the booms should be above water. They would be hinged at the ship end and supported by floats near their outboard extremities. The entire apparatus would be suspended from Samson posts on each side of the ship. A hydraulic control console for the booms is located on each wing of the wheelhouse. When housed, the booms and transducers are stowed along each side of the accommodations.

The catamaran design was selected to provide low roll angles and a large working area. The asymmetric hulls are connected by heavy bow girders. The machinery and fuel are carried in the hulls and all accommodation and laboratory space is above deck. The crew accommodation is small but of good quality. A computer room, occupying 18 square metres, is located on the main deck and the 33.1 square metre main plotting room is directly abaft the wheelhouse. There is a very large working deck on the after end with a 1,250 kg articulated crane on each side. Figure 2 shows the general arrangements of the vessel.

The wheelhouse is equipped with steering and engine control consoles on each wing and in the centre. To provide the high precision steering necessary the Danish EMRI system has been installed. This is interconnected with the positioning control for automatic steering along survey lines. The ship does not have total dynamic positioning.

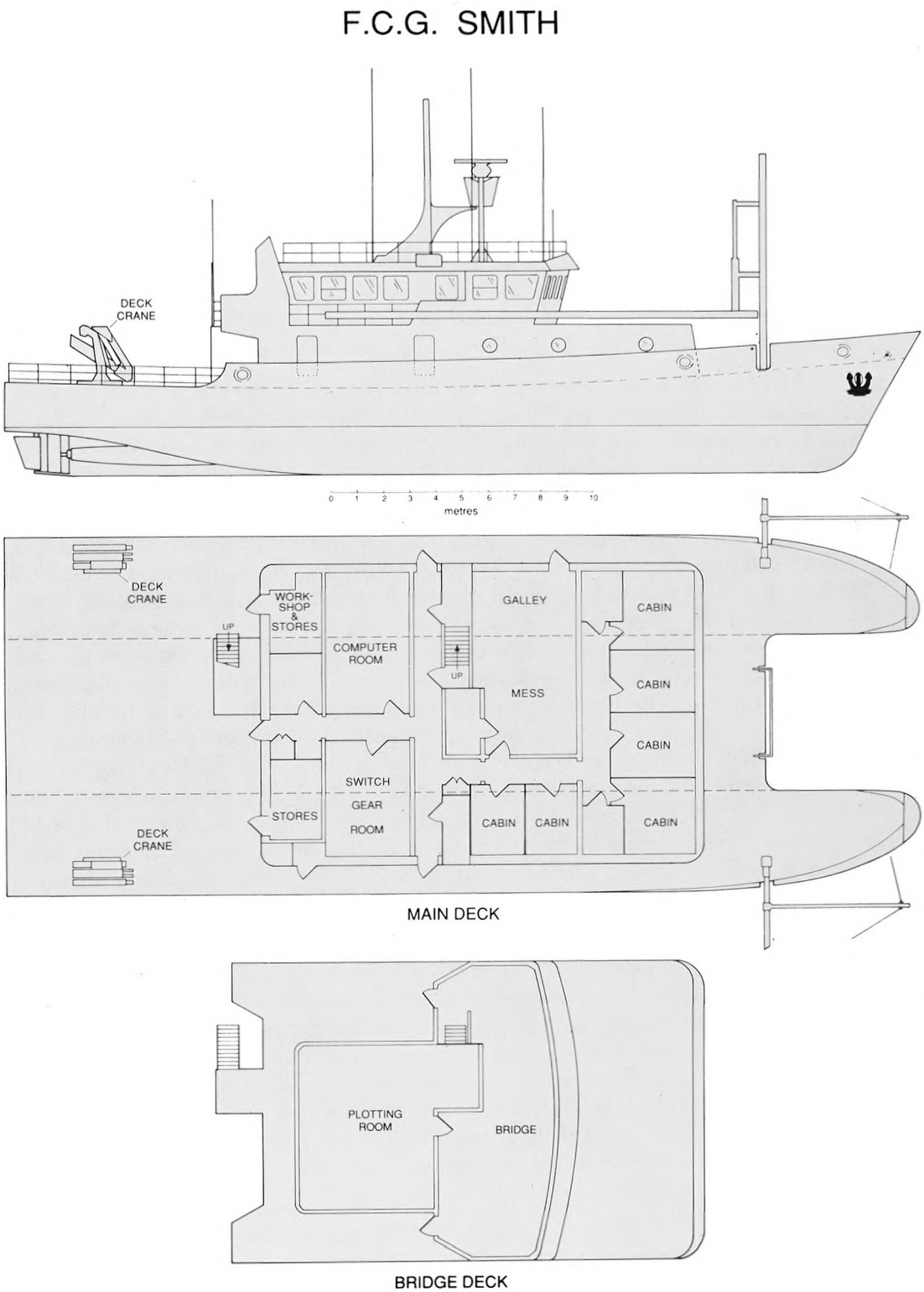

FIG. 2.— General arrangement diagram.

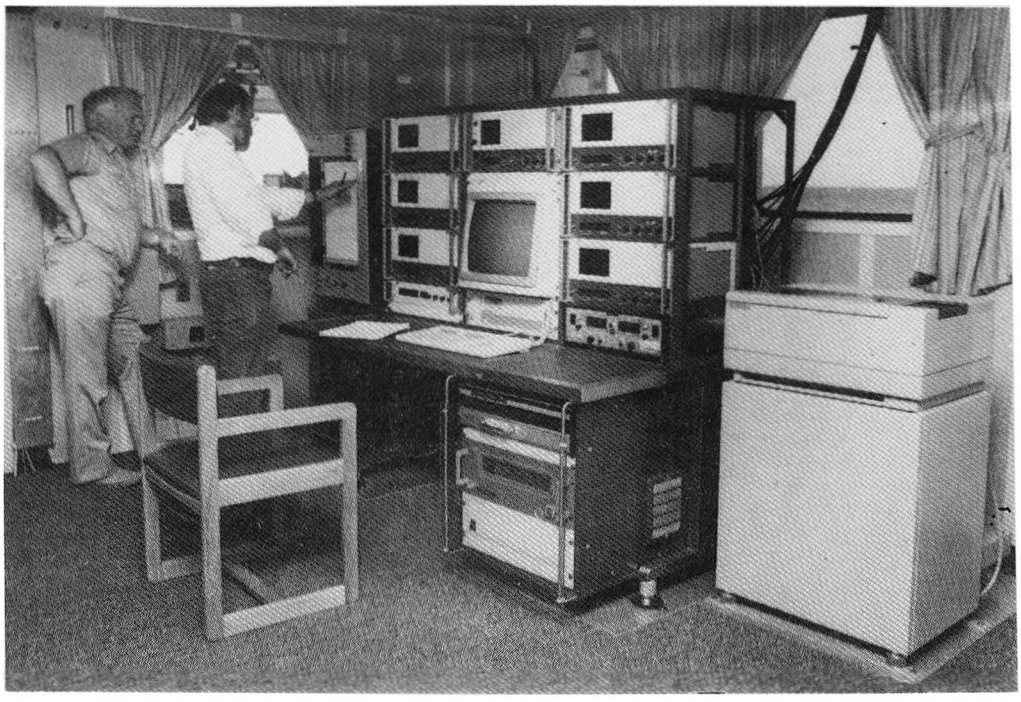

FIG. 3.— Navitronic sweep system console.

Hydrographic Survey Equipment Sweep System

A Navitronic Seadig 201 acoustic sweep system is installed on the vessel (Fig. 3). A block diagram of the configuration is shown in Figure 4. The vessel is currently utilizing 29 transducers giving a swath coverage of approximately 38 metres. With the installation of another six transducers for the 1987 field season, the coverage will be increased to 46 metres. When operated in its fastest mode, the vessel is capable of making 42,000 depth measurements per minute. On a typical day up to 500,000 depth measurements are recorded on magnetic tape for subsequent off-line processing.

