

MARCONI IN RADAR

A brief account of the Marconi Company's activities in the Radar field.

In the past ten years the Marconi Company has designed, constructed and installed some 60 to 70 major radar installations and has supplied radar equipment to the value of £50,000,000 to nearly 30 different countries. During the same period the rate of expenditure on radar research and development has approached £1,000,000 per annum.

The story of this Company's activities in the Radar field begins in the early years of the War, when it was called upon to design and install the transmitting masts and arrays for the many new stations which were required for the extension of the radar defence chain along Britain's south and west coasts. In addition to this air defence work, the Company made a major contribution to Naval radar during the War by developing and manufacturing a completely new air warning equipment.

The end of the War resulted in large-scale cancellations of radar production contracts for the armed forces, but despite this the Company was able to develop its interest in radar during the immediate post-war period by supplying equipment to various foreign navies, assisting with its installation and training personnel in its use.

The success of these activities encouraged Marconi's to investigate the ground radar requirements of foreign countries. This resulted in important orders and led the Company to embark upon the production of an improved version of centimetric radar equipment made during the War.

By 1948, the rapid expansion in the Company's radar business, resulting from foreign orders, necessitated the setting up of an adequate sales and manufacturing organization, and the Services Equipment Division, as Radar Division was originally called, was formed under Mr E. N. Elford as Manager.

Also in 1948, the worsening international situation led the Air Ministry to decide upon urgent action to improve the state of Britain's radar defences. At the end of the War, many radar stations had been closed, while in others the technical equipment had been sealed up in the operations buildings ready to be brought back into use if the need arose. It was now necessary to restore the condition of these stations and improve their performance.

That year the Company was approached by the Ministry of Supply to undertake a study of the complete radar defence of this country and to make recommendations for its improvement. Such a request had never before been given to a commercial organization, as until then research into radar defence had been one of the closely guarded secrets of the Government Research Establishments. In the autumn of 1948 a contract was signed to provide consultant services on the radar defence system of Great Britain. This provided an opportunity for detailed examination of existing radar techniques and a number of proposals were made by the Company to improve on wartime designs. The lines for future development were also suggested, and these were subsequently to form the basis of much of the later work to be carried out to improve the static defences of the United Kingdom and to build mobile convoys for use overseas. The study was undertaken by Dr Eastwood, who had been on the Headquarters staff of No. 60 Group during the War, and is now the Company's Chief of Research. He was assisted by a team of experts and they used Trimley Heath G.C.I. station for experimental purposes.

In 1949 the urgent action taken by the Air Ministry to bring back a number of radar stations into operational use, gave Marconi's an opportunity to employ its radar skill on a large scale for the first time. Buildings containing radar equipment, which had been sealed up for two years, revealed on being opened that extensive reconditioning of the apparatus would be necessary to bring them back into operational use. Together with certain electrical engineering concerns, who had been engaged in the original construction of radar stations, the Company undertook the task of re-installing and re-equipping a number of C.H. and G.C.I. stations.

By this time Marconi's had become recognised as the leading radar engineers in this country and were required to undertake the task of re-engineering the wartime equipment for re-manufacture and use in the expanding requirements for radar cover over the British Isles.

Increases in home requirements quickly followed and the Company became engaged in re-building all the aerial arrays on the East and West coast C.H. stations. This task required the training of a number of engineers and tradesmen in techniques which had long been forgotten, for the fitting of C.H. aerial arrays had been developed during the War into a specialised art and only a number of sketches and a limited amount of test equipment remained to show how the best results had been achieved. By searching through official files, sufficient information was obtained to start large-scale manufacture of equipment needed for this programme and an installation effort was organized to complete the task in 18 months. When it was completed the United Kingdom was once again given early-warning protection by the C.H. chain of stations. This action provided a breathing space in which to design and equip a new chain to give greatly improved performance. The contract given to the Company to re-engineer the wartime units required careful examination of their working conditions and the re-design of many of the components, to take advantage of the up-to-date

techniques which were then available; it was also necessary to carry out fundamental design changes to turning gears and aerial systems.

At about the same time a contract was obtained from a European country to supply ground defence radar equipment to the value of £1,000,000. This equipment was generally similar to that used by the Royal Air Force during the War, but a considerable number of improvements were incorporated.

Also in 1949, the Air Ministry, through the Ministry of Supply, made known its intention to construct a new chain of radar stations in the U.K. This was a far reaching plan designed to make use of the latest techniques available and to secure maximum freedom from enemy attack by putting most of the stations deep underground in concrete structures. Marconi's were called upon to co-operate closely with the Air Ministry in the design of these stations, and to meet the requirements of replacing the country's radar defences the Company's resources were rapidly expanded.

