Radar Systems International

MARCONI

No. 19

Marconi Radar wins Europe's largest ever air traffic control order

Complete radar and communication systems for Saudi Arabia

The Saudi Arabian Government has awarded a contract worth over $500 Million to a team of three international companies led by Lockheed Aircraft International A.G. and including Marconi Radar Systems Limited and Federal Electric Company ITT. The three companies have carried out a detailed survey and extensive evaluation of the Air Traffic Control requirement in Saudia Arabia for the Civil Aviation Department, and after negotiation with the Saudi Arabian Government, the prime contract was recently signed with Lockheed for the modernization of the whole air traffic control system of the kingdom, with Marconi Radar and Federal Electric as principal sub-contractors.

Marconi Radar Systems Limited have a large slice of the task, concerned with the provision of air traffic control radars, display systems and communication systems. System design and further survey work is already well under way, and the manufacture, installation and commissioning of the total complex will be completed over the next three years. Mr Sutherland, Managing Director of Marconi Radar speaking of this contract said "This vast and exciting new project continues our close association with the Kingdom of Saudia Arabia and represents further major export success for our new ranges of equipment. This contract confirms Marconi's position as a world leader in the supply of turnkey air traffic control systems".

The Marconi Radar share of the project, which also includes the products of Marconi Communication Systems Limited, is truly comprehensive, in that it includes the integration of the radar, display and communications into the national system, together with the full backing of spares, documentation, training and support services.

Land of Achievement

Saudia Arabia has made remarkable strides forward in the past few years. Supported by huge oil revenues the Kingdom has embarked on a programme of industrialization and social improvement on a huge scale. In a country of 830,000 square miles about half of its 5M inhabitants cling to the traditional nomadic life, the remainder being mostly farmers in scattered settlements and townspeople.

A new five-year plan calls for an investment of $142 billion and covers road improvements, housing, drinking water supplies and irrigation, expansion of ports and harbours, investment in capital industry and increases in schools, vocational training and universities.

This new contract is part of the improvement and expansion of aviation facilities and is in line with the far reaching and forward looking policies being pursued by Saudia Arabia.

Meeting the Challenge

Marconi Radar was chosen to take part in this important contract, not only because of the suitability of its equipment but also because of its proved ability to tackle undertakings of this scale and complexity. The company has always concentrated its efforts towards system design and execution and has been instrumental in providing some of the world's largest and most important radar schemes, both civil and military.

As a result it has built up a considerable fund of experience and has formed expert teams capable of tackling the many aspects of large-scale contracts. The execution of large projects of this nature necessitates the co-ordination of many independent disciplines and activities. They include site preparation and building construction, system engineering, equipment development, production delivery, installation, commissioning and, in many cases, training of operators.

They involve various departments with Marconi Radar, outside suppliers and specialist sub-contractors, other companies within GEC-Marconi Electronics group (as in this instance, Marconi Communication Systems) and the General Electric Company.

The co-ordination of all these activities is the function of systems management, which has available to it the most advanced techniques to ensure maximum efficiency, including computer processed PERT networks.

Only a company with Marconi Radar's breadth of experience and depth of resources can successfully handle requirements on this scale, and ensure a cost-effective, totally compatible system.

Farnborough International '76 special Pages 2&3

Marconi Radar at Farnb

Seawolf—search and track

Seen for the first time in public the Seawolf GWS325 weapon system's tracking and surveillance radars are being shown on the Marconi Radar stand.

Beacuse Seawolf concentrates most of the electronics of the system in the onboard equipment, the missile containing only a minimum, Marconi Radar was given the overall systems responsibility for this advanced weapon system.

After exhaustive and successful land based trials Seawolf/GWS 25 is now undergoing extensive sea trials in HMS Penelope.

Seawolf/GWS25 had to meet one of the most exacting technical specifications ever laid down for naval short-range anti-missile/anti-aircraft defence of frigate class ships. The requirement of a low cost, small, lightweight missile with no on-board testing meant that the necessary sophistication is concentrated in the onboard electronics.

