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" K.D. MUTIARA " THE NEW SURVEY SHIP OF THE ROYAL MALAYSIAN NAVY

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in cooperation with Maierform GmbH (designers of the ship)
and Prakla-Seismos GmbH (sub-contractors for the supply,
installation and integration of survey and navigational equipments).

INTRODUCTION

The first Royal Malaysian Naval Survey Ship, K. D. *Perantau*, a converted British minesweeper, was commissioned for service in 1969. After operating in Malaysian waters for three years it was found that K. D. *Perantau* alone could not meet the survey requirements of the country. An additional survey ship was therefore required.

In May 1973, the requirement for a new survey ship was initiated, and after very thorough research and study specifications were completed in their final form towards the end of that year. An international tender for the construction of the ship was called for in early 1974, and after more than 8 months of careful evaluation of the tenders and contract negotiations, the contract was finally awarded in January 1975 to a local shipyard, the Hong Leong-Lürssen Shipyard Berhad, Butterworth, Malaysia.

Construction started towards the end of 1975, and the vessel was launched in November 1976. Fitting out was completed by September 1977 and after extensive sea trials, especially of the survey equipment, the ship was finally accepted and commissioned for service in the Royal Malaysian Navy in December 1977 as K. D. *Mutiara*.

The specifications

The final form of the specifications as they went out to tender was of paramount importance as the ultimate design of the ship depended on this, and the operator's requirements were considered to be safeguarded by making these part of the contract. The intended role of the ship and

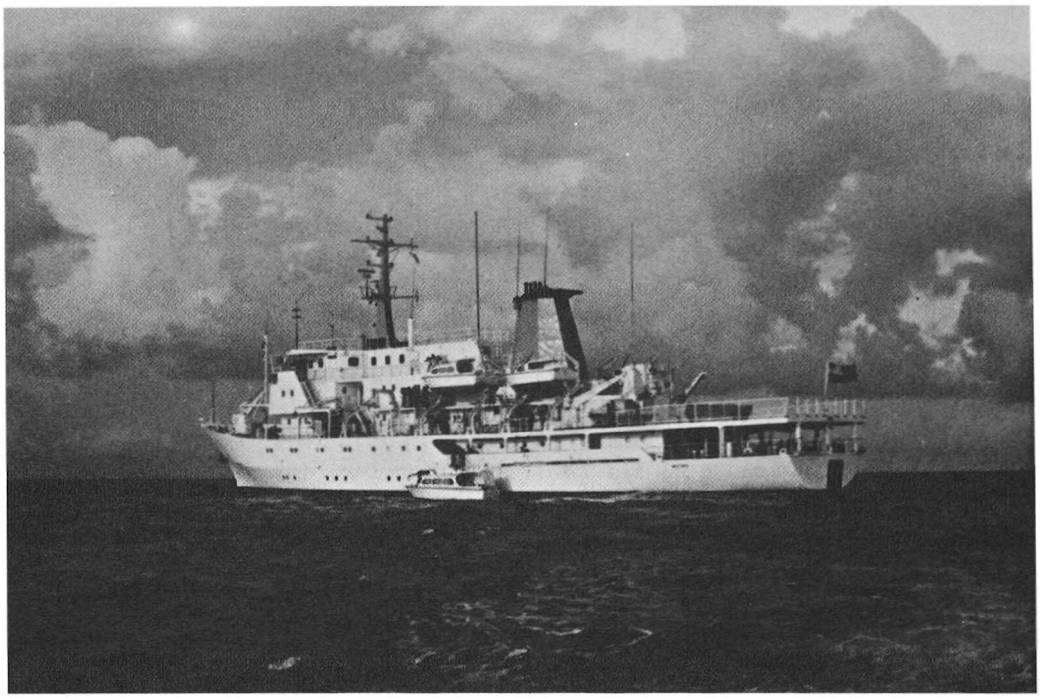

FIG. 1. — The survey vessel K.D. *Mutiara*.

its major features were clearly spelt out, but flexibility was left for the designer to design the ship to the best standards of naval architecture.

The vessel was to be designed and equipped specially for operation in the tropics, to carry out offshore and inshore hydrographic surveys, harbour and river surveys, and limited oceanographic observations.

The construction phase

The local shipyard, Hong Leong-Lürssen Shipyard Berhad, was solely responsible for the timely and successful completion of the vessel in every respect, although the survey and navigation systems were sub-contracted to Prakla-Seismos GmbH and the communication systems to Debeg. To integrate these advanced equipments from different suppliers into optimum systems required insight into the subsystem design layouts, as well as technical knowledge and experience with the performance of the individual equipments. It was therefore an important management decision to assign specific subsystems of the whole project to only a few experienced sub-contractors. This action clearly defined lines of authority, and allowed the sub-contractor to train selected members of his staff in the equipments from other suppliers to a degree that he could supervise the installation without the need of the equipment manufacturer's representative. The fact that the survey team was also well trained before acceptance trials enhanced understanding and cooperation.

