SINGLE ROLE MINE HUNTER

BY

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(*Sea Systems Controllerate*)

Background

In September 1980 the Admiralty Board endorsed a new Mine Countermeasures (MCM) 'Concept and Numbers Policy'. Amongst other matters the policy recognized the high unit cost of the HUNT Class MCMV and identified the need for a cheaper vessel to complement it. Such a vessel would have to meet the same principal MCM threat as the HUNT Class but cost savings were to be sought through less sophisitication, reduced versatility, and possibly the acceptance of a somewhat higher degree of risk from the mines to be hunted.

The HUNT Class MCMV is equipped for both minesweeping and minehunting, and in addition is employed in a secondary role as a patrol craft. The requirement to provide a cheaper vessel has led to the concept of a craft equipped primarily for minehunting as being the most effective form of active MCM and accordingly the craft has been designated as a Single Role Mine Hunter (SRMH).

Four contenders were identified as being types of vessels which warranted further study, these being:

(*a*) A single role version of the HUNT Class.

(*b*) The tripartite Belgian/Dutch/French mine hunter.

(*c*) A large hovercraft.

(*d*) A new design of displacement craft specifically designed to fulfil the Navy Department requirements.

After investigations and early feasibility studies it was concluded that only a purpose-designed vessel would be capable of meeting the requirements, rectification of the shortcomings identified in the alternatives being such that it was unlikely that these could compete on a cost basis. The proposal to proceed on the basis of a purpose-built design was ratified and the vessel as currently defined is as a result of the decision. The first of the class will be H.M.S. *Sandown*. A model is illustrated in FIG. 1.

An artist's impression of the SRMH, together with additional information relating particularly to the weapons and AIO fit, can be found in an article by Wright[1]. The application of the magnetic target in the case of the SRMH main engine was discussed by Robson[2].

Design Basis

It was decided that deeper feasibility studies should be undertaken by a member firm of British Shipbuilders as part of the policy of greater involvement by industry in the design and procurement of defence equipment. The shipbuilder concerned had in the past conducted design studies into a mine hunter of similar size as a private venture and also had considerable expertise gained in the design and construction of the HUNT Class.

The requirements call for all applicable Government and British Standards to be observed in addition to MOD Standards. It was implicit, however, that the use of proven commercial equipment rather than new design be considered in the quest for low cost; the shipbuilder was tasked with challenging standards where it could be shown that their application would

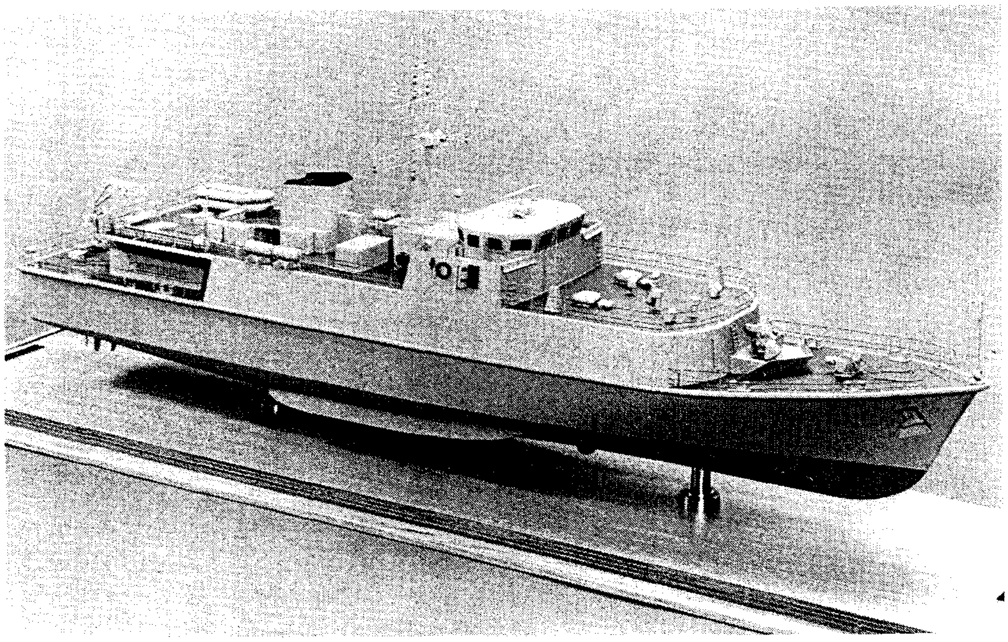

FIG. 1—A MODEL OF THE SINGLE ROLE MINE HUNTER

increase costs, and was required to employ value engineering solutions to problems arising during the design process.

