ENG INF

The quarterly for BBC engineering, technical and operational staff

AUTUMN 1991 No. 46

# TC's NEW DISH ANTENNA

During the late summer, a 9 metre dish antenna was installed at Television Centre, above the roof of the Central Wedge. Used for both transmitting and receiving, it can be aligned on geostationary satellites across an arc from 53 degrees east to 56 degrees west. The receiving facilities were expected to be in service towards the end of November.

According to Peter Marchant, Chief Engineer, Television: "*Not only will the dish pay for itself in a little over two years and then continue to provide large savings for many years to come, it brings new flexibility to the reception of OB and international traffic.*"

A full description of the installation will be published in our next issue.

Des Hill, ACED

*The 9 metre dish being hoisted onto the roof of Television Centre on 21st September*

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# ENG INF

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| | |
|---|---|
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Stories for the Spring edition should be forwarded to the Editor by Friday 14th February, 1992.


# Transmitter News

The following services opened or changed between 24th August and 15th November:

### New TV relays

| | |
|---|---|
| Gravelly Hill | Birmingham |
| Hampstead Heath | London |
| Leitrim | Co Down |
| Ramsgate | Kent |
| South Tredegar | Gwent |
| Tedburn St Mary | Devon |

### New FM stations

| | |
|---|---|
| Berwick-upon-Tweed | Northumberland |
| Saddleworth | Gtr Manchester |

### Radios 1 and 4 on FM

| | |
|---|---|
| Carmarthen | Dyfed |

### Mast flashing safety lights

| | |
|---|---|
| Manningtree | Essex |
| Meldrum | Grampian |
| Mendip | Somerset |
| North Hessary Tor | Devon |
| Redruth | Cornwall |
| Rosemarkie | Highland |

### Local Radio

An opt-out of Radio Sussex opened in the Guildford area on 14th November, operating on 104.6 MHz. Known as ***BBC Radio Surrey***, it broadcasts 40 hrs of local programmes each week, taking Sussex programmes at other times.

# In Brief.....

## EsIC Conference

Due to difficulties in confirming the speakers and venue, the annual EsIC Conference had to be put back from its usual November date. It will now be held on the 28th and 29th of January, 1992, at the usual venue — the IEE, Savoy Place. Further details from John Pinniger of EID on White City 25985.

## D&ED's Open Days

D&ED's annual Open Days will be held at Avenue House on Wednesday 29th and Thursday 30th January, 1992 — coinciding with the EsIC conference. The building will be open from 9.30 am to 4.30 pm on both days and everyone in the BBC is welcome to attend on either day.

D&ED staff will be available to demonstrate the range of new equipment designs produced over the past year, as well as the wide range of services available to the BBC. Further details from D&ED's Liaison Engineer — Bob Hartley — on AH 4375.

## Engineering Components Catalogue

Did you receive a copy of the ***Engineering Components Catalogue*** last April? If you should have but didn't, it could be because you moved offices and haven't yet told us. So, to help us revise our mailing list, D&ED would like to hear from any recipients of the catalogue who have changed addresses.

If you have a copy of the change-of-address slip which is sent out with each catalogue, could you please complete it and return it to Neil Sutton, Room 215, Avenue House, as soon as possible. Alternatively, you can ring Neil on AH 4287 and give him details of your new BBC address.

The current issue of the catalogue was published in April 1991 and an updated price list was released recently; copies of both can be obtained from Neil on request. The next edition is due to be published in April 1992 — so please make sure Neil has your correct address and requirements well before then.

Peter Jefferson
Technical Information Manager
D&ED

## Wales

Film dubbing operations in Cardiff have been moved from the Stacey Road premises to Theatre B at Llandaff. The new **Film Dubbing Theatre** has a totally-digital audio mixing console; an AMS Logic console with twenty-eight stereo channels and two groups; Otari multitrack and Studer A812 tape machines; R-Dat and CD players, sep-mag equipment and a Sony BVW-75 vt machine. All equipment is interfaced to the desk via a/d converters, thus allowing the digitised sources to be processed with minimal degradation and recorded digitally on the Audiofile.

The biggest advantage of the desk is its automation. Setups — including fades, gain and Eq — can all be saved and recalled at a later date, whilst mixes can be performed in real time allowing adjustments to be made before the final recording.

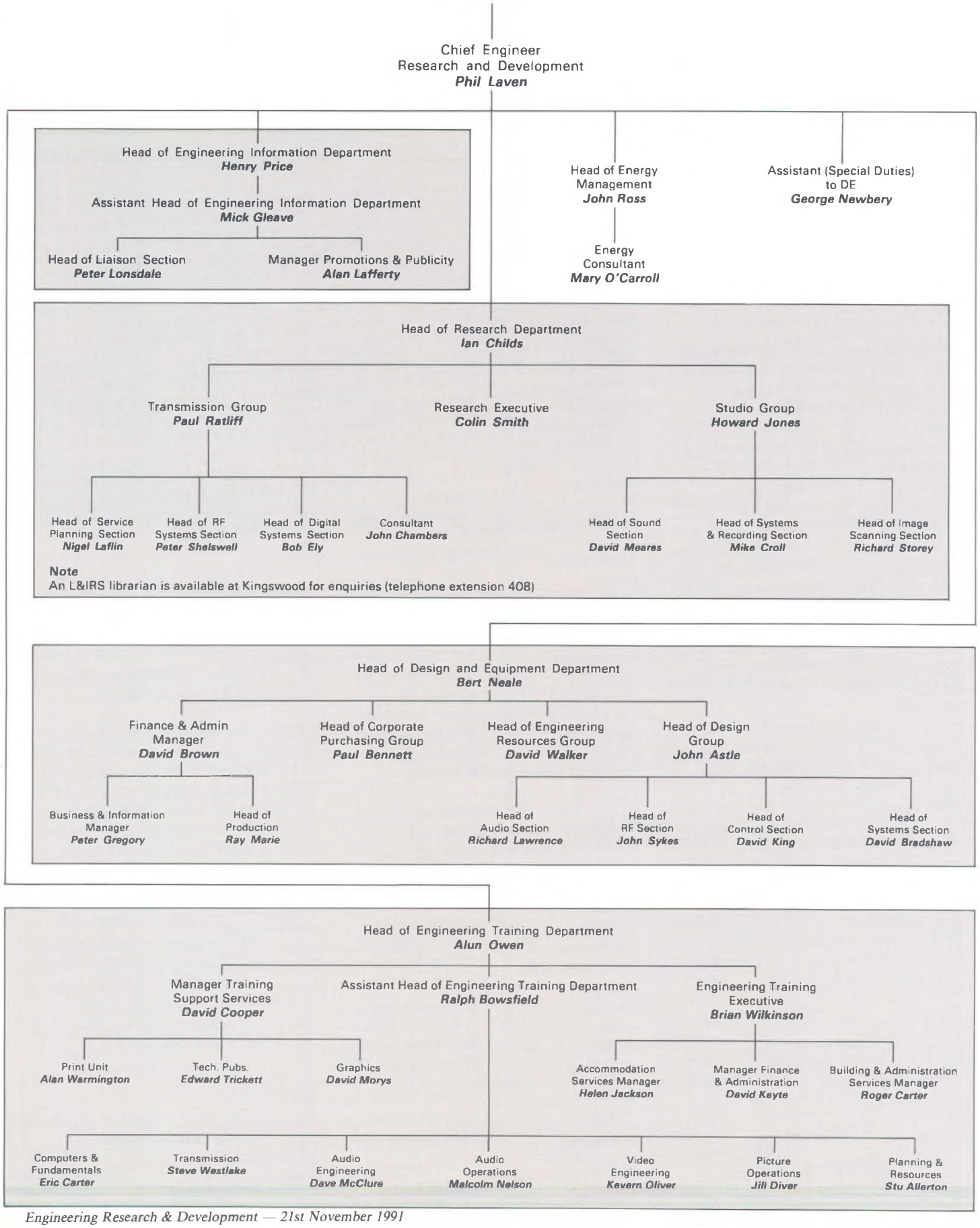
According to film dubbing mixer, Tim Ricketts: "*The greatest advantage of this desk will be the time savings in setting up the desk. No longer will it be necessary to labour through every fader and knob; a simple recall from floppy disk memory will restore the correct levels. We have already had some considerable success in the dubbing of* ***Filipina Dream Girls****, a drama recently shown on network television*".

The installation contractor was Television Systems Ltd (TSL) of Maidenhead, under a project led by P&ID Tel.

Eric Hutchinson
Recording and Film Group
P&ID Tel

# FAMILY TREES

## Engineering R & D




*Engineering Research & Development — 21st November 1991*

# SOUTH & WEST REGION

## Southampton moves into the 90s

**On September 9th, television broadcasting from Southampton moved from the old premises at South Western House to the new purpose-built Broadcasting Centre at Havelock Road in the centre of town. Pat Turner describes the new centre.**

The BBC has had a presence in Southampton for over three decades. Until recently, the regional home has been a converted hotel — the old South Western Hotel — where existing Home Service wireless studios were converted to television use. Many of the remnants of a bygone age were still there such as impressive marble-lined public areas and ornate plasterwork in the television studios.

It did not make an ideal broadcasting centre: the newsroom was cramped, chimneys with real soot had to be used as cable ducts between floors; the studio could only be used on-air with the ventilation system turned off, and equipment bays were crammed into every nook and cranny. Radio Solent, housed on a separate floor, had to face similar difficulties.

The need for a new Broadcasting Centre was identified ten years ago — a requirement which would give the opportunity to bring together both TV and Local Radio in one bi-media centre. Five locations were considered and the Havelock Road site came out favourite.

At the time, it was being used as a municipal 'bomb site' car park, the most significant feature being its slope. The ground falls away steeply from the frontage on Havelock Road to its lower end in West Park Road, a difference in level of about 8m. Further challenges came from the London to Southampton railway running adjacent, artesian wells below and the chimes from the Civic Centre belfry opposite. The main redeeming feature was its proximity to the centre of the city and therefore its accessibility to the public.

After extensive discussions with all parties, a project plan was drawn up and approved by the Board of Governors in March 1988. Work then commenced on the detailed design.

### Building Design

South & West Region laid down a number of design requirements. Principally, there was a need to bring TV and local radio together in a common newsroom and to maintain flexibility throughout the building, so that future changes in BBC policy and programming arrangements could readily be incorporated. There was also an urgent need to provide Radio Solent with new facilities as the existing equipment had become a maintenance liability.

Peter Ward, Southampton

*Aerial view of the new Broadcasting Centre in Southampton*

Southampton City Council also set tight guidelines — in particular, the building should complement the Civic Centre. This is a dominant landmark in Portland stone with copper roofs, designed in the 1930s by E Barry Webber. Its 50m high belfry was a lookout for fire watchers during the Battle of Britain.

