MILITARY SYSTEMS

The advantages to be gained from the use of television techniques for a wide variety of tasks in the military field have become increasingly apparent in the past few years. The Marconi Company enjoys the advantage of combining many years of experience in producing electronic systems for military purposes with an involvement in all aspects of television, both for broadcasting and non-broadcasting purposes, dating from the earliest days of the art. Marconi's are acknowledged as leaders in each of these fields both for technical innovation and for setting the highest standards of performance.

The value of this experience has been recognised by the award of a number of feasibility studies and development contracts for the application of television techniques to various military system requirements. These contracts have in turn contributed to the fund of specialist knowledge and expertize that has been built up within Electro-Optical Systems Division so that it is now in a position to offer, in addition to a range of equipment specifically produced for military use, highly skilled services for the following activities:

Feasibility Studies
Development of Equipment and Complete Systems
System Analysis and System Co-ordination
Field Trials
Field Trials Data Reduction
Installation and Commissioning Services
Post Design Services
Training of Customer's Personnel

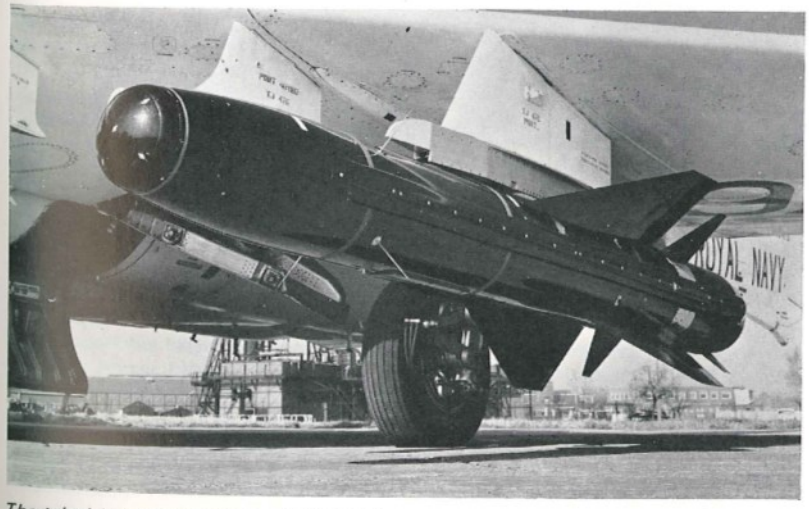
These services are available, in whole or in part, to carry out programmes to produce systems or sub-systems to meet special requirements.

To provide some indication of the Division's capability a few of the systems for which it is responsible are described below.

MARTEL

Martel, an Anglo-French interdependence project, is a high accuracy air to surface stand-off missile with a range of many miles. Two versions have been developed, one using a TV guidance system developed by The Marconi Company and an anti-radar version developed by S.A Engins Matra in France. In Britain, the missile itself has been developed by Hawker Siddeley Dynamics.

A small rugged camera in the nose of the TV version produces a picture which is displayed on a high-brightness picture monitor in the cockpit of the launching aircraft. The observer uses a joystick control to adjust the field of view of the camera via a command radio link. When the target has been identified and centralized in the field of view, further command signals align the flight path of the missile with the line of sight of the camera until impact. The accuracy of the system has been proved in a highly successful series of trials in which targets 10ft in diameter have been hit at a range of many miles. The success of the development and trials has led to the placing of a substantial production order for this missile which will be used to arm the United Kingdom Services.



The television guided version of MARTEL

SEACAT Missile Control

An example of the use of television techniques to improve the performance of existing optically guided weapons systems is the work carried out in association with Short Brothers & Harland for the Royal Navy's 'SEACAT' surface-to-air missile. This missile is at present controlled by an operator who views the target through an optical system and uses thumb joysticks to gather the missile after launching on to the target line-of-sight and guide it until impact. The hazard to, and possible physical discomfort of, an exposed operator position on the Director inevitably lead to some deterioration of efficiency under adverse conditions. A system consisting essentially of a camera, mounted on the target tracker radar, and collimated with the radar line-of-sight providing signals to a signal processing unit and picture display, can be used to automatically control the

missile. Apart from the camera head, all equipment may be located in a protected environment below decks, signals being fed from the camera by slip rings.