The vessel's owners have a big part to play during the construction phase of such a ship in order to ensure that the builders achieve the required standard and that operational standards are met. In particular, it is important that the overseeing be thorough and that mock line-up procedures be carried out before cables are laid and the equipment fitted. A good relationship with the shipyard and its sub-contractors must be firmly established, and finally all parties must continuously exercise a maximum of goodwill and compromise throughout the construction phase.

A comprehensive technical training programme for the ship's crew was included in the contract, and this comprised training of operators as well as of maintenance personnel, but with emphasis on the latter. For the specialized equipment, the personnel were trained overseas by the manufacturers. Further training was also carried out on board during equipment installation and trials.

Sea trials and documentation

The owners of the vessel were primarily interested in ensuring that all systems worked efficiently and to the specifications in an environment representative of Malaysian survey areas, while the shipyard and sub-contractors were primarily interested in the timely delivery of the vessel. To ensure that both these objectives were achieved smoothly a schedule of sea trials, and the specifications and methods of trials were carefully drawn up during the construction phase. The adopted procedures were closely followed during the acceptance trials, and the appropriate documents were completed and signed by responsible officers representing the owners and the shipyard.

General characteristics

Based on the specifications, the consultant naval architects, Messrs. Maierform GmbH, Bremen, West Germany, drew up full plans of the vessel for the shipyard. To meet naval requirements, and taking into consideration the construction capability of the chosen shipyard, the vessel was designed with the following main characteristics.

Length overall	71.00 m
Length between perpendiculars	64.00 m
Moulded breadth	13.00 m
Depth to main deck	6.00 m
Depth to tween deck	3.70 m
Maximum draught	4.00 m
Deadweight all told	725 tons
Fuel tank capacity	325 m^3
Fresh water tank capacity	106 m^3
Ballast water tank capacity	166 m^3
Complement	143 officers and men.