The Broadcasting Centre in common with others of its type is a 'highly serviced' building. Such requirements do not generally go hand-in-hand with good aesthetics; the local town planners had a personal interest in its design because of its prominent location directly opposite their own offices in the Civic Centre!

The design adopted has a copper roof and artificial stone pilasters on a contemporary external shell. Care was also given to landscaping as the site previously had the appearance of a relatively-green park, as well as being adjacent to a pedestrian walkway leading to the railway station.

ACED was responsible for the conceptual design, based on the Region's requirements. The building construction programme was split into two phases — *shell* and *fit-out*. Detailing and site management of the shell was assigned to local architects, following client and planning approval.

The fit-out was detailed and managed in-house by ACED, because of the inherent specialist content and the need for interdepartmental liaison. The contract was split into several sections in order to ensure early completion of the Local Radio areas, which were described in ***Eng Inf*** No 43.

### Green Heat

The new building is unique within the BBC in that heat is provided by a geothermal heating system. A study was made of the options for fuelling the new building, including the geothermal heating system run jointly by

Southampton City Council and private enterprise. This had been operating for some years and was already supplying a number of nearby buildings. Brine is pumped 1.8km down a bore hole to a hot aquifer. The returning fluid at 760°C is passed through a titanium plate heat exchanger. Heat is distributed around the city by pumps supplied with power from a CHP (combined heat and power) diesel generator. Additional heat for stand-by is supplied by boilers in the Civic Centre.

Use of the geothermal system releases space which otherwise would have been taken up by a boiler house and chimney. The running costs are comparable to gas and cheaper than oil; a minor disadvantage is that the heater batteries and radiators need to be slightly larger because of the non-standard temperature but this was allowed for when comparing costs.

## Technical Design

The bulk of the technical installation has been implemented by P&ID Tel, under several contracts specified jointly with South & West Region.

### Pal, component or digital?

A study was carried out at an early stage to establish the most cost-effective and flexible video standards for the centre.

A simple Pal system offered significant cost advantages but a limited amount of component routeing was also included in order to minimise the number of codecs required — particularly between graphics devices and the Beta SP vt equipment. A digital implementation was ruled out, both on cost grounds and because of the limited range of equipment available at the time of tendering (December 1989).

### TV Studios

Two studios are available, sharing common control rooms and camera equipment. Studio A (180 sq metres) has been designed to be set and lit, if necessary, by one person using a comprehensive remote control system which controls both mechanical positioning and the lighting levels of the luminaires. It has a saturation lighting rig with sixty luminaires — a mixture of single and dual sources suspended from remotely-controlled pantographs. All power and control signals are fed by festoon cables to allow maximum movement of the pantographs and other equipment.

A triple concentric cyclorama track runs around the studio at a height of 5m. This allows the pantographs complete with luminaires to be cleared away above it for storage. Once set, lighting control is via an Arri Image control system. A second unit provides preset lighting for self-drive news bulletins etc.

Studio B (50 sq metres) has a simple rolling-bridge grid with a single cyclorama track at 3m.

The Ikegami HK355P cameras are equipped with a Radamec EPO remote control system. Pan, tilt, zoom and focus, as well as the usual camera exposure functions, can be controlled by one operator if necessary, releasing valuable effort for acquisition in the field.

Studio A has been designed for shared use between Television and Radio Solent. The television sound control room with its Calrec M series desk was specified with this in mind, as was the dubbing suite which incorporates an AMS Audiophile. The facilities in the three-machine vt edit suite have been enhanced slightly to cope with simple tv transmissions when the normal tv control rooms are in use by Radio Solent. It can also act as a back-up to the main technical system in the event of a major fault.

Peter Ward, Southampton

*PSC edit room*

Peter Ward, Southampton

*Studio A*

## – SOUTHAMPTON –

### Newsroom

The newsroom, with editing, graphics and library areas immediately adjacent to it, forms the heart of the ***South Today*** news operation — South's flagship. Full viewing and preview facilities are available together with comprehensive communications to other areas. Autoscript prompting is driven from a fully-equipped workstation within the area. The ENS system is shared by both Television and Local Radio.

The vt cutting rooms are transmission-capable, in order to put rushes on-air if necessary.

The graphics equipment from SW House has been rationalised into a single dedicated area. Facilities include a Quantel paintbox, Aston wallet and Cintel artfile and slidefile.

***Southern Eye*** — the region's topical features programme — has its production offices on the floor above, which also accommodates further editing areas.

### VT and TK

The station will now only use the Beta SP format for origination. A multi-format area has been installed to cope with the library footage archived during the last ten years including valuable Falklands material. The area has at least one machine capable of replaying/recording each obsolescent format, except 2-inch, and can also deal with up/down-line transfers and transmissions.

A Mk II Cintel telecine machine from Bristol has been refurbished by P&ID Tel with assistance from S&W Region to replace the SW House equipment.

### Presentation

A new presentation desk has been installed, based on the Grass Valley Master 21 mixer. A custom-built control surface, similar to that on the previous equipment, has been added — as in other English Regions — to enable self-operation whilst in-vision.

Facilities have been included to enable opt-out on both networks.

### Power supplies

Power Systems Section of TED provided connection to the electricity supply. A 30kVA standby generator has been installed, mainly to support Radio Solent in case of power failure. A limited amount of power is also available to maintain the network tv feeds through the building to the main Rowridge transmitter on the Isle of Wight.

### Telecommunications

Optical fibres are used for connecting the vision circuits to the local BT switching centre, with the signals still being carried in analogue form. Special arrangements were made during the run-up period in order that pilot programmes and inserts could be made prior to the final on-air date.

A pair of simple tilting masts — actually modified street lamp standards — are used to carry local radio and tv antennas. The matched mono lines carrying Radio Solent's output have been replaced with a stereo digital circuit to Rowridge.

### Acknowledgement

The author would like to acknowledge the efforts of the contributors who helped compile this article and for their much-valued co-operation throughout the project.

Pat Turner, Project Manager
Studio and OB Group
P&ID Tel

# WHITE CITY
## RF distribution system

**David Errock describes the comprehensive rf distribution system which is now available to staff in White City.**

The task of installing a technical cable network in the White City building was a very different proposition to that of working on a purpose-built modern studio centre, or on offices in one of the Corporation's older buildings. The architect's design aim at White City was to offer flexible accommodation which could be adjusted without major building works. To this end, the imposing shell of the building contains six open-plan floors with some demountable cellular offices and only a minimum of slab-walled areas. Demountable in this context implies an office which can be removed or reconfigured in less than an hour!

With flexibility such as this, it is not an option for the technical installer to drill into the office walls or run permanent cables inside them. Even lights are switched with infra-red remote controllers to save cabling to wall switches. All technical cables had to be terminated in the building's floor boxes and all technical items needed to sit on special clip-mounted shelves or on free-standing items of furniture.

It came as quite a shock to discover that facilities could not be supplied to the offices using a few kilometres of PSN cable, a box of cable clips, a hammer and a drill! Not only that, but the only space allocated in the floor boxes — after power, phones and data had all taken their share — was one standard square conduit box. This dictated that we must use a single rf distribution network to carry all the various technical services around the building.

### Design requirements

The original 'design & build' contractor — Balfour Beatty — had provided a limited rf system to a 1986 specification. This had not anticipated the growth in metropolitan commercial radio stations or the impact of satellite tv. Its design was based around supplying only 150 outlets — the number originally considered adequate for White City's intended use.

Once it became apparent that the majority of occupants would be programme makers and that the building would be used to originate and edit programmes, it was clear that this system was totally inadequate. Worse was to come when, during commissioning of this Balfour Beatty system, many interference problems were discovered — mostly caused by pirate stations and the new incremental fm stations. It became clear that a complete re-appraisal was necessary.

Mark Edgar, Radio Projects

*The headend equipment*

By surveying a number of existing BBC systems in other buildings, some useful experience was immediately acquired. In London BH, for instance, nearly every office now has an rf outlet. These have been added on an ad hoc basis over the years and have been characterised by shortcomings inherent in the original design.

Systems in older buildings tend to be expanded in an unpredictable fashion, creating a technical restriction to the maximum number of services which can be distributed. As the number of services increases, so a regular alteration of the distributed programmes is necessary. Sources then need to be manually replugged according to the current requirements of the users.

To provide the ideal installation for White City, we gave ourselves some objectives based on the above experience:

1. Every workstation (in every office) should have the potential for a comprehensive ringmain service.
2. The headend should have the maximum capacity which was technically feasible and financially viable.
3. The system should conform with White City's philosophy of contract maintenance and should not need constant supervision or frequent attendance. In effect every user would do his/her own source selection.

## Headend

The television provision consists of twenty-one channels — all carried in the standard uhf bands IV and V. These carry off-air terrestrial feeds (including provision for Channel 5), nine satellite channels (including BBC TV Europe) and line feeds from TV Centre. This type and size of system is now common in larger hotels. In addition, two out-of-band channels are available for carrying special services around the building.

The radio provision consists of a larger number of channels than we believe has ever been achieved on an internal cable system before. The White City system currently carries forty-five channels, as shown in the accompanying box.

The aim was to put all the sound services within the normal 88-108 MHz spectrum of Band II. From the tenders returned and advice received, only one company (Telec Communications) agreed that the scheme was feasible. They believed their offer achieved the necessary performance by using a scaled-down version of an IBA-specification transmitter drive, built by Sound Broadcast Services (SBS). The spurious products generated by each of these units were sufficiently low in level to allow clean reception by the user, even after all forty-five modulator outputs had been combined and then processed by the distribution chain.

The SBS modulation design offers various front panel controls, including frequency adjustment by thumbwheel, and a deviation meter; all for a similar price to that of a standard cable headend modulator.

To ensure optimum use of the available bandwidth, it was necessary to produce a bandplan specific to the building and to operate a closed cable system. In other words, all services would be individually remodulated onto the distribution cable in fixed, pre-planned, frequency windows; rather than being routed direct from an aerial into the building distribution chain, unaltered in frequency.

To ensure complete integrity of the audio signal and optimum flexibility of the system, it would be necessary to reduce all incoming services to baseband audio. If done conventionally, this would have introduced two problems — there would have been a disproportionately high cost to pay in stereo encoding equipment, and the RDS information would have been lost in the process, much to the dismay of the RDS Development Manager.