It is capable of meeting wide ranging threats from missiles and aircraft from very high to very low altitudes at varying speeds up to in excess of mach 2.0.

The echoing area is extremely small and must be seen in severe weather and sea conditions, even close to land.

Reaction time in these circumstances must be very rapid with no time for human intervention. The system, therefore, is completely automatic from the first detection to the final interception, once the peace/war switch has been made.

The systems uses line-of-sight guidance with differential tracking and a microwave radio command link. Two new radars working as a back-to-back S-and L- band assembly have been developed for the systems, and cover all requirements for

Surveillance antenna of GWS25/Seawolf.

air and surface surveillance. The L-band radar is a high-powered, self-adaptive radar, with sophisticated data-handling which resolves both velocity and range ambiguities, initiates tracks, carries out threat evalution, takes the engagement decision and performs attack allocation by assigning a tracker and feeding it track co-ordinates. IFF (Indication Friend or Foe) and electronic counter-counter-measures (ECCM) are also incorporated.

The new tracker radar, operating in the X-band, is also a self-adaptive system and is capable of controlling and directing a number of Seawolf missiles to interception, by using differential tracking and providing radio control for line-of-sight guidance.

The system also includes a differential tracking optical television system, produced by the Electro-Optical Systems Division of Marconi-Elliott Avionic Systems. This monitors the firing and is capable of taking over missile control during flight should circumstances demand.

The missile installation includes a six-round launcher which is the responsibility of Vickers Limited and which is capable of rapid rates of fire and of firing salvoes. The missile made by the British Aircraft Corporation, has a solid propellant boost motor and is capable of supersonic performance.

New antenna gives increased range

25ft S600 Series Antenna

The S600 series of transportable radars has achieved remarkable success. Designed to a modular format, successive improvements in system components throgh advances in technology have been incorporated without compromising design status or availability.

The latest enhancement is the S1061, a larger antenna with a 25 foot aperture, incorporating the patent Marconi squintless feed and retaining transportability. The increased range performance and reduced side-lobe level gives the new S624 and S625 radars even better detection and ECCM capability, although still using the current transmitter/receiver and signal processing equipments.

For transportation the complete reflector, feed and turning gear assembly is constructed within an ISO freight container format which enables it to be manoeuvered using standard semi-trailers and handling equipment. One man can fold down or re-erect the complete antenna.

FARNBOROUGH INTERNATIONAL 76

5-12 SEPTEMBER 1976

At Farnborough Internatio four major new systems, b

Since the last Farnboro success in the provision of market, culminating in the front page.

Allied to this increased a of its effort to the develop full advantage of latest te distributed data system is

Furnace — new autom

Marconi automated air defence systems provide the means for virtually instantaneous assessment of air situations, methods of control and advice on the most effective use of the defence resources. Controllers are left free to make vital decisions and the very necessary time advantage is gained to enable retaliating forces to be used with maximum efficiency against any threat.

The FURNACE system, being presented publicly for the first time, provides display processing and intercept capabilities sufficient for all levels of command, from control and reporting posts through to complete air defence operations centres. A typical configuration provides automatic tracking of up to sixty aircraft and interception control of up to six simultaneous engagements by manned interceptors or SAM batteries within the confines of a single transportable cabin, the S5014.

The adoption of program controlled systems, using replaceable disc stores, allows changes in weapon systems,

Marconi Radar—other pro

S800 low cost weapon radar

Proof of the effectiveness of the Marconi 800 Series radar was amply demonstrated when it completed firing trials at HMS Cambridge, The Royal Navy's gunnery range, last year.

On these trials every operable shell fired was observed to be on target — a 100% record of accuracy.

The 800 series was designed as a low-cost, highly adaptable radar range, incorporating tracking and surveillance radars operating in the X-Band. This frequency was chosen to meet the need for lightweight and compact equipment for installation in small ships or military vehicles, whilst at the same time providing radar with high performance in fire control systems.

