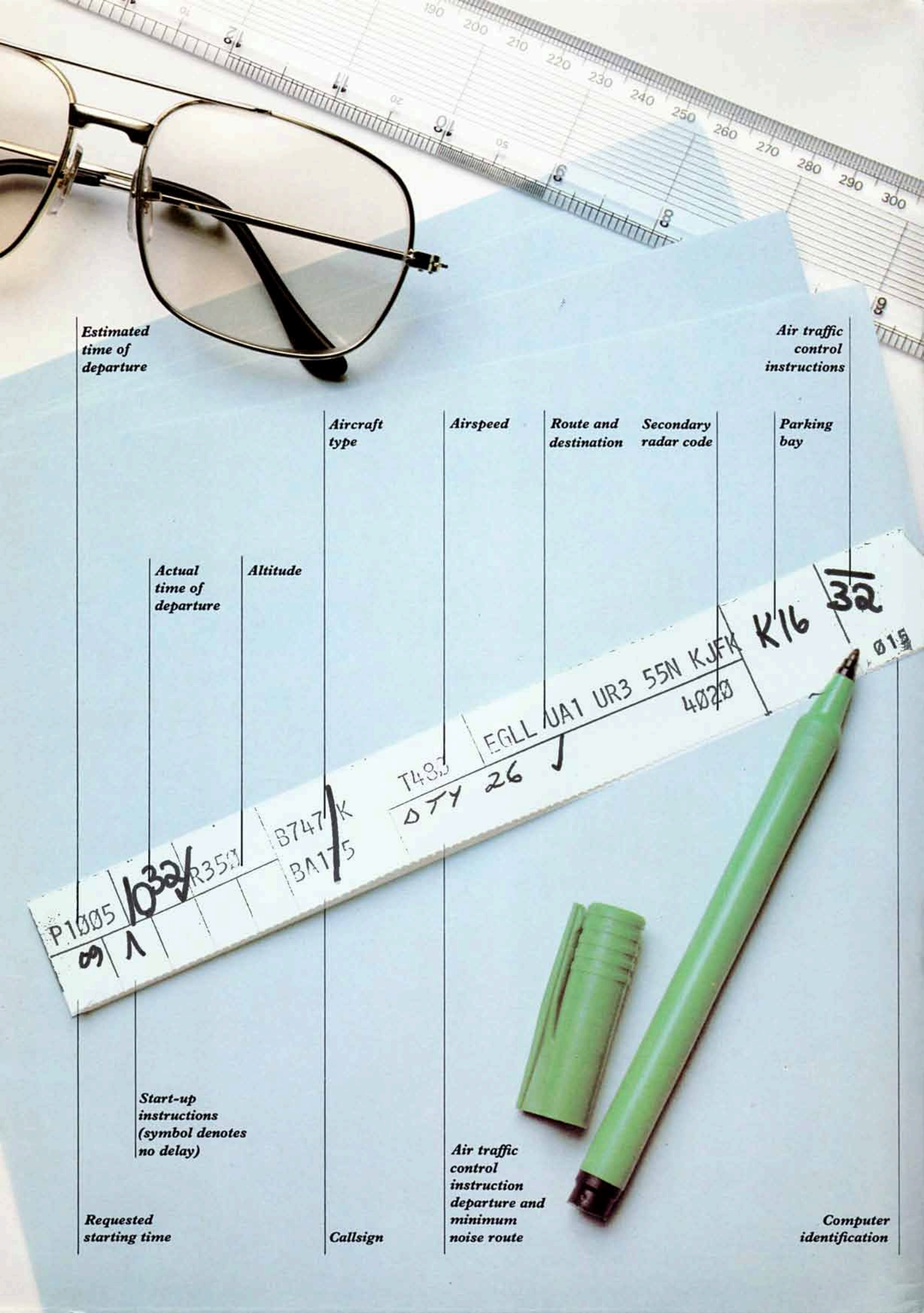
AIR TRAFFIC CONTROL AT HEATHROW

Civil Aviation Authority


Estimated time of departure
Actual time of departure
Altitude
Aircraft type
Airspeed
Route and destination
Secondary radar code
Parking bay
Air traffic control instructions
P1005
1032
R351
B747/K
BA175
T483
EGLL UA1 UR3 55N KJFK
4020
K16
32
015
09
1
DTY 26
Start-up instructions (symbol denotes no delay)
Requested starting time
Callsign
Air traffic control instruction departure and minimum noise route
Computer identification

AIR TRAFFIC CONTROL AT HEATHROW

Introduction by the Chief Officer Civil Aviation Authority Heathrow Airport London

The pilot of every public transport aircraft (that is, one that carries paying passengers or freight or both) must file a flight plan. The pilot plans his route, decides his economical height and speed, and calculates his fuel requirement. His flight plan also gives the time he expects to arrive at various points, and his ETA (estimated time of arrival). Before completing the flight plan the pilot consults the meteorological department because wind strengths affect his speed, and he may need to alter height or course to avoid bad weather or to take advantage of a following wind. Finally, he submits his plan to Air Traffic Control.

◀

Heathrow Airport, London is the world's busiest airport for international aircraft movements. Counting each landing or take-off as a movement, the National Air Traffic Services at Heathrow Airport controlled more than a quarter of a million movements in 1977. At peak times in the busy summer months we control an average of more than 900 movements a day and up to 70 movements an hour – more than one aircraft landing or taking-off every minute.

So much for the statistics. How do all these aeroplanes get in and out safely day after day, in nearly all weather conditions? How is it integrated with the air traffic taking off from or landing at other airports in the United Kingdom or with other aircraft which are overflying the country on their way, say, from Europe to North America?

Although our prime interest is in getting the aircraft up or down, we never overlook the fact that *our* customers, the airlines, want reliability and regularity for their schedules in order to serve *their* customers, the passengers. In 1977, nearly 24 million passengers passed through the terminals at Heathrow. Heathrow also handled £8791m-worth of goods – financially more than any other port in the United Kingdom.

To most air travellers, and to the many other visitors to Heathrow, the control tower is the visible reminder of the air traffic services. Very few will be aware of the nation-wide organisation and planning which are necessary to ensure that each aircraft flies safely along its selected route, carefully separated from, but integrated with, all other aircraft movements taking place at the same time.

Our aim here is to take you behind the

scenes, to explain how air traffic at Heathrow is controlled, to describe the highly professional approach of our air traffic control and telecommunications staffs, and to give you some insight into the highly sophisticated and very expensive technical equipment which has been installed to ensure that air traffic flows safely and efficiently. It is worth remembering that Heathrow never closes. It is open for operations twenty-four hours a day every day of the year, although for noise reasons flights are severely restricted at night.

NATIONAL AIR TRAFFIC SERVICES

Air traffic control over the United Kingdom and at most of the major airports is provided by the National Air Traffic Services (NATS), an organisation responsible jointly to the Civil Aviation Authority (CAA) and the Ministry of Defence (MOD) for the guidance of both civil and military air traffic.

NATS' first objective is to ensure the safe, orderly and expeditious flow of air traffic, but the system is also designed to minimise operational delays, fuel consumption and aircraft noise.