The target is centred in the camera field of view by the target tracking radar and the missile launched. As in the initial stage the missile follows a free flight trajectory which may differ to some degree from the nominal launch axis, a wide angle lens is used by the television equipment to ensure that the missile enters the field of view. When the missile appears in the camera field of view the television system detects a high brightness flare carried on the body of the weapon and determines the relative position of missile to target. The bearing and elevation commands necessary to lay the missile on to the target line of sight are automatically computed and transmitted to the missile via a radio command link. At this stage control may be handed over to an operator, located in a protected environment below decks and viewing the target on a monitor.
The faster reaction time of the television system as opposed to the human operator during the critical initial gathering phase enables targets to be engaged at closer range than when using manual gathering, an advantage which is increased by the fact that its performance is not affected by environmental discomfort. It is available as a retro-fit to existing installations or as an integral part of a new system.

The Marconi television fire control system has been successfully proved with the sea-to-air missile SEACAT

Reconnaissance from a helicopter using a hand-held camera

Reconnaissance and Surveillance

Television has made a significant break-through in military surveillance with the development of low light cameras, enabling observers to 'see in the dark' with great clarity. The Company have investigated most of the available low light sensors and have developed to a production stage, cameras using Image Isocon and SEC Vidicon tubes.

Using these low light level cameras together with a suitable lens system, targets or intruders can be observed under starlight conditions on an overcast night at distances of several miles. For this application, television has a great advantage over systems requiring active illumination, e.g infra-red searchlights, since low light television systems are completely passive and do not, therefore, reveal themselves.

Target Location, Identification and Tracking

As well as its use in guidance systems for missiles, television can be used with gunfire control systems. One of the principle uses in this role is to back-up the radar system in providing bearing and elevation information to the control computer. This is especially important with targets at low angles of elevation since the 'clutter', caused by the radar beam bouncing from the surface, tends to reduce the accuracy of a radar system.

Using a suitable lens system, television can also be used to give visual identification of target. In this role it can do more than merely replace the conventional binoculars. By selectively processing a video signal, poor contrast subjects can be detected against a concealing background to give information than could not be discerned by the eye. These signal processing techniques can, in fact, be used to advantage in many military applications, including low light television surveillance.

EDUCATIONAL AND TRAINING SYSTEMS

The Marconi Company designs and supplies a wide variety of television systems, which include standard and custom-built studios and mobile television units, to meet the individual requirements of educational authorities and training organizations. Over 50 major educational establishments in the United Kingdom are now equipped with Marconi systems.

The 322 series of vidicon cameras, consisting of the V322A, a single unit camera, and the V322B, an integrated viewfinder camera, were developed to meet the needs of educational television with simplicity of operation and reliability as major design features. These cameras can be supplied with manual control facilities to supplement their automatic operation where very advanced educational programme techniques are to be employed.

Television Studios

Television studios, with facilities for the production and recording of lectures and demonstrations are now an accepted aid to both staff and students in educational establishments.

With the ability to distribute and display programmes over a wide area, they provide an ideal medium for extending both the scope and the effectiveness of teaching staff.

Lectures produced in a studio may be delivered simultaneously to students in several rooms throughout the building. Programmes once recorded may be replayed many times. This is a great step towards alleviating teaching problems caused by an acute shortage of qualified staff and an increasing number of students.

The effectiveness of a lecture is greatly enhanced by using television to bring demonstrations within easy viewing distance of each student. Small detail, normally only visible to a minority of the class near the front of the room can be seen with equal clarity by every student. For a television studio to be a useful yet economical tool in education, it is absolutely essential that permanent operating staff should be kept to a minimum. This, in turn, means that operation of the equipment should be as simple as possible and The Marconi Company has therefore, made simplicity of operation the key factor in the design of all educational television equipment.

A typical Marconi Studio requires only two permanent staff, the producer and technician since such functions as cameraman and sound and vision mixer can be easily performed by students.

Typical standard studio control room

Many factors determine the scope and nature of each installation but the following facilities are typical of many Marconi installations throughout the United Kingdom.

(a) Two Studio Vidicon Cameras Type V322B with integral electronic viewfinder and lens turret.

(b) Telecine arrangement for 16mm and 35mm slide projectors, utilizing a Vidicon Camera Type V322A.