The first major production order from the Ministry was for a large number of mobile radar convoys and was quickly followed by further contracts to supply equipment for the new static radar chain to be used in the defence of the United Kingdom. The re-building of the radar defences of the United Kingdom was given the code word 'Rotor', and the supply of mobile equipment for tactical use was covered by the code word 'Vast'. It was to deal with these commitments that the present organization of the Company was set up to handle radar equipment design, station planning, equipment production, installation and testing. To co-ordinate all the activities of the 'Rotor' programme, the Air Ministry set up a special Progress Committee under the Chairmanship of Air Commodore (now Air Vice-Marshal) W. P. G. Pretty. This committee started work in December 1950 and was soon holding regular meetings, to discuss production, installation and civil building requirements. The Company co-operated closely with the various departments of the Ministries and with their Civil Consultants, Messrs Mott, Hay & Anderson, who were responsible for all the building design and for progressing the site constructional work. The building programme was started in 1950 and carried through in a manner which surpassed many of the wartime efforts in speed of completion.

As a result of these large Government orders it became necessary to acquire additional manufacturing space for the production of aerial cabins and turning gears, and for this purpose the English Electric Company secured the use of a large Government factory at Accrington, and undertook the assembly of 600 cabins in 18 months. The Accrington factory was responsible for the construction of all the mechanical turning gears used in the aerial heads. Messrs Scanners, a member of the Marconi Group, supplied aerial systems and the Accrington factory assembled the complete cabins containing turning gear, aerials and transmitters, manufactured in the Marconi Works. Meanwhile, the production of display equipment for operations cabins was in hand by many sub-contractors, so that the manufacturing load was spread throughout the radio industry.

The period immediately following the War was one of acute shortage of materials and of specialised labour, and the Rotor Progress Committee was given special powers by the Government to issue priorities to industry, the Marconi Company being given ' Super-Priority ' on all orders for materials required for the programme. This priority was the highest possible at that time and ensured first call on all available specialised materials in the country.

The recommendations made by the Company in the Radar Defence Study had indicated the lines for future research, and an opportunity to carry out many of the recommendations now occurred. Under a separate contract Marconi's were required to undertake the design and development of transmitters of higher power than had hitherto been produced, of M.T.I. techniques, and of a completely new display system which would meet the needs of the Services for some years to come. This latter system was designed as a fixed coil C.R.T. display, which alone could provide the facilities of multiple head selection, video mapping, trace expansion and inter-trace marking. In less than three years a design was completed and a production plant organized to manufacture 600 display consoles and ancillary equipment. The production was planned to be completed in 15 months in order to be in step with the installation requirements of the programme.

The Rotor programme called for the installation by the end of 1953 of a large number of G.C.I. stations, which together with a lesser number of C.E.W. and C.H.E.L. stations provided the improved radar cover for the United Kingdom. In the first stage the Air Ministry and Fighter Command planned to use wartime designed equipment which had been re-engineered and at a later date to add improved display facilities when these became available. This idea was later modified and only the newly designed fixed coil display system was installed in the G.C.I. stations. In order to meet the needs of station design and layout of equipment, a special Planning Section was formed for this task and, together with various Air Ministry branches, the plans were completed and passed to the Consultants for incorporation in the building drawings. By 1951 the first site became ready for installation.

Parallel with the design work, development of equipment was being carried out and as soon as designs were settled, production was planned for large scale manufacture. The production of equipment was a task comparable with any that the Company and its associates had undertaken and involved the setting up of a special Contracts and Production Section to co-ordinate the efforts of nearly 100 sub-contractors, including some of the largest firms in the country, who were engaged in the production of radar equipment. In all, several hundred major units of equipment had to be designed, scheduled, manufactured and transported to each of the installation sites.

The production of the new fixed coil display system involved the close co-operation of the design engineers and the production staff in order to

achieve the volume of output necessary to sustain the installation programme. Altogether, over 1,620 display consoles of all types, and ancillary equipment, were manufactured.

The installation programme commenced in 1951 and grew in volume until up to 20 sites were in hand at the same time. In the final stage of the programme the Company was handing over operational stations at the rate of two sites per month. This programme necessitated the expansion of the installation staff of the Company to 300 engineers and tradesmen, and further, to assist in the installation task, a number of sub-contractors provided specialised effort. At the peak of the programme about 500 men were engaged on field installation duties. Installation of the first G.C.I. station was completed in December 1953 and work continued until the middle of 1955. By then, the main task had been achieved, within a few months of the final plan.

With the conclusion of the installation of these major stations the Company undertook to provide maintenance teams to carry out the initial periodic maintenance which the Air Ministry, due to the rapid expansion of the radar chain, was unable to tackle; also, for a period of four years down to the present time the Company has been providing a Senior Engineer resident on each G.C.I. station to assist the R.A.F. in the operation and maintenance of their equipment.