Typically, it is designed for use with control systems for guns with calibre from 20mm to 4.5in, short range point defence missile systems and sea-skimming missiles such as Exocet or Penguin.

X-Band gives good detection and tracking performance against air targets and is particularly effective against surface targets, a major requirement for fast patrol boats and coastal defence.

A megnetron transmitter offers frequency tuning over 10% of its band to avoid jamming, and at the same time maintain the stability necessary for the incorporations of MT1 signal processing, necessary for detecting sea-skimmers or low-level aircraft which take advantage of the natural cover provided by sea or terrain.

Typical among the systems incorporating the 800 Series is 'Sapphire', which has resulted from a collaborative development by Marconi Radar and Sperry Gyroscope. The 'Sapphire' system is capable of maintaining rapid and accurate control of small and medium calibre guns, against air, surface

800 Series tracking radar

and shore targets. The system consists of a Marconi 800 Series tracking radar, incorporating television tracking, a Sperry digital predictor and a weapon control console. 'Sapphire' was the system involved in the successful trials at HMS Cambridge.

The 800 Series has been sold to the UK Ministry of Defence for the Royal Aircraft Establishment who are using it for control and trajectory measurement purpose at the Larkhill and West Freugh ranges.

Simulation or

Simulation systems form a vital and indispensible part of training. Many of these systems, particularly those involving large teams of operators such as radar defence systems, require extensive installations to which the teams must come for periods of training.

Realistic training at operational positions usually only occurs during set exercises, and the opportunities for operators to perfect their procedures in other circumstances are deficient because of the lack of life like conditions.

In the case of radar installations particularly for small units, such as ships, Marconi Radar have introduced systems for on-the-spot training which provide fully realistic conditions for the operational team.

Called STEG (Simulated Timebase and Echo Generator) the system brings the simulator to the operator, whether ashore or afloat. Designed for use in a normal working environment, the complete STEG assembly consists of a main unit to which a hand-held keyboard is connected by a flexible lead. The

Automatic visibility measu

The Marconi IVR (Instrumented Visual Range) system is designed to measure and record automatically the range of visibility at an airport runway.

The continual and accurate presentation of this information is not only a vital aid to safety but also helps to maintain schedules and avoid diversions in the presence of unfavourable weather.

The IVR Mk2 provides facilities for both Category 2 and (with alternative modules) Category 3 airfields, and is capable of handling up to six field-sites on various runway configurations.

The system employs a variable number of unattended field-sites which are installed alongside the runway and which gather photometric data used to assess visual range. These optical systems are housed in special casings and remain operable in rain, hail or snow, fully protected from sand, dust, insects and birds.

Information from the field-site is transmitted to a central processing unit, where a computer scales the optical data against calibrated references, assesses the visual range and displays it digitally in a form compatible with international ATC operational procedures.

The system is in service at most major British airports and at Cairo, Prague, Rujadh, Jeddah and Dharan.

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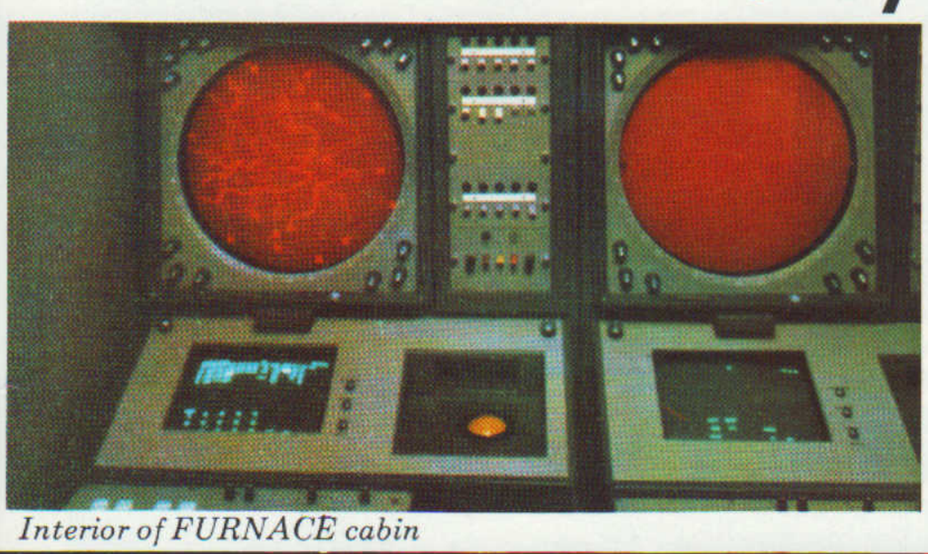
onal 76 Marconi Radar is showing for the first time rief details of which are given below.
ugh Marconi Radar has continued its considerable large scale radar systems particularly in the overseas ir largest order ever, news of which is given on our