The application of these constraints has led to a straight-forward approach to systems, using fundamental principles as described below. The design has evolved around an Upkeep by Exchange (UXE) policy of providing adequate dedicated removal routes for machinery items in order to reduce downtime and maximize hull availability. Emphasis has been placed on availability for the proposed mission pattern, support being provided from Forward Support Units (FSU).

Design Details

The emphasis on minehunting and the consequent absence of minesweeping gear has had a considerable influence on the design and has led to a quarterdeck area dedicated to the primary role. The various design investigations have resulted in a vessel of 50 m length at the waterline and 10·5 m beam. These dimensions represent the best compromise between the requirements for seaworthiness and ship motion for the envisaged operational areas on the one hand and the avoidance of problems associated with pressure signature on the other.

In view of the vessel's size, attention has been paid to crew comfort in adverse conditions and has resulted in accommodation and operational spaces being concentrated in the middle third of the vessel. The view from the bridge also received attention at an early stage. The general arrangement is shown in FIGS. 2 and 3. Accommodation is provided for a total of 40 men including 7 officers and 9 senior rates.

In view of the method of operating the ship using advanced minehunting techniques, the allowable magnetic signature has been considerably relaxed compared with ships of the HUNT Class. Strict attention has been paid to the allowable magnetic signature of individual equipments and the overall signature prediction has been closely monitored by use of a mathematical model. The ship's signature will be controlled by a degaussing system whilst in service.