Two systems are being used for positioning, Motorola Mini-Ranger III and Krupp Atlas Polarfix. They may be used individually or together; however, in the latter instance all data are recorded but an integrated position is not computed in real time. Real time along-track profiles (Fig. 5) of the raw depth data are generated on a Raytheon 1807 Line Scan Recorder. This record serves as a monitor on the quality of the depth data and is utilized in the subsequent post-processing procedures.

The Navitronic system is directly interfaced to the EMRI steering system. Experience to date indicates that the system is capable of consistently maintaining the ship within a few metres of a predetermined survey line so long as the ambient conditions are consistent, i.e. no heavy gusts of wind, rapid fluctuations in currents or 'spikes' in the positioning data.

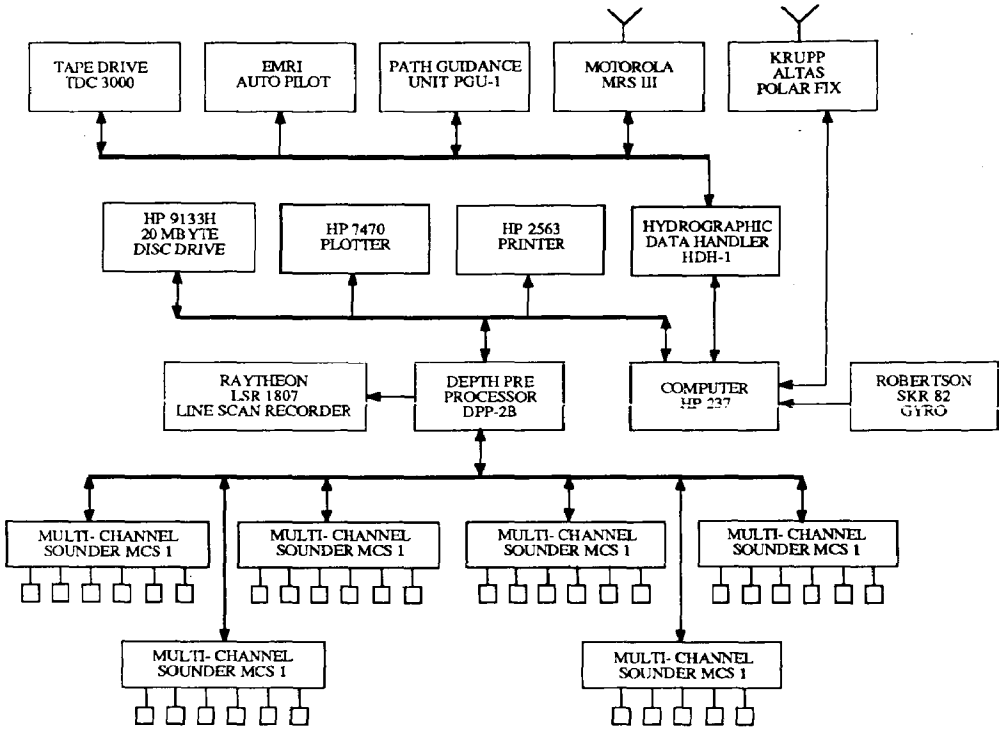

FIG. 4.— Block diagram of the Navitronic acoustic sweep system.

All survey data are logged on a Tandberg TDC 3000 cartridge tape recorder for subsequent off-line data processing on a Micro Vax II computer system (Fig. 6). The processing package for this application was designed and written by hydrographic staff at the Bedford Institute of Oceanography.

