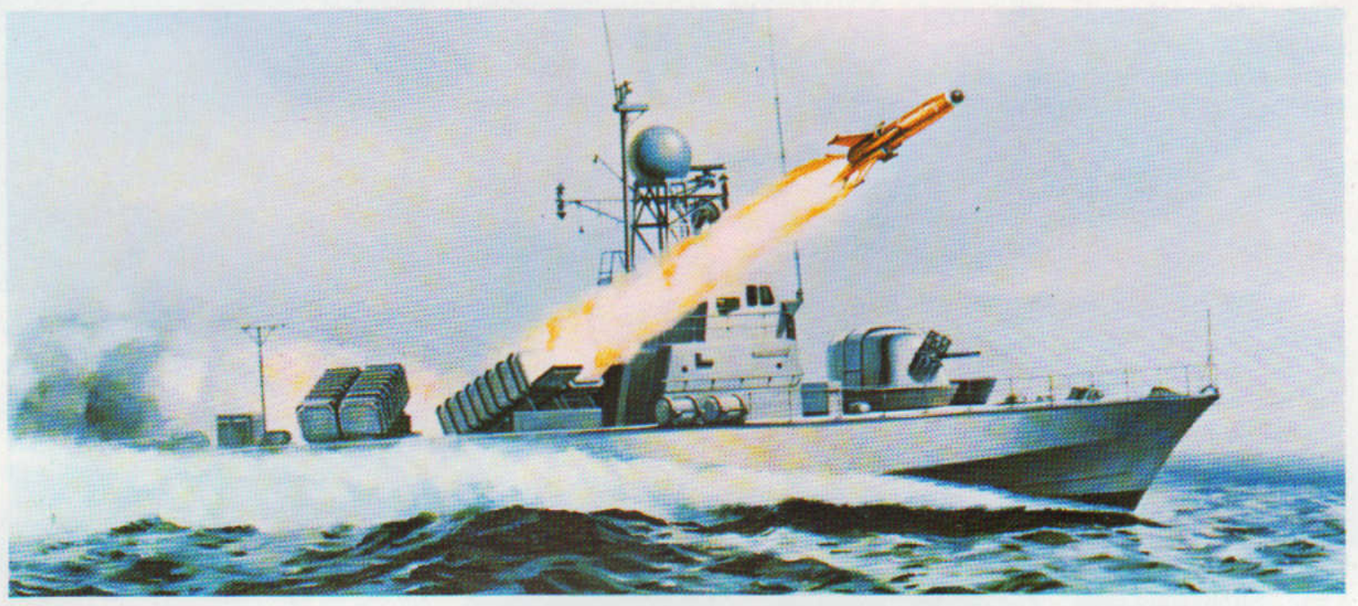
Radar Systems International

MARCONI

No. 25

Small Ship Weapon Systems

Marconi Radar has gained a wealth of experience in the design, production and installation of advanced weapon systems for fast patrol boats and similar small fighting vessels. At present the company is engaged in fulfilling a £multi-million contract for a number of vessels. The considerable experience of Marconi Radar with naval radars such as the S800 series and the Company's involvement in the provision of high technology radar and weapon systems for the Royal Navy, gives Marconi the capability to produce a new, modular range of naval surveillance radar to meet the sophisticated threats of the 1980s. This new range, known as the S1800 series, contains a group of highly effective stabilized equipments with a spread of capabilities effectively covering the defence needs of any modern warships.



Lightweight Sea Dart

The GWS 30/Sea Dart weapon control system is fitted in Royal Navy Type 42 destroyers and in the Type 82 and Invincible class cruisers. The system, which includes Marconi Type 909 tracking and illuminating radars, is fully operational and provides anti-aircraft and anti-missile defence, together with a surface-to-surface strike mode.

A new system has now been designed, based upon proven components of GWS 30 and suitable for fitting in ships with displacements down to 300 tons. The system, known as Lightweight Sea Dart, uses Marconi Radar control, the British Aerospace Dynamic Group Sea Dart missile, together with a new lightweight launcher and support electronics.

The Lightweight Sea Dart system has a full capability against surface targets to the radar horizon and a kill range in excess of 20km against air targets. The semi-active system provides defence against sea skimming targets and ensures good system performance in heavy ECM environments.