ctivity Marconi Radar has been devoting a large part ment of new and more effective systems which take chniques. The wide-spread success of the Locus 16 prominent among these.

nated air defence system



Interior of FURNACE cabin

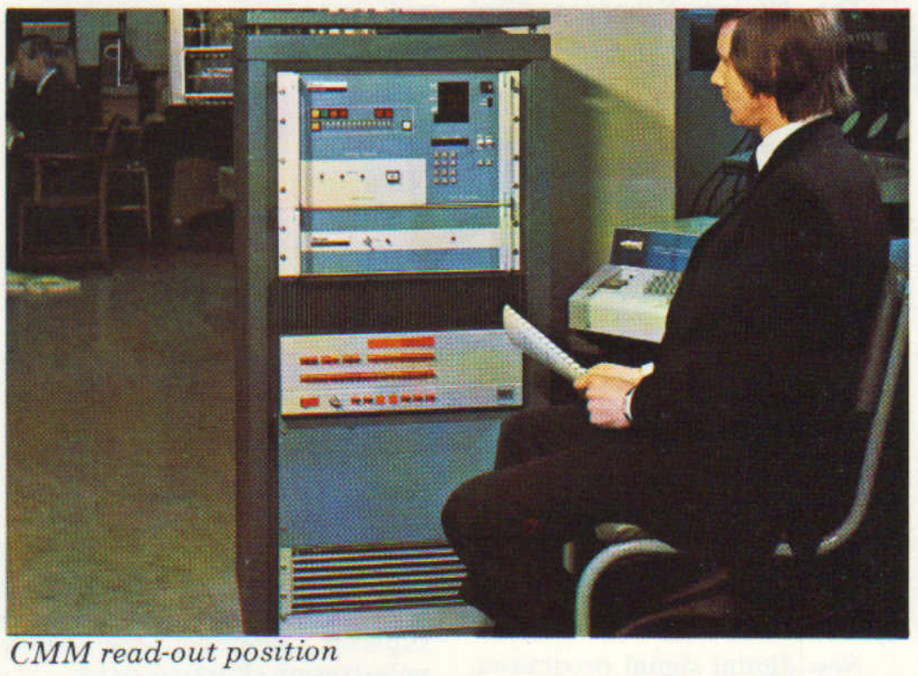
tactical procedures and system states to be accommodated quickly and easily. Adoptive programs in conjunction with rapid man/machine communications using electronic data displays and touch mask data entry, direct operators along a logical decision tree which minimises operating times and reduces the possibility of errors when working under stress.

The presentation at Farnborough illustrates the system architecture and capabilities provided at all stages of the air defence command structure.

System management by CMM

The management of large systems whether for defence, civil aviation or communications, can be greatly assisted by the application of computer-based techniques.

Marconi Radar have developed Computer Modular Monitoring (CMM) to ease the problems of system management. It puts the power of computerized instru-



CMM read-out position

mentation at the disposal of the operator gathering data from local and remote equipment and presenting information on its status and availability.

CMM can provide detailed equipment information and present it in a simple form, as well as offering complete system checking and automatic fault location.

