

H.M.S. 2010

A GLIMPSE OF THE FUTURE

BY

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ABSTRACT

The engineer in the year 2010 will have quite a different ship to run and this article provides a lighthearted look at what he may be faced with. Although it is ME orientated, many aspects have a whole ship implication.

Introduction

You have just been appointed as the MEO of H.M.S. 2010 (FIG. 1). What can you expect?

This dissertation, whilst purely hypothetical, is intended to give you a taste of the future. Some aspects are based on current developments and initiatives whereas others have not yet emerged from the crystal ball. I do not believe that the weapon system RASTUS exists, for instance, but reduced manning, progressive upkeep and A.C. gas-electric main propulsion are less than figments of the imagination. Some of the ideas put forward in the article 'Engineering in the Royal Navy—Towards the Automatic Warship'¹ have been incorporated in your ship, H.M.S. 2010.

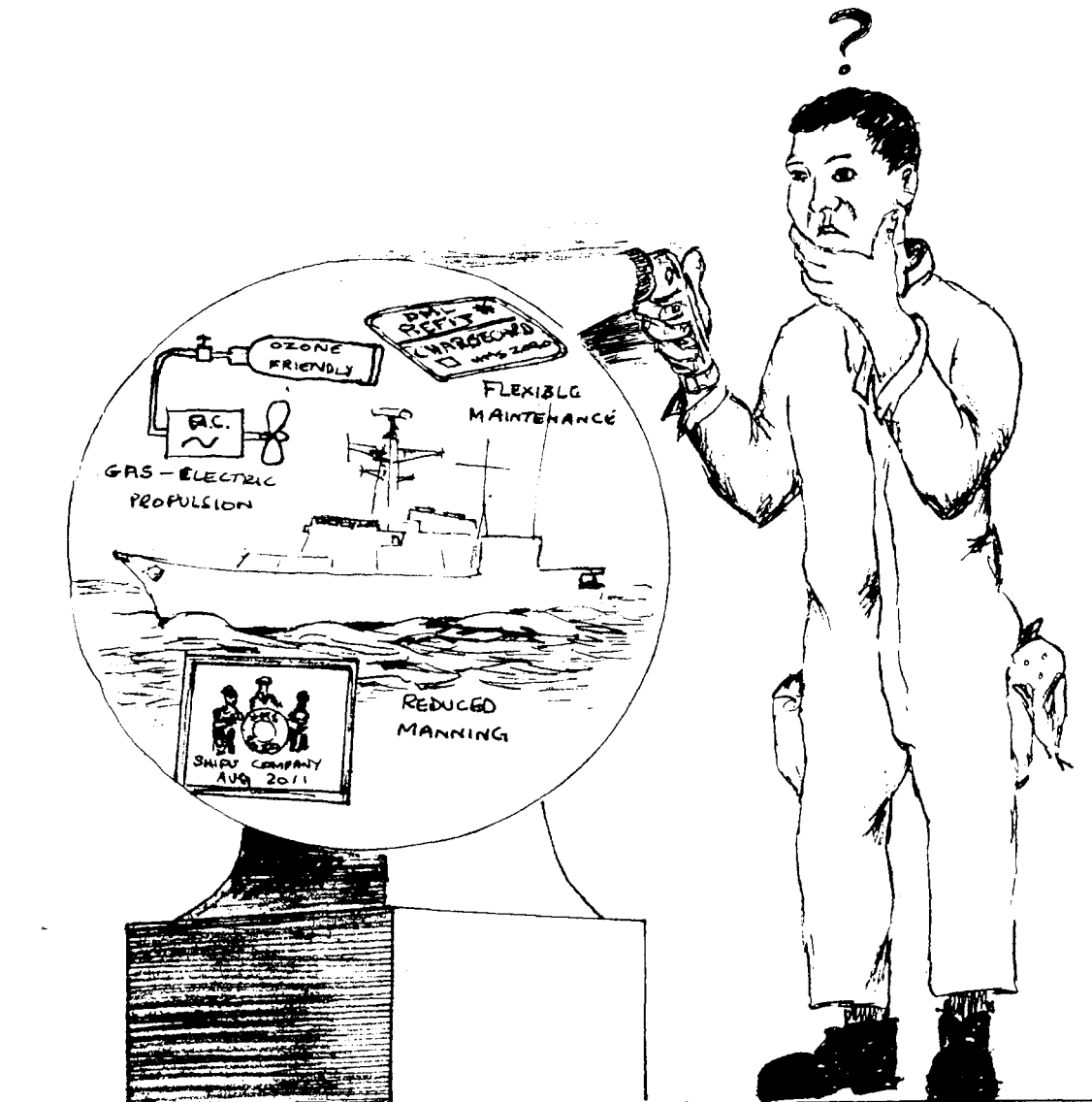


FIG. 1—A.D. 2010

drawn by Brian Glennon

The Ship

A 3000 tonne, ASW frigate with limited AAW capability. The hull is steel with a GRP/steel composite superstructure for light weight and low reflectivity. Propulsion is gas-electric and is described later. Ship management is through a Whole Ship Management System (WSMS) using duplicated data highways. Novel weapons systems include the Remotely-operated Active Sonar Targeting Unmanned Submersible (RASTUS) and a coil gun.