A target illuminator is co-mounted with the Marconi ST802 tracking radar which forms part of the proven Sapphire gun control system and this combined system provides complete missile and gun control against air and surface targets. An automatic TV tracking facility is included to improve the performance of the gun system at very low angles of sight. The tracking radar includes MTI circuits to ensure that small targets can be detected in clutter; automatic computer controlled acquisition minimizes reaction time.

Lightweight Sea Dart, using Marconi tracking and illuminating radars, is the ideal multi-purpose naval weapon system. It is lightweight, reliable and robust and suitable for mounting in a very wide range of ships.

Seawolf for the Small Ship

The design of a suitable version of the successful GWS25/Seawolf for small vessels is under active consideration. The form of the radar guidance equipment and alternative methods that could be used in launching the missile are numerous. The unique capability of GWS25/Seawolf as an anti-missile system, in all conditions, and its fully automatic response to threats, are vital aspects of the system. It is the aim of Marconi Radar to ensure that these inherent aspects of GWS25/Seawolf are maintained when the system is fitted on smaller ships.

Demand for S800 Series Radars

A range of lightweight high technology radars has been developed by Marconi Radar for surveillance and tracking. The S800 system is ideally suited for use on fast patrol boats and other vessels up to the size of frigates, and is in demand as part of today's integrated weapon systems now being increasingly fitted to this type of vessel.

The 800 series radars are modular as well as lightweight. This weapon system provides efficient surveillance, successful detection, rapid acquisition and accurate target tracking. The systems are complete with PPI displays, computer control and all necessary interface equipments, and will control guns of all calibres to 130mm and missiles of many types.

The systems comprise surveillance radars, X and S-band; tracking radars operating in X-band, PPI display systems, weapon control consoles, fire control predictors and vertical reference equipment, etc. Compatible Marconi Radar training aids are also available.

Surveillance Radars

The radars Type S810 and S811 are lightweight, stabilized X-band surveillance radars for offshore craft and for fast patrol boats. The S810 X-band surveillance radar has a range against surface targets as far as the radar horizon. Target detection and allocation is made at the Tactical Command Suite which comprises a 30cm PPI display and a digital computer which provides tracking assistance to the operator. The S810 provides accurate target data for offensive weapons, such as surface-to-surface missiles to give these small craft a powerful strike potential.

The radar S820 operates in S-band, has longer range performance and is suitable for large strike craft.

Tracking Radars

The ST802 is a fully automatic lightweight tracking radar giving accurate space-stabilized target data for a variety of weapon control systems. The radar is autonomous and generates its own stabilized search patterns based on target range and azimuth data obtained from the Tactical Command Suite of Ship's AIO (Action Information Office).

Tactical Command Suite (TCS)

The TCS is a flexible AIO system for small ships where a fully integrated AIO is not economically justified.

The basic TCS comprises a 30cm radar display with facilities to allow a single operator to track four targets and to allocate these to the ship's weapon systems. Automatic track sequencing allows the operator quickly to update his tracks by means of a tracker ball. The Locus 16 computer provides the central control.

New gun system for small craft

A low-cost answer to providing an effective gun and control system for small patrol craft lies in a new system originally conceived by the Admiralty Surface Weapon Establishment. The 105mm gun, which has proved so effective in many tanks, forms the main armament of these vessels. The vital control system is the latest development of the Marconi Radar gun control and fire control systems.

This combination is designed specifically for installation in offshore patrol vessels and similar craft to provide a simple self-contained, accurate and easy to operate gunnery system.

The mounting

The mounting has been designed to be entirely self-contained, requiring only an external power supply which is fed through a simple slip ring. This is sufficient for the two man crew to carry out all functions. The system is continuously monitored with a positional display fed to the ship's plot, director control of the weapon system can also be linked to any selected control system.

The mild steel mounting completely houses the two man crew, the entire weapon system, including fire control, and up to 30 rounds of ammunition. Optional extras such as assisted loading, hoist and de-icing equipment are available.

Designed to be commissioned in the factory, the complete package can be quickly installed into craft of about 35 metres and upwards with minimal ship's fitting.

The 105mm gun

Designed and developed by the Royal Armament Research and Development Establishment, and manufactured by the Royal Ordnance Factories, the 105mm tank gun is of orthodox design using a fixed ammunition system. It is in wide and successful use throughout the world.

The weapon system

Since 1945, Marconi Radar have been actively involved in the research and development of power control systems for both naval and military applications. The expertise gained has been applied to the design of the two systems which control this 105mm gun mounting.