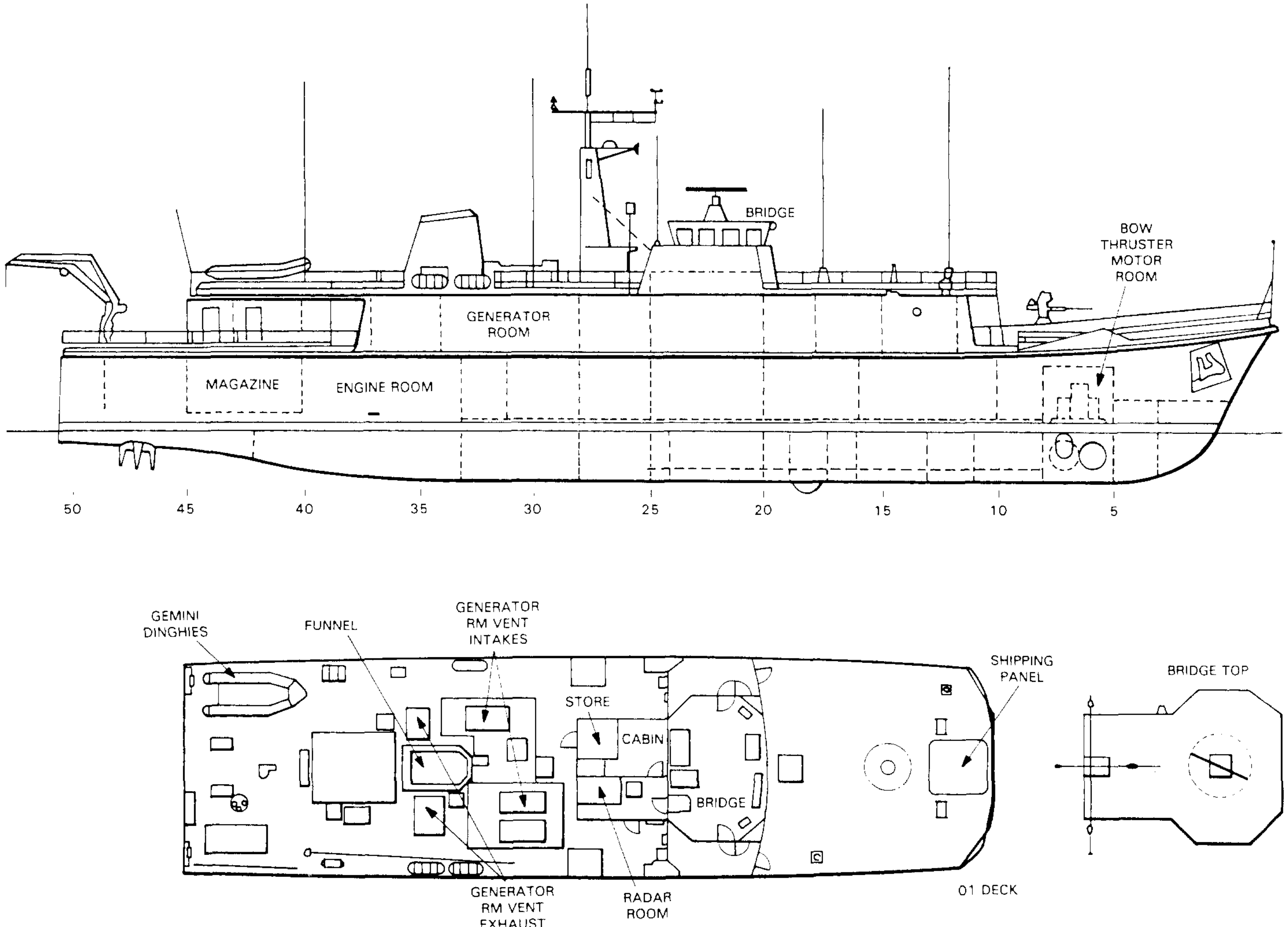

FIG. 2—THE SINGLE ROLE MINE HUNTER

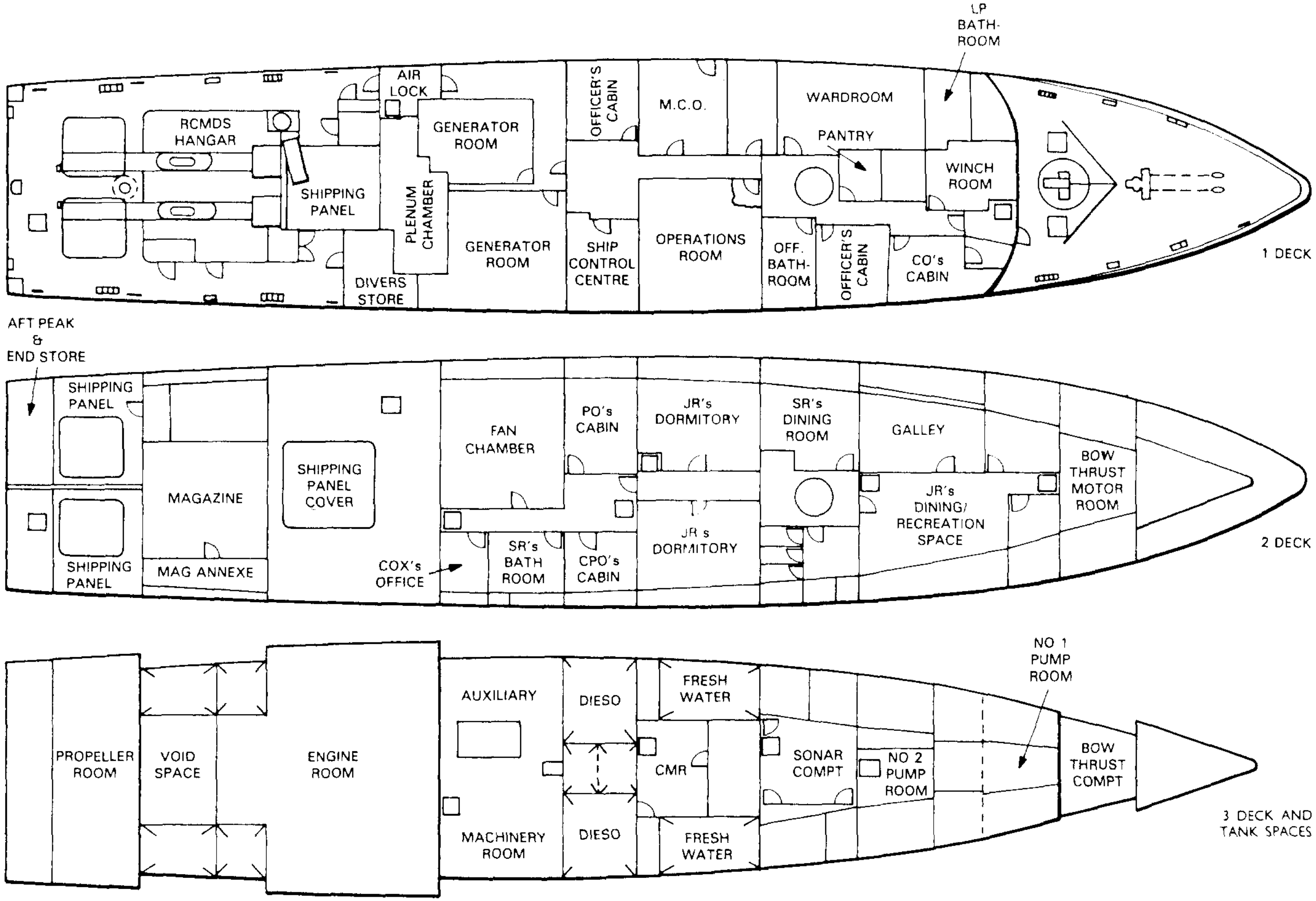

FIG. 3—THE SINGLE ROLE MINE HUNTER

Method of Propulsion

The staff target for the ship calls for a high degree of manoeuvrability coupled with the achievement of signature targets for noise and magnetics. The various propulsion options investigated are shown in FIG. 4. The more demanding of the operations associated with minehunting which have a heavy influence on ship design comprise the ability to hover at a set point after coming to rest, circling around a set point at a given radius, and the ability to cover a given track within prescribed limits. It soon became apparent that these varied requirements could only be met by active rudders or Voith Schneider Propellers (VSPs) and that electric propulsion, particularly at minehunting speeds, would be the most effective method of reducing noise. Propulsion by diesels would offer the best method of achieving the high speed and transit conditions.