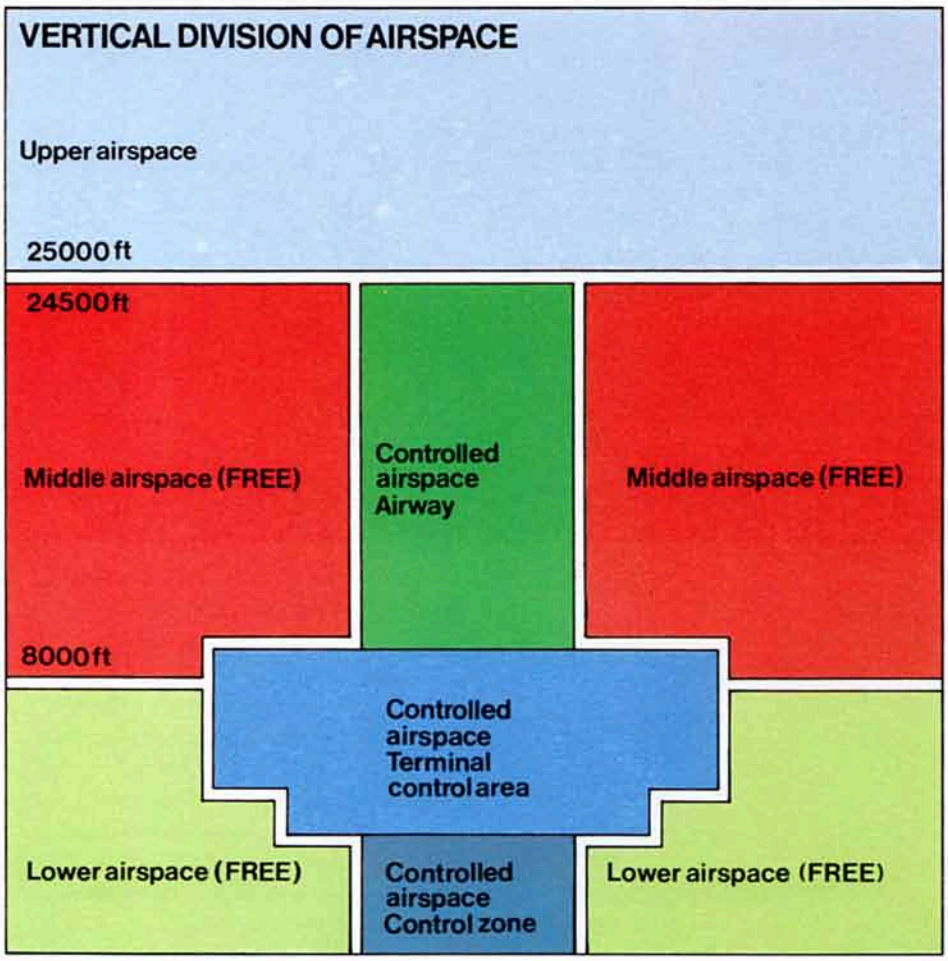
UK AIRSPACE

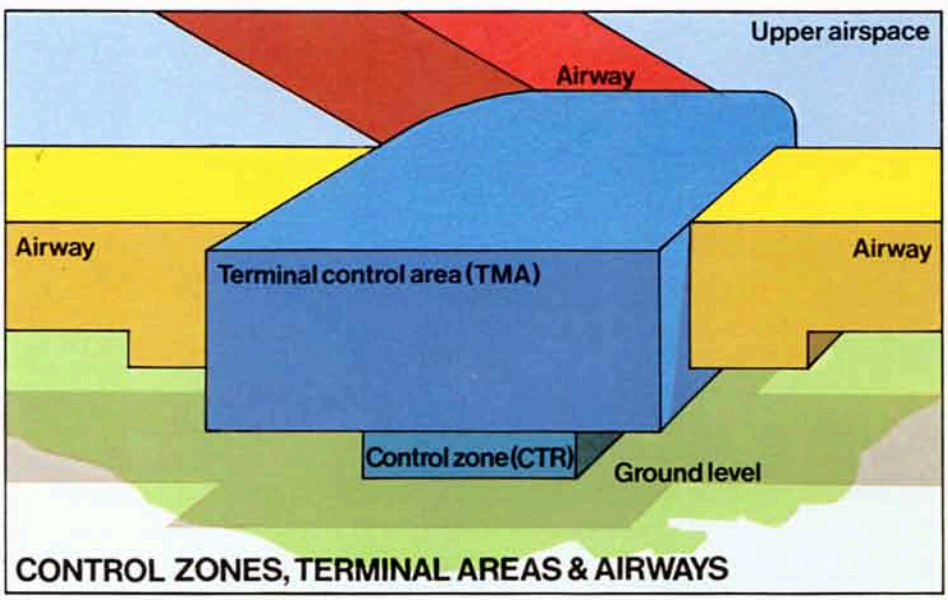
United Kingdom airspace extends not only over the land mass but also over the surrounding seas and oceans where it meets the airspace of adjacent countries. UK airspace is divided into two Flight Information Regions (FIRs) : London and Scottish. Aircraft flying in these two Regions are controlled from two centres. Those in the London FIR are controlled from the London Air Traffic Control Centre (LATCC) at West Drayton, a few miles from Heathrow Airport. The Scottish FIR is controlled from the Scottish Air Traffic Control Centre at Prestwick, several miles south west of Glasgow. Within these FIRs are areas of controlled airspace, which are themselves divided into three parts.

1. Control Zones *surround and protect major airports. The control zone for Heathrow extends from ground level to a height of 2500 feet.*

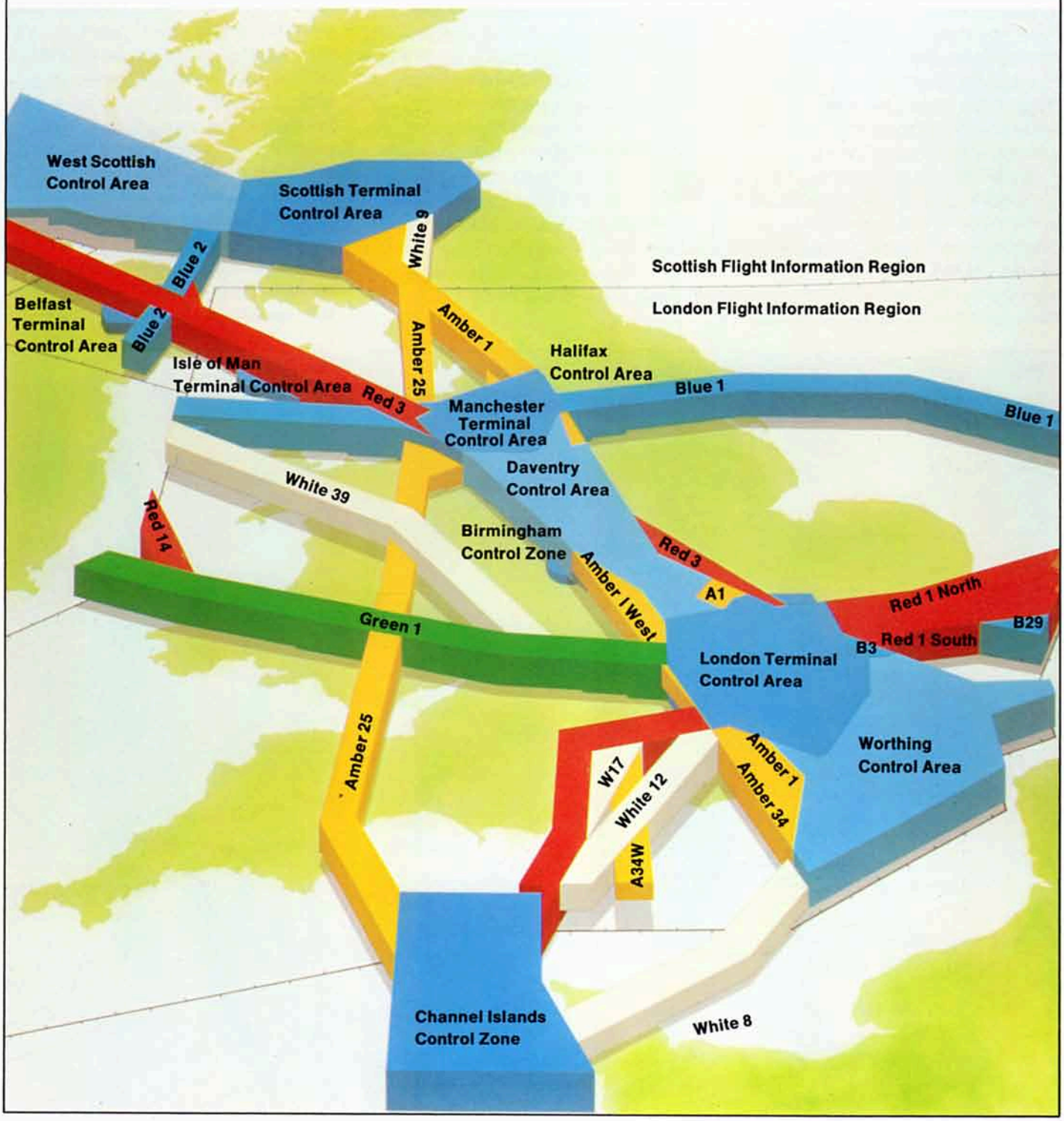
2. Terminal Control Areas (TMAs) *protect the inter-sections of busy airways and groups of large airports. The London TMA embraces Heathrow, Gatwick, Luton and Stansted airports.*

3. The airways, *which could be described as motorways in the sky, connect the TMAs. The airways are corridors of space ten miles wide up to a height of 24,500 feet from a base which is usually between 5000 and 7000 feet. Above the airways, Upper Air Routes cater for high flying aircraft, many of which are transitting UK airspace.*





AIRWAYS IN UK AIRSPACE



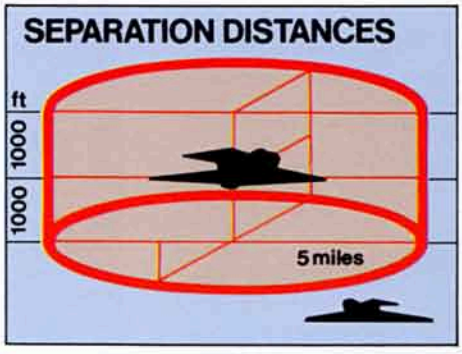
SERVICES PROVIDED BY NATS

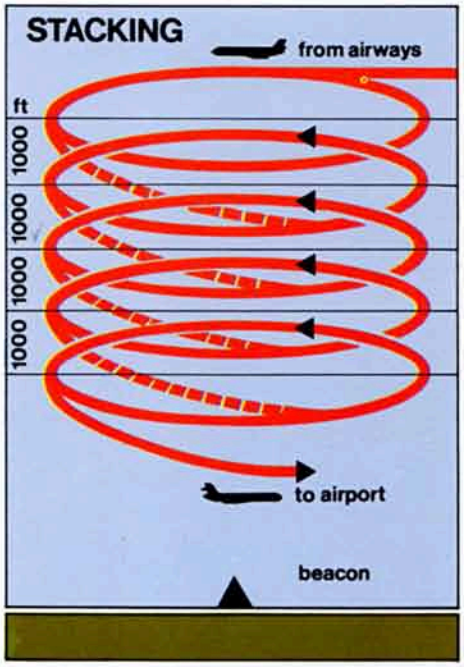
As well as ensuring that aircraft are adequately separated, the National Air Traffic Services provide flight information and alerting services to aircraft flying under their control. *Flight information* consists of all the data required for the safe navigation of aircraft, such as the radio frequencies of airport control towers, the serviceability of navigation aids, the height, speed and direction of other aircraft in the vicinity when required, and the weather conditions prevailing at the destination airport. Should an emergency arise, the *alerting service* brings into action all those organisations which can assist,

A captain plans his route in the Aeronautical Information Service room

such as the RAF Co-ordination Centres, the police and other rescue services including fire brigades and HM Coastguard.

In controlled airspace, the function of air traffic control is to keep each aircraft safely separated from all others by internationally agreed standards. This is achieved either by allocating different heights or by arranging certain minimum horizontal distances between aircraft. The separation distances vary: for example, an aircraft flying along the airways under radar surveillance may not pass within five nautical miles of another if it is at the same height; alternatively, if two aircraft are less than five nautical miles apart horizontally, then they must be at least 1000 feet apart vertically. Above 29,000 feet, this separation is increased to 2000 feet.





CONTROLLING INCOMING AIRCRAFT

Aircraft approaching Heathrow are directed by the London Air Traffic Control Centre to one of four reporting points located by radio beacons at Bovingdon, Lambourne, Biggin Hill or Ockham. Before they land at the airport, pilots need to know the prevailing weather conditions, the runway in use and the navigational approach aids available. This information, known as the Automatic Terminal Information Service, is recorded and continuously transmitted on the radio frequencies of the radio beacons. Pilots receive this recorded information while their aircraft are

A Doppler VHF omni-directional radio beacon used by aircraft to navigate to and from Heathrow

approaching the beacons and before direct radio contact is established with the Heathrow tower. A similar service is operated for departing aircraft, by transmitting the information over one of the airport's local VHF frequencies. These messages are updated from the Approach Control Room every half an hour or whenever there is a significant change in the information.

At peak times there is a "rush hour" in the air just as on the ground and aircraft may arrive at the reporting points more quickly than the airport is able to land them. As it is essential that the landing separation is maintained, they have to wait their turn to land and

are instructed to form a "stack" by circling at different heights around the reporting points.

To avoid wasting fuel and delaying passengers, a scheduling committee of all the airlines using the airport reduces traffic peaks at the busiest hours as far as possible by agreeing staggered arrival and departure times.