The first phase of the Rotor programme was followed by two contracts which provided for the re-building of C.E.W. stations with fixed coil displays and the subsequent construction of further stations to give additional cover to approaches to the British Isles. Some of these later stations were constructed on remote Scottish islands, which presented considerable problems of transportation and access, and with the co-operation of the Army and Air Force, equipment was despatched by ship and by landing-craft to be installed by the Company.

With the completion of the island stations Marconi's can claim with some pride and justification to have been responsible for the design and construction of all the major radar stations in use by the Royal Air Force in the United Kingdom. It is perhaps interesting to note that the total installed capacity of Marconi Radar transmitting equipment on all Air Ministry stations exceeds some 150 MW and the number of installed displays is in excess of 1,200.

A further development of the radar defence chain has been undertaken by Marconi's by the introduction of large scale displays using 21" C.R.T.s and an improved Type 7 aerial system. The Company has also undertaken design work to integrate into the Rotor system radars manufactured by other Companies and American radar equipment, and is solely responsible for the integration of this equipment for N.A.T.O. use and for use on the British radar stations. The Company is now engaged on the installation of these and further major developments.

Mention should be made of G.C.I. stations which were installed in Germany for the Air Ministry during 1956 when the Company was asked to co-operate with other manufacturers who provided specialised equipment. The whole of the design and layout of the stations was undertaken to meet the requirements of the Air Ministry, and the necessary supervisory staff was provided to facilitate the construction of the stations by German civil engineers. The programme represented an achievement in co-ordination of design, production and installation, and was completed within a few days of the project target dates. At the conclusion of the installation work the Company was asked to provide a resident engineer for each of these stations to advise on the maintenance and operation of the Marconi and all other radar equipment.

Whilst the activities of the Rotor and subsequent programmes tend rather to overshadow achievements with private venture projects, these take a very important place in our activities. High power units in the 'S' and 'L' bands have now been developed for commercial use and many of these have been sold to European countries.

One of the early tasks of the Research Department of the Company was to re-design the old wartime 50 cm Type 11 transmitter for high power and to provide M.T.I. facilities. It had been intended to use this equipment on the Rotor stations as a standby, but this requirement was not pursued and a quantity of these transmitters became available for commercial sale. A new aerial was designed and this, associated with a re-engineered transmitter/receiver and M.T.I. system, became the radar Type S 232, which was found to provide a very efficient system of civil aircraft approach and control.

The Ministry of Transport and Civil Aviation have ordered several sets of this equipment for use in London Airport, Gatwick and Elmdon. The London Airport installation will shortly be improved by fitting a new 500 kW high-power 50 cm transmitter.

The Type S 232 equipment and its later development, Type S 264, both operating on 50 cm and provided with extremely efficient M.T.I., are being supplied to Civil and Military airports in Britain, Belgium, France, Germany, Hong Kong, India, Jersey, New Zealand, South Africa, and Switzerland.

The Ministry of Supply Establishments at Farnborough, Bedford and Boscombe Down, have been supplied with 50 cm and 10 cm equipment, which together with Marconi displays provide the radar cover necessary at these airfields which are used in the development of military aircraft. In the design and layout of these stations Marconi's have co-operated fully with the Service organizations concerned, providing them with the operational facilities they have needed, and in doing so considerable experience has been obtained in the specialised radar needs for aircraft research.

In the Naval radar sphere the Company has co-operated closely with Messrs Vickers-Armstrong on several shipboard installations in providing fire control equipment, and has now produced a highly accurate search and fire control radar using a new aerial system with fixed coil displays. This is being incorporated in two new ships now being built by Vickers-Armstrong for a foreign navy.

The Royal Navy's latest carrier 'Victorious' employs an entirely new volumetric search radar using a Marconi high power transmitter and receiver. The whole equipment has been specially developed for aircraft carrier use. Several of these sets are in production for other carriers. For use in destroyers new air warning and target indicating radars have been developed.

The Air Ministry study contract of 1948, referred to earlier, revealed the need to detect smaller and faster targets and to spread the radar cover widely over the available frequency bands. Much effort has been directed into the development of high power transmitters in 'S' and 'L' bands and also into the development of M.T.I. facilities.

In co-operation with the Ministry of Supply, Marconi's have established a full scale radar test site in Essex and this site is connected by radio link with the Company's Research Laboratories at Great Baddow. Work is continuing on data processing and data storage in connection with the equipment on the test site.

The Marconi Research Laboratories have been working for a number of years on related radar engineering problems including turning gears, aerials, semi-conductors and special materials.

The rapid developments in the aircraft industry have brought the world into the Jet Age almost overnight and the Globe has shrunk to a few hours' flying time. Radar control is essential to all future progress and Marconi equipments are being designed to cope with the vehicles of the future, be they aircraft or missiles—civil or military.