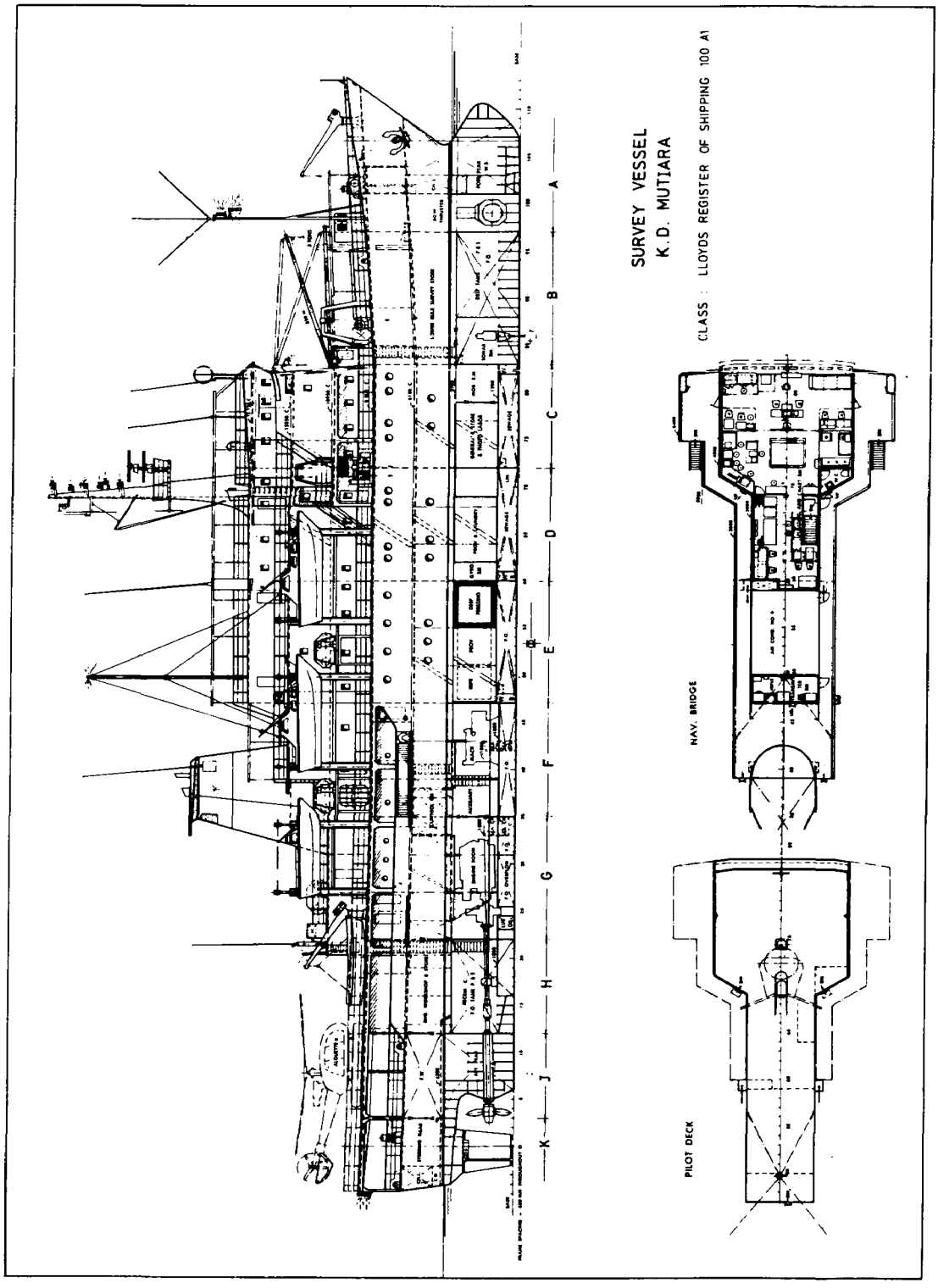

FIG. 2. — K.D. *Mutiara* – General arrangement plan.

Propulsion is by two main engines (Deutz type SBA 12 M 528, 2,000 bhp each at 1,000 rpm) with twin input and single output reduction gear on one controllable pitch propeller.

Capacities of tanks and stores are sufficient for minimum endurance of 4,500 nautical miles at a speed of 16 knots, plus 30 days with auxiliary machinery.

The vessel has been designed such that sufficient intact stability and nearly level trim will be obtained under all load conditions, and watertight compartments and tank spaces are so arranged that the vessel will remain afloat even if two of its hull compartments are damaged. (See fig. 2.)

Hull construction and outfitting of the vessel comply with the rules and regulations of Lloyd's Register and with the current SOLAS convention and pertinent IMCO resolutions.

Speed, behaviour, manœuvrability

The following requirements laid down by the Navy were carefully considered in the hull design and in the machinery layout:

— 16 knots maximum continuous speed at maximum continuous rating of main propulsion plant;
— Minimum squat effect when underway;
— Best possible sea behaviour;
— Excellent manoeuvrability under all conditions of speed.

To fulfil these requirements with optimum results and minimum engine power, the vessel has a Maierform-SV-bulbous bow, as recommended by the designers. For the verification of this recommendation, model tank tests with a conventional hull model and another with a Maierform-SV-bulbous bow were carried out during the design phase. Results of these tests showed that the SV-bulbous bow had definite advantages. During trials of the ship these results were confirmed.

To improve the vessel's seakeeping quality, a pair of Vosper stabilizer fins for reduction of roll were fitted. A Becker rudder with an additional fin rudder and a Pleuger bow thruster assure excellent manoeuvrability.

Craft and deck equipment

The following craft specially designed for survey work are carried:

— 4 survey boats, 7.50 × 2.60 × 1.40 m, with 106 hp diesel engines (see fig. 3);
— 2 workboats, 6.45 × 2.53 × 1.30 m, with 106 hp diesel engines;
— 2 assault boats with outboard engines;
— 2 dinghies with outboard engines.

The survey boats and work boats are slung on gravity davits. To facilitate lowering and hoisting in rough sea conditions, the winches are self-tensioning and electrically driven.

For survey and research work the following deck equipment has been fitted:

— 1 hydraulic oceanographic winch taking 4,000 m of 4 mm wire rope;
— 1 hydraulic bathymetric winch taking 6,000 m of 6 mm cable;
— 1 hydraulic heavy duty geological winch taking 4,000 m of 12 mm wire rope;
— 1 A-frame for use with the oceanographic winch;
— 1 A-frame for use with the heavy duty geological winch;
— 1 slewing davit for general survey work;
— 2 3-ton derricks with hydraulic winches;
— Complete diving equipment, including an air compressor and a decompression chamber.

FIG. 3. — A survey boat.