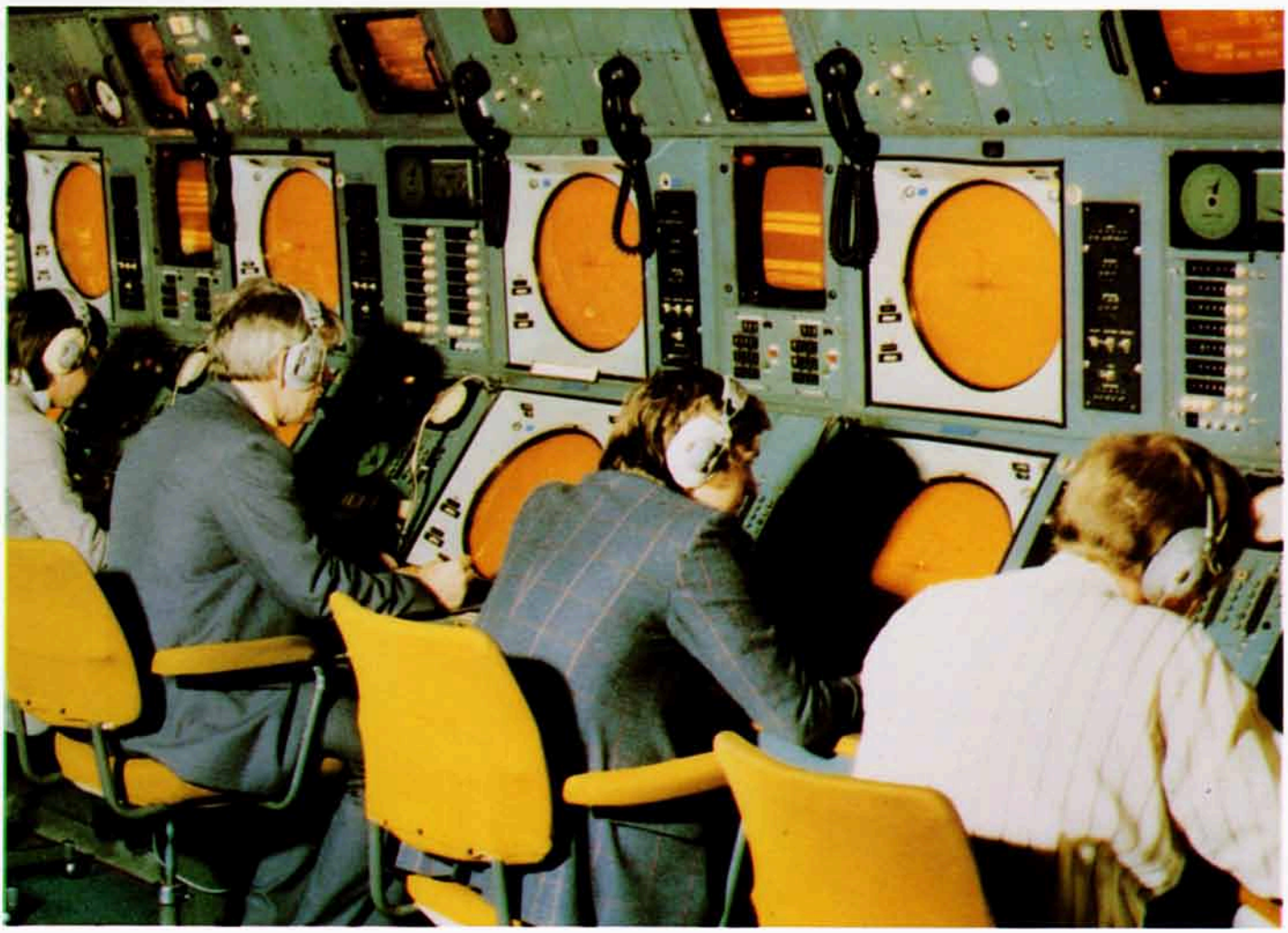
IN HEATHROW CONTROL TOWER

In the control tower at Heathrow there are two distinct air traffic control functions – approach control and aerodrome control. Although these two functions have to be separated into different floors in the tower, the procedures which are used ensure a fully integrated service.

Approach control, located on the sixth floor of the tower, is responsible for aircraft arriving at Heathrow. It controls them from the moment when LATCC hands them over until they have been lined up to land on one of the runways, when aerodrome control takes over.

Aerodrome control operates from the Visual Control Room at the top of the tower, some 120 feet from the ground, giving a panoramic view of the airport. Aircraft are controlled from here on their final approach to land, when they are preparing for departure, when they are taxying and during actual take-off. Aircraft and vehicles moving on the runways and taxiways are also controlled from the Visual Control Room.

The Approach Control Room



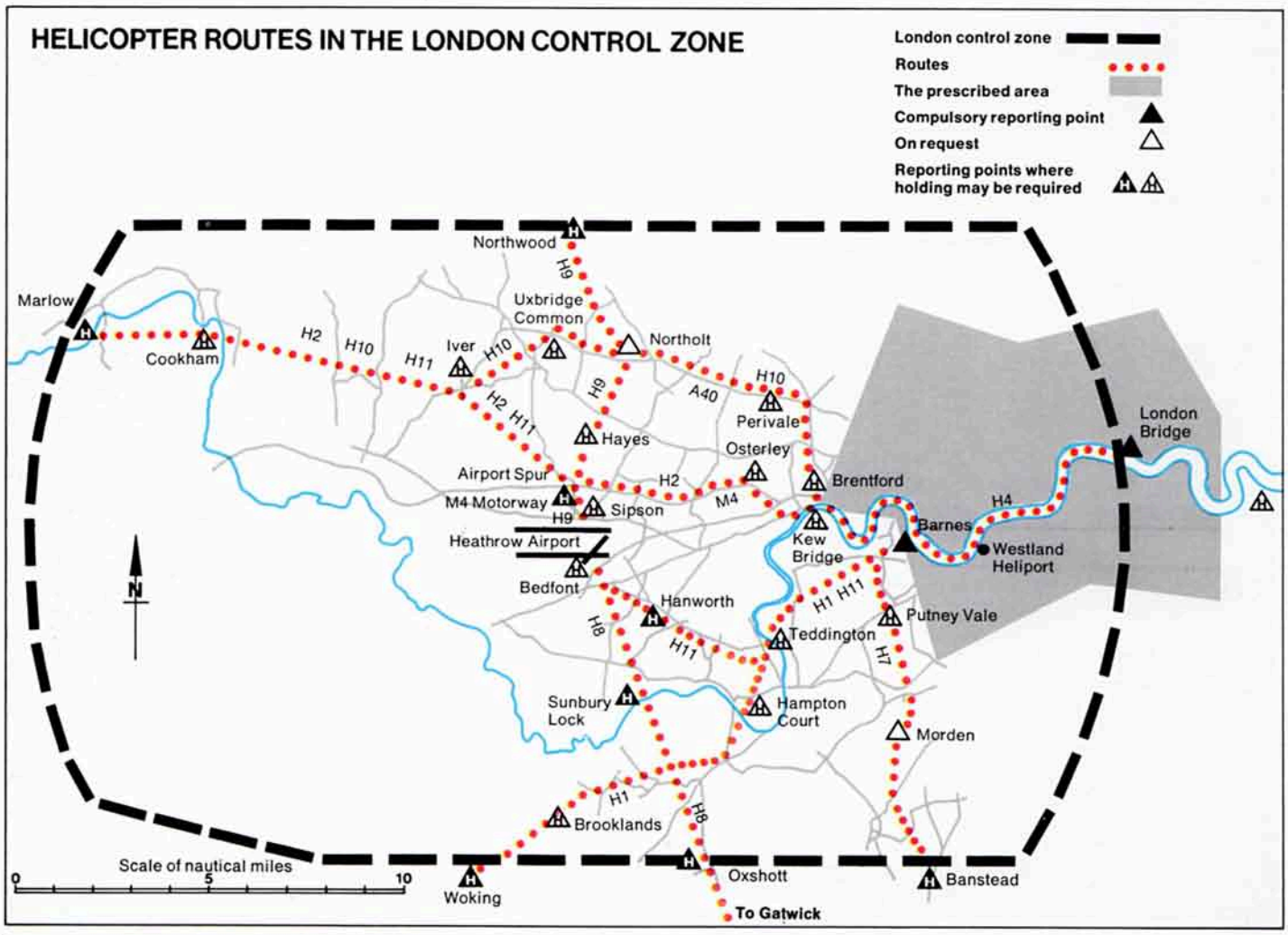
APPROACH CONTROL

In the Approach Control Room six controllers work as a team. They consist of two Approach Controllers, two No 1 Radar Directors, a No 2 Radar Director and a Special Visual Flight Rules Controller. The team work in semi-darkness so that they can see their radar displays as clearly as possible. Each Approach Controller, with his No 1 Director, controls the traffic from either Bovingdon and Lambourne in the north, or from Ockham and Biggin Hill in the south.

When the aircraft is approaching the reporting point, LATCC informs the Approach Controller, who listens for the first call from the pilot when the aircraft's radio has been tuned to Heathrow's "approach" frequency. He instructs the pilot either to enter the "stack" at the reporting point or, if there is no delay, to fly in a direction which will bring the aircraft into the sequence of landing traffic.

The Approach Controllers and the two No 1 Directors work closely together, instructing pilots to adjust their height, speed and route so that two orderly streams of aircraft, one from the north, the other from the south form the approach pattern to the airport.

Aircraft in these two streams are handed over to the No 2 Radar Director so that he can integrate them into a single stream of aircraft approaching the runway. At this stage, a correct landing interval must be established and the No 2 Radar Director ensures that all aircraft are correctly separated, depending on the prevailing weather conditions and type of aircraft involved. Because of their great size and weight, wide-bodied aircraft, such as the Boeing 747, Tristar and DC10, and also Concorde, create more turbulence to the air through which they pass than smaller or slower aircraft. As this turbulence can upset the flying characteristics of lighter aircraft following behind,



AERODROME CONTROL

greater separation distances have to be provided.

The Special Visual Flight Rules Controller in the Approach Control Room is responsible for helicopters, executive and light aircraft that want to land or are flying within the Heathrow control zone and do not join the main stream of traffic. These aircraft are fitted into the approach pattern to cause as little inconvenience as possible to the main commercial traffic. Helicopters are required to fly along special helicopter routes in the London area to keep them over thinly populated areas, such as parks or rivers.

When the two streams of approaching aircraft are satisfactorily merged into one stream and aligned with the runway at a distance of some six to eight miles from touchdown, responsibility for their control is transferred to the Air Arrivals Controller who sits in the Visual Control Room at the top of the tower. It is his responsibility to make sure that runways are safely used to their maximum capacity.

When, from his commanding position overlooking the whole of the airfield, the Air Arrivals Controller can see that the runway itself is clear, he then issues the landing clearance to the first incoming pilot. He gives him the current direction and strength of the surface wind, condition of the runway surface when necessary and, if for any reason it is not safe to land, he will issue overshoot instructions.

To monitor the spacing between aircraft the controller uses the Distance from Touchdown Indicator (DFTI) which shows part of the radar picture that is used in approach control displayed on a small tube so that the controllers can see the aircraft's distance from its touchdown point and its separation from the next aircraft.