The solution was to use a high quality am/fm domestic tuner, modified such that in the fm mode the full undecoded multiplex signal was delivered to a single output socket. This was then fed into a wideband modulator, thus preserving the original stereo signal and the relevant RDS data. In the am mode, a pre-emphasised output was provided from the same socket allowing the headend tuner to be switched between mw/lw/vhf without any need to adjust controls on the modulator. Complete interchangeability of equipment is thus achieved without the need for sophisticated alignment routines.

## ROLEC TUNER Memory Allocations

| Ch | Service | Freq (MHz) |
|---|---|---|
| 01 | Radio 1 FM | 100.7 |
| 02 | Radio 2 FM | 101.1 |
| 03 | Radio 3 FM | 101.5 |
| 04 | Radio 4 FM | 101.9 |
| 05 | Radio 5 AM | 90.7 |
| 06 | World Service | 103.9 |
| 07 | Radio 3 AM | 89.9 |
| 08 | Radio 4 AM | 90.3 |
| 09 | GLR FM | 102.7 |
| 10 | GLR AM | 91.1 |
| 11 | LBC FM | 103.1 |
| 12 | LBC AM | 91.9 |
| 13 | Capital FM | 103.5 |
| 14 | Capital AM | 92.3 |
| 15 | Choice FM | 92.7 |
| 16 | Greek/WNK FM | 93.1 |
| 17 | Jazz FM | 93.9 |
| 18 | Kiss FM | 94.3 |
| 19 | Melody FM | 94.7 |
| 20 | BBC Bedfordshire | 95.1 |
| 21 | BBC Essex | 95.5 |
| 22 | BBC Kent | 95.9 |
| 23 | BBC Oxford | 98.7 |
| 24 | BBC Sussex | 99.9 |
| 25 | Invicta FM | 102.3 |
| 26 | Premier Radio | 107.9 |
| 27 | Spectrum AM | 88.7 |
| 28 | Sunrise AM | 88.3 |
| 29 | Commons Clean Feed | 104.3 |
| 30 | Lords Clean Feed | 104.7 |
| 31 | BBC1 Nicam | 106.3 |
| 32 | BBC2 Nicam | 106.7 |
| 33 | London ITV Nicam | 96.7 |
| 34 | Channel 4 Nicam | 97.1 |
| 35 | Channel 5 Nicam | 97.5 |
| 36 | CNN Sound | 99.1 |
| 37 | Sky News Sound | 98.3 |
| 38 | Sky One Sound | 97.9 |
| 39 | Eurovision Sound | 99.5 |
| 40 | Telfax Sound | 100.3 |
| 41 | BH Ringmain 7 | 105.7 |
| 42 | BH general P/B 1 | 105.5 |
| 43 | BH general P/B 2 | 105.9 |
| 44 | Unassigned | |
| 45 | BH Timecode | 107.1 |
| 46 | GNS Tannoy | 89.5 |
| 47 | Unassigned | |
| 48 | Unassigned | |
| 49 | Unassigned | |
| 50 | Unassigned | |

From the output of the modulators, the cable distribution chain is designed to interpose only three amplifiers before reaching any outlet socket. This has the effect of minimising any intermodulation products, resulting in signal levels which achieve a uniformity of within 4dB across both TV and Radio bands on each of the 2,400 possible outlets in the building.

Minimising interference within the headend room was achieved by careful geographical arrangement of the sensitive off-air receiving equipment and the relatively-powerful modulation equipment. Leakage outside the building was also a concern but, fortunately, the relevant BS specification defines the maximum permitted levels of rf leakage. Put simply, it should not be possible to receive any of the White City services outside the building, using conventional receiving equipment.

To ensure the continued safety of the valuable headend equipment, a VESDA (Very Early Smoke Detection Apparatus) unit has been installed in the room.

### Office Equipment

A further objective followed logically from the above requirements for the headend — to provide uniform items of office equipment which would interface with the ringmain system, which would be compact and cost effective, and which would give the user a choice of services in a manner which was easily recognisable.

A large number of staff moving to White City had been served by the 'classic' copper ringmain and powered loudspeaker systems installed in their old London W1 offices. All this equipment had to be replaced by something with an rf input socket which had a fairly small footprint. Fortunately, the relatively large quantity of equipment which was required allowed us to consider having a custom-built unit.

Following a competitive tendering process, the cheapest and most impressive option turned out to be the Rolec 'RadioSpeaker'. This is an incredible device for its size, having similar performance to the Wharfedale Diamond type of loudspeaker. With a footprint of 180mm x 180mm, it still finds room for a British-made PLL (phase-locked loop) tuning system, capable of storing up to 100 preset stations. These stations are defined on installation so that the user simply taps in the preset number and the unit will tune to the stored frequency. This is an important feature as it allows a multichannel rf system to be as simple to use as twelve-way copper ringmain ("*The DG's speech is on Point 9*" instead of "... *on 103.70 MHz*").

The installation task of manually storing one hundred presets on each receiver could have been very tedious. However, the RadioSpeaker has an RS232 serial connector which can be connected to either an engineer's keyboard (which allows manual programming, with an lcd screen for frequency display), or to a pc or Psion Organiser which can download all the presets in under two seconds!

For traditionalists, the RadioSpeaker is even fitted with a transformer-balanced tape input.

Two other versions of this unit are also made:

1. An 'NCA Radio' — for use in NCA's open plan areas. It has no loudspeaker, just a headphone socket.
2. An RDS stereo tuner to replace existing tuners in hi-fi rack systems.

The other item needing widespread replacement was the 'GNS Tannoy' news information pa speaker. As previously mentioned, the construction of the building does not lend itself to the installation of a hard-wired pa system of this type, and so it was clear that this service should also be distributed on the rf cable. The 'GNS Speaker' was thus developed from the RadioSpeaker to be a still smaller fixed-frequency unit, featuring a single preset for tuning, a cheaper tunerhead and a lower overall cost. Surprisingly, it was possible to make the price of the GNS unit similar per speaker to the installed cost of a conventional pa system.

Earlier in this article, I outlined the objectives that the White City ringmain system was designed to meet. Following the successful installation of the infrastructure and with over 1,600 outlets presently in use, we feel that we have not only been successful in satisfying the requirements of a wide range of professionally-informed and critical customers, but also have succeeded in proving the feasibility of constructing a distribution system of this size.

David Errock
Project Leader
Radio Projects

Rolec

*A selection of Rolec office-listening receivers*

# WORLD SERVICE

## Audibility improvement programme, 1981-1991

**Gordon Harold summarises the recently-completed World Service 10-year audibility improvement programme while, on the following pages, Peter Lamb and Steve Lee describe the projects carried out by TED at three hf sites, as part of the improvement programme.**

On Friday 10th May 1991, the last link of the audibility improvement programme was set in place with the opening of the Skelton C transmitting station by the Honourable Mark Lennox-Boyd MP, Parliamentary Under Secretary at the Foreign Office.

*"This is the final piece in our global jigsaw. It means that the entire ten year £100 million first phase of the current audibility programme has been delivered to time and within budget"* said John Tusa, Managing Director of World Service *"and the difference this programme has made to our reception has been one of the key factors why the World Service has more than maintained its audience lead over other international broadcasters".*

The 1981-1991 audibility programme — agreed by the Callaghan government in 1979 and implemented by the first Thatcher administration in 1981 — made more investment capital available than BBC World Service (formerly BBC External Services) had ever had before in its entire history. The resulting overall gains in audibility — through more primary coverage (ie single hop) — are not easy to quantify but are well illustrated in maps 1 and 2 on page 11.

The bid for a major and on-going transmission refurbishment programme began as early as the mid-1960s. That bid had to go through a good many formative changes and had to survive numerous government modifications and cut-backs before emerging as the 1981-1991, £100 million, audibility improvement programme.

### History

Three successive Government reviews — by Sir Thomas Rapp in 1965, Sir Harold Beeley in 1967 and finally by Sir Val Duncan in 1969 — recommended that the highest priority should be given to improving the audibility of the External Services through major capital investment — to match international broadcasting competition around the world.

A capital programme of some £11.0 million (at mid-1960s prices) spread over four to five years was recommended but never fully implemented. Consequently, throughout the 1960s and 70s, the transmission equipment continued to be inferior in number, power and diversity, compared with that used by the major international competitors.

Ian Reynolds, ETD

*The new Control Room forms the heart of the Bush House modernisation programme*

In August 1977, a Central Policy Review Study (CPRS) — which was undertaking an overall study of UK overseas representation — concluded: *"because of public expenditure constraints in the UK, the BBC has not been able to modernise its transmitters sufficiently fast to keep up with these developments. As a consequence there has been a decline in the audibility of its programmes. An extensive capital programme is now needed to achieve audibility".*

As part of its submission to that CPRS, External Services proposed ten developments over the period 1977-1987. These included: modernising the studio and technical facilities at Bush House; replacing low-power 1940s vintage transmitters in the UK by more and higher-powered transmitters; the construction of new relay stations in the Seychelles, at Hong Kong and in Gibraltar; the upgrading of transmitter capacity at Cyprus and Ascension; and establishing satellite programme feeds to all relay stations. This plan proposed carrying out these projects with an increase in the annual capital funding from £2.1 million to £6.1 million (at 1976 prices).

In February 1978, in the wake of the CPRS review, a joint BBC/FCO (Foreign and Commonwealth Office) Technical Planning Committee was set up. The report of this committee in August 1978 recommended a minimum programme costing an additional £20.2 million (at 1977 prices) over the five years, 1979-1983. This programme included most of the developments previously sought by the BBC, with some variations, but omitted Hong Kong.

In November 1978, the then Foreign Secretary, David Owen, agreed this preferred minimum development programme. However, since the cost was £4.0 million more than the government had authorised, he asked External Services to meet the extra cost by making savings. The BBC resisted this idea and proposed instead a re-phasing of the programme so that the agreed £20.0 million ceiling would not be exceeded in the five year period ending March 1984.

This set in train a round of discussions between the BBC and government, leading to yet more variations in the

proposed projects and their phasing within the overall programme. These complex negotiations were made even more difficult by the changes in government during 1979. Nevertheless, the current programme was finally agreed by the Callaghan government in 1979 and then implemented by the first Thatcher administration in 1981; it was set to run over the 1981-1991 period at a capital cost of £100 million (at 1981 prices).

## Achievements

Over the 10-year period, the following projects have been completed by teams in World Service, Transmission and the FCO's Communications & Engineering Department (a full description of the Transmission-managed projects at Skelton C, Cyprus and Rampisham begins on page 12):

**Modernisation of Bush House:** As the source of all World Service programme output, the facilities at Bush House have to meet the diverse needs of programme makers in thirty-six languages. Whilst some work is ongoing, most has been completed. Refurbishment of twenty-six major studios has been finished and work is proceeding on the remaining four, with completion expected in 1992. A new control room/central technical area began full operational service in January 1991 (see ***Eng Inf*** No 44).