The gun control equipment is based on well proven components to give a high operational performance and reliability. The power drive system stabilizes the gun against ship's motion using rate gyroscopes mounted on the gun cradle. To acquire the target the mounting is positioned by a single operator using a simple hand control to carry out both the training and laying function.

The fire control equipment is based on the Marconi SFCS600 the heart of which is a mini-computer used to solve the ballistic equation. The computer initiates a single aiming mark which is injected into the gunner's optical laser sight. The gunner puts this aiming mark on to the target and fires. Great accuracy and high speed of engagement are the designed aims of this system.

All components of the weapon system are housed within the gun mounting thus providing a complete package which facilitates swift and easy installation.

Marconi and submarine systems

Marconi Radar has been associated with naval equipment since the 1930s, resulting in a large pool of resource and hard-earned expertise, with an extensive capability in submarine systems. Marconi Radar and the Vickers Shipbuilding Group are co-operating closely in a new patrol submarine design which incorporates many alternative features.

Propulsion system
The overall system design and project co-ordination for the propulsion system for the new patrol submarine is being carried out by Marconi Radar who are liaising with Vickers Shipbuilding Group and the sub-contractors.

The system incorporates equipment from Marconi Radar's Control and Simulation Division and other GEC companies. The main propulsion motor is a twin armature non-compensated machine, supplied by GEC Machines Limited, Rugby.

Generator
The submarine has two 1,400W generators for battery charging and surface running/snorting. These are a.c. generators with in-built rectifiers to give a d.c. output. The a.c. generators are supplied by GEC Machines Limited, Rugby, and the rectifier units by Marconi Radar.

Propulsion switchboard
The propulsion switchboard is supplied by GEC Machines, Bradford and contains the necessary switchgear for regrouping batteries and armatures for different propulsion speeds. It contains two circuit breakers for motor protection.

Field supply
Marconi supply a static drive unit for each field of the twin armature motor. This consists of a thyristor chopper stage which can be remotely controlled to give the desired field levels. Separate field supplies ensure good armature current sharing at full speed and enable running on a single armature.

Slow speed propulsion
A static drive unit can be supplied for a variable voltage armature supply for slow speed propulsion. Judicious setting of armature and field levels gives high efficiency at slow speed. The static drive unit consists of a unidirectional thyristor chopper which is remotely controlled.

Propulsion control electronics
A microprocessor-based propulsion control system can be provided to give automatic speed control of the main motor in all propulsion states.

RN patrol submarine leaves Portsmouth Harbour

The system controls the starting and grouping camshafts and the field and armature drive units, provides and/or checks the interlocks, and provides the automatic acquisition and maintenance of desired speeds.

The microprocessor unit contains extensive self-checking and built-in test facilities.

Automatic battery charge controller
A microprocessor-based control system can be provided to give automatic battery charging routines. The same hardware is used as for the propulsion control electronics, but with a different software package.

The charger controls the battery charging generator via the AVR.

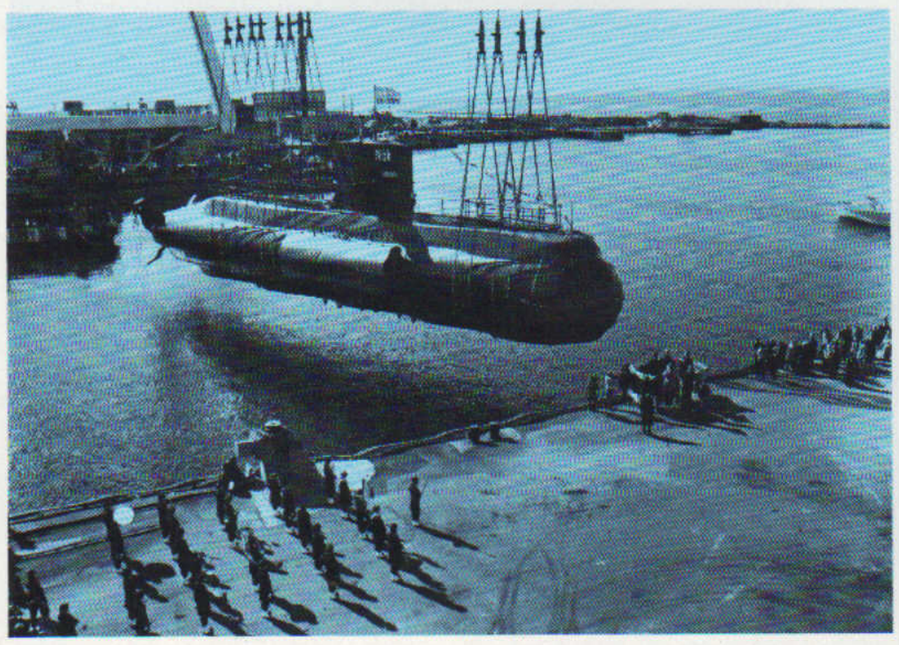
Battery health monitoring
Marconi can supply a system for monitoring the health of battery cells. Measurements can be made of voltage, temperature, specific gravity and electrolyte level, by a sensor fitted to and powered from the cell.