Above *Distance from Touchdown Indicator*
Below *The Visual Control Room*

GROUND MOVEMENT CONTROL

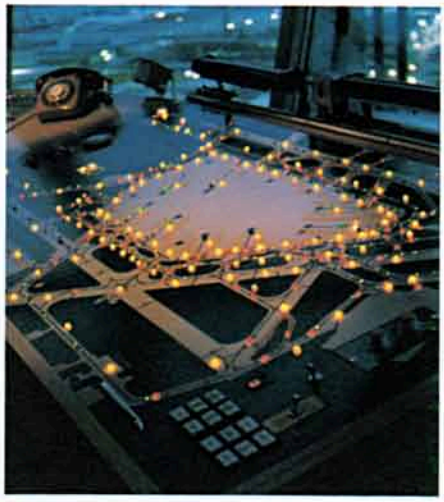
After the aircraft has landed, it is important that it should leave the runway as quickly as possible to unload its passengers or freight and to keep the runway clear for the next arrival which may be fast approaching the runway threshold. When the aircraft is clear of the runway the Air Arrivals Controller instructs the pilot to contact the Ground Movement Controller who then directs the aircraft to its parking stand.

The Ground Movement Controller watches the inbound taxying aircraft's progress and integrates its movement with other aircraft and vehicles. He is responsible for separation between taxying aircraft, both arriving and departing, aircraft being towed and airport service vehicles. All this traffic is in radio communication with the Ground Movement Controller.

In the daytime, when there is good visibility, he controls aircraft and vehicles by direct observation which is why the Visual Control Room occupies such a commanding position in the airport complex. At night, or in poor visibility, a radar called the Aerodrome Surface Movement Indicator (ASMI) is used to monitor aircraft and vehicle movement. Its scanner is mounted above the roof of the Visual Control Room at the top of the tower. It is a downward-looking primary radar with a scanner rotating at very high speed. Runways and taxiways show up clearly on the display as well as the aircraft and vehicles which need to be tracked. The ASMI display in the Heathrow Visual Control Room, like television, is bright enough for daylight viewing.

At night, the aircraft are assisted by green centreline and red stop bar lights embedded in the taxiways. These lights can be illuminated in sections to allow a discrete route to be signalled to ensure that no two aircraft are in or crossing the same section at any one time. The lighting system is operated by an Air Traffic Control Assistant in the Visual Control Room who listens to and acts on the instructions issued by the Ground Movement Controller. The lighting control panel is designed in the form of an airport map, with press switches which directly operate the lighting system on the airfield.

Left *Aerodrome Surface Movement Indicator display showing the pattern of runways and taxiways at Heathrow*



The airfield lighting control panel

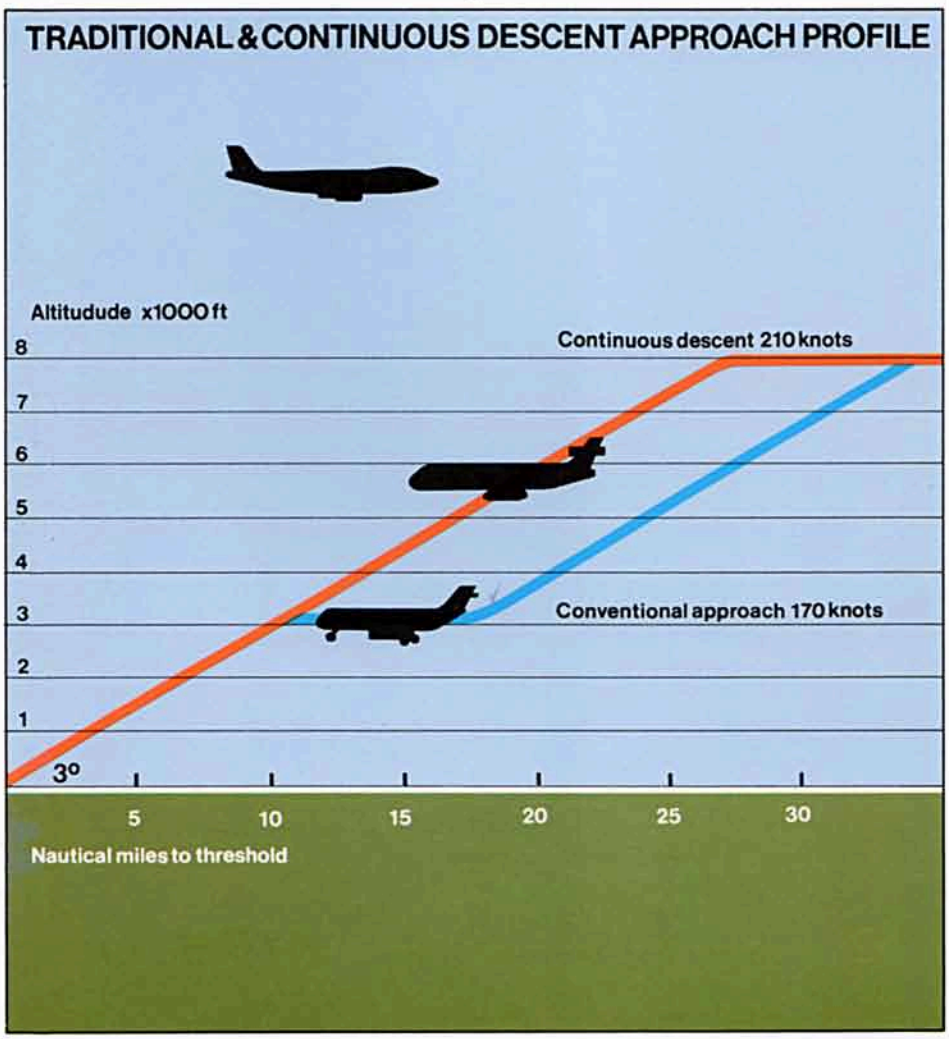
CONTROLLING DEPARTING AIRCRAFT

When an aircraft has loaded its fuel, catering supplies, baggage and passengers, the doors are closed and seat belts fastened, and the pilot makes a radio call to the Ground Movement Planner in the Visual Control Room for permission to start engines. The Ground Movement Planner advises the pilot when to start so that he will not be unduly delayed either in the air or on the ground, thus saving fuel. He has to consider how many other aircraft have started up, whether there is any congestion along the outbound air routes, both in the UK or abroad, and the availability of time and height "slots" made necessary by the congestion. When the Ground Movement Planner has given the pilot "start-up" clearance and received confirmation that he is ready to move, the Ground Movement Controller takes over. He allows the aircraft to be pushed back from its stand by tractor, advises the pilot of the runway in use and guides him to the runway holding point, making sure that there is sufficient separation between the aircraft and vehicles moving in the operational areas of the airport.

NOISE ABATEMENT

Aircraft noise is a nuisance for most people who live near the airport or under one of the flight paths. Wind, temperature and humidity changes can make a great deal of difference to the amount of noise heard at any particular time. However, a number of measures are taken to minimise the problem. Over built-up areas, minimum noise routes have been defined which carefully route aircraft over the less densely populated areas. Engine climb power is also reduced for the period when aircraft must fly over some built-up area. Different runways are used for take-off and landing and these are regularly alternated so that noise is spread equally over the areas lying beneath the landing and take-off routes, and flights are severely restricted at night. "Continuous descent approach" techniques from the stack to touchdown are regularly used in a further attempt to reduce the amount of noise reaching the ground.

An aircraft making a continuous descent maintains a higher speed without lowering his undercarriage and flaps. As a result less engine power is required, giving a quieter approach.



DEPARTURE

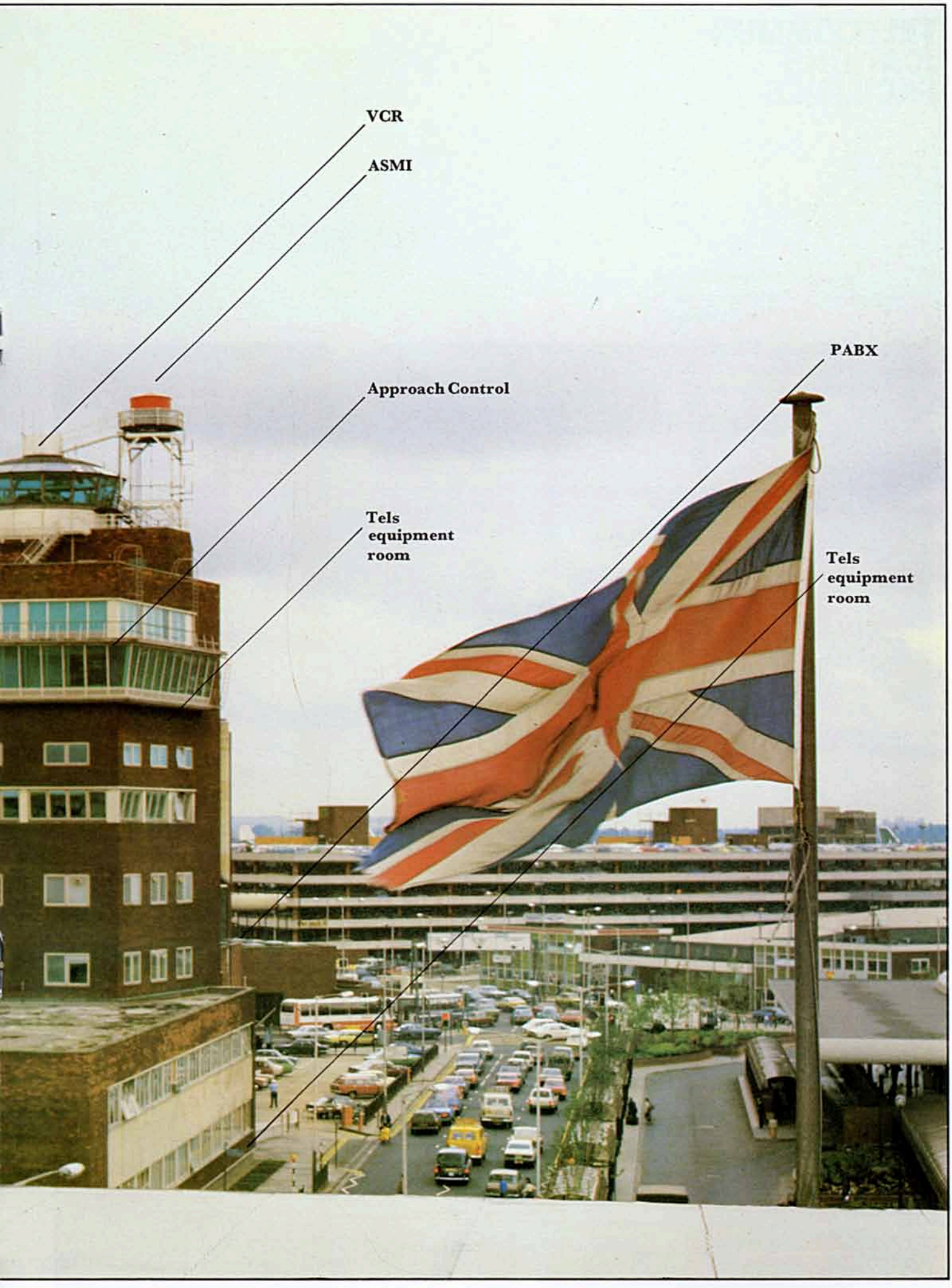
As an aeroplane approaches the holding point on the taxiway, responsibility is transferred to the Air Departure Controller, who lines up the aircraft in departure sequence to obtain the maximum use of the runway concerned. For example, when two aircraft of a similar type are departing in rapid succession, one for a north-bound destination followed by one for a south-bound destination, they may be allowed to leave one minute apart, but, due to the many types of aircraft

using Heathrow, the time interval may be increased depending on aircraft type and their specific departure route.