**Satellite feeds to overseas relay bases:** The move to equip all existing World Service relay bases to receive programme feeds from Bush House via the IntelSat geostationary communications satellites began in 1982. By 1985 the project was complete and suddenly relay stations had programme feeds available at something approaching studio quality. That improvement in quality and reliability was passed on immediately to millions of BBC listeners around the world. It was an early and vital benefit from the improvement programme — possibly the most far-reaching single improvement in signal quality; certainly a giant leap forward for World Service audibility.

**Transfer of mf facilities from Crowborough to Orfordness:** The availability of 500kW of mf power on both 648 and 1296kHz — strategically placed at Orfordness on the threshold of Europe — has revolutionised listening to these two frequencies in West and Central Europe. 648kHz now has its own special tri-lingual network, providing an integrated 24-hour service in English/French/German to an influential audience throughout northern France, the Benelux countries and northern Germany. 1296kHz has become one of the mainstays for audiences throughout Central Europe, particularly listeners to the Polish Service throughout the latter half of the 1980s when the shortwave frequencies carrying that service were heavily jammed for much of the time.

**Replacement of fourteen 1943-vintage 100kW hf transmitters at Crowborough and Skelton B:** The systematic replacement of 1940s-vintage hf transmitters in the UK has suffered the odd hiccup or two, not least in terms of finding a preferred green-field site in the south west of England to take advantage of better propagation characteristics. However, the final solution has involved the redevelopment of Rampisham with eight 500kW transmitters and Skelton with four 300kW units, and the provision of two extra 250kW transmitters at Cyprus.

**Replacement of four low-power hf transmitters at Cyprus:** This project was completed in 1983 but, because of planning changes, the two 250kW units mentioned above were added. These came into service in Spring 1991. Although all the redevelopments at Cyprus were not quite finished by August 1990, this strategically-placed relay base was still able to provide very effective additional coverage of the Middle East during the Gulf Conflict. More recently, the effectiveness of the new transmitters and antennas at Cyprus was demonstrated graphically in August 1991 by the now famous reception report from Mikhail Gorbachev, detained in the Crimea as part of the abortive coup in the USSR: *"We were able to catch some broadcasts and find out what was happening. We got BBC best of all ..."*.

**Construction of a new relay base at Hong Kong:** The new 250kW hf transmitters at Hong Kong provided primary shortwave coverage of East Asia, including northern China, for the first time. They played a key role during the momentous events of May/June 1989 with the students revolts in China and the subsequent massacres in Beijing's Tiannanmen Square. The *"Thank you BBC"* banners of the grateful Chinese students provided a potent illustration of the effectiveness of the new station.

**Construction of a new relay base in the Seychelles:** This relay — utilising two 250kW hf transmitters — became operational on 25th September 1988, bringing much-needed and long-awaited improvements to the WS signals serving East Africa. Audience research and listener reports from the area indicate that the audibility improvements have been dramatic.

**Provision of two additional 250kW hf transmitters at Ascension Island:** This project, which also included new antennas, was completed in Autumn 1989. The much-needed additional transmitter capacity at this heavily-committed relay base — with its requirement to serve both Africa and South America, even simultaneously at some times of the day — has allowed better targeted coverage to be provided across these two large service areas.

**Provision of an additional 250kW hf transmitter at Singapore:** This project was completed on schedule in March 1987. The extra transmitter offers improved scheduling flexibility at this key relay site serving South East Asia.

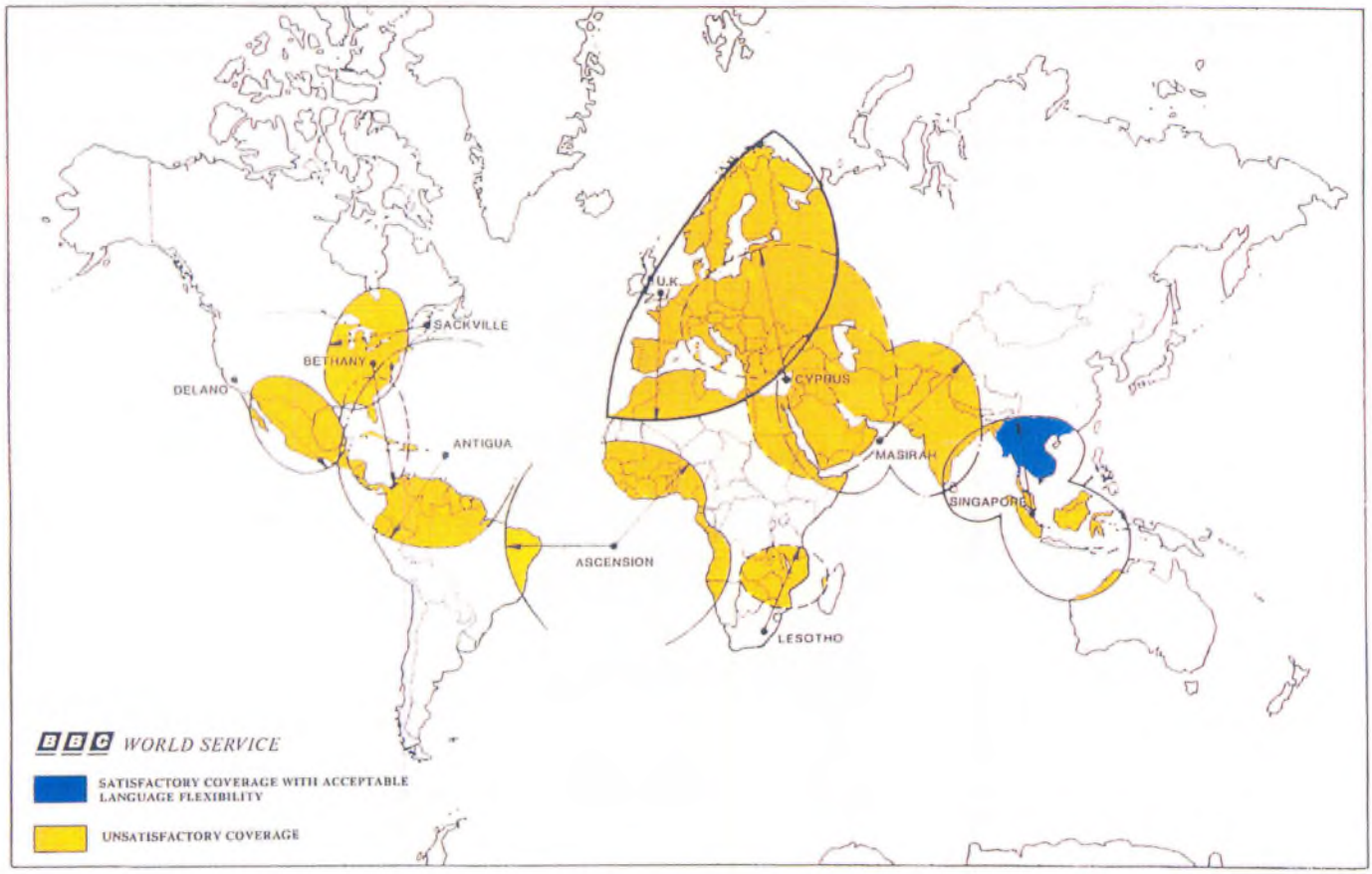
**Provision of an additional 100kW hf transmitter at Lesotho:** This project was completed on schedule in September 1987. A supplementary project to install a 100kW mf transmitter was completed in just under one year. It provides a new service in a frequency band which is heavily utilised by local domestic broadcasters targeting black audiences in the Republic and the adjacent territories.

## The Future

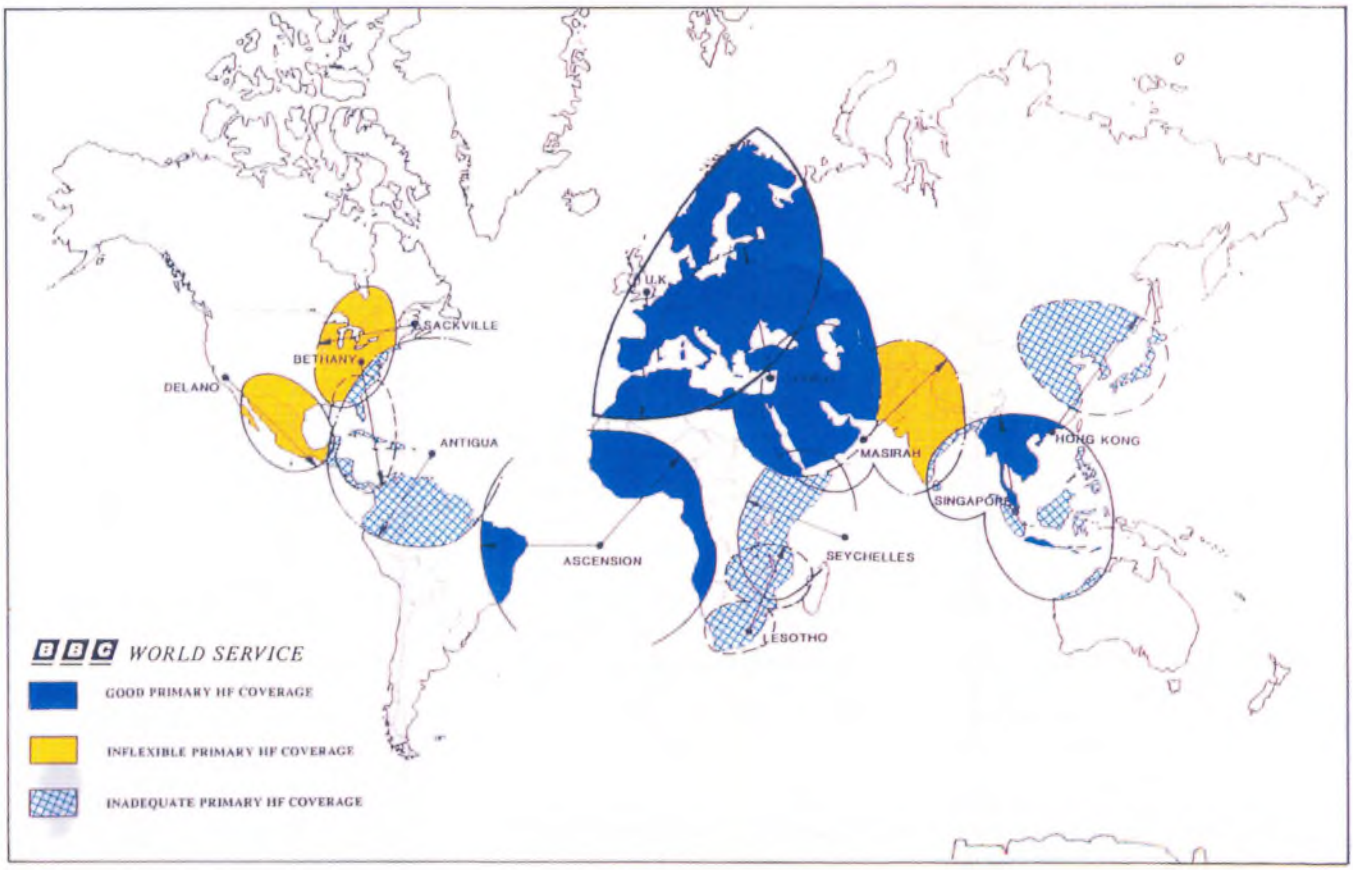
Map 2 shows the quality of the primary hf coverage achieved by the autumn of 1991, at the completion of the 10-year improvement programme. The yellow areas indicate those parts of the world where the coverage is either not sufficiently flexible to meet the full programme service needs, or where the signal strengh is low.