Power supply inverters
Static inverters can be supplied by Marconi to provide main a.c. supplies. These inverters convert the battery variable-voltage d.c. supply to 440V 60Hz three-phase supplies for distribution throughout the vessel. The converters are designed to have excellent transient performance and high efficiency.

Automatic battery charge controller

Inverter suite

Swedish launching of 1,000 ton submarine



Illustrated above is the somewhat unorthodox method used for launching the 1,000 ton Swedish submarine *Näcken* last year. The *Näcken* is the first of three submarines of their particular class to be built. The second submarine *Neptun* was launched last December and the third vessel *Najad* is still under construction.

The *Näcken* was "launched" by His Swedish Royal Highness the Duke of Halland at Kockum's shipyard at Malmo in the south of Sweden. The 1,000 ton submarine was gently lowered into the water by Kockum's gigantic crane, one leg of which is visible in the background.

The *Näcken,* or *Näk* in its diminutive form, is the name of a legendary Swedish water sprite. These vessels represent some significant advances in submarine technology using the most up to date electronic equipment including Marconi inverters and degaussing equipment. The vessel requires only a small crew. Marconi engineers were present at the launching.

New Surveillance radar for Royal Navy

Marconi Radar has supplied a new surveillance radar system for the British Navy. It is seen here fitted on HMS *Invincible.*

Eventually it will be replaced by the S1030 surveillance and target indicator (STIR) radar at present nearing the completion date.

Marconi Radar has supplied HMS *Invincible* with a large amount of equipment including the Sea Dart tracker radar seen forward of the bridge.

Seawolf in Service

HMS *Broadsword* is the first of the Type 22 anti-submarine frigates to be fitted with the world's finest anti-missile missile system. This is the Seawolf/GWS25 guided weapon system being fitted on Royal Navy ships to provide them with the most effective defence available anywhere against air and ship-launched missiles.

Marconi Radar is the prime contractor for this advanced weapon system and is responsible for the total electronic package.

Utilizing Marconi Radar electronics and antennas and the British Aerospace Seawolf missile, Seawolf/GWS25 possesses a unique defence capability against a wide spectrum of targets. In particular, it can track and destroy a greater variety of anti-ship missiles and aircraft than any known comparable system in production. Seawolf/GWS25 is a point defence anti-missile system designed to give ships, of frigate size and above, a powerful means of defending themselves against the missile and close air and surface threats of the 1980s. The system is capable of operating effectively under severe environmental conditions, and its fully automatic response to threats, ensures that any incoming missile or other target will be engaged.

The action sequence for the Seawolf/GWS25 system, starts with the detection of an incoming missile target by the L-Band pulse doppler radar. Target bearing, range and velocity are automatically extracted and fed into the surveillance data-handling computer. A small number of consecutive detections is sufficient to enable the computer to form an unambiguous track on the target for automatic threat evaluation. The IFF system first identifies targets which are potentially hostile and then the computer compares the characteristics of the tracks with a stored table of criteria for threat assessment. In the event of an immediate threat the appropriate tracker/launcher combination will be selected to engage it. All the above operations take place automatically within only a few seconds of initial target detection.

Target acquisition

When a tracker and launcher has been selected to engage a particular target, target data is passed to the tracker which, under the control of the tracker computer, slews to the indicated bearing and then commences a search in elevation.

Once the Marconi tracker has detected the target it "locks-on" for bearing, elevation, range and velocity and starts to track the target. Radar tracking will be used for both the target and the missile, unless the target is at low level and the quality of radar tracking is degraded in elevation; in which case the system will automatically switch to the television mode.

The television equipment includes split optics to provide separate tracking channels for both the target and Seawolf missile and the method of operation is similar to the radar mode.

The missile installations includes a six-round launcher, which is capable of rapid rates of fire and of firing salvoes. Hand loaded, auto-controlled, with high slewing rate and pointing accuracy, the launcher also provides all weather protection for the Seawolf missile.