(c) Caption Scanning of standard 10×12in. caption cards.

(d) Vision mixing of up to six inputs.

(e) Sound mixing of up to eight microphone inputs and four high-level inputs.

(f) Disc reproducer and audio tape recorder.

(g) Production control panel including remote controls for telecine.

(h) Studio intercommunication, 'fold-back' and public address.

(i) Separate matching audio and vision control consoles.

(k) Synchronizing and distribution equipment.
(l) Studio lighting.
(m) Three preview and one 'line' monitor.

These requirements formed the basis for the development of a standard studio system which meets the needs of educational authorities intending to set up a closed-circuit television system. If offers economy in both apparatus and operating personnel, yet still provides the facilities required to meet all the various applications envisaged in the field of educational television. Due to the flexibility of its design, the system can be adapted to meet the specific requirements of the individual user.

Full details of this system are given in SP191.

The control room for one of the two Marconi equipped studios at the Inner London Education Authority's Television Centre

Mobile Recording Units

Recent developments in the field of video tape recording have brought this extremely valuable technique, once considered viable only in broadcasting television applications, within reach of many more users.

The use of a video tape recorder in conjunction with educational television equipment is of particular value because recorded programmes can be used to relieve the pressure on teaching staff. It is possible, within certain limitations, to interchange recorded programmes between educational establishments; thus making the maximum possible use of specialized lectures throughout the country.

Television facilities vary from one educational installation to another, as do recording requirements, but it is often appropriate, for flexibility, to have a mobile recording unit. The design of the unit is dependant upon many factors, but two typical examples are as follows:

Fully mobile unit

This is a self-contained three-camera recording unit which will meet the needs of educational authorities who wish to establish a mobile television facility. This system offers economies in both apparatus and operating personnel, yet still provides all the facilities required to meet all the various applications of a mobile system. The equipment and its layout is typical of that which has been successfully employed in meeting a wide variety of educational requirements throughout the United Kingdom.

A 3-camera mobile recording unit

The complete system is contained in a 35cwt vehicle and provides all the facilities normally found in an educational studio control room. The vehicle is furnished as a television control room with full facilities for the origination, processing and recording or distribution of audio and video signals. The vehicle has storage accommodation for the cameras and all the ancillary equipment such as video monitors, microphones, and accessories associated with a mobile system. No special power supplies are required, as the whole system will operate from a single 13-amp mains supply.

Full details of this mobile system are given in SP 194.

Portable Unit

A simple, yet highly flexible system is centred on a transportable control console. The console in its simplest form is

equipped with a video switching unit, an audio mixer and an intercommunications unit. Inputs are provided for television cameras and microphones and the output can be fed into both a video tape recorder and a distribution system. The console, the video tape recorder and the signal-orginating equipment are capable of transportation in a small van.

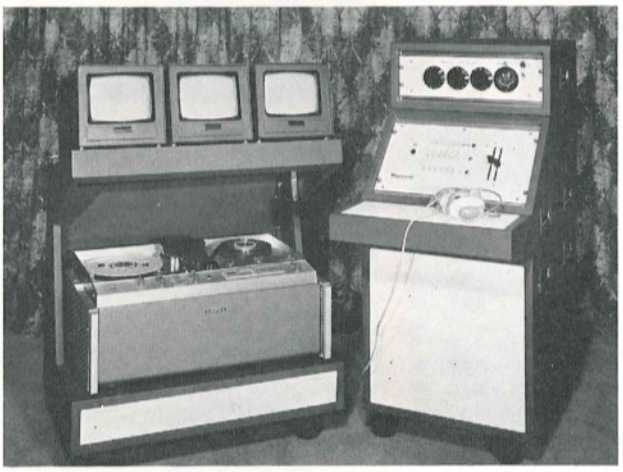
The size of the unit has been kept within limits which allow it to be manhandled easily about a building where doorways, lifts and stairs have to be negotiated. It is particularly useful when it is necessary to work in a number of different departments in which large fixed machinery or equipment is involved in the demonstration.

The modular form of construction used, together with the flexible nature of the equipment design, enables a simple system to be expanded to include more complex facilities such as mixing with a minimum of equipment redundancy. A major advantage is the ability to start at a low cost and progressively expand as more funds become available.