The Men

The ship's company is 73 in total, complemented as follows:

- 10 officers—CO, XO, MEO, 5 Weapon Ops officers (WOO) and 2 Flight. The 5 WOOs comprise 1 AAW Head of Department (HOD), 1 ASW HOD and 3 watchkeepers.
- 14 ME—DMEO (warrant officer or charge chief), CPOMEA (EL), 5 PO, 7 JR. The policy of 'de-enrichment' of complements, introduced in the 1990s to combat the demographic trough, has left you with one M expert (DMEO), one L expert (CPOMEA(EL)) and a handful of highly capable POs and JRs. For instance the Shipwright is a POMEM (Hull ADQUAL).

- 31 Weapon Operator Maintainers (WOMs)
- 10 Supply & Secretariat (includes medical)
- 6 Air (to be augmented when second helo embarked)
- 2 civilians (Naafi/laundry)

Your Machinery

Underlying Theme

The underlying theme which has affected the choice of your machinery is one of minimizing the number of prime movers and complex systems whilst maximizing on automation. This is primarily to cater for the tight manpower constraint but has through-life cost benefits also.

Main Propulsion

Fully Gas-Electric² with four Intercooled Regenerative Gas Turbo-Alternators (ICR GTAs) in two Power Rooms. These supply two 15 MW, water-cooled A.C. Motors via cyclo (or possibly pulse width modulation) frequency converters. It is worthy of note that a two 14 MW Cycloconverted A.C. Diesel Electric propulsion system is now entering service in three cruise liners. Advantages over 'conventional' propulsion are quoted as high reliability, better flexibility, ease of control, and quietness, especially at low speed.

Auxiliaries

- (a) *Power.* A 440V 60Hz ringmain is fed from the 3.3kV GTAs via MG sets in each Power Room. i.e. there are no auxiliary generators. An emergency Diesel Generator (750 kW) is situated in the Auxiliary Machine Room and can be started electrically for routine testing or hydraulically under 'black ship' conditions. This DG is also intended for running auxiliary in harbour if necessary.
- (b) *Air.* There is no HP or LP air main. Three small fully automatic High Pressure Air Compressors (HPACs), installed as U x E modules, provide BA (breathing) air in three of five D.C. sections, each with an upperdeck charging point. The gas turbines are electric start and the radar waveguides no longer require air for drying.
- (c) *Water.* Fresh water is provided by Reverse Osmosis plant. H.P. Salt Water is provided by five fire pumps on their own sections. These automatically start and check shut their section isolation valves only when a fire alarm is initiated within the section. The firemain is otherwise maintained in a dry condition to minimize the risk of flooding.
- (d) *Cooling.* There is no chilled water system as such. Weapon systems are all in NATO standard exchangeable modules with self-contained thermo-electric cooling systems³ which have the advantage of doubling up as heaters when the system is not in use. Whereas the good shock resistance, low noise and low maintenance of thermo-electric cooling makes it a sensible choice for modular weapon systems, its high cost and weight mean that your air conditioning runs on a conventional fridge cycle modified to conform with the Montreal Protocol Agreement on CFCs.
- (e) *Boats.* Your 2 RIBs are powered by diesel inboard/outboards. These power units are U x E with one spare carried.
- (f) *Ventilation.* Each of the five D.C. sections has its own isolated, conditioned ventilation system. Redundancy is provided by manually

opened vent cross-connections between adjacent sections which automatically close in the event of fire. The ship operates on a Total Air Conditioning principal, meaning that the citadel is permanently in 'Condition Alpha'.

- (g) *Domestic machinery.* The amount of domestic machinery is much reduced due to reduced manning, pre-prepared food and the use of microwave ovens. A single galley/fridge/store complex feeds the whole ship. Waste and sewage are incinerated.

Machinery Layout

The design is such that the loss of one main machinery space will not completely disable the prime sources of power; main propulsion and power generation are split into self-contained sub-units. The machinery layout is shown in FIG. 2.