Trials have included stringent climatic and durability tests carried out on prototypes of the equipments. Both surveillance and tracker radars have proved their worth against various targets in heavy clutter environments. The targets successfully engaged included Mach 2 Petrel rockets and 4.5in shells.

A Seawolf missile at launch

Seawolf surveillance and tracking antennas

The complete control systems capability

As a foremost supplier of Royal Navy equipment, the following describes the activities of the Control Systems Department of Marconi Radar Systems at Leicester. This department has been associated with naval and military equipment since the 1930s. It concentrates most of its effort in the defence field and has an annual turnover of several million pounds.

Over the years the Control Systems Department has designed, developed and manufactured a wide range of electrical control systems for naval use, most of which have been sponsored or subsequently adopted by the Ministry of Defence (Navy) and many foreign navies.

The department is in a position to act as a main contractor for major projects. This can cover all aspects from the initial feasibility study, through project definition, design, development and manufacture to installation and commissioning, training and post-design services.

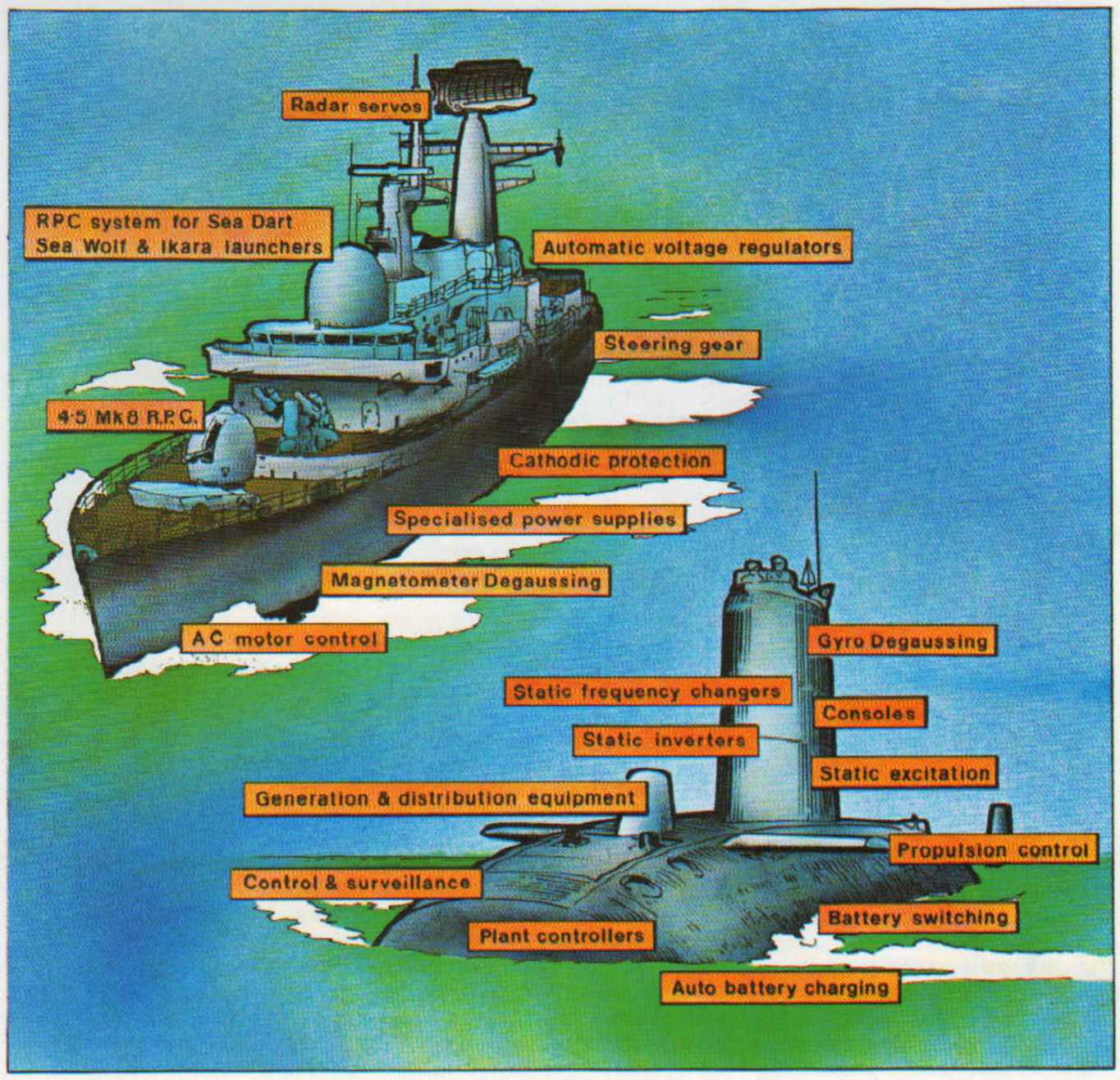
One of the department's main areas of activity is in power servo drives for weapons, and Marconi Remote Power Control (RPC) equipment is found on nearly every gun mounting and missile launcher in service with the Royal Navy. A typical RPC involvement includes systems for the 4.5in Mk. 8 gun, the RN Ikara missile launcher, the Sea Dart missile launcher and the A/S Mk. 10 anti-submarine mortar.