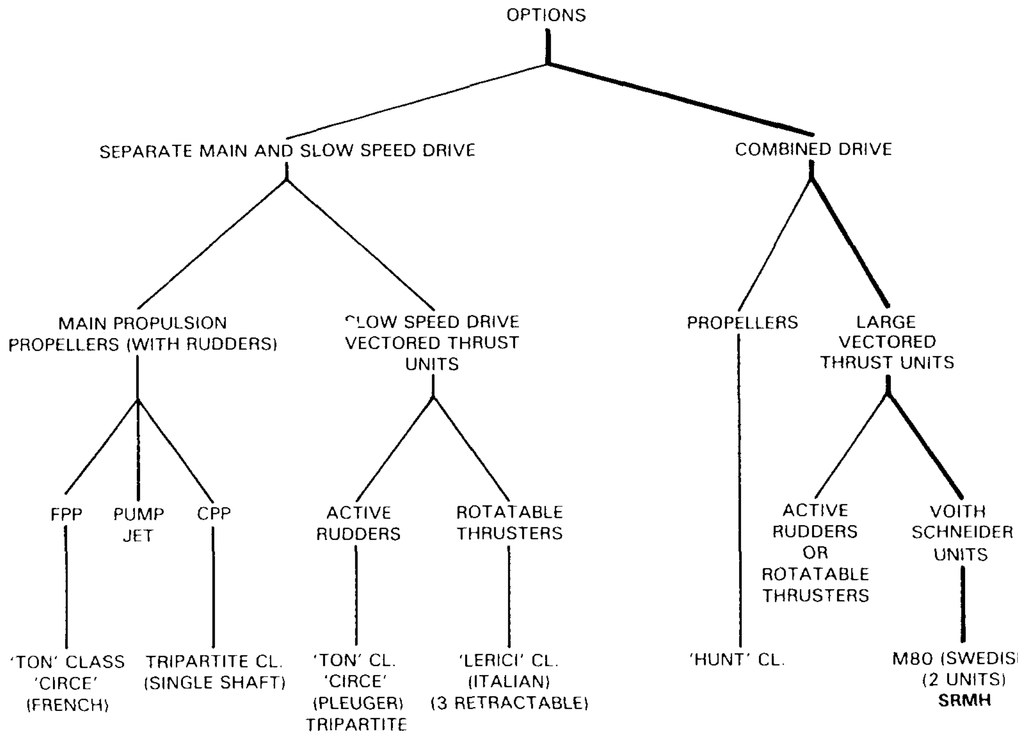

FIG. 4—SRMH: PROPULSION AND MANOEUVRING OPTIONS

The operating principle of VSPs is shown in FIG. 5 and their capability of thrust in any direction caused them to be nominated for the SRMH.

A bow thruster has been incorporated into the design since it appears unlikely that desired directional control could be achieved in high seas and wind states at slow speed by VSPs alone.

Observing that two alternative methods of propulsive power are utilized, both driving into each propulsor, the drive system adopted involves the use of synchronizing self shifting (SSS) clutches and is shown in outline in FIG. 6. Fluid couplings are incorporated between the motive power and clutch in each case as an aid to starting, and a torsional vibration decoupler for the main propulsion diesels. The drive from the propulsion electric motor to the main shaft is by belt as a means of avoiding the generation of discrete tones which would arise if a geared drive were used. Each machinery set is raft-mounted to reduce underwater noise transmission and as an aid to meeting the desired shock capabilities.