With the aircraft lined up in a take-off sequence, the Air Departure Controller issues individual take-off clearances. When each aircraft is safely airborne it is handed over to the London Air Traffic Control Centre, which continues the process of seeing it safely on its way through the London Region, before it is handed over to a controller in an adjacent Region.

Below *View of the airfield and a departing 747 from the Visual Control Room*

THE CONTROL TOWER


VCR
ASMI
PABX
Approach Control
Tels
equipment
room
Tels
equipment
room

TELECOMMUNICATIONS FACILITIES

Telecommunications are an essential feature in the safe and efficient operation of air traffic control. Equipment used at Heathrow includes VHF air-to-ground communications, primary and secondary radar, and closed circuit television systems. To ensure their efficiency, air traffic services at Heathrow have 12 radio telephone channels for the control and direction of aircraft in the air and on the ground. There are also three channels which can be used either by Heathrow or by the London Air Traffic Control Centre. Two more channels, which are allocated to the Automatic Terminal Information Service, are used to transmit meteorological and other essential information continuously to arriving and departing aircraft.

In addition to the facilities for radio communication with aircraft, service vehicles at the airport are also provided with radio links. These use a UHF radio telephone system, with some of the ground channels linked to VHF aircraft channels so that the controllers can hear both vehicles and aircraft as if they were on the same frequency.

The whole radio network is fed through a distribution and control system located on the ground floor of the tower. This system enables controllers to select any radio channel or telephone line they need. They can use the telephone system without removing their headsets, because the left earpiece and microphone of their headsets are connected to the telephone while the right earpiece remains connected to the radio network so that incoming radio calls can always be heard.

Standby and emergency services are incorporated in the system to maintain communications under all conditions. Each channel has a main and standby transmitter and receiver, while standby handsets are available which are used to bypass all the distribution equipment and connect the controllers direct to the transmitter and receiver stations. In addition, there is emergency equipment in the tower to provide ten VHF channels in the event of a complete breakdown of all the other standby services. Nothing can be left to chance.

All speech communication on the air-to-ground radio channels is recorded in accordance with the standards laid down by the International Civil Aviation Organisation (ICAO). The recordings are made on multi-channel recording equipment and the recording tapes are retained for 30 days after use so that they are available in the event of any incident needing enquiry. The tapes are examined from time to time to maintain a high standard of operation of the control and radio telephone communications procedures and equipment, and reports on sample tapes give a quality control service.

Because of the close spacing of frequencies in the aeronautical radio band, the main transmitter and receiver stations are located sufficiently far apart to avoid interference. At Heathrow the transmitter station is sited about 1 mile (1.6 km) south-east of the control tower, while the receiver station is about the same distance west of it.

Top *Maintenance on three-channel radio telephony recorder*

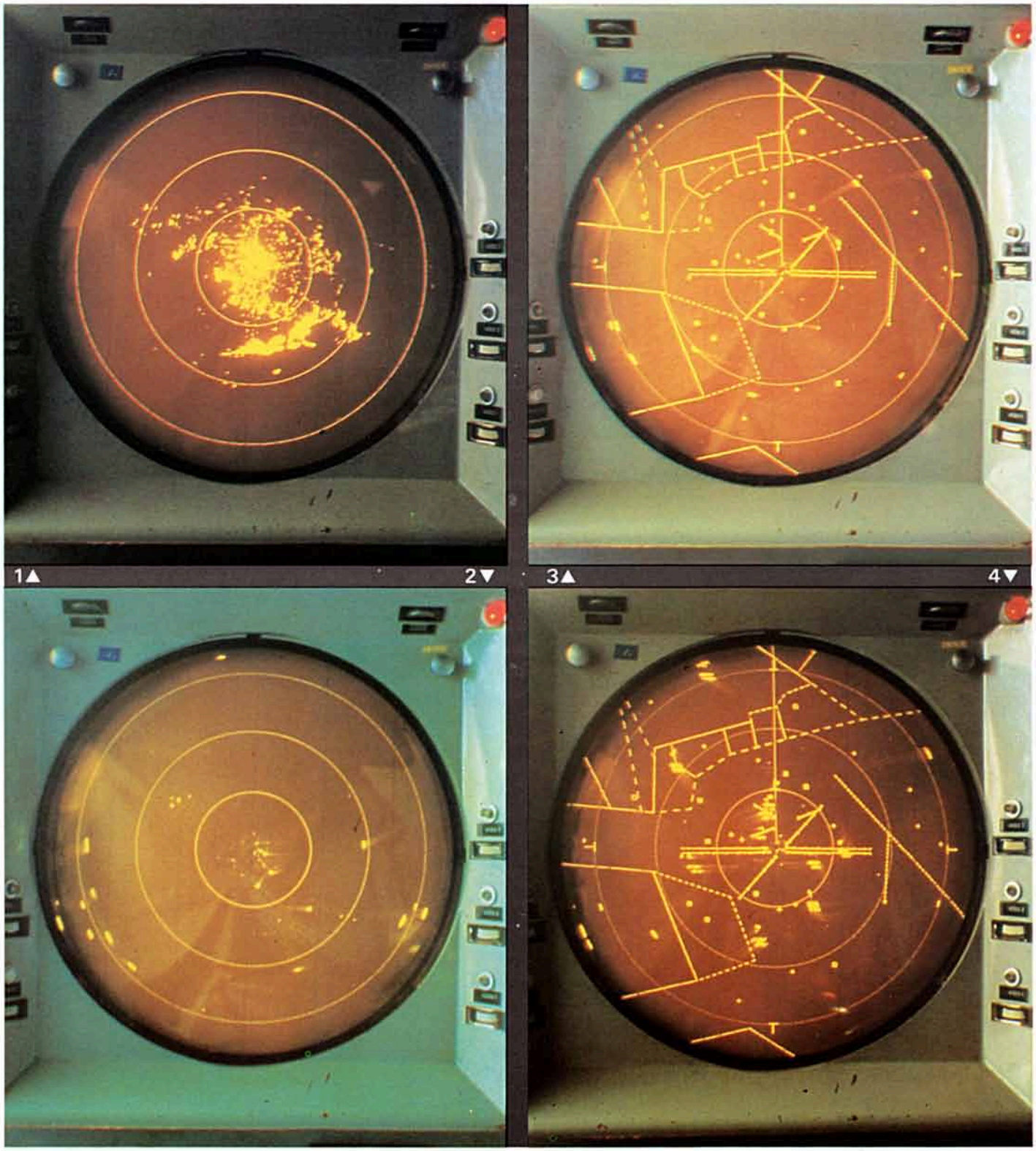
Centre *Radio telephony receiving aerials*

Bottom *Aligning equipment in the telecommunications workshop*

Below *Instrument landing system monitoring bay in the Telecommunications Equipment Room*

Radar picture development.

1. *Unprocessed radar picture showing ground echoes.*
2. *Ground echoes cancelled leaving only moving targets.*
3. *Electronic map added to assist positioning.*
4. *SSR labels added to selected moving targets.*



RADAR

The controllers in the approach control room in the tower use radar data derived from four different sources:

Cossor ACR VI	*10 cm Surveillance radar*
Plessey AR 1	*10 cm Surveillance radar*
Marconi S264A	*50 cm Surveillance radar*
Cossor 5G	*Secondary surveillance radar*

The first three are primary radars. They operate on the principle that energy transmitted through the radar aerial is reflected back from an echoing object, such as an aircraft, terrain or building, and this echo is received by the same aerial and presented as a "paint" or "blip" on the radar display tube. The target is entirely passive and the strength of the reflection depends on the size of the echoing area. As only reflections from aircraft are required, unwanted fixed echoes from the ground and other objects are eliminated by electronic devices to present the Air Traffic Control Officer with as clear and "uncluttered" a picture as can be provided.

Secondary surveillance radar, on the other hand, depends on the active participation of the target aircraft. Virtually all aircraft engaged in the public transport of passengers or freight are required to be fitted with equipment known as a transponder which receives a signal from the ground transmitter and sends a reply on a different frequency. This reply is in the form of alpha-numeric data and usually includes flight identification, route and height. The first two items are fed into the transponder by the pilot on instruction from air traffic control and height is obtained from a direct link to a pressure altimeter installed in the aircraft. Because the information is sent back on a different frequency from the radar transmitter, unwanted echoes are easily eliminated by tuning the ground radar receiver. On the controllers' radar, each aircraft blip is labelled with its identity, height and route.

RADAR DISPLAYS

These signals are from widely separated sites on the airfield but are brought together and combined with the video map in the radar data processing and distribution equipment in the control tower.

The video map produces a picture from a photographic plate which accurately shows the extended centrelines of the runways, the reporting points and other geographical data. This helps to provide confirmation of any aircraft's position to the controllers. Various maps are available for different purposes, such as the helicopter routes, and it is possible for the controller to select and enlarge part of a map if he wishes.

CLOSED CIRCUIT TELEVISION

Close circuit television techniques are used to transmit and display information to and from the Control Room. Two systems are used at Heathrow:

1. A display of information *showing the current situation at each of the four stacks – the aircraft and their various heights. This information is transmitted to the London Air Traffic Control Centre so that vacated levels can be re-allocated to newly arriving aircraft. It also allows information from the northern stacks to be displayed to the Sector controlling the southern stacks and vice versa.*

2. A display of local weather observations *These are called "weather actuals" and are transmitted periodically to the controllers at Heathrow and LATCC as well as to the meteorological forecaster, the meteorological briefing office and to some of the airlines at the airport.*

INSTRUMENT LANDING SYSTEM

When the No 2 Radar Director in Approach Control has positioned the aircraft on to the extended centreline of the runway, the pilot completes the approach by using the instrument landing system (ILS).