Launcher power controls have also been designed and supplied for the Seaslug, the first guided missile in the Royal Navy and for the latest Seawolf system.

Another main area of activity covers a wide variety of equipment and machinery controls for naval vessels. This comprises primary and secondary plant for both surface ships and submarines, including power generation, distribution, conversion, and control and surveillance equipment. Much has become standard equipment for the Royal Navy and certain Commonwealth and foreign navies.

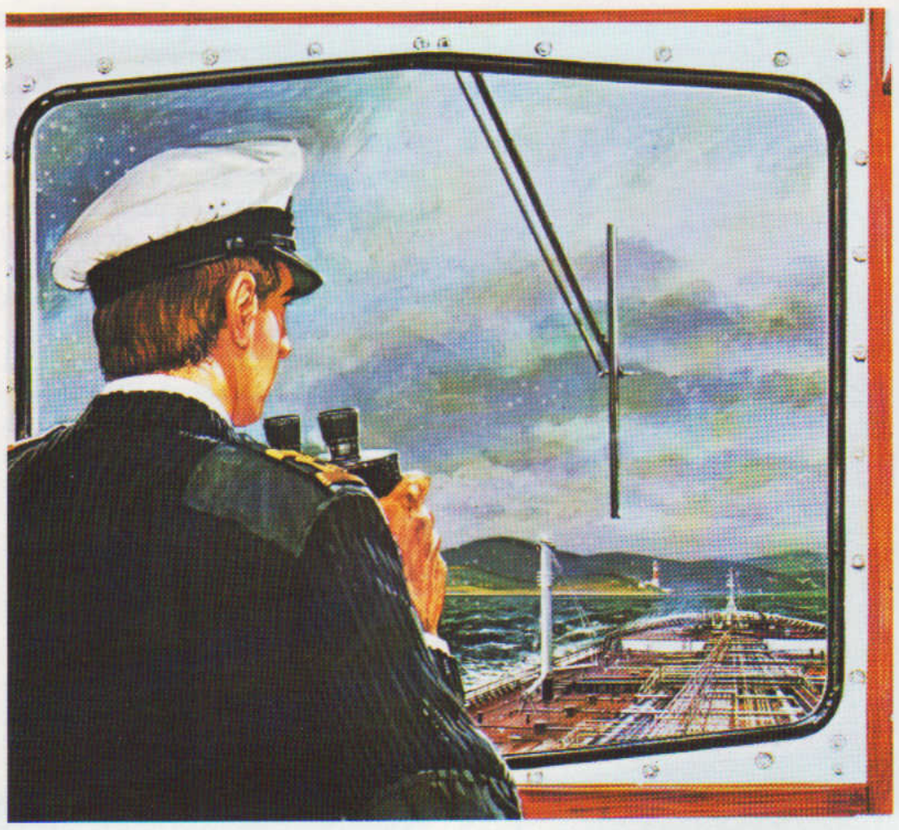
The department also has a comprehensive capability in degaussing equipment including gyro controlled and magnetometer controlled systems, and a wide involvement in ship's electrical systems.

Marconi Radar has been assessed against Defence Standard 05-21, and became one of the very first companies to be approved at the first attempt.



Big ship handling simulator contract

£1M maritime trainer uses Tepigen



An order, valued at nearly £1 million has been received by Marconi Radar from the Department of Industry, as prime contractor for the supply, installation and commissioning of a ship handling trainer for use by a maritime college in Britain.

Marconi Radar will employ the company's well proven computer generated imagery system, Tepigen, allied to a Decca ship simulator bridge, to provide an advanced all-weather, day and night training system.