Survey, navigation and communications equipment

As required by the specifications laid down by the Navy the sub-contractor, Messrs. Prakla-Seismos GmbH, of Hanover, West Germany, was entirely responsible for the supply, installation and integration of the survey and navigational equipment, although part of the survey system

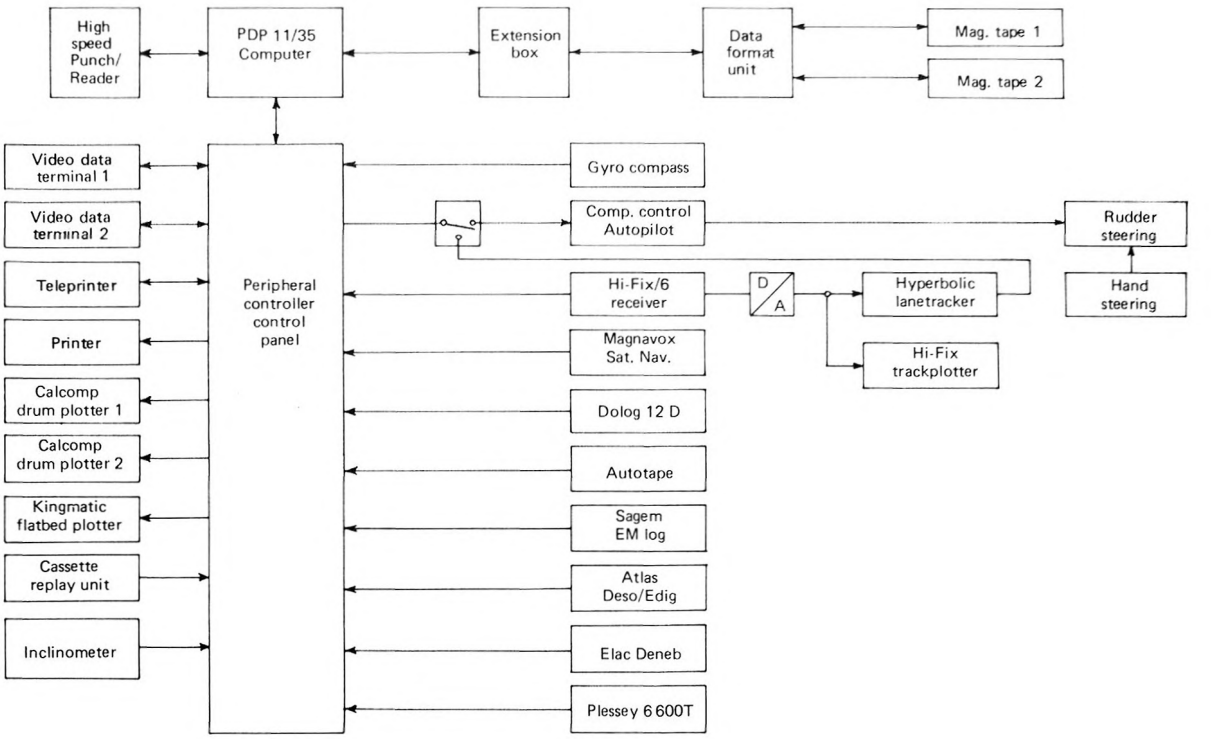

FIG. 4. — Equipment, interfaced with computer, for data acquisition, navigation and data processing.