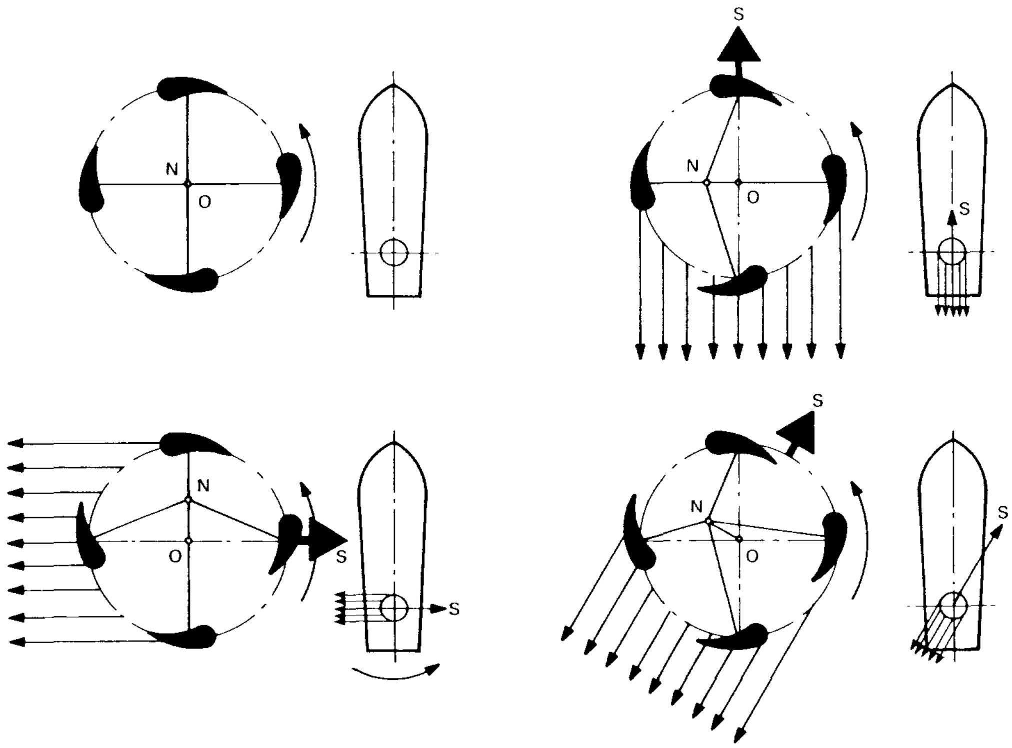

FIG. 5—OPERATION OF THE VOITH SCHNEIDER PROPELLER

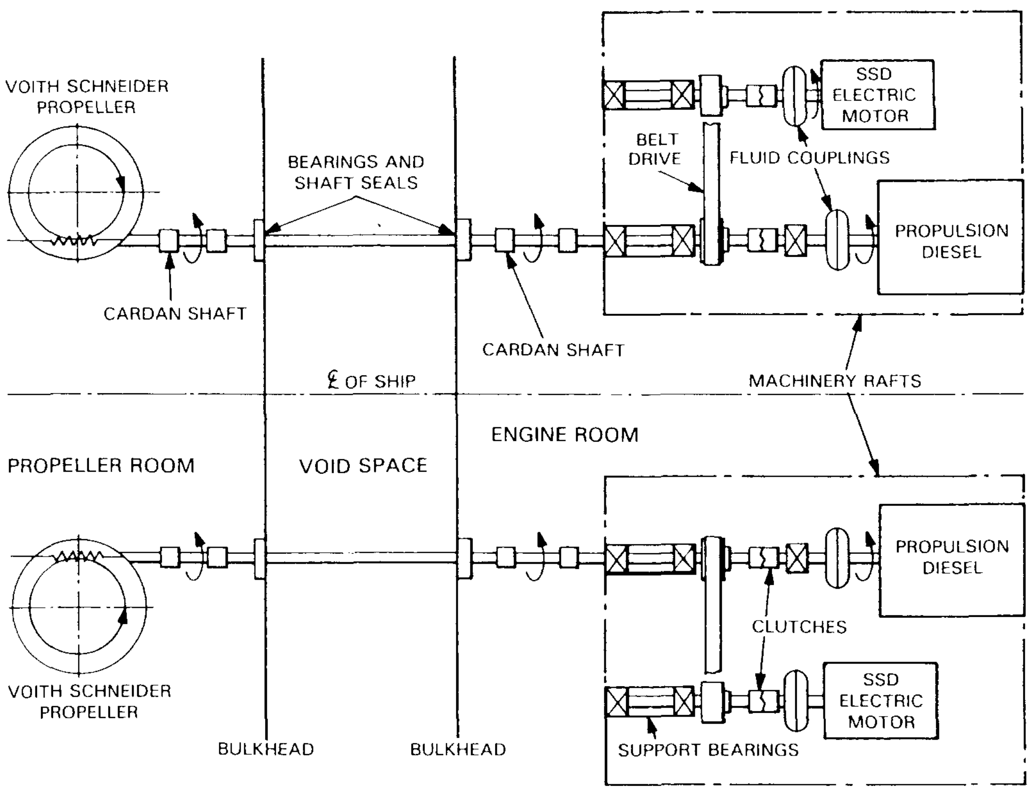

FIG. 6—SRMH: TRANSMISSION SYSTEM

Drive from the raft-mounted propulsion package is transmitted to the VSP by way of an internal shaft. This is mounted in bearings supported from internal bulkheads and connected at each end by cardan shafts incorporating flexible couplings to cater for movements likely to be encountered under shock conditions.