The ILS is a radio system which transmits two beams, one – the localiser – operating on VHF, the other – the glide path – operating on UHF. The localiser beam defines the centreline of the runway and extends along the approach path for twenty miles. The glide path beam defines the angle or glide slope which the aircraft should fly while following the localiser course to approach the runway, safely clearing all obstacles. When this system is coupled to the aircraft's flight control system on certain aircraft, they can make automatic landings in very poor visibility. To ensure the utmost reliability in any conditions, the ILS equipment has to be tested to a 10-million-to-one failure factor. It employs duplicate electronic systems, no-break power supplies and continuous monitoring of signal accuracy and integrity.

Alternatively, a pilot may use the aircraft's ILS instruments visually to correct his position relative to the glide path and centreline while he controls the aircraft manually.

There are three internationally recognised categories of ILS performance:

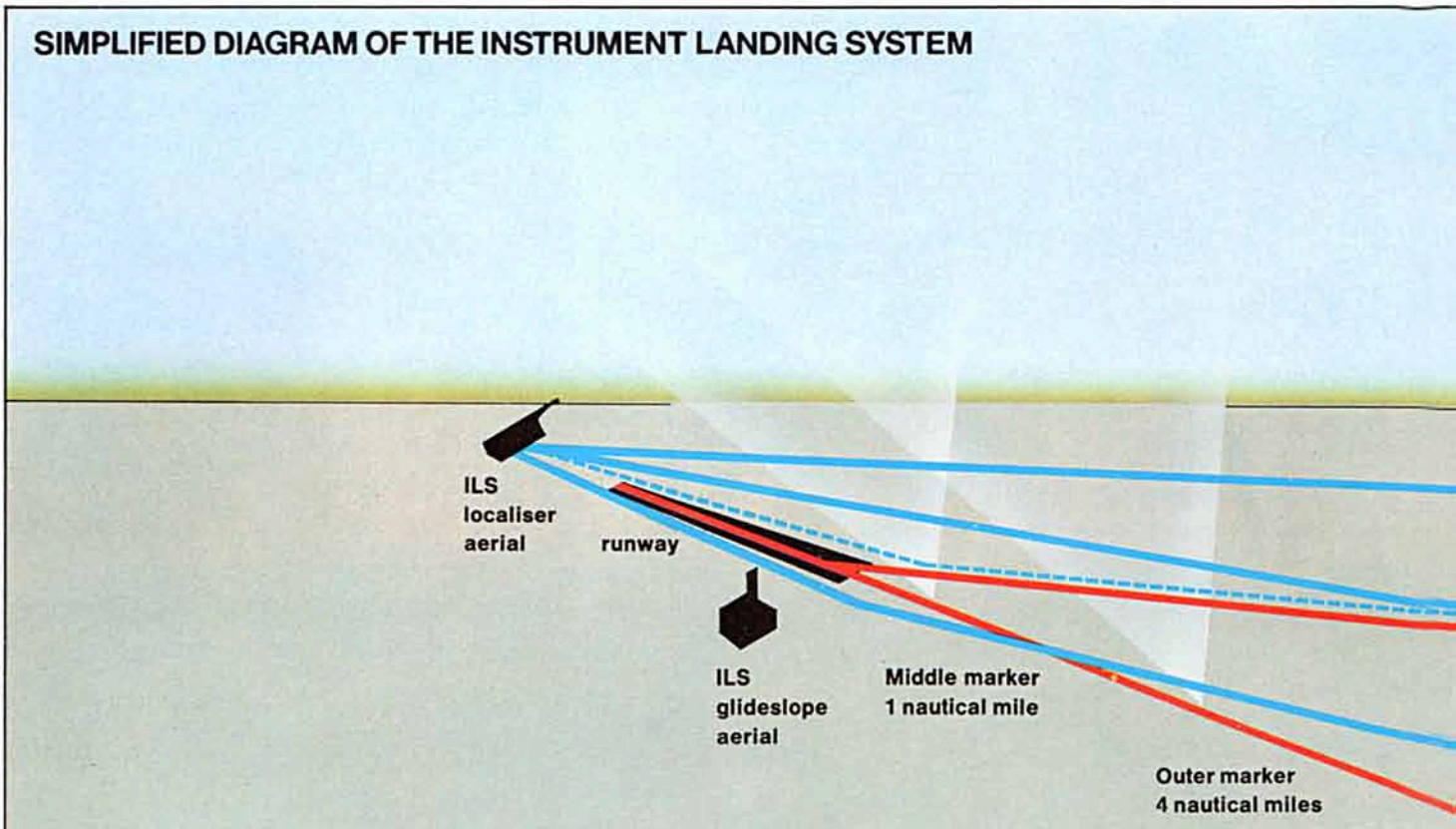
Category 1

For operations with a minimum cloud base of 60 metres and forward visibility down to 800 metres runway visual range (RVR).

Category 2

For operations with a minimum cloud base of 30 metres and forward visibility down to 400 metres RVR.

SIMPLIFIED DIAGRAM OF THE INSTRUMENT LANDING SYSTEM



Side view of ILS localiser aerial

ILS glideslope aerial

IRVR equipment

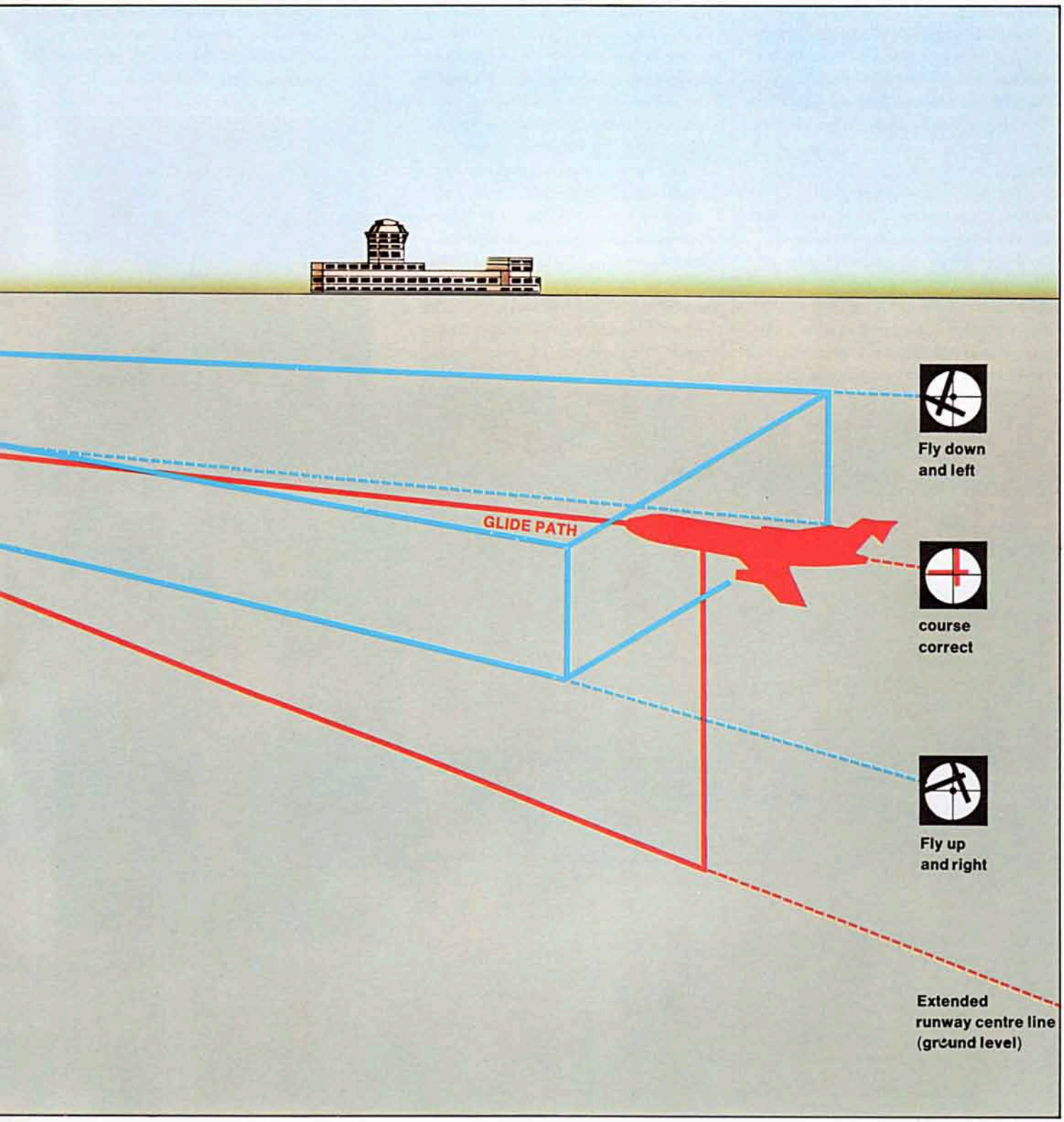
Category 3

For guidance down to and along the runway with no cloud base. This enables aircraft to land and take off in fog conditions if they are equipped with a suitable flight control system. The four main approaches at Heathrow can operate in Category 3.

The operational integrity of the instrument landing systems is checked every month by the Civil Aviation Authority's Flying Unit, which uses aircraft equipped as flying laboratories to measure and check the accuracy of the systems. To maintain complete accuracy, the systems are recalibrated every year.

RUNWAY VISUAL RANGE

Pilots attempting to land or take-off in low visibility need accurate measurements of the visibility along the runway they intend to use. A system called the Instrumented Runway Visual Range (IRVR) automatically measures and provides this information. Three measurements are taken on each runway – at each end and in the middle. IRVR equipment involves using an instrument called a transmissometer which measures the loss of light from a source projected over a standard distance. The measurement is fed into a computer together with other data, such as runway lighting intensities, giving a computed runway visual range of each area of the runway which is then displayed in all the operational control rooms of the control tower. The information is transmitted to pilots by air traffic control when the visibility falls below 1500 metres.



CIVIL AVIATION COMMUN-ICATIONS CENTRE

International airline operations are supported by a world-wide point-to-point communications system, called the Aeronautical Fixed Telecommunications Network (AFTN) which is specifically planned for air traffic purposes. Its task is to pass messages with content and format laid down by the International Civil Aviation Organisation. Most developed countries have one main switching or relay centre feeding a national network of sub-centres and terminals. Britain's centre is on the second floor of the Control Tower at Heathrow, where the international AFTN circuits from neighbouring countries terminate, and are connected to seven other similar centres in Europe and North America.