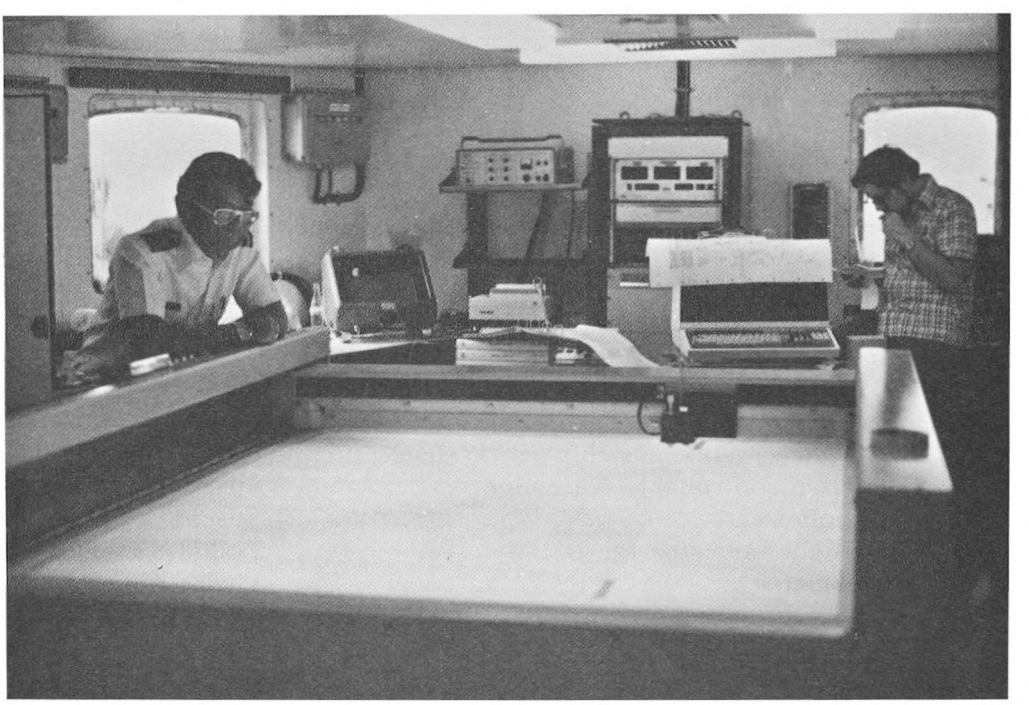

FIG. 5. — The plotting room.

was actually installed by Marconi Space and Defence Systems (England). Messrs. Debeg were responsible for the supply and installation of all communications equipment.

Most of the survey and navigational equipment is interfaced with a 32 K computer with various input and output peripherals including a large flat-bed plotter and two drum plotters. Facilities are provided for computer control of the autopilot for automatic lane-keeping of the Hi-Fix/6 system.

The online system program computes position fixes from two navigational systems, and the dead reckoning position from the ship's gyro and log with updates by satellite fixes. A real-time track plot and a sounding plot may be output simultaneously.

Offline programs provide facilities for editing and reprocessing of data recorded on magnetic tape, and for the drawing of chart borders, lattices and symbols. A program is also available for processing ashore the 3D position of multi-pass satellite observations recorded. (See figures 4 and 5.)

The comunication systems fitted onboard are tailored for both naval and survey requirements. Portable HF transceivers and walkie-talkies for detached camps and shore parties facilitate the smooth execution of survey operations.

The following is a list of the main surveying and navigation equipment; numerous instruments for surveying ashore and the usual chart-room instruments are also carried.

1 Gyro Compass	Anschutz
1 Magnetic compass	Ludolph
1 Electromagnetic log	Sagem
1 Doppler sonar log	Krupp Atlas
1 Radio direction finder	Debeg
1 Electronic position fixing system	Decca
1 Electronic position fixing system	Cubic
2 Electronic calculators interfaced to Autotape DM-40 A	Hewlett-Packard
1 Satellite navigation receiver with shore recording facility	Magnavox
1 Data acquisition and processing system with PDP 11/35 computer, for use with Kongsberg and Calcomp plotters	Marconi Hydroplot
1 Electronic crystal master clock system	Prakla-Seismos
1 Computer controllable Autopilot	Anschutz
1 Lane follower	Anschutz
1 Left/Right indicator for DM-40	Prakla-Seismos
1 Anemometer	Theiss-Kuma
2 Survey echosounders with digitizers	Krupp Atlas
1 Deep echosounder	Elac Deneb
1 Sidescan sonar	Ore
1 Horizontal echosounder	Elac Panorama
4 Echosounder trace readers	RMN design

6	Distance Measuring Equipments	Siemen Albis
2	Distance Measuring Equipments	Hewlett-Packard
1	Barometer	Baromac
1	Chronograph	Elsec
3	Tide gauges	Plessey
1	Thermosalinograph	Plessey
1	Temperature, salinity, depth, sound velocity probe	Plessey
6	Reversing water bottles, each containing a comprehensive set of thermometers	Richter & Wiese
2	Direct reading current meters	Plessey
2	Self-recording current meters	Plessey
2	Tracer buoy systems	Decca

Survey boat equipment

1	Echosounder and digitiser	Krupp Atlas
1	Hi-Fix/6 receiver	Decca
1	Data logger	Marconi
1	HF transceiver	Racal

Communications

1	HF TX transmitter	Marconi
3	HF transceivers	Redifon
2	HF receivers	Redifon
2	VHF/UHF transceivers	Plessey
1	FM/VHF transceiver	Philips
1	RATT system	Redifon
1	Auto-alarm receiver	Redifon
3	Lifeboat transceivers	Debeg
7	Portable HF transceivers	Racal
8	VHF walkie-talkies.	

CONCLUSION

Although K. D. *Mutiara* is the first surveying vessel to be built in Malaysia, and is also the largest ship to be built locally, its standard of finish and performance are very good and thus the new vessel measures up to any of its class in the world. K. D. *Mutiara* is indeed proving a fine survey vessel.