The aim of World Service will be to turn those yellow areas blue, by a further phase of audibility improvements — the highest priority being the Indian subcontinent. Research shows regular audiences of 58 million listeners to BBC programmes aimed at South Asia — in English, Hindi, Urdu and the other major languages of the region. It is a priority objective for World Service to provide that audience with more competitive, better-quality signals as soon as possible.

Gordon Harold
Chief Engineer
World Service




*Map 1: World Service hf coverage in 1981 at the start of the current Audibility Improvement Programme*




*Map 2: World Service hf coverage in 1991 at the end of the current Audibility Improvement Programme*

# TRANSMISSION

## New hf facilities at Skelton, Cyprus and Rampisham

**Peter Lamb and Steve Lee describe three of the various Transmission projects completed under the World Service current audibility improvement programme.**

One of the programme's objectives was to improve audibility of hf broadcasts to Eastern Europe and the USSR. To do this effectively, given the prevailing propagation conditions, transmission would have to be switched from Skelton in Cumbria to a new site in the south of England.

One possible site at Henstridge, Somerset, was identified but the BBC failed to get planning permission because of local objections. Thus, to partly solve the problem, Rampisham was redeveloped with eight (and later, ten) 500kW transmitters. However, a second site was needed to complete coverage of the target area. The favoured option in 1983 was the Foreign and Commonwealth Office (FCO) site at Orfordness, on the Suffolk coast, which was to take over from Crowborough and had space to develop new hf facilities.

Doug Frostick, WS

*Skelton C: Peter Lamb dwarfed by the coaxial feeder awaiting installation*

It soon became apparent that redevelopment of Orfordness would be expensive — due to the need for extensive land-filling and extra large foundations. Thus an alternative site at Bearley, near Stratford-on-Avon, was sought in 1983/4. However, like Henstridge, the BBC failed to get planning permission and a second more-detailed look was taken at Orfordness which, in 1986, became the BBC's responsibility along with other FCO hf sites. Again, Orfordness was dismissed on the grounds of expense. However, the FCO had already purchased seven 300kW Marconi transmitters for use at Orfordness and these now became available for redeployment by the BBC.

Engineering Division then put forward an alternative to the Orfordness scheme which would meet the audibility requirements at lower cost. This alternative comprised two projects: to build Skelton C with four of the FCO transmitters, and to install two additional transmitters at the British East Mediterranean Relay Station (BEMRS) on Cyprus. Skelton C would be able to cover most of the target service area, while the remainder — Scandinavia and northern USSR — would be covered from Cyprus which has excellent propagation paths on northerly bearings. The plan was accepted by World Service and the FCO in 1988.

### Skelton C

At this time, two transmitting stations were in operation at Skelton. ***Skelton A*** had ten Marconi 250kW transmitters, designed in the early 1960s, and an eleventh unit of the same type was being transferred to it from Daventry. ***Skelton B***, about 1.5km away, had six STC 100kW transmitters which were installed in 1943 — the oldest hf transmitters in the BBC — and, because of the difficulty in obtaining spare parts, these were rapidly becoming unmaintainable. Furthermore, with no automatic control facilities, they were also expensive to operate.

Re-engineering Skelton B would therefore provide an ideal means of meeting the World Service audibility requirement.

#### Planning

A project team was formed with specialists from TED and ACED, and planning began in earnest. First of all, how was the new development to be implemented? World Service could not release the Skelton B transmitters from service until March 1990 at the earliest and, because of the unsuitability of the old building for modern equipment, it was decided to develop a new station — designated ***Skelton C*** — at the northern end of the site, not far from Skelton B.

This part of the site was covered with masts supporting the old single-band Skelton B antennas which would be replaced by modern types as a part of the development. A phased withdrawal from service was thus agreed with World Service to allow construction to proceed. The new building was designed, antenna layouts produced, tenders obtained from prospective contractors and the project plan was finally formed in detail.

The main project was given financial approval in February 1989, costing a total of over £17 million. The timescale set for the work was tight: the first two transmitters and their associated antennas were to be fully in service by March 1991 — just two years away. Whilst site works commenced, the final technical details of the system were put together.

Skelton C was to be built as a fully-automatic station, run with no operational staff in attendance — the first time this has been attempted for a major hf station anywhere in the world. It would initially be equipped with four 300kW transmitters, with a building

design which would allow extension to accommodate a further four transmitters if required in the future. The transmitters would feed fifteen wideband curtain arrays, erected on self-supporting towers. Stayed masts would have been unsuitable because of the high loadings of modern antennas and the requirement to squeeze the maximum number of antennas on to the site. In addition, some changes to the masts and antennas serving Skelton A were needed to optimise the site and fulfil the World Service coverage requirements.

Balfour Beatty won the contract to handle all the site works. This included the demolition of thirteen of the old masts, to be replaced with eighteen towers varying in height from 40 to 99 metres — the highest permitted on the site. Alan Dick and Company gained the second structural contract — to replace seven Skelton A masts with six new 76 metre masts in revised positions to suit the changed antenna requirements. The contract for the transmitter building was won by Lowther Construction, a local company, with the power installation being supplied by W H Smith (Electrical Engineers) who also won the technical power installation contract.

## Choice of Equipment

As mentioned earlier, the four transmitters would be Marconi 300kW units, inherited from the FCO. They were of the B6126 'frequency-follow' type, which is described in the accompanying box. Two of the FCO units were redeployed to Cyprus, to enable work there to begin as soon as possible, and two new transmitters of the same type to replace them were purchased for Skelton C.

Marconi also gained the contracts for supplying antennas: fifteen at Skelton C and five at Skelton A. Work on a number of other Skelton A antennas was to be implemented by the local Skelton antenna team. All of the Skelton A replacement antennas were to be of the single/dual band variety, whereas eleven of the Skelton C antennas would be of the modern octave-bandwidth type, covering four or five broadcasting bands. The other four Skelton C antennas would be large dual-band types covering the 6 and 7MHz bands, chosen to give the best possible performance at these lower frequencies.

One major departure from previous UK practice is in the feeder system at Skelton C, where the decision was made to use a 50ohm coaxial system throughout. The system chosen was similar to that used for the first time by the BBC in Hong Kong and Seychelles and, in the case of Skelton C, was selected largely on the grounds of reliability and lifetime cost, bearing in mind that the station was to run unattended. Alan Dick and Company was given the contract to supply and install over 5 kilometres of Kabelmetal 100/230 semi-flexible feeder (the figures are the diameters in millimetres of the coaxial inner and outer) which were to run above ground level, requiring a support every 2.5 metres — a considerable civil works exercise.

The other part of the feeder system is the coaxial switching matrix which, at Skelton C, was to be fully equipped for maximum flexibility, allowing any of the transmitters to be switched to any antenna or into the Marconi dummy load for test purposes. Coaxial matrices are very compact, with a single cross-point occupying a space less than 0.5 metres square, and the system at Skelton was to be installed indoors at the end of the transmitter building with the feeders leaving via ducts. A contract was placed with Technology for Communications International for the matrix. Their model was a new design using 9-inch coaxial switches, and the BBC unit was the second to be manufactured. Technical evaluation and type approval was therefore particularly important.

## B6126 hf transmitter

The B6126 is a sophisticated transmitter offering fully-automatic tuning on a frequency-following basis. With power on, it is only necessary to apply a drive frequency in any of the WARC broadcast bands and issue a tune start command. The transmitter responds by measuring the drive frequency and comparing the result with a look-up table to derive band switch positions and basic settings for tuning capacitors. When these coarse settings have been established, the automatic tuning system enters an algorithm that establishes the correct tuning points and load conditions for the tuned amplifier.

As tuning proceeds, the transmitter power output is increased in stages from a tune condition through low and medium power until full output at the desired frequency is achieved. The time taken to change frequency can be crucial when there is a break of only a few seconds between different programmes and, although this tuning time is somewhat variable depending on the particular change involved, the transmitter will typically deliver modulated output in any of the bands from 3.9 to 26.1MHz within twelve to sixteen seconds of a change being initiated.

Having completed basic fine tuning the transmitter enters a routine to optimise power conversion efficiency. All tuning operations are generally completed within 2.5 minutes after tune start. In operation an automatic load-match routine samples load conditions at regular intervals and acts to compensate for slow changes in antenna vswr.

Series pulse duration modulation is employed using a high power tetrode as a switching valve. In addition to improving efficiency, this system of modulation offers opportunities for using an hf version of dynamic carrier control (DCC) to reduce energy costs and, with an eye to the future, conversion to reduced-carrier single sideband operation employing the envelope elimination and restoration method of ssb generation.

Remote control functions and revertive indications allow the transmitter to be readily integrated with D&ED's hf automatic control system. The transmitter is designed to require minimal attendance and incorporates comprehensive protection circuits. The high tension crowbars are of particular interest in that they are required to discharge the power supply with sufficient speed such that a length of five amp fusewire connected between the ht conductor and earth via a vacuum switch is not ruptured when the switch is closed — which has to be demonstrated during acceptance! This somewhat frightening specification is necessary to protect the high power tetrodes used in the modulator and final rf stage against arcs. These valves are designed to very fine limits to achieve a high performance and the manufacturer stipulates the use of an efficient crowbar system as a condition of guarantee.

One other important aspect of an hf transmitter design is its efficiency, because of the large amount of power consumed. The B6126 achieves 65% (mains power in, to rf out) over almost its entire frequency range.