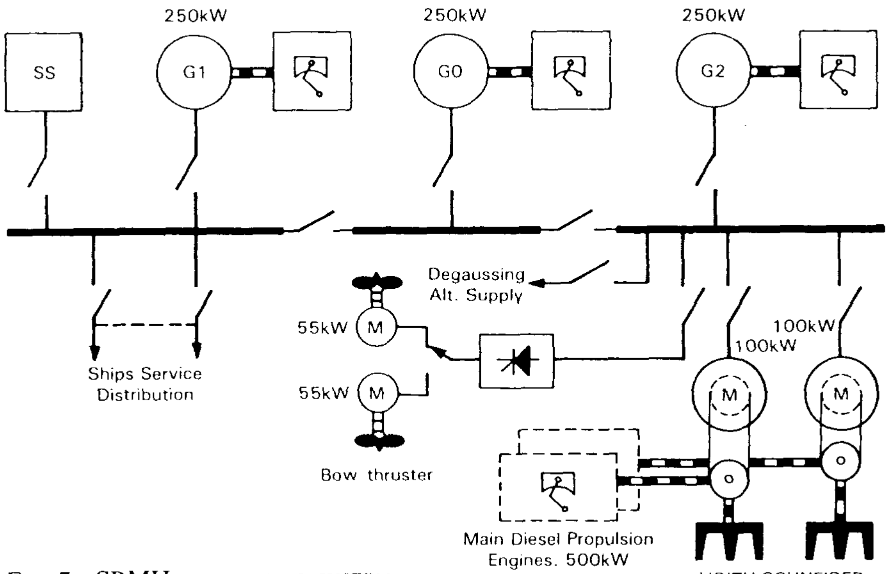

FIG. 7—SRMH: ELECTRICAL SYSTEM

Electrical power both for silent propulsion by electric motor and for ship's services is provided by three radiator-cooled diesel generators, each of 250 kW output, fitted high in the ship to reduce water-transmitted noise. The generators are connected to a single switchboard and arranged so that when on silent drive one generator is normally employed for propulsion and one for ship's services, with the remaining set standby for either duty as shown in FIG. 7. The slow speed drive (SSD) power has been selected to meet the most demanding requirements foreseen whilst minehunting. In the most favourable conditions the power requirements of the SSD are minimal and the generator sets can be run in continuous unattended parallel operation. By this means the loads associated with ship's hotel services and propulsion may be shared, thus avoiding the problems associated with low power running on turbo-charged diesel engines.

Auxiliaries and Ship's Services

In order to reduce cost and to control the ship's acoustic signature, advantage has been taken of the short mission times to eliminate all inessential items. Of those systems remaining only those necessary for the primary task will be operated during minehunting and whilst on slow speed drive.

Machinery to be run while minehunting is mounted on a common raft in the Auxiliary Machinery Room, as an aid to noise reduction.

(*a*) *Fuel System*. Design of the fuel system has drawn heavily on the experience gained during hostilities in the Falklands and has resulted in the development of the system shown in FIG. 8. Fuel is stored in two deep tanks and transferred as required to a central service tank via a filter and coalescer. Clean fuel is then drawn from the service tank by duplicated fuel supply pumps and directed to header tanks for the diesel generators which constantly overflow into the main engine header tanks which in turn overflow back into the service tank. Because the header tanks are thus never less than full the use of this cascade system reduces the maximum amount of fuel stored at elevated levels. The fire risk is consequently reduced, whilst ensuring that in the event of electrical power loss a sensible minimum of fuel is available for use until power is restored. Flexibility has been incorporated into the system by various emergency and cross connections, and a hand pump is fitted to assist in initial start-up and emergency situations.