A suite of programs is available to merge, sort, carry out overplot removal and flag selected depths for plotting. The large volume of data that can be collected in any day makes data processing a formidable task. Typically, only 0.5% to 0.8% of all logged soundings are selected and plotted on the final field sheet. While the Micro Vax II is capable of keeping up with the task, two major bottlenecks have been experienced. One is in the area of generating bottom coverage plots from the depth data. This problem is due to the limitation in plotting speed of the HP 7586 plotter and can be minimized by the acquisition of a laser or electrostatic plotter. The second bottleneck lies in the area of data verification and editing. This problem has its origins in the enormous volume of data that is collected by the system and its resolution is not straightforward.

Towed Paravane System

Installation of the Navitronic sweep system was given top priority for the 1986 survey season. Components for a towed paravane array similar to the system formerly employed by the Danish Hydrographic Service have been

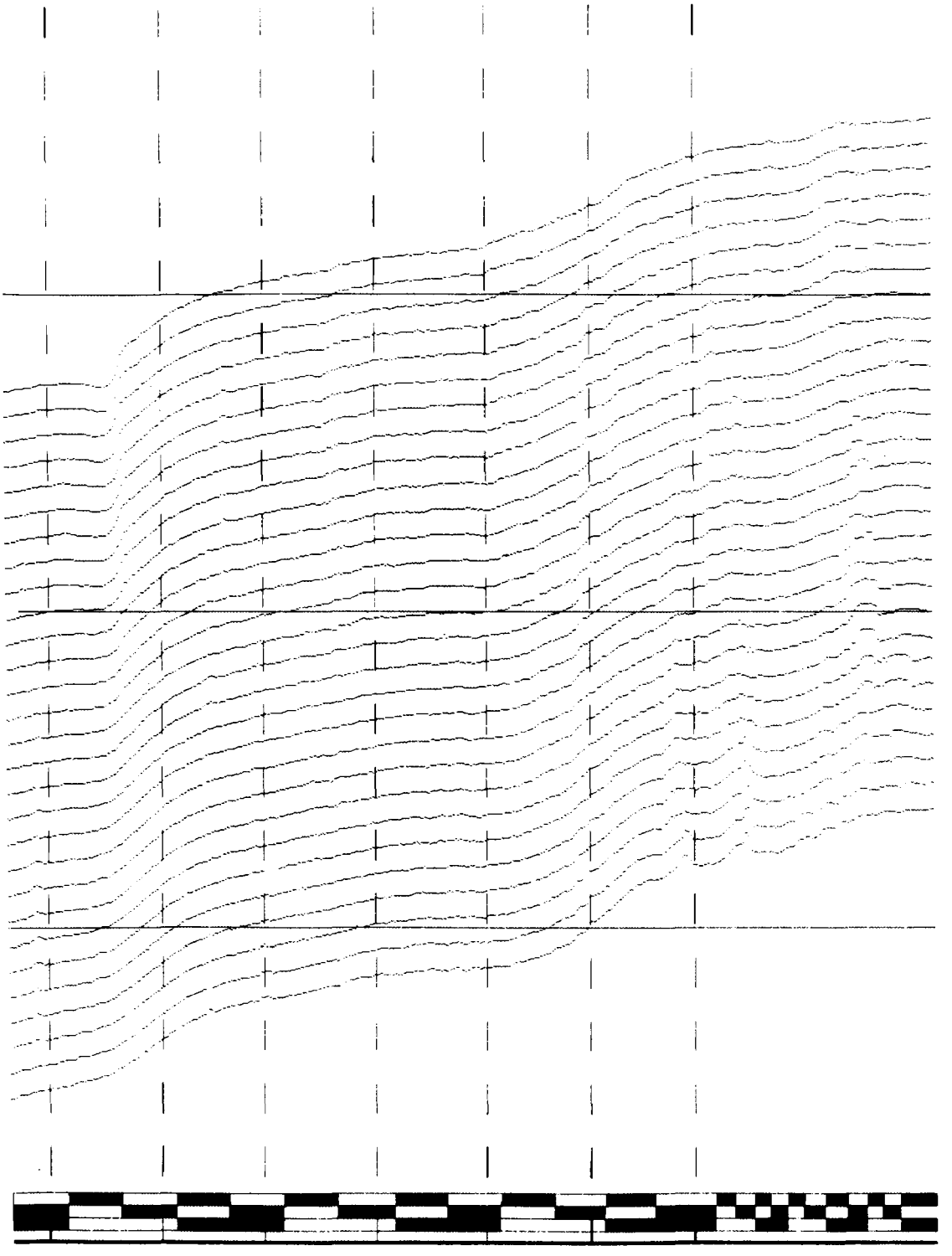

FIG. 5.— Along track depth profiles.

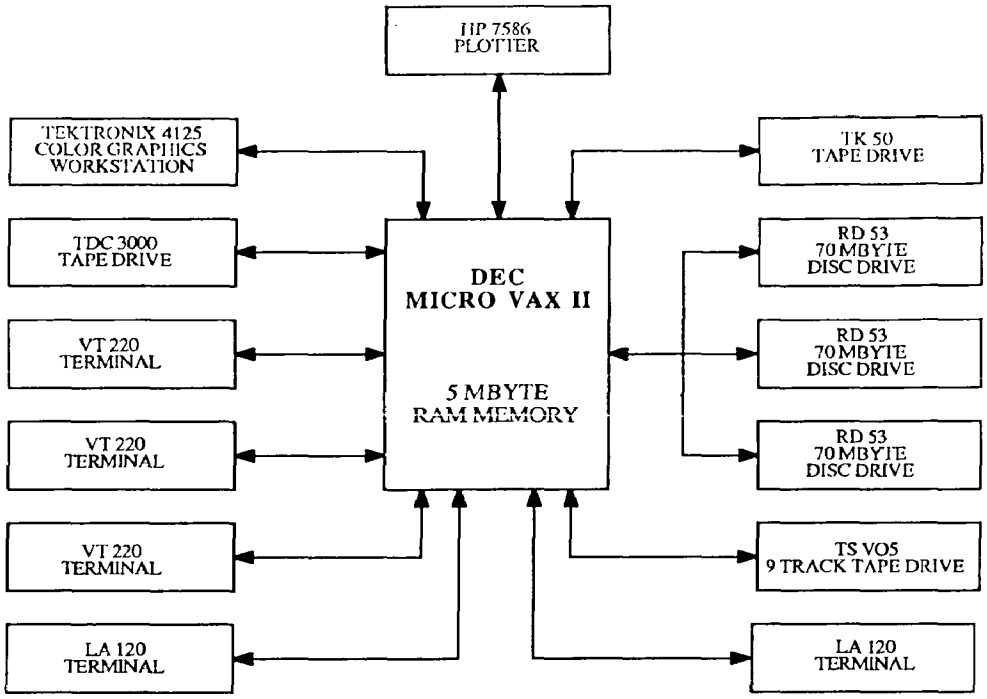

FIG. 6.— Block diagram of the data processing system.

acquired and will be installed for the 1987 session.

With a depth range capability of 1,500 metres, this system will complement the Navitronic Seadig 201 sweep package and be primarily used on coastal projects where the depth range of the Navitronic system is exceeded.

The towed paravane array system will consist of three transducers, one installed on the ship and two on towed floats giving a 200-metre swath. While 100% bottom coverage will not be generated, the amount of line running for a given project will be significantly reduced. ELAC LAZ 721 sounders and STG 721 depth digitizers have been acquired for this application. The equipment will be interfaced to the Navitronic system for data logging and navigation.

Summary

The *FCG Smith*, in the first year of operation, has proven to be a highly manœuvrable vessel well suited to the task of providing 100% bottom coverage surveys in critical areas such as dredged channels, harbour entrances and docksites. With the implementation of a towed paravane system for the 1987 field season, the vessel will commence coastal survey projects. The vessel has been well accepted by the hydrographic staff and provides them with a new and effective 'tool' for charting Canada's navigable waters.