# – SKELTON C –

Alan Spencer, TED

*Skelton C: new towers and antennas under construction with the 99m tower in the foreground*

### Automatic control system

Finally, the hub of the transmitting station: the control system. All the stations built as part of the audibility programme have used a system which was designed and developed by Designs Department (now part of D&ED) in conjunction with Transmitter Capital Projects Department (now part of TED). It provides full automatic control of all transmitters, antennas and programme feeds to the required schedule, together with comprehensive monitoring which, in the case of Skelton C, would be fed to a remote terminal at Skelton A from where any manual operations such as changes to the schedule could also be carried out. D&ED gained the contract for supply and installation of the system against commercial competition.

The control system operation is maintained under power failure conditions by a battery back-up installed under the power contract. A small diesel generator (which was removed from Skelton B) is used to maintain other essential services, although the transmitters themselves would be shut down during a power failure.

### Construction

Mast clearance started in April 1989 and building construction began at the end of May. An area was set aside for a contractors' camp and, by the end of July, piling for the tower foundations had begun. Work continued apace over the autumn period and, by the end of 1989, most tower and mast foundations had been completed and the power installation in the building was in progress.

Skelton is a notoriously wet site — see the fritillary story in ***Eng Inf*** No 42 — and the Skelton C area is particularly low lying. Thus, the control of flooding and improvements to drainage provided continual problems throughout the project. However, the winter of 1989/90 was relatively kind and only a little time was lost due to the weather conditions. Erection of the tower steelwork started in February 1990 and the building contractor worked hard to hand over the main part of the building on time in early March. The technical contractors began to arrive and the next phase of work was under way. Transmitters and associated equipment were moved into place and the technical power installation continued.

By early May 1990, the first four towers had been completed and the installation of the antenna system could start. From this point on, the logistics of the project became far more complicated. With many contractors on site at the same time, co-ordination of activities was vital and a strict safety regime was imposed to ensure satisfactory working practices. Frequent meetings were held to review progress and reschedule activities as necessary.

This was also the time at which technical problems began to surface. Within any large project, however well planned, items are overlooked or misunderstood, and all these matters need to be resolved urgently and at minimum cost. With good co-operation in all areas, nothing occurred to seriously impede progress and, by August 1990, the station was beginning to take shape — with the first line of seven towers complete, antennas and feeders well under way, the switching matrix installed and low voltage supplies available for transmitter testing.

High voltage supplies became available for the transmitters in September 1990, marking the start of the final commissioning phase. As Christmas approached only the final link in the chain was missing — the D&ED automatic control system. This was intentional, as the plan was to fully test the control system before sending it to site, thus minimising site installation costs.

However, with just over three months to go before the station service date, the thought of sixteen bays of control equipment still soak testing in London did give rise to a certain amount of anxiety. However, the installation task of interfacing it with every other item of equipment on the station went well and, by the middle of February 1991, the control system was in an operational state.

The final six weeks leading up to the service date were fully occupied with power testing, system testing, resolution of problems and training of operational staff. In the early hours of 31st March 1991, Skelton C entered service in time for the start of the World Service summer schedule, with its initial complement of two transmitters and six antennas serving southern Europe and north Africa.

Between April and September, work continued on the rest of the equipment and, by the end of September, a further two transmitters and nine antennas — serving eastern Europe and the Caribbean — were ready for service. Only the demolition of the old Skelton B building remained for the project to be complete.

Peter Lamb
Proj. Man., Skelton C

## Cyprus

The British East Mediterranean Relay Station (BEMRS) on Cyprus has transmitted External Services since 1957 under the management of the FCO. In 1986, the FCO and the BBC entered into a contract for the BBC to manage the technical operation and development of the station (and the other FCO sites at Masirah and Orfordness) on behalf of the British Government.

In the three decades since its inauguration, the station has expanded considerably. In 1986, It comprised three separate sites, and utilised a total of three mf and eight hf transmitters. The main site at ***Zygi***, some 30km east of Limassol, had all the hf transmitters and one of the mf services. The remaining mf transmitters were located at ***Ladies Mile***, 6km south west of Limassol. The third site, ***Zakaki***, was the hf receiver site, situated 1km north of Ladies Mile. In 1982, programme feeds via satellite were introduced and, since then, the hf

receivers have been used in a standby mode only.

### Transmitters

Of the seven Marconi B6126 transmitters purchased by the FCO and held in store at Orfordness, three had already been installed at Daventry, and the remaining four were destined to go to the new Skelton C station. Two new transmitters of the same type were purchased under the Cyprus scheme. To save time and to make early use of idle assets, two of the Orfordness transmitters were installed at the Zygi site in Cyprus, and the two new transmitters, when manufactured, were sent to Skelton to replace them. The transmitters for Cyprus were, however, modified for 250kW operation — to suit local conditions — but have the option of reverting to 300kW operation at a later date. A fuller description of the B6126 transmitter is given in the box on page 13.

The transmitters were installed in an extension to the transmitter hall, which was designed by a Cypriot consultant civil engineer working to instructions issued by ACED. The building construction, and the electrical and mechanical services installation, was carried out wholly by local contractors under the consultant's supervision.

### Power supplies

High voltage power supplies for the new transmitters were afforded by adding two extension vacuum circuit-breaker panels to the existing 11kV switchboard. The existing electricity supply from the Electricity Authority of Cyprus was of adequate capacity for the additional load. However, providing the low voltage auxiliary supplies was more problematical.

The lv system had grown in piecemeal fashion as the station had developed. This had resulted in each transmitter or group of transmitters having a dedicated hv/lv transformer, and lack of redundancy or cross connection greatly hampered maintenance. Also, two large standby diesel alternators had recently been removed from the site and this had left an unnecessarily large and dispersed distribution system.

Rather than add new plant to supply the new broadcast equipment only, and thereby further expand the system, an extensive rationalisation of the lv submain distribution has been carried out. A measure of the changes effected can be appreciated from the fact that two new transformers have replaced seven, and a new lv switchboard has replaced three lv switchboards and two hv switchboards. The complete plant and cabling package was provided by Elequip Ltd of Leicester.

### Output Combiners

The requirement for additional transmission from Zygi to cover Scandinavia and northern USSR would conventionally have been met by building additional antennas. However the shape and size of the site precluded the installation of additional arrays on northerly bearings, and acquisition of additional land was not possible. The use of channel combiners, which combine the outputs from two transmitters at different frequencies, provided a solution to this problem.

Combiners have only been employed by the BBC on one previous occasion for high power hf transmission — in a screened lumped-component implementation on Array 5 at Daventry. For Cyprus, a contract was placed with Technology for Communications International (TCI) for 300kW combiners. These were similar to 100kW and 250kW designs provided by TCI for Trans World Radio, Far East Broadcasting and the Voice of America.

The Cyprus combiners are of balanced transmission-line sections which form suitable rejection and tuning elements. Three stages of rejection filters are employed to achieve isolation at input ports in excess of 60dB and input VSWRs of less that 1.2:1. The high isolation requirement was specified to achieve a high level of system total isolation between transmitter outputs, to reduce the combiner's effects on transmitter auto-tune circuits, and to minimise intermodulation products.

Arrays 53 and 54 are multi-band curtain antennas covering the 6, 7, 9 and 11 MHz bands. TCI's task was to provide two twin-channel combiners for Array 54, permitting combinations of 6/7 MHz and 9/11 MHz, and one twin channel combiner for Array 53 permitting a combination of 6/7 MHz. Bypassing facilities — to allow the antennas to be used normally without the combiners in circuit — were included. The work also involved the necessary uprating of each antenna (achieved by replacement of powered components) and provision of switchgear to enable remote mode selection for combiners and antennas.

HF combiners of transmission-line form are normally less expensive than their lumped-component counterparts, in particular because costly vacuum or gas capacitors and large inductors are required for the latter, to handle the very high currents and voltages involved.

The Cyprus combiners are impressive, employing transmission-line conductors of 54 mm diameter strung between 9 metre high lattice masts, which also serve to support giant rf switchgear, weighing 250kg. Numerous corona shields adorn the hardware. The combiner for Array 54 occupies a site area of 1/3 of an acre, behind the antenna.

The uprated antennas are, in fact, complete curtain replacements (less aperiodic screen) within the support harness for each bay. These have to handle in full mode, the combined power of two 300kW transmissions in different frequency bands, which have an equivalent average power of 900kW and an equivalent peak power of 4800kW.

### Crosspoints

The Zygi open-conductor (i.e. unscreened) type rf switch matrix was orginally supplied to the FCO in 1964/5 for 100kW operation. It was enclosed within a fully-cladded structure to provide environmental protection; the presence of dust pollution from a nearby cement works was (and is) of significant concern! In 1981-83, Cyprus was re-equipped by Marconi with 250 kW antennas, utilising the same matrix.

In addition to the high rf field strength within the open-matrix — which creates maintenance and safety limitations, and inherently high coupling between transmission paths — the Cyprus matrix also suffered power-handling problems at high frequencies, due to the effect of high ambient temperatures within the enclosed structure. The presence of mf induction on the connected antenna feeders was also a problem for maintenance staff.

Although the replacement of the matrix was budgeted for future years, significant advantages were perceived in carrying out the replacement as part of the audibility project. Not only would the problems just mentioned be resolved,

but also interfacing the new control system with a new matrix is very much easier than modifying an old matrix, particularly when there are access limitations. Most importantly, the high cross-coupling between circuits had to be eliminated if the auto-tune feature of the new transmitters was to work correctly. The plan adopted was to replace the matrix with a modern screened version, equipped to operate at high ambient temperatures. Replacement in situ represented the best value for money.

Replacement of the 34 x 10 matrix was achieved by Par Industries over a six month period of night shifts, working six nights per week. Transmitter lines were replaced in sequence, sections at a time. The work involved replacement of all matrix equipment, including switchgear and local control circuitry. Additionally, a considerable number of external open-wire feeder diversions were completed to reduce rf coupling and to reallocate some of the matrix outlet ports. The final task involved relocation of an existing Brown Boveri test load.

The new matrix, designed for 300kW operation, employs a variety of new features incorporated to increase reliability, safety, and technical performance. New designs for feeder outlets, terminations, and insulators have been introduced, together with electric drives for switchgear. Additionally, all inlet and outlet ports on the matrix have been equipped with feeder isolating and earthing switches.

RF cross-coupling between transmission paths has been significantly improved, even over previous screened-matrix designs. A simple matrix switch modification has resulted in an improvement of 17dB for a single switch cross-over; ie, to -74dB at 10MHz. The worst-case figure for a typical transmission path on the Cyprus matrix has been measured as -62dB at 26MHz; an average figure for previous designs is of the order of -50dB. Again, high isolation will reduce intermodulation products and prevent adverse effects on transmitter auto-tune circuits.