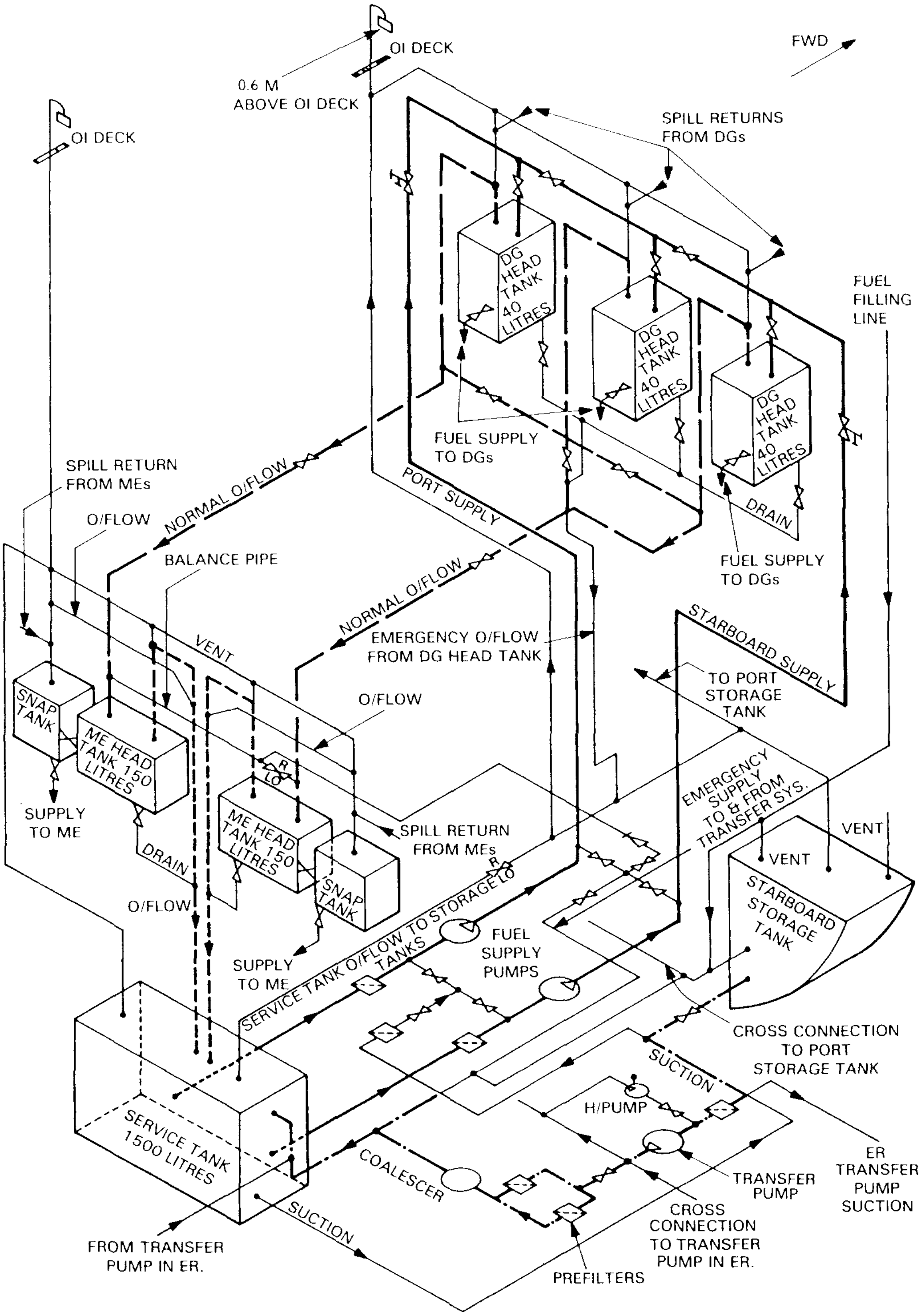

FIG. 8—SRMH: FUEL SYSTEM (SOME VALVES OMITTED FOR CLARITY)

(*b*) *Lubricating Oil Systems*. Storage of lubricating oil has been reduced to the minimum required for changing and replenishment, allowing for the ship's envisaged operating cycle. Contaminated oil is stored in a dedicated tank and will be discharged at a suitable disposal point on return to harbour.

(*c*) *Compressed Air System*. The system as designed allows adequate stored air for use whilst minehunting and it is not intended to run air compressors whilst on task unless absolutely necessary. All air is to the purity standard required for diving, and dedicated bottles will cater for diesel engine starting if system pressure is low.

(*d*) *Sullage System*. To reduce complexity the ship will not be fitted with an oily water separator, and separate sullage holding tanks are provided since the area of operation will preclude the discharge of oily waste overboard. Discharge on return to harbour will be through a deck connection.

(*e*) *Fresh Water*. No provision has been made for the production of fresh water but space exists for the installation of an RO plant later if absolutely necessary. Sufficient fresh water for the ship's duty cycle is stored and allows for the expected daily consumption. Hot water will be supplied by individual electrical calorifiers at user points.

(*f*) *Sewage System*. The design incorporates a vacuum sewage collection and holding system utilizing fresh water flushing, thus avoiding the necessity to run sea water pumps whilst minehunting. The use of a vacuum system which does not rely on gravity provides maximum freedom in the layout of accommodation. Discharge of sewage holding tank contents whilst alongside will be arranged via a dedicated sewage discharge pump.

(*g*) *Air Conditioning System*. Accommodation and operational spaces will be air conditioned to temperate conditions by a duplicated direct expansion compressed gas system and the resultant cool air distributed throughout the conditioned spaces by trunking and fan. To avoid the use of pumps no chilled water system is fitted.

(*h*) *Fire Fighting Systems*. Fire fighting for the ship will be by fixed two-shot Halon systems for machinery spaces, backed by sea water and AFFF systems. A fixed pressurized tank is fitted for magazine protection and by this means it has been found possible to dispense with the need to run pumps during minehunting operations. In case of fire the necessity to start pumps, with attendant noise risks, will be by command decision.