The system consists of a Control Centre, Data Selection Units (DSUs) and a Digitizing and Control Unit (DACU).

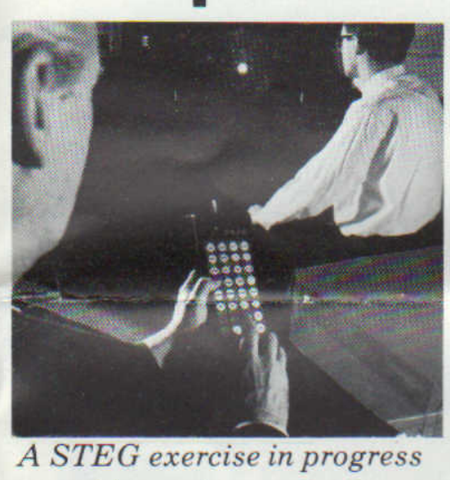
At the Control Centre, the central processor makes the necessary interpretations of the gathered data, remotely controls the equipment being monitored and holds the conclusion ready for display on command. The present status of all the main services in all the stations can be controlled and supervised from a Central Office by means of a keyboard and a display. Records can be printed or punched automatically and, if required, can be sorted and abstracts prepared.

DSUs, which are not much larger than a box of matches, are implanted in all the main assemblies to gather analogue, digital, time, pressure and temperature information in a logical manner. They collect the desired information and multiplex it over a single pair of wires to the DACU, which as well as controlling and displaying the information being monitored locally, digitizes it for transmission over a normal telephone channel to the Control Centre.

oducts

Though not on display at Farnborough this year, there are many Marconi Radar products which are of improtance to avionics, among which the following are of particular interest.

the spot



A STEG exercise in progress

assembly can be coupled to any radar PPI display through an Intermediate Unit. The system enables the operator to use his own display as a simulator at any time that it is not in operational use. STEG will generate or reconstruct critical radar situations which can be varied, stopped or repeated at will by operating the keyboard. The simulator will reproduce radar echoes from aircraft, surface craft, clutter, thermal noise, wind and blind arc.

The simulator can either superimpose echoes on a background picture derived from a radar receiver or can generate totally simulated pictures.

Tepigen – effective training

Computer Generated Imagery (CGI) is a radically new technique for producing pictures, in which a television picture is synthesized wholly from a computer without the use of a TV camera, videotape or film.

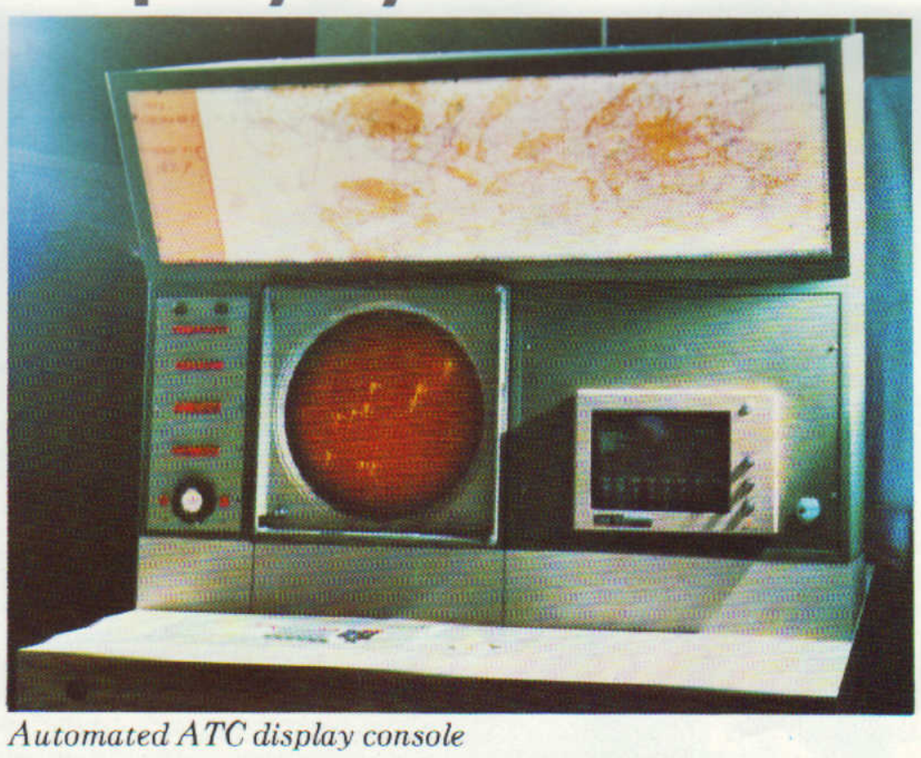
Pictures produced in this way can be manipulated to give a view which changes as the observer changes his direction of vision. Marconi Radar has developed a system under the name of TEPIGEN (Television Picture Generator) which harnesses CGI to provide a range of important applications including aircraft flying, vehicle driving, weapon aiming, optical tracking, ship handling and periscope viewing.