Tepigen, or television picture generator, is a completely new technique for producing and displaying synthesized scenes from a computer only. This is done without the intermediate use of a TV camera, models, video tape or film. The computer stores the scenes in its memory. The scenes may be a real, or an imaginery arrangement of ships, islands, coastlines, aircraft or land views.

In the maritime simulator, the view from the simulated bridge changes in accordance with the conning of the particular ship which is the subject of the simulation exercise.

At the same time the level of natural light is varied automatically to suit the time of day and the weather conditions prevailing. Mist and fog and possible hazards may be introduced. No particular knowledge of software or of computers is required to set up the scenes to be used during a simulation exercise. It is a feature of Tepigen that scenarios can be composed more easily, faster, and much more economically than by film projection and the use of solid models.

The primary purpose of the new simulator is to provide better training in ship handling to increase safety at sea. The requirements for this training have been aroused by a number of recent incidents at sea, which alerted the public to the possibility of a major ecological disaster. A Government paper issued in January 1979 outlined measures to prevent collisions and the stranding of noxious cargo carriers in waters around the United Kingdom. Amongst other recommendations the paper stated that "Simulators to provide training and refresher courses should be made available to the United Kingdom and that other countries should be encouraged to do so". It further stated that "overseas aid should be made available" for the latter purposes and that "the possibility of using EEC funds should also be explored".

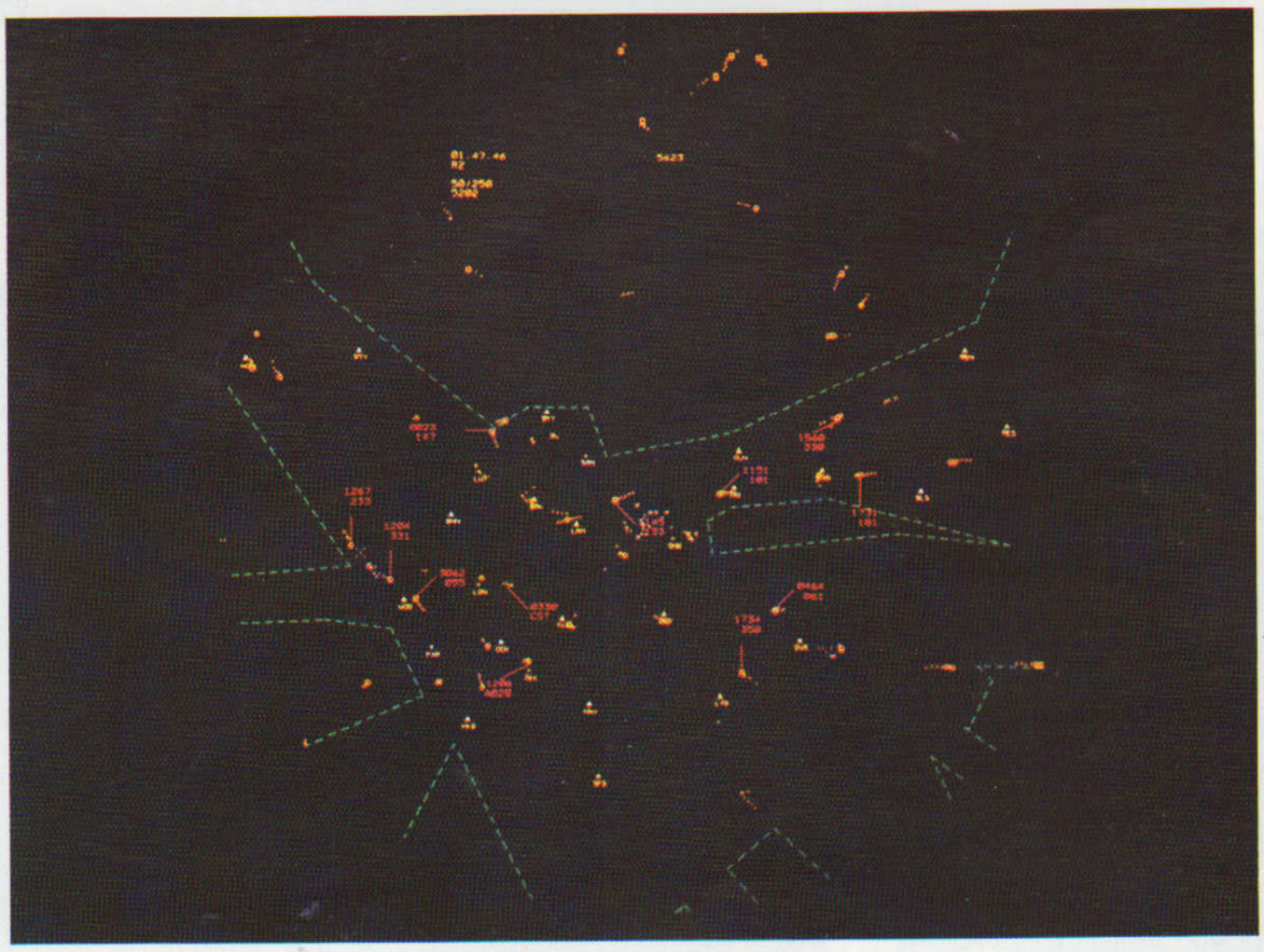
The Marconi Radar Tepigen system has already proved its success at home and overseas with contracts for gun and guided weapons aimer trainers as well as ship handling simulators. It has the most advanced specification in the world in computer generated imagery and when allied to the well-proven Decca bridge and drive equipment provides a training system of unique capability.