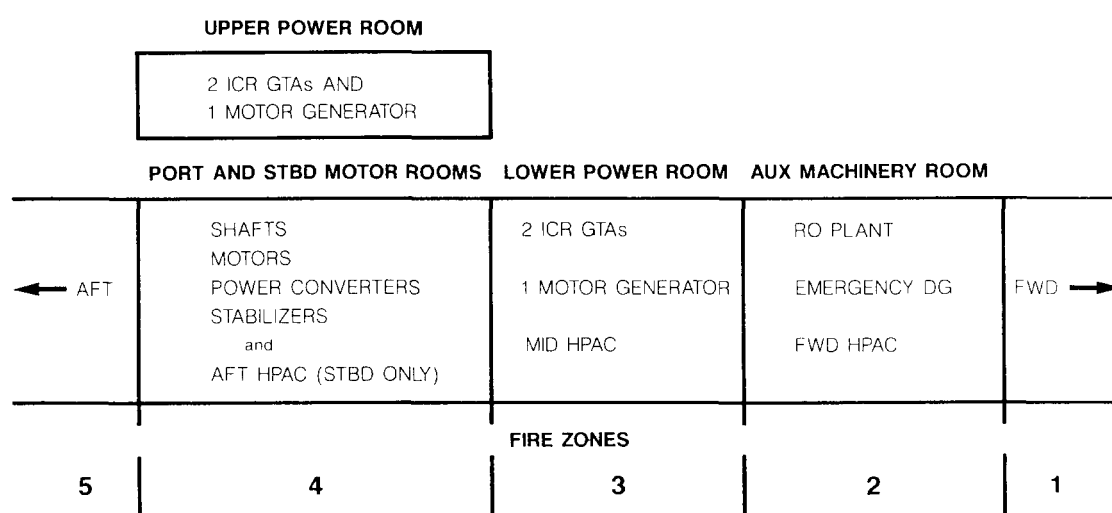


FIG. 2—MACHINERY SPACE LAYOUT

HPAC: High Pressure Air Compressor
ICR GTA: Intercooled Regenerative Gas Turbo-Alternator
RO: Reverse Osmosis

Machinery Control

The WSMS, through federated sub-systems, absorbs the machinery control function along with other functions such as NBCD, maintenance management and administration. The primary control position is on the bridge with an LMEM as the only permanent watchkeeper. He is assisted by:

- An automatic call-out system for the maintainer and/or the MEO depending on the severity of the fault initiating the call-out.
- Largely automated machinery drill procedures allowing the watchkeeper only a power of veto before each step is taken. Manual control is possible as a fallback, using the system prompts as a guide. Equally a manually detected or exercise failure can be injected to initiate a drill.
- A power management system which, unless specifically inhibited, starts and stops the GTAs automatically to meet the ship's power demands. GTAs can be allocated a priority for use to cater for running hour management or minor defects.
- An IKBS or expert system for assistance with fault diagnosis (primarily for use by the equipment maintainer).

Secondary control positions are provided on 2 deck, one in each fire zone, adjacent to the WSMS data highways. These provide only basic propulsion control and limited alarm information, providing that one of the data highways remains intact. Tertiary control from local positions is available as a last resort.

Machinery Rounds

Machinery rounds are not necessary for taking readings, although maintainers are responsible for doing rounds of their machinery once every 12 hours. These rounds are occasionally used for taking Condition Monitoring readings from sensors or positions that are not normally monitored by the surveillance system.

The Office

This is a paperless ship. Mail is all electronic, transmitted either by landline when alongside or by satellite at sea. Files, BRs, drawings, IPCs, maintenance and any other information required is all stored on optical disc. ME documentation, *in toto*, fills a mere seven discs. Information can be 'transported' to remote locations by downloading to portable devices. The system is extremely friendly: for example a search on LUB OIL FILTER will index all technical, stores, drawing and maintenance details for selection as required by the user. Incidentally typing was introduced as a mandatory qualification in the R.N. in the mid 1990s to ensure full keyboard proficiency at all levels.

Upkeep and Maintenance

Upkeep

The ship has been designed for a 25 year life with only one Refit which is at approximately mid-life; this includes a capability update. For the remainder of the time the policy of Progressive Upkeep applies in which all maintenance activities are undertaken during 4-week Assisted Upkeep Periods (AUPs) which can include docking as required. With three AUPs each year you get more assisted maintenance per annum than in the old days but then you are *operational every year*, (apart from the mid-life refit), with none of the major disruption you used to get from RPs and DEDs. In order to comply with this philosophy the ship has been designed such that all foreseeable maintenance and repair actions can be achieved within a four week period, to include set-to-work and harbour trials. This has had a major effect on the design of removal routes to meet the 4 week target. The implementation of an Integrated Logistic Support policy during design has helped to ensure that the optimum balance has been met, with respect to ship through-life cost v. availability, U x E v. repair *in situ*, line overhaul/test facilities v. onboard repair/test facilities, and for spares holdings.