Apart from its usefulness in the educational field, a portable recording unit has enormous potential in industry for training purposes.

Full details of this portable system are given in SP 212.

The mobile unit's production area



The portable recording unit

INDUSTRIAL TELEVISION SYSTEMS

Closed-circuit television is now well established as a tool for aiding process control and for the 'point-to-point' transfer of information. It assumes great importance wherever monitoring of production processes is required at locations remote from the control centre and under circumstances where it is costly or dangerous to station personnel. The use of such aids not only assists in increasing the safety and efficency of plant operation, but also contributes to considerable reductions in manpower by contributing to centralization of process control. One of the particular advantages of using closed-circuit television is that the camera cannot give a false reading and that as long as it continues to relay information to the control point there can be no possibility of inaccuracy.

The Marconi Company has amassed a wealth of experience in the planning and installation of industrial closed-circuit television systems particularly in the steel and power generation industries. The equipment has been designed for the utmost robustness and reliability, achieved by the use of solid-state circuitry, ensuring the highest standard of performance in extremely hazardous industrial environments. It is capable of continuous operation in extremes of temperature and humidity and will successfully combat the effects of severe vibration and dust pollution.

The uses for industrial television systems are wide and varied and a number are described in the following paragraphs to give an indication of their value in specific applications.

Furnace flame viewing

The power generation industry was among the first to adopt television as part of a control instrumentation system and today over 160 camera channels are in use with the Central Electricity Generating Board alone. The technique of viewing, via a water-cooled periscope, the interior of boilers where interior temperatures may exceed 2000°C is now well established. It enables the individual furnace flames to be monitored in order to provide a check of combustion conditions, particularly during the critical ignition period. By this means it is possible to prevent an explosive accumulation of unburned fuel resulting from delayed ignition.

Boiler drum water level viewing

Equally well established in power stations is the use of a camera to view the drum water level gauge, which may be over 100ft from the operating floor, and transmit a picture to the central control room. Failure of the water supply to the drum would be followed by the total evaporation of the water in less than 30 seconds at the temperatures and pressures now being used. The disastrous consequences of such an occurrence make it imperative that an instantaneous and accurate indication of the water level is available in the control room if the employment of a man at each gauge, which must of necessity be situated at the level of the water in the drum, is to be avoided. With the development of modern generating plant boiler pressures have been increased to the point, around 2000p.s.i.g, where the refractive indices of steam and water approach one another so closely that boiler drum gauges cannot in themselves provide an adequate discrimination between steam and water in adjacent ports. This has led to the development of a boiler drum gauge attachment (see page 300) in which the paths of light shining through the gauge ports are increased by reflection so that the small difference in refraction is amplified to provide a clear lateral displacement of the illuminated areas indicating water and steam on a ground glass screen. The televised display of this attachment in the control room provides an unambiguous indication of the water level. This case may be taken to emphasize the point that in order to apply television successfully to industrial applications it is necessary to consider the overall requirement and produce a complete system to meet it, not merely a good television equipment.

Boiler drum water level presentation

Camera installation at a critical point in a power station coal feed

Cameras viewing the interiors of 'nodulizer' pans in a cement works

Conveyor monitoring

A generating station may consume up to 19,000 tons of coal in one day. This may be fed directly from incoming trucks in sidings via hoppers and conveyors to the furnaces or it may be stock-piled at the station before use. Monitoring the flow of such vast quantities of fuel demands a complex conveyor system with careful and accurate control together with constant surveillance. The television monitoring system employed at the C.E.G.B's Drakelow C Generating Station near Burton-on-Trent has sixteen Marconi cameras positioned at critical points in the supply line with pictures from all cameras displayed continuously in the plant control room, where a single operator controls the whole supply using information from a mimic diagram aided by the televised pictures. The ability of the camera equipment to continue to operate reliably without special protection in an atmosphere heavily loaded with coal-dust gives a good indication of the standard to which modern industrial television equipment has been developed.