(*i*) *Refrigeration and Deep Freeze*. To avoid unnecessary cost and complication, self-packaged free-standing cabinets have been incorporated for both cold and cool storage.

(*j*) *RAS*. The ship will be fitted for replenishment at sea of fuel, fresh water and dry provisions, with a helicopter pick-up point on the top deck.

Control

To meet the manoeuvrability targets the optimum controls for both ship and machinery are necessary. It was recognized at the outset that the targets for hovering, circling and track keeping would be so demanding as to rule out manual ship control and hence the controls have developed along the lines shown in FIG. 9.

Three separate modes are employed while in slow speed drive, viz. fully automatic, computer assisted manual, and manual. In each case ship data will be displayed on a VDU mounted on the helmsman's console, the necessary inputs in the fully automatic mode being derived from the various sensors associated with the Action Information Organization (AIO) fit for the ship, e.g. radar, SATNAV, radio fixing, etc. The optimum form of the controls is still being studied.

While on diesel drive control will be by direct throttle controls and this also is shown in FIG. 9.

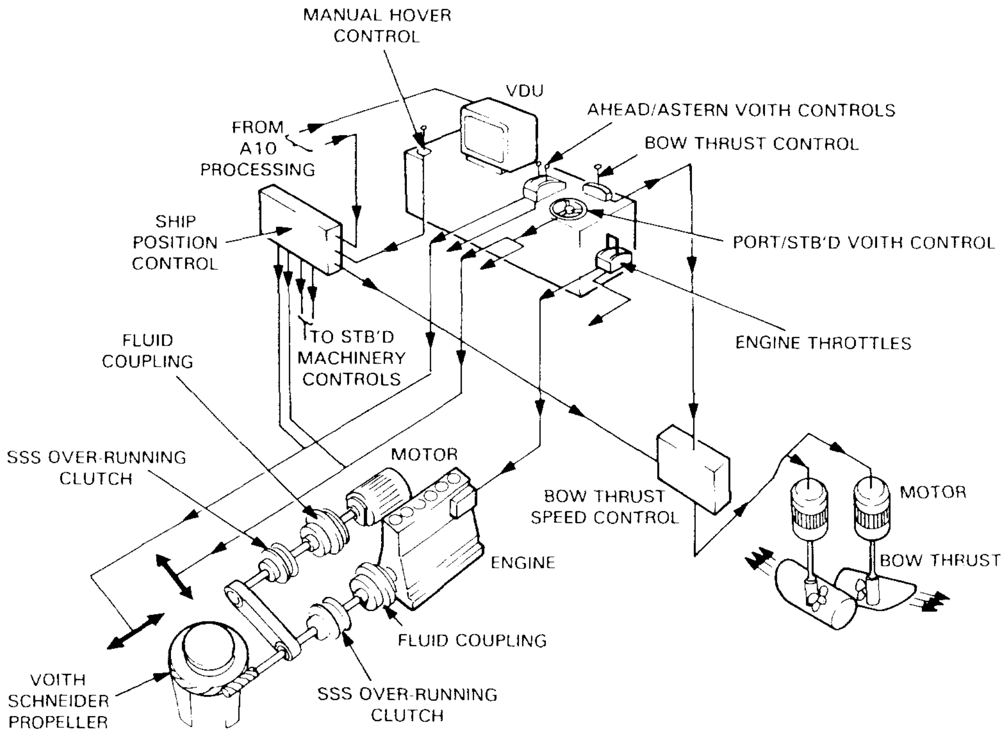

FIG. 9—SRMH: PROPULSION MACHINERY CONTROLS

The SRMH is fitted with a Ship Control Centre (SCC) in which is mounted the main switchboard and machinery start/stop and surveillance panels. In all modes the primary control position will be the helmsman's console on the bridge, and watchkeeping in the SCC will be for monitoring rather than traditional throttle watchkeeping.

Selection of Equipment

In accordance with government policy on maximizing competition and devolving work to industry, the lead shipbuilder has been tasked with seeking competitive tenders for all equipments and in some cases this has led to proposals from contractors hitherto unknown in defence circles. This is seen as a vital step in achieving low unit production costs (UPC) for the ship.

Detailed information on the equipment likely to be selected is not yet available, for reasons associated with the present stage of the contracts.

Conclusion

The single role concept, simple approach, and maximum competition have combined to form a cost-effective solution to the problems of detection, classification and disposal of mines, and should prove a versatile and worthwhile addition to the R.N., seeing service into the 21st century.

References

1. Wright, R.: The Single Role Mine Hunter; *Naval Electrical Review*, vol. 37, no. 4, April 1984, pp. 1-6.
2. Robson, P. G.: Diesel engines for low-magnetic signature applications in MCM vessels; *Journal of Naval Engineering*, vol. 27, no. 3, June 1983, pp. 437-441.