The ship's bridge equipment in the simulator is a developed version of the Decca Ship Simulator which has been successfully in use at the College of Nautical Studies at Warsash for nearly two years. The bridge contains all the normal "on-board" instruments, radar and navigation displays and these will be integrated with ship's performance equations developed by the Department of Industry's National Maritime Institute and the Marconi Tepigen system to provide a fully realistic ship handling trainer with the principal advantages of extreme flexibility and simplicity of preparation and authentic operation.

Signpost for seafarers

The manned Bishop Rock lighthouse in the south west of the Scilly Isles is often the first sight of Britain to be seen by mariners. Normally a Marconi Racon surmounts this famous lighthouse. The Racon is installed on a mounting above the helicopter landing platform. However, when a helicopter is due to make a landing (as in the photograph) a trapdoor arrangement comes into operation. By this means the Racon is lowered quickly and easily and then occupies an inverted position underneath the landing platform. More than 300 Marconi Racons have been sold throughout the world.

Marconi Radar's latest four colour displays



The accurate interpretation of the displayed information on a cathode ray tube is often of vital importance. The observer requires a high degree of concentration, training and skill in order to extract the maximum data from a c.r.t. display. To assist the observer in his task and prevent possible ambiguities the Marconi four-colour display is now available. This latest advance in the c.r.t. presentation of information is the high definition multi-colour penetron display. This colour display with its clear picture in up to four distinct colours has made itself immediately acceptable in the operations room. The display's superb clarity and unambiguous colour discrimination makes it a first choice for many roles where c.r.t. displayed information is in use. Examples are in defence systems where friendly and hostile targets can be differently colour coded, including any neutral targets in a third colour and the background topography in a fourth colour. Another example is in air traffic control operations where many permutations are possible such as different colour coding for arriving or departing aircraft, climbing or descending aircraft. The safety aspect inherent in the use of these various colours for specific parameters of flight would seem to be obvious. The use of colour differentiated functions in a display have other advantages for the user besides the important safety aspect.

Marconi Radar has been engaged in the design and manufacture of colour displays for over twenty years, the earliest version being a three colour large scale projector. The latest Marconi high definition colour displays incorporates penetron tubes and are based on the Company's unique and long standing experience.

Digital simulation

Marconi digital radar simulators are based on complementary hardware and software systems. By virtue of modular design, they can be assembled into a wide variety of system configurations to meet all training requirements.

The role of the digital simulator is 'environmental', in that it creates realistic working situations for training staff, under esssentially operational conditions. In these days of optimum equipment and working space utilization, it is particularly important that operators are fully conditioned to working under pressure before this occurs in 'live' operations. The scope of digital simulation is not, however, merely limited to individual controller training, but enables exercises to be conducted at system level with all control elements working together. It is now quite practical and economical to plan for simulation to cover at least 80% of training to qualification standard, with the remaining 20% carried out under operational supervision on the real system. This presents a complete reversal of formerly accepted proportions.

Unlike other training methods, which to varying degrees require manual intervention, digital systems allow precise exercise 'specification' (which may be exactly repeated if required) in order to obtain assessment of results. Not only can standards be set and maintained for individual performance and team efficiency, but also the techniques employed can be effectively evaluated and improvements made in operational procedures.

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