Cement production monitoring

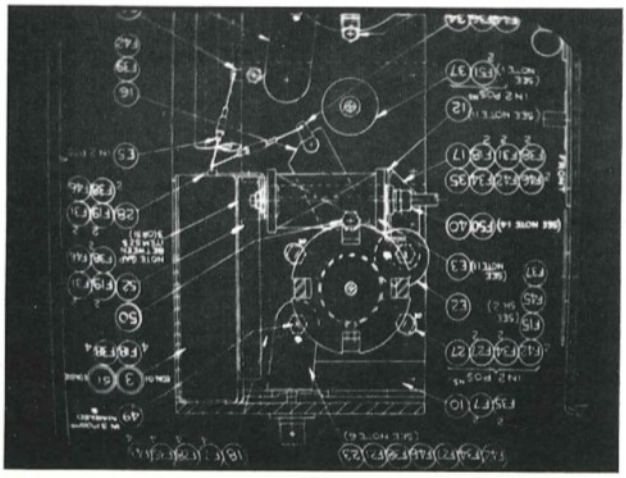
The introduction of centralized production control in the cement industry has given rise to the use of television in a number of situations where previous practice was to employ men to observe and control critical processes locally. At the Dunbar works of Associated Portland Cement Manufacturers, Ltd, television is used to monitor conditions within the 'noduliser' pans in which finely crushed limestone is sprayed with water and rolled into pellets about ⅜in. dia. Only by strict control of the flow of the raw material and water can the required size be maintained. After formation, the nodules are conveyed to one of three 300ft long rotating kilns for heating to 1500°C. On a similar plant at Malmo in Sweden cameras in water-cooled housings are positioned on the firing hood of the kiln to view the interior so that it is now possible to view and control from one central position the production of nodules and their heating in the kiln.

Remote viewing of billet cutting

In the steel industry closed-circuit television is being used as part of a billet length measurement system. This system assists in achieving accurate cutting of hot billets after the rolling process from the control pulpit.

Red hot steel billets are cut to length by a hot saw which is controlled by an operator from a vantage point in the control 'pulpit'. They are progressed under the control of the operator until the leading end reaches a position adjacent to a measurement scale marked alongside electrically driven rollers which carry the billet. A V321 camera on an overhead track is located to view the scale and the billet so that the operator can view and adjust the position of the end of the billet on a monitor in his pulpit prior to cutting. The advantages over previous methods are speed, accuracy and manpower and material economies.

Systems of this type have been installed at the Workington Iron and Steel Company's plant in Cumberland and at the Brymbo Steel Works plant near Wrexham in Denbighshire.



Drawing presentation at a viewing station

Information transfer

The Marconi Company has developed various systems for the 'point-to-point' transfer of information. At its' own factory at Basildon a system enables views of drawings, stored in a central library, to be transmitted by camera units to a number of viewing stations. The viewing station is given complete control of the system magnification, which allows even the smallest detail to be read easily, and movement of the camera so that any area can be viewed. This system requires only a single library of drawings, under the control of one person, which maintains the essential library integrity. In addition, a significant amount of time is saved by providing viewing facilities in the work areas, thus eliminating journeys to the print room, and obviating the necessity to enlarge or print any drawings.

The camera installation at Littlewoods

Another example is the system installed at Littlewoods, where millions of football pool entries are handled each and every week and unquestioned accuracy and high speed in announcing winning entries is an essential requirement. To this end a closed-circuit television system is used as an additional aid in the checking of pools entries. Two cameras are used in conjunction with a computer and an optical reading and sorting machine to select entries with maximum points. A third camera scrutinizes the operation of semi-automatic machines employed to determine the exact number of minor dividends.

LARGE SCREEN PROJECTION SYSTEMS

Large screen projection is one of the most impressive developments in television today. The ability to reproduce events instantaneously on a large screen has many applications. It is being used to provide faithful close-up reproduction of surgical technique as a teaching aid in hospitals. Modern defence organizations are making use of large screen television to provide the immediate presentation of strategic information to groups of tactical controllers and a specially designed version is being used in many countries for the Visual Flight Attachments to Flight Simulators to provide greater realism in pilot training. It is also being used to bring the excitement of 'live' theatre to out-of-town audiences as well as proving a powerful aid at conferences and conventions.

Two editions of the Large Screen Colour Projector (see page 301) are available, one for flight attachments and one for theatre use. The Company has supplied more than thirty of these systems and the projector was cited in The Queen's Award to Industry for Technological Innovation in 1968.

The flight deck of a Trans World Airlines flight simulator showing the visual flight attachment presentation