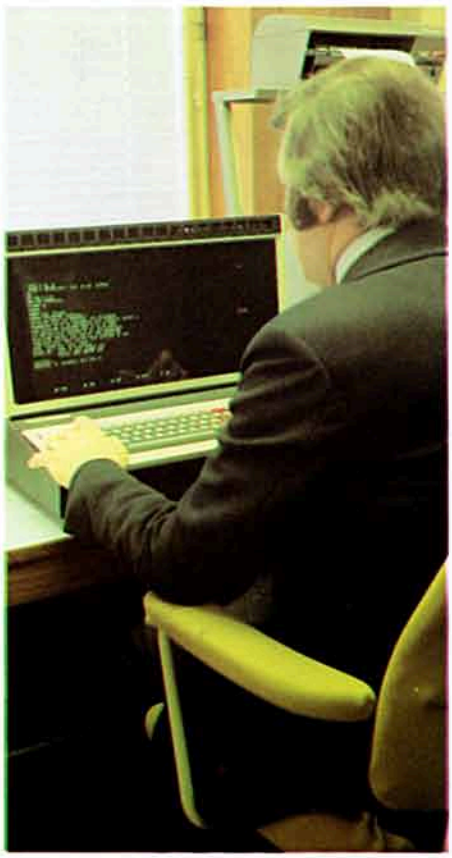
The basis of the addressing system is a simple code. The code for Heathrow is EGLL. The E indicates Europe, the G Great Britain and LL London Heathrow – EGKK represents Gatwick, EGSS Stansted. The codes are designed for automatic message routeing purposes. The countries involved have agreed routeing responsibilities for normal operations, with alternative routeings if breakdowns occur. Up to four additional letters may be added to the address code to enable automatic routeing beyond the national centre.

In the CACC at Heathrow all routeing is fully automatic, using dual Ferranti Argus 500 digital computers to identify the address codes and switch each message to the on-going route according to the agreed routeing plan. Each computer is capable of maintaining the complete operation. The maximum capacity is $\frac{1}{4}$ million messages per day and an average day's throughput is 60,000 messages. Messages may also be transmitted automatically to addresses by telex either as normal routeing or as a diversion from a direct line connection.

AIRPORT TELEPHONE SERVICE

The National Air Traffic Services provide an automatic telephone exchange for subscribers throughout the airport with equipment hired from the Post Office. It is a very busy switchboard and the operators are skilled in helping callers who may not be familiar with the complexities of the many organisations operating at Heathrow.

An important part of the telephone service is the emergency console, which has direct lines with air traffic control, the police, and the fire and rescue services. It enables the operator to intercept emergency calls between air traffic control, the police and the fire service so that all the other organisations likely to be required can be immediately alerted.



Above *The airport telephone room*

Top right *Routine maintenance examination of the magnetic disc store*

Right *The Visual Display Unit for direct communication with the computer*

THE STAFF WHO PROVIDE AIR TRAFFIC SERVICES

The provision of air traffic services requires many different specialist skills, with everybody making their own specific contribution to the overall efficiency and safety of the system. Those involved include not only air traffic control officers and telecommunications engineers but also a great many staff who provide support services, such as teleprinter operators, air traffic control assistants, typists, drivers and administration staff.

RECRUITMENT

An Air Traffic Control Officer must hold an air traffic control licence and it may only be held from the age of 21 so that, to allow sufficient time for training, would-be controllers are recruited from the age of 18, while engineers, who do not have the same age limitations, may be recruited a year or so younger. Air Traffic Control Officers are recruited internally or directly from school. Ex-pilots and navigators may also be recruited. Air Traffic Engineers are mostly recruited direct from school and occasionally a few experienced engineers from other industries. They start their careers as cadets in specialist colleges run by the CAA — ATCO cadets study at the College of Air Traffic Control, Hurn, near Bournemouth, while ATE cadets study at the College of Telecommunications Engineering, Milton Keynes.

General view of the operations room in the Civil Aviation Communications Centre

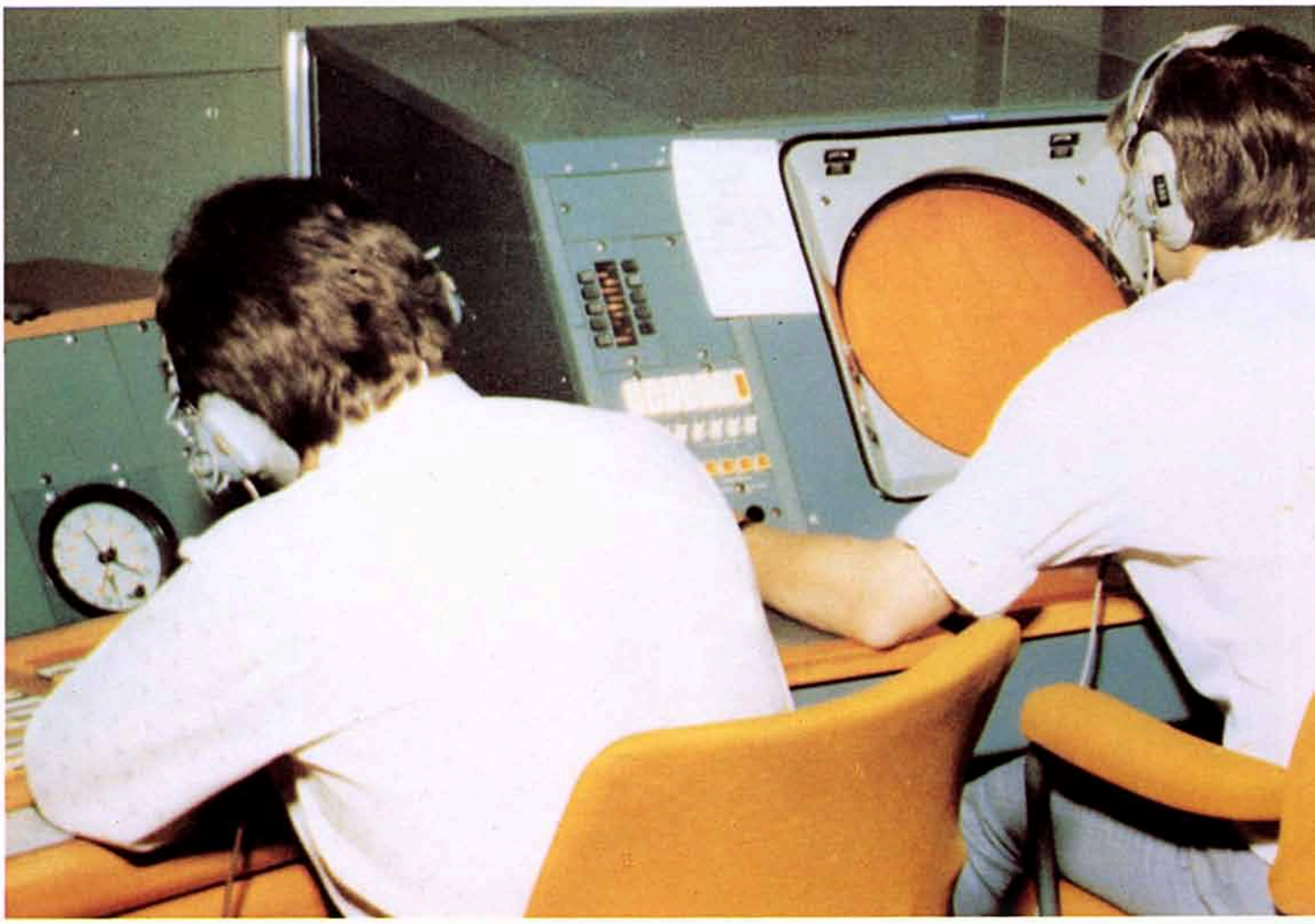
AIR TRAFFIC CONTROL OFFICERS

To qualify for their licences Air Traffic Control Officer cadets attend a course lasting 2½ years. Lecture training alternates with field training at airports and control centres throughout this period. Flying instruction to the private pilot's licence standard is also given so that they understand the limitations of aircraft and the problems which confront pilots.

On achieving the required standard, they are awarded their basic licence. Even then, before they may practise solo they must work under supervision at their new aerodrome until their basic licence is endorsed for the location at which they will work and this additional training is carried out locally (at Heathrow this takes about a year). Any subsequent move involves further local training.

At Heathrow, some of this local training is done on a radar simulator. This uses a Ferranti FM1600 high speed digital computer, programmed to represent the Heathrow air traffic environment. The simulated aircraft can be "flown" through the Heathrow procedures while the controller practises his skills without affecting the live operations at the airport. Two individual exercises can be run simultaneously. Either or both of the exercises can be temporarily "frozen" by the instructor at any given time so that a particular aspect can be discussed with the students.

Controlling air traffic is regarded as a potentially stressful occupation and planned breaks are scheduled into the duty times so that an ATCO at Heathrow does not occupy any operational position for more than two hours without a break.