In TEPIGEN the performance characteristics of the 'vehicle' are modelled mathematically in a simulation computer. In response to the operator's use of the controls, the computer

A tank generated by TEPIGEN

continuously updates the reading and position of the vehicle. This information enables the TEPIGEN scenario computer, which contains a mathematical model of all the scenery within 'viewing' distance, to calculate what is within the observer's field of view, where it is located and how it is orientated. The Picture Generator then visualizes the scene as video signals suitable for television projection, direct viewing or viewing with infinity optics.

Automated ATC display system



Automated ATC display console

Marconi Radar has used its extensive experience of air traffic control and data processing to produce a range of automated ATC display systems as a means of reducing controller stress and workload, thereby enabling more efficient and expeditious use of the available airspace.

These systems use the capabilities of the Locus 16 computer to provide radar data processing and flight data handling facilities. To give cost-effective solutions to a broad spectrum of operational requirements, four standard packages have been designed, each having a combination of facilities appropriate to the needs of approach, terminal area, en-route or area controllers. At Farnborough the en-route sector control system is being shown, using 16in and 23in displays.

This uses primary and secondary plot extracted data fed by narrow band links from the sector surveillance radars. Trail dot presentation for combined or separate plots is enhanced by touch labels including callsign or SSR code, different height functions and controller ident. Digital maps, range/bearing readout, altitude filters, quick-look, minitabs and silent handoff are included as standard facilities. Available as options are full auto-tracking on secondary and/or primary plots and flight data entry from local or remote video data terminals.

As a special feature, controller plot designation, normally provided by a tracker ball, is being additionally provided by a Digilux touch mask on the 16in display.

Marconi digital simulation

Marconi Radar simulation systems are based on completely digital techniques. By virtue of modular design, they can be assembled into a wide variety of system configurations in order to meet the training requirements of both Air Defence Control and Air Traffic Control at differing levels of complexity.

Digital simulation offers very much more than just a replacement for earlier analogue training schemes. The role of the digital simulator is 'environmental', in that it creates realistic working situations for training staff, under essentially operational conditions. In these days of optimum air space utilization, it is particularly important that operators are fully conditioned to working under pressure before this occurs in 'live' operations. Digital systems allow precise exercise specification (which may be exactly repeated if

Marconi displays in the Navy's computerized tactical trainer

required) in order to obtain assessment of results, so that individual and team efficiency can be judged and improvements made in operational procedures.

The system is driven by a high-speed general purpose computer with a store configuration to suit the particular requirement. This interfaces with simulation peripheral hardware.

ement IVR

VR field site

50 cm — still going strong

One of the most successful and effective radars ever designed for air traffic control, the Marconi 50cm S264, has been given a new lease of life by the addition of a replacement kit that not only enhances its performance but also improves its reliability still further.

Marconi S264 ATC radar at Wellington NZ.