Steve Lee, TED

*Cyprus: switch matrix looking between transmitter lines 203 and 211*

Steve Lee, TED

*Cyprus: Array 54 6/7 MHz combiner at Zygi*

## Automatic control system

The existing automatic system for control of the transmitters and antennas could not be expanded to control the two additional transmitters, nor could it control the combined arrays. The programme switching equipment was in excess of 25 years old and, although automatic, was very labour intensive to program. Therefore a new automatic control system (ACS) has been commissioned at BEMRS. It is the latest version of the system developed jointly by D&ED and TED which is in service at a number of UK and overseas hf stations.

The Cyprus system has a number of new features. It controls thirteen senders, more than any previous system. These comprise the two new frequency-following senders, existing channelised senders, and manually-tuned equipments. Included in the thirteen senders are three parallel pairs of mf transmitters. Interfacing mf transmitters into the hf control system has required hardware and software development of the system, as well as much painstaking effort to modify the old transmitters. An added complication is that two of the mf transmitter pairs are located at Ladies Mile, remote from the control system apparatus. Control and monitoring of these transmitters is carried over a specially-installed microwave link.

The ACS treats each combiner as two antennas. Control and revertive lines, which would normally connect the array controllers to their respective arrays, are intercepted by a combiner interface. This interface, which was built by D&ED to a Transmission specification, controls input and output port switching of the combiner, as well as the array bearing. It also ensures that the rf power delivered to the combiner does not exceed its safe limits.

The apparatus bays of the ACS were manufactured, tested and installed by D&ED under a competitive contract. Assembly and testing was first carried out in the UK, before being partially dismantled for shipping to Cyprus. TED engineers have engineered the interfaces and interconnections to all the transmitters, arrays, programme sources, and to the rf switching matrix. With the large number of sender and arrays involved, this has been a major undertaking. The transfer of the station to the new system — whilst still in service — has been a major aspect of the job, and has been achieved on schedule.

## Comms links

The new microwave link referred to above replaces an existing inter-site communications system. Programme feeds, and control and monitoring for the Ladies Mile transmitters, were formerly routed via a microwave link connecting Zygi with Zakaki, and

thence from Zakaki to Ladies Mile by land-line. This bearer also carried the reserve programme feeds to Zygi.

An 8 Mbit/sec duplex digital shf link has been installed between Zygi and Ladies Mile. As the two sites are separated by 33 km, mainly over the sea, space diversity reception has been provided, to minimise the effects of severe tidal fading.

The link conveys duplex audio, telephony, and telemetry using only 2 Mbit/sec, and a further 2 Mbit/sec is used for tv surveillance. An 8 Mbit/sec link was purchased because it was the only available link in the allocated frequency band and it made economic sense to purchase off-the-shelf equipment. The link together with the necessary tower, screened room, etc was provided and installed by GEC Plessey.

Now that the link has been replaced, standby hf off-air programme feeds will be dispensed with and the Zakaki site will be disposed of.

### Project management

Cyprus is the first major project undertaken by TED using pc computer-based project management tools. The package chosen — ***SuperProject Expert*** — is now in use for all projects, large and small, in the department. The help that this package gives to planning timescales, resources and cashflow and, more importantly, the flexibility given in project monitoring and control — to account for unforeseen events and problems — is of inestimable value in a complex and fast-moving project environment.

Overseas projects can be expected to be interesting and challenging, and to have unique features due to the local environment, customs and culture; Cyprus has been no exception. It is with great credit to all involved that the objectives of this important part of the audibility programme have been achieved.

### Acknowledgements

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TED

## Rampisham

The transmitting equipment at Rampisham has been under almost constant change for ten years as the station has been re-engineered to modern standards. Firstly, a completely new antenna field was constructed in the early 1980s using self-supporting towers to support modern wideband antennas, connected to the switch station by balanced screened feeders.

In addition, the transmitters were upgraded and, for the first time, the BBC undertook the installation of 500kW types to replace the old lower-power units. A new control system was also installed to give fully-automatic operation. The increase to 500kW was intended to give the BBC signal the edge over other broadcasters in the crowded hf broadcasting bands around Europe.

The increase in power to 500kW brought with it what seemed to be a totally disproportionate number of problems. 300kW working was, at the time, fairly standard but the 2dB increase resulted in large numbers of component failures and a host of problems caused by the high rf voltages and fields. After some difficulty, the first four 500 kW transmitters built by AEG were brought into service in early 1985. This was followed by an even more difficult commissioning period for the next four transmitters, made by Marconi, and it was not until 1987 that these came into service. Both types of transmitter were new developments using pulse duration modulation for high efficiency, with automatic tuning systems to allow automatic operation.

The final stage of the audibility improvement programme at Rampisham has been the replacement of two old 100kW transmitters — installed by Marconi in 1961 — with modern 500kW units. After some debate, the unit chosen was the B6128 — a new Marconi 500kW design using an improved system of pulse duration modulation. A new transmitter hall has been built at the rear of the transmitter building, within the existing shell, and in March 1990 installation got under way.

Again, 500kW lived up to its reputation for problems and it took a great deal of Marconi development effort to solve these. However, by the beginning of 1991, the light at the end of the tunnel could be seen and the first transmitter entered service on 12th March, followed by the second on 17th June. The old 100kW transmitters were finally removed from the front of the building and the area refurbished. The ten-year Rampisham project could at last be said to be complete, and the station takes its place as the only BBC station operating fully automatically at the 500kW power level, with its final total of ten transmitters.

Peter Lamb
Proj. Man., Rampisham
TED

P. Farquarson, Rampisham

*Rampisham: the transmitter hall prior to the installation of the two Marconi 500kW units*

# NETWORK TELEVISION

## *EastEnders* Stage One

**Laurence Tuerk and Tom Hyland describe the new facilities provided at Elstree for *EastEnders* and how they were achieved.**

***EastEnders*** started in early 1984 — the production facilities being established the previous year at the newly-acquired Elstree Centre. The BBC adapted Studio C for the indoor scenes, built the famous 'Albert Square' lot, and fitted in the other support areas (scenery, dressing rooms, costume and so on) using existing buildings on the site. Some new equipment was provided but many redeployed items were pressed into service, some bought from ATV with the site and some transferred from Television Centre.

Over the years the programme has been very successful but, by 1990, it was apparent that improvements were needed. The cramped sets in Studio C had led to a rather static and repetitive shooting style with a limited range of camera shots — the production team wanted more floor area. The equipment was well and truly worn out (the cameras were twenty-one years old) and replacement was overdue. The physical separation of the studio, lot and dressing rooms made scheduling inefficient — areas needed to be integrated. Ideas were therefore developed to overcome these deficiencies and, during 1990, the plans for the 'Stage One' project were born.

The brief was to adapt part of an industrial building known as Unit One on the Elstree site to form a sound stage of about 1000 sq metres; to construct accommodation for dressing rooms and other support areas alongside the stage (and adjacent to Albert Square), and to supply the current generation of lightweight camera, recording, lighting and stereo sound equipment. Detailed planning started in October, formal approval for the project came a few days before Christmas and, only six months later, the completed facility was handed over to the production team on 1st July this year.

Unit One is a large steel portal frame 'industrial shed' — approximately 150 metres long with a clear roof span of 27 metres — which was built in the 1960s for ATV. BBC use of the building has been varied: visual effects, scenery construction and storage, for example.


TC Photographic Unit

In mid 1987, the north end of Unit One was converted to house the 'Town Square' set for ***Allo Allo***. This conversion effectively became the forerunner of the Stage One project.

### Acoustic treatment for *Allo Allo*

ACED's Acoustic Architect, Keith Rose, assessed the acoustics of Unit One in 1987 and found that the building's performance in terms of sound insulation and reverberation was poor. Sound insulation provided by the external walls (280 mm cavity brickwork) was reasonable but the roof (asbestos cement sheets/glazing) provided little sound insulation from external noise. There were also large doorway openings onto the surrounding roadways.

Before moving into Unit One, ***Allo Allo's*** Town Square had been an external set. Hence it was decided that remedial work to increase the sound insulation of the shell — both expensive and time consuming — was not essential. However, as the long reverberation time was unacceptable for recording purposes, acoustic treatment to the walls and roof was required. Coupled with this was the need to provide a structure to support production lighting.

ACED considered a number of alternatives and arrived at a single solution to meet both requirements. This consisted of a modular steel frame of stock components draped with a high density mineral wool quilt, effectively creating a large 'marquee' within the existing building. The steel frame supported both the lighting and the quilt, and the use of stock components minimised 'lead-in' and on-site construction times.

Acoustic Tests showed that the average sound reverberation time, over a frequency range of 250 to 4000 Hz, had been greatly reduced from 3.31 to 0.51 seconds.

### Building requirements for *EastEnders*

Unlike the relatively straightforward ***Allo Allo*** scheme, the ***EastEnders*** requirement generated a considerable amount of building work.

- Firstly, a new accommodation block was required to house dressing rooms, costume, make-up and similar ancillary functions.
- Secondly, the performance area previously used for ***Allo Allo*** needed extending by 50% to create a stage area as large as possible and to ensure that the stage floor was suitable for camera tracking.

- Thirdly, upgrading of the building fabric was required to increase its acoustic integrity. This involved building additional walls and sound lobbies, replacing existing doors with acoustic doors and, most importantly, reducing the noise caused by rain impact on the roof so that the tight recording schedule for ***EastEnders*** would not be disrupted by inclement weather.

- Finally, new mechanical and electrical services were needed to serve the entire Stage One building complex.

Urgent negotiations were conducted with the local planning, building regulations, and fire authorities in order to obtain the necessary statutory approvals as quickly as possible. Building work was scheduled to begin in January this year and the project team notionally split the available time (six months) into a 4-month building programme, followed by two months for the technical installation.

Various minor items of 'enabling work' were carried out late last year to reduce pressure on the main building contract and to avoid unproductive overheads during the Christmas holiday. The main building contract, following competitive tender, was let to Bovis Construction Ltd.

As the method of construction needed to be 'fast track', ACED advised the use of as many off-the-shelf stock components as possible, with the Dressing Room Block being a factory-made system of prefitted-out modules bolted together on site. This accelerated the overall construction time and made for easier management of the site.