Air traffic controllers learning Heathrow procedures

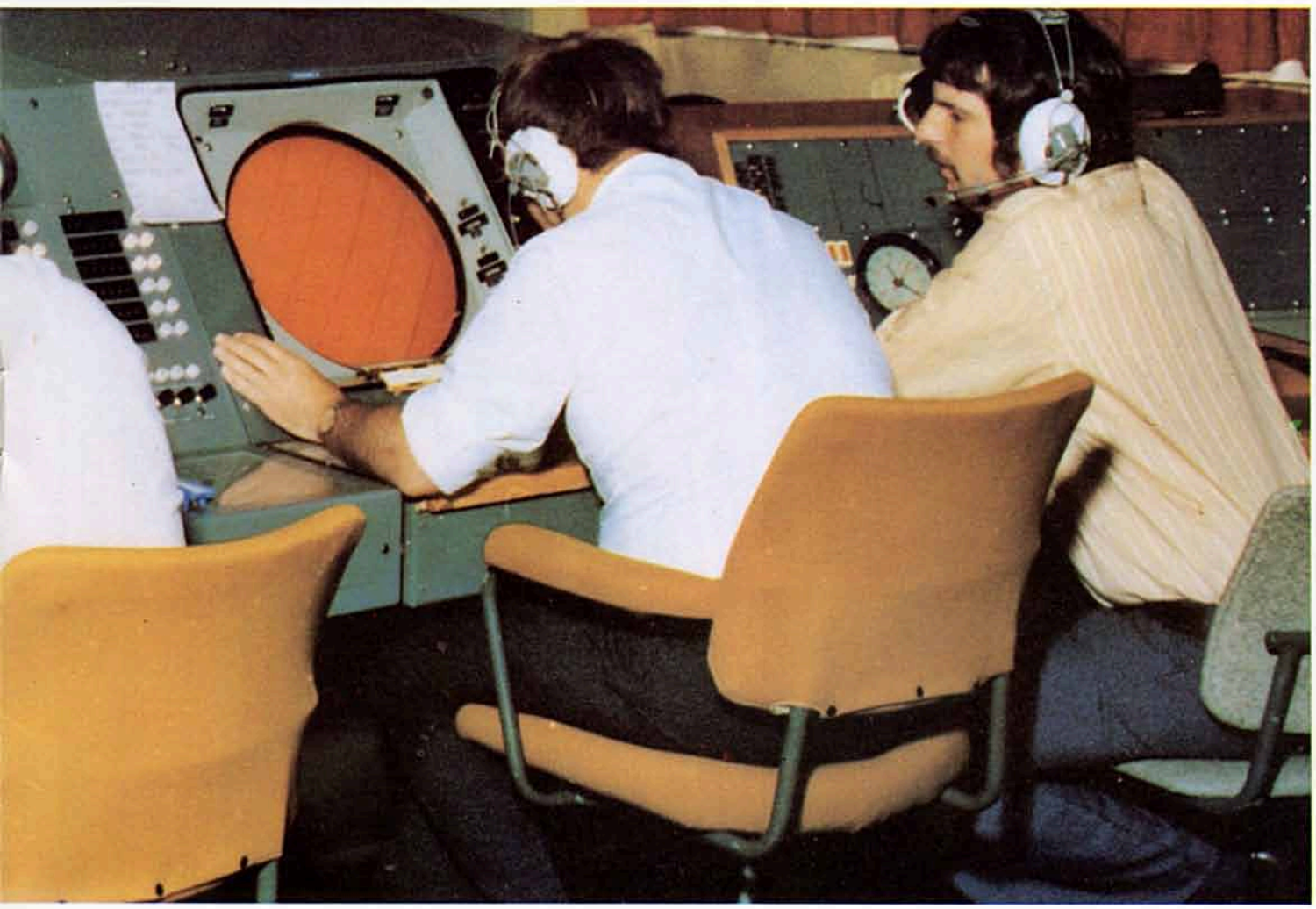
AIR TRAFFIC ENGINEERS

Air Traffic Engineer cadets undertake a three-year engineering course divided between the college at Bletchley Park, Milton Keynes and a College of Further Education. They study for the TEC Diploma or Certificate in Aerospace Studies – Air Traffic Engineering. Field training at airports, air traffic control centres and other specialist establishments is also given to gain practical experience in civil aviation telecommunications.

At Heathrow, the engineers undertake watchkeeping duties and learn about the equipment and systems installed at the airport. When on duty, the engineers' principle task is to maintain the equipment and systems and restore any service to full efficiency if a breakdown should occur.

OTHER STAFF

Air Traffic Control Assistants are employed to provide essential support to the controllers by relieving them of the many routine and clerical tasks so they can concentrate on their principle function of helping aircraft on their way. Similarly, those who operate the telephone service and teleprinter system make an important contribution in the overall provision of a reliable, efficient and safe air traffic control service.



INSTRUMENT APPROACH CHART ICAO

BEARINGS ARE MAGNETIC
ELEVATIONS IN FEET A.M.S.L. 310
HEIGHTS IN FEET ABOVE THRESHOLD ELEVATION OF RUNWAY 28R .....(233)

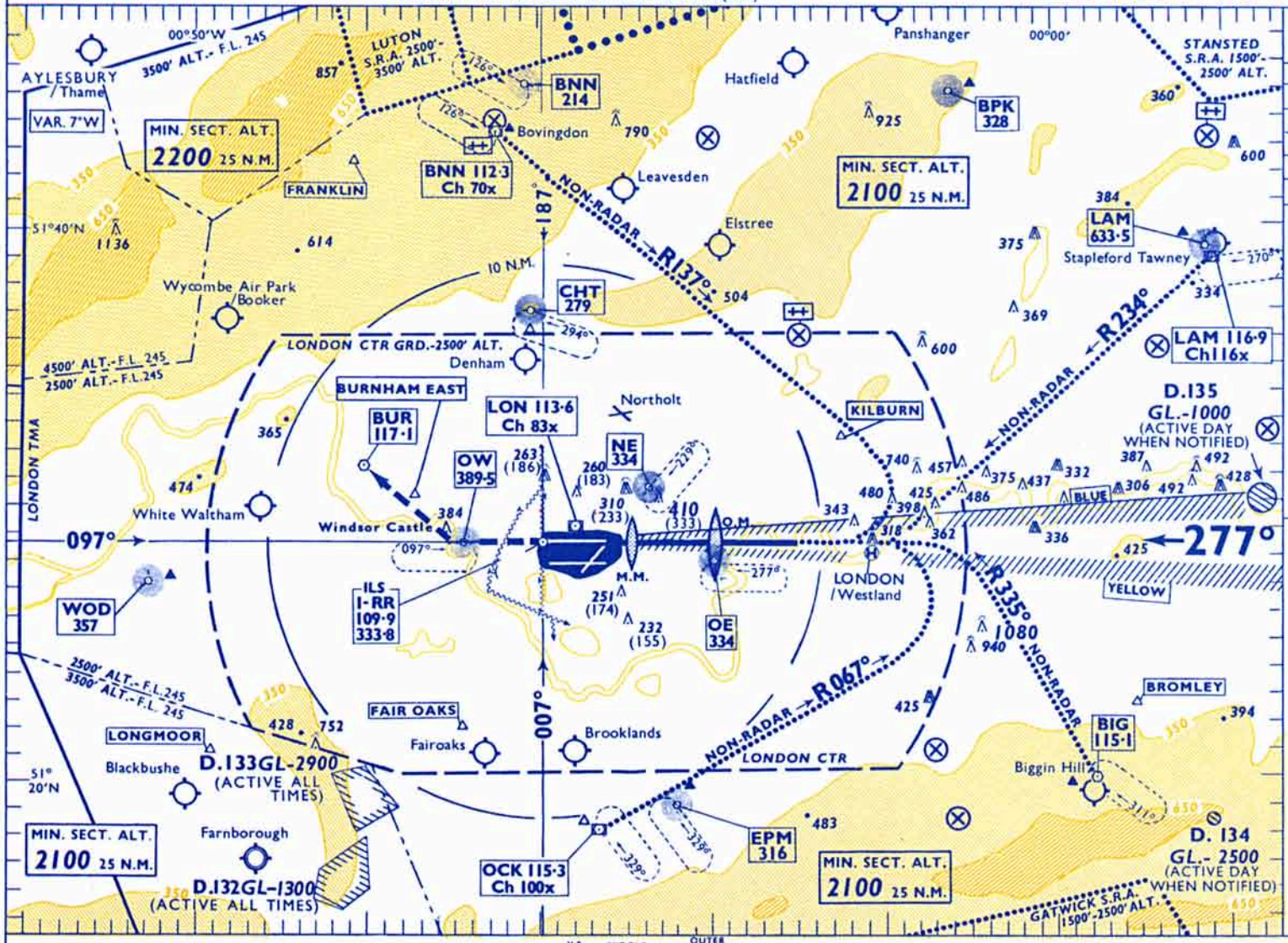
ELEV. 80 FT.
CONTOURS COMMENCE 300 FEET ABOVE AERODROME

MANDATORY PROCEDURE

LONDON/Heathrow
CATEGORY II ILS R/W 28R

51°28'N 00°27'W

LONDON/Heathrow CATEGORY II ILS R/W 28R



AERODROME OPERATING MINIMA	TAKE OFF	DAY	NIGHT
	LANDING	DAY	NIGHT

DISTANCE BETWEEN MARKERS				90 KTS
O.M. to M.M. 2.8 n.m.				1min. 52sec.
M.M. to R/W threshold 0.9 n.m				36 sec
120 KTS	140 KTS	160 KTS	180 KTS	195 KTS
1min. 24sec.	1min. 12sec.	1min. 3sec.	56sec.	52sec.
27sec.	23sec.	20sec.	18sec.	17sec.

RADIO

APP 119·2 119·5 120·4 121·5 127·55
HEATHROW APPROACH

RADAR 119·2 119·5 120·4 121·5 127·55
119·9 for Special VFR Flights
HEATHROW DIRECTOR

TWR 118·7 118·5 121·5 121·7 for initial call by departing A/C
121·9 GMC
121·85 Dep ATIS 121.0 118.7
HEATHROW TOWER

LIGHTING

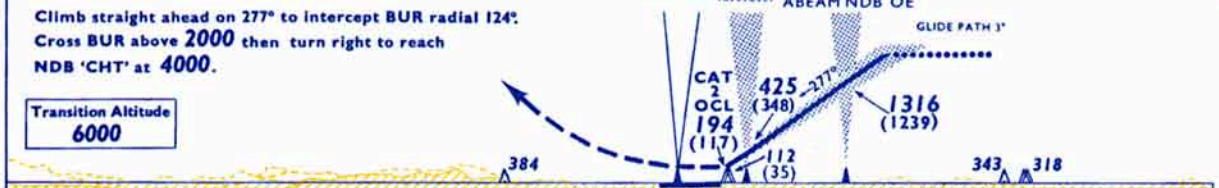
APP LTG
28 R 905 M HI coded CL/5 bars
Supp. Ltg. 300 M VASI's.

RNWY LTG
28 R
HI Bi-d with HI Bi-d colour coded CL Red end lights
TDZ 914 M
Elevated snow sodium lighting
HI and LI Green thresholds with HI wings bars.

OTHER LTG
Green CL or blue edge taxiway
Obstructions
Red exit lighting

OVERSHOOT (Based on 1:40 Climb):–
Climb straight ahead on 277° to intercept BUR radial 124°. Cross BUR above **2000** then turn right to reach NDB 'CHT' at **4000**.

Transition Altitude **6000**



Without Radar:–

INTERMEDIATE PROCEDURE VALID FOR 90–240 KTS T.A.S.

From VOR 'BNN' leave on radial 137° maintaining 7000.* At 'BNN' DME range 7 n.m. commence descent to 2500. At 'BNN' DME range 19 n.m. turn right to intercept ILS localiser course.

From VOR 'LAM' leave on radial 234° descending to 2500. On passing VOR 'LON' radial 096° turn right to intercept ILS localiser course.

From VOR 'OCK' leave on radial 067° descending to 2500. At 'OCK' DME range 13 n.m. turn left to intercept ILS localiser course.

From VOR 'BIG' leave on radial 335° descending to 2500. At VOR 'LON' radial 105° turn left to intercept ILS localiser course.

* Normally ATC will instruct aircraft to fly at the appropriate equivalent flight level

CHANGE:–OBSTRUCTIONS

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GLOSSARY OF ABBREVIATIONS

AFTN	Aeronautical Fixed Telecommunications Network
ASMI	Aerodrome Surface Movement Indicator
ATCO	Air Traffic Control Officer(s)
ATE	Air Traffic Engineer(s)
CAA	Civil Aviation Authority
CACC	Civil Aviation Communications Centre
DFTI	Distance From Touchdown Indicator
ICAO	International Civil Aviation Organisation
ILS	Instrument Landing System
IRVR	Instrumented Runway Visual Range
LATCC	London Air Traffic Control Centre
MOD	Ministry of Defence
NATS	National Air Traffic Services
RVR	Runway Visual Range
SSR	Secondary Surveillance Radar
TMA	Terminal Control Area
UHF	Ultra High Frequency
VCR	Visual Control Room
VHF	Very High Frequency

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