The United Kingdom Civil Aviation Authority uses Marconi 50cm radars almost exclusively for radar coverage of the important UK air routes. Marconi in conjunction with the CAA carried out an extensive study to see how modern techniques could be applied to maximize the performance of these radars.

As a consequence Marconi Radar was awarded a £½ million order to improve the performance and reliability of the CAA's 50cm radars. The contract was aimed at providing improved radar visibility of aircraft and significantly reducing the time needed for equipment maintenance.

New digital signal processors, type S7100, were incorporated which significantly improved the moving target indication (MTI) performance and increased the visibility of aircraft to radar in conditions of heavy ground clutter. New low-noise solid-state receivers (type S2050) and the replacement of valve circuits in the transmitters by semi-conductors also contributed to performance improvement and to the overall reliability of the radars.

The Civil Aviation Authority's installation programme for the modernization of nine Marconi 50cm radar sites was completed in one and a half years. At certain sites the improved reliability has allowed the equipment to be reconfigured from dual to single channel installations, the surplus equipment being used to improve other radars, and the equipment procurement made to cover more sites than initially planned.

Following on this programme of improvement for the UK, air traffic control radars, New Zealand's Ministry of Transport, Civil Aviation Division, awarded a £300,000 contract to Marconi Radar to update the 50cm radar system for Wellington air traffic control centre, as the first stage of a total modernization programme for the Wellington radar service. Marconi Radar supplied, in addition to the new solid-state receiver equipment and digital processors, new antenna equipment and displays.

Wellington Radar was originally supplied by Marconi in the early 1960's as were all the New Zealand ATC radars. It had been in use for 16 hours a day during its 13 years of operation and the updating provides better performance and facilities to meet the demands of increasing air traffic densities. The performance of the the radar head has been improved by the installation of a new high-cover reflector to give better coverage and a new feed system gives superior sidelobe and cross polarization characteristics.

In additon air traffic controllers now have Marconi Radar's latest S3017 displays together with three S3202 video map generators. The modernization was carried out without interruption to the service except for a short period while the new reflector was fitted.

Marconi Radar have now received an order worth £230,000 to improve the 50cm radar at Kastrup, the airport which serves Copenhagen. The provision of transmitter conversion kits and solid-state receivers together with digital signal processors for the dual electronics S264 A/H radar at Kastrup will extend, for many years to come, the radar which was originally installed in 1961 and which has given excellent service throughout that time.

Other orders for these simple conversion kits are being negotiated at present, and there is no doubt of their effectiveness in prolonging the life and improving the performance of one of the world's most successful ATC radars.

SEEC — A real first in radar

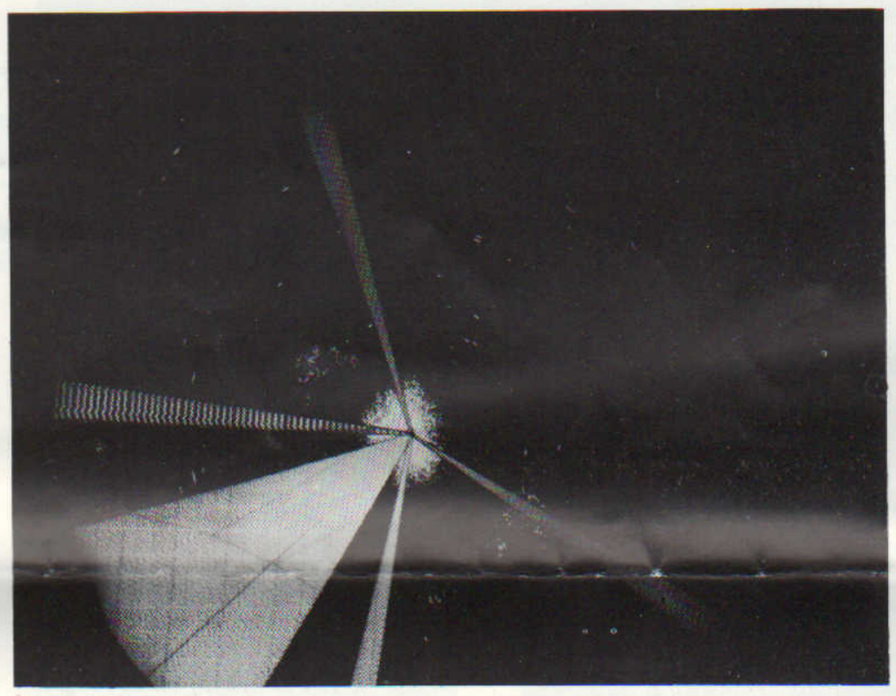
Marconi Radar has achieved yet another first in radar simulation product development with SEEC (Simulation Equipment Electronic Countermeasures).