Maintenance

You are still running a Maintenance Management System but with a difference. Your machinery has been designed from the start with Condition Based Maintenance in mind and Condition Monitoring forms an integral part of the WSMS. The amount of time-based maintenance is very limited and primarily concerned with safety items. Your shore-based Squadron Support Office runs your MMS, generating the MAINREQS for each AUP based on routine feedback from the ship via FICS (satellite data transfer). With this form of early warning, better planning for large defect items is made possible. FICS also affords you, or any of your maintainers, a means

of simply requesting technical advice when away from home. The decision to repair onboard or wait for the next AUP remains yours, assisted by the trend plots from your CM system. The advanced warning given by your sophisticated CM sensors means that you hardly ever hear of a catastrophic machinery failure these days; in fact tales of 'hot blade showers on the flight deck' are folklore, only related by those old timers who remember COGOG propulsion. Your shore-based Supply Officer's budget is also kept in better shape as a result.

NBCD

The ship is divided into five 'Fire Zones' with the machinery space in Zone 4 divided longitudinally (FIG. 2). Your ability to survive is largely dependant on automatic and /or remotely operated systems. A four-man attack party (sea or harbour) is still the initial response. To complement his fire-retardant overalls each member of the team will pick up an all-in-one helmet which has an integral thermal image display, comms and breathing air connection. If the leader of the attack party is to avoid an automatic system response he must acknowledge the emergency alarm *en route* to the incident. This is done by means of a push stop located at each zone boundary on each deck. Automatic systems are fitted in all high risk compartments (approx 60% of the ship) and take the form of High Expansion foam or water-fog drench. Incident control can be from a number of positions on the WSMS net. Incident reports are semi-automated by input from variable output temperature and water level sensors.

A Typical Day

- 0700 *Call the Hands* as usual (pipe only just reintroduced to maintain some vestige of tradition.), select MACHINERY on your COMCON plasma screen. Other options are: SIGNALS, MESSAGES, VIDEO/TV LINE (ship or personal disc input), DESK. The machinery screen gives you numerous options at various levels of depth ranging from a VA spectrum of a running Gas Turbine to the tank state or an OPDEF summary. You see that LMEM P. Button has the morning watch, his first since passing his unit ticket, so rather than call up the 24 hour summary you buzz him for his own report to be left in your 'post box' whilst you go to breakfast.
- 0800 *Morning Brief*. Whilst this could be achieved electronically with Heads of Departments (HODS) sitting at their desks, the CO rightly believes in a daily get together. The CO has his summary of all relevant network messages on his COMPMAN (a sort of electronic filofax); on this any messages relating to ship's programme or external facilities can automatically be checked against the planned programme for conflicts....the wise OPS Officer is busy doing this whilst you are getting your morning machinery sitrep. All HODS have a similar personalized summary to the CO's, with optional additions of the weather, daily orders, exercise briefs, etc. All this should prevent any fast balls on recorded information. Unrecorded information will no doubt allow human nature to take its course in providing the occasional spectacular foul-up, thus maintaining sanity. Passwords/controlled keyboards allow all levels of information to be handled on the network (e.g. your 206).
- 1030 *RAS(L)*. Apart from a very limited augment of watchkeepers for Special Sea Dutymen, this is a four-man operation, two on the tanker and two at your end. Station keeping is automatic (with manual override, of course).

- 1330 *NBCDX/Machinery Drills*. The problem of having Machydrills in the dogs has been solved by invariably combining them with NBCDXs. FOST provides exercises on disc which can be run as is, or modified by ship staff to emphasize particular aspects. These exercises are equally important as a check on the automated emergency procedures as they are for training the ship's company.
- 1630 *MEO's rounds*. An opportunity to eyeball not only 'worries', highlighted by the WSMS, but also your team. Officers are actively encouraged to visit the other three Messes (CPO, PO, JR) and will normally have a mess number in each, This is to overcome the 'big ship, small company, electronic isolation' problem.
- 2030 *Wardroom Movie*. Watch it in your cabin if you must but the icecream and banter remains in the wardroom, along with the 'big screen' (albeit an electronic one) with 'round sound'.
- 2200 The last thing you do today is dash off a quick disc to your husband at home.

Acknowledgements

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References

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