The United Kingdom Ministry of Defence has placed a contract for the evaluation of a facility at an RAF Sector Operations Centre to provide a simulated electronic warfare environment at radio frequency level. The system and its associated measurement together are designed to verify radar performance against both active and passive (chaff) jamming on a continuous real-time basis and provide fully realistic technical and operational personnel training.

As part of the overall electronic counter-counter-measure (ECCM) strategy most air defence radar systems are normally fitted with technically advanced receivers and anti-jamming circuitry and use tactical control techniques to locate and over-come the enemy jammer. Use of own aircraft to test the system involves four major limitations; international agreements on radiated power, adverse effects on the electromagnetic environment, security and operating costs. Thus functional checks of the facilities and practice of techniques remains largely theoretical, with some aspects never being experienced. To overcome these difficulties and to ensure a high state of operational readiness in peacetime, Marconi Radar have developed the SEEC system.

SEEC provides a dynamic simulation of airspace activity and local electromagnetic environment which can be injected into the "front end" of an operational radar. For the first time it is possible, under controlled conditions, to co-ordinate the capability of a radar station for electronic counter-counter-measure and associated control tactics in the presence of an apparent airborne jamming threat.

The simulator can generate a number of aircraft responses (skin echoes) which may represent either 'quiet' aircraft or



jammers. A comprehensive range of jamming types and power levels is available. The tracks can be fully controlled, either by computer stored flight-plan or by control instructions which are accepted at a number of 'pilot' consoles, having facilities for "real-time" input/output of control data.

SEEC comprises a number of hardware and software modules which can be configured to suit any known 2D or 3D radar requirement. It is believed to be the first general purpose designed equipment of its type to be marketed.

V-MATS is derived from TEPIGEN shown here.

Training Navy aimers

Marconi Radar has developed a new versatile multi-aimer trainer, V-MAT, and is to supply the first system to the Royal Navy at a cost of about £½ million.

The new system, will provide training for up to eight missile aimers simultaneously, creating highly realistic pictures in their optical sights.

V-MAT is based on the Marconi Tepigen (Television Picture Generator) system which, using computer generated imagery techniques, synthesizes television pictures wholly from a computer. The V-MAT simulator gives students the opportunity to practice tracking targets which have the appearance of, and react as, real targets. The basic system is easily adapted to simulate various naval roles, using missiles or gunfire, by changing the software and the type of the controls used by the student. Marconi Locus 16 data-processors are used to drive both the picture generation and the control of the exercise.

The instructor can monitor the progress of his students continuously from the Exercise Control Console where he can also introduce a wide variety of problems for the students to solve. A print-out of the 'figure of merit' of each student's performance is immediately available as well as recording and replay facilities.

Visual aiming systems are currently receiving a boost as a result of the development of infra-red and low-light optical sights whose performance is unaffected in hostile electronic warfare environments, and this enhanced interest in optical tracking has created a demand for a training system such as V-MAT. The cost of fuel, the cost of missiles and the danger involved in certain exercises has made 'learning on the job' more difficult, but the V-MAT type of training is particularly cost-effective because it rapidly identifies those trainees who have a natural aptitude for the very exacting tasks of tracking and aiming.