## Management Contract

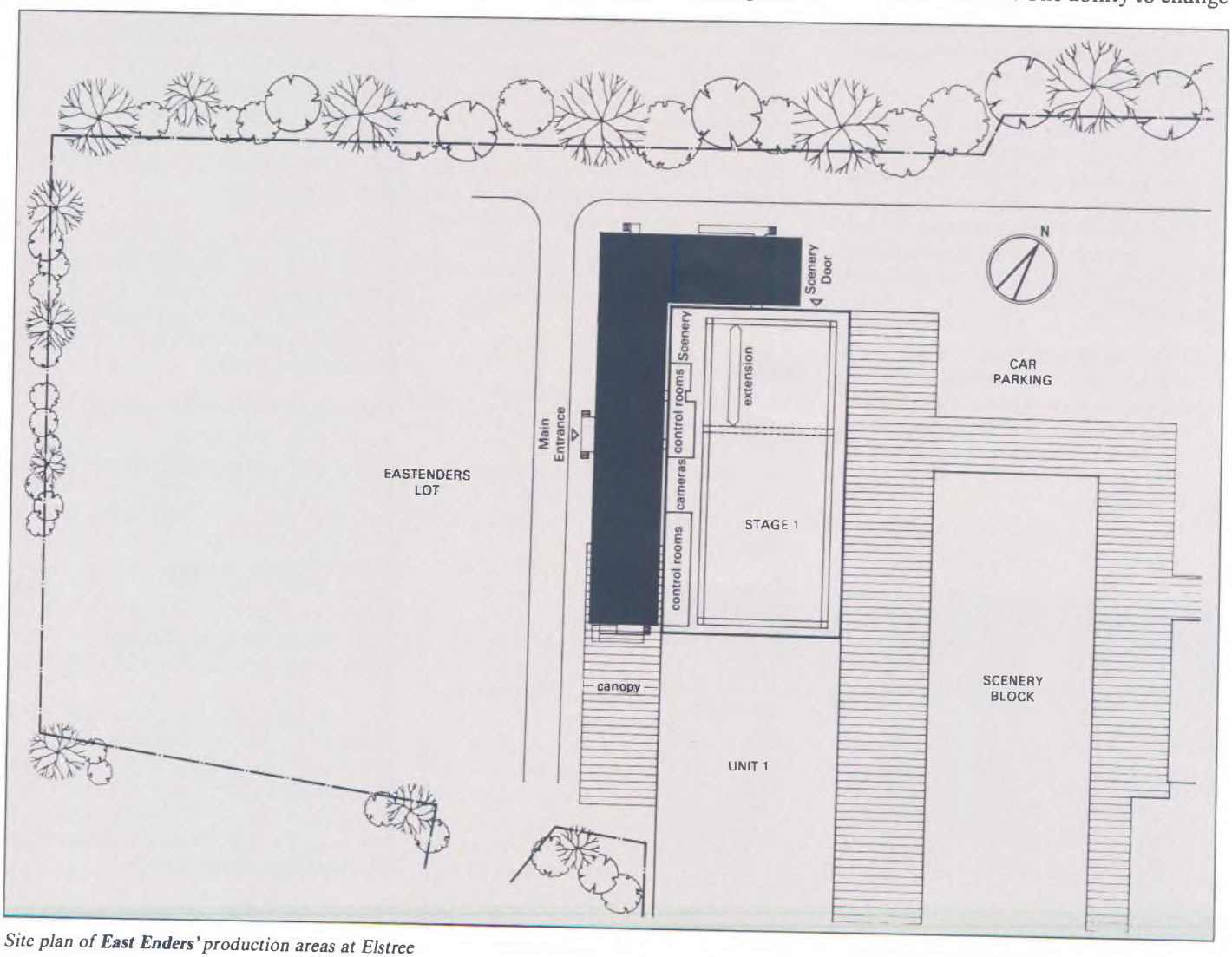
The short design/lead-in time meant that there was a shortage of hard information for tender purposes. After considering a number of alternatives, a Management Contract was recommended where the Management Contractor is part of the design team. This offered a number of advantages for the project such as maximum design/contract time overlap, additional cost planning/control advice, use of the Management Contractor's expertise to exploit changing market conditions to the advantage of the BBC, and flexibility to change the design if needed.

It was also possible to limit the BBC's financial exposure, as the work would be divided into eleven separate sub-contract packages, each let at different times. Of these, eight were competitively tendered while the others were directly negotiated due to their specialist nature. The most significant packages were as follows:-

### 1. Roof

Not only was there an acoustic problem due to rain, but also its general condition in terms of repair and thermal insulation was poor.

The preferred solution was to re-roof, but initial cost estimates indicated that this would be too expensive, so an 'over roof' scheme was tendered. However, the depressed state of the building industry resulted in very competitive prices and the preferred re-roof option became viable. The ability to change




*Site plan of **East Enders**' production areas at Elstree*

tack without cost penalty was a definite plus for the contract adopted.

The new roof is a build-up of three layers of metal sheeting, with two layers of 80 mm thick mineral wool sandwiched between. The sandwich build-up was designed by Keith Rose to 'deaden' the roof (eliminating impact noise) and to produce the best possible resistance to airborne sound whilst using lightweight materials.

The job was difficult to carry out whilst work continued below, but the end result is a great improvement in terms of acoustics, it is watertight and is far superior in terms of thermal insulation.

**2. Dressing Room Block**

This package comprises thirty-three dressing rooms (most with shower and WC) together with numerous ancillary rooms (costume, make-up etc). The entire complex consists of 1150 sq metres of accommodation on two levels and was constructed almost entirely off-site.

The usual way of heating such a building is by electricity but the lack of available power on the Elstree site resulted in the adoption of a gas-fired system which is cheaper to run. This created more work on-site but represented better value-for-money in the long term.

The accommodation modules were constructed in Hull and the first to be transported to Elstree were coincidentally viewed by Tom Hyland on the A1 somewhere in Yorkshire!

**3. Stage Floor**

The existing screed was not level enough for tracking cameras, so a re-floor was required. An epoxy resin system was adopted, ideally to be laid over the existing screed but this was found to be inadequately bonded to the ground slab and had to be removed.

In order to minimise cost, the fire lanes around the perimeter were not re-floored and the overall thickness of the new floor was kept to a minimum. Hence the new finish level is slightly lower than the original surrounding areas.

John Green, TC Photographic Unit

*Stage One during construction (March 1991)*

The finished product has been described as "*the best studio floor in the London area*" (Anon!).

**4. Modular Frame/Acoustic Quilt extension**

These two packages, separately let, were extensions of the original ***Allo Allo*** work. Both were directly negotiated due to their specialist nature and were refined on the basis of experience.

The existing quilt was extensively repaired during installation of the extension and, as well as extending the modular frame, a horizontal tubular lighting grid was constructed over the entire Stage One area.

## Lighting

The large floor area of Stage One (similar in size to studio TC1 at Television Centre) meant that an extensive production lighting installation was needed. The design of this was a careful balance between cost, feasibility and flexibility.

John Green, TC Photographic Unit

*The completed Lighting & Vision control area*

It is not a traditional 'saturation rig' as normally installed in multi-purpose studios — this would have been far too expensive and, in any case, the roof height and construction would not have permitted the installation of hoists. Neither is it a 'film style' rig where lanterns and dimmers are brought in as required and rigged for a specific scene. Instead, the solution adopted was to have a fairly large number (365) of permanently-installed dimmers and outlets feeding a wide selection of different types of luminaire. Many of these are permanently rigged and focussed to light the sets that are in use every week (for example the 'Queen Vic' pub and the cafe interior), but there is a stock of others available to be used week by week for the sets that are only in one or two episodes.

The range of equipment includes traditional hard and soft sources as well as parcans and fluorescent softlights. Television Lighting department has made considerable efforts to match the look of the interior sets to the exterior shots from the lot.

The dimmers were supplied and installed by DEW Engineering and the lighting control system is a Strand Gemini. The installation was managed by Bob Gower of P&ID Tel's Power, Lighting & Mechanical Group.

## Vision, Sound and Recording

The vision, sound and recording installation is extremely simple when compared with the standards of multi-purpose studios. ***EastEnders*** uses a completely gimmick-free multi-camera shooting style — there are no fades, wipes, CSO, DVE or any of the other features common elsewhere. The 'vision mixer' therefore consists simply of a row of eight buttons to cut between cameras.

Four cameras (plus a spare) have been installed; they are Ikegami HL-55A ccd types. Six wallboxes around Stage One provide camera and sound connection points. There are also three exterior boxes on the lot, which are cabled back to a small apparatus room.

Sound facilities are based on an 18-channel Calrec 'Compact' sound desk,

with cartridge, CD, and ¼-inch tape machines for adding background and spot effects.

Stage One is the first production studio in London to record its output onto vt machines in the local apparatus room (rather than in a central recording area). At present the programme uses D2 digital composite machines, but it is planned to change to D3 equipment when this becomes available in a few months time. Post-production editing, dubbing and transmission of the final tape continue to be carried out at Television Centre.

The Stage One technical installation was handled in-house by Julian Stone of P&ID Tel with other members of Studio & OB Group.

### Credits

The successful completion of the project in such a short timescale, and within budget, required hard work, long hours and the close collaboration of all the project team. Within the BBC, staff in ACED and P&ID Tel carried the bulk of the load, but with considerable support from other departments. We were served very well by our contractors, particularly Bovis Construction whose team proved totally committed to completing the job to our satisfaction. A clear brief from the users (led by Michael Ferguson, the Executive Producer of ***EastEnders***) was a great help, as was a willingness to overcome the inevitable problems that emerged.

The finished facility is not an architectural gem nor is much of the equipment at the leading edge of technology — it was never intended to be either of these things. It does however give an efficient, effective and pleasant environment for the production team so that ***EastEnders*** — a cornerstone of the BBC1 schedules — remains the best programme of its type.

Tom Hyland
Project Co-ordinator
ACED

Laurence Tuerk
Project Manager
Res.Dev.Group, Tel.

# ENG TOR
## Positive Action Scheme for women

**As women are under-represented in engineering areas, Engineering and Technical Operations Recruitment (Eng TOR) and Network Radio decided to run a positive action scheme for women this year. It was designed to run within the existing structure of the vacation training scheme and is described here by Rachel Smiley.**

Many ***EngInf*** readers will be familiar to some extent with Eng TOR's vacation training scheme. It involves a number of six-week placements for engineering undergraduates across the whole spectrum of engineering departments within the BBC.

The scheme gives penultimate-year students an insight into the work of a broadcast engineer, and also gives the BBC the chance to observe the students 'in action' prior to possible employment. Vacation Training has proved to be an excellent recruitment tool. It has resulted in the successful intake of engineers with a realistic view of the job and the commitment to pursue a career within the BBC.

Several hundred students apply each year and interviews take place between January and March, usually on campus during the milkround. At the interviews

M.R.M.

*Stevie Lloyd in the control room of a Radio 5 studio*

we look for motivation, relevant hobbies and practical interests, a good understanding of fundamental electronics and a genuine interest in broadcasting.

The various engineering departments in the BBC are discussed with the students, who are then matched up with the areas to which they are most suited. Finally the most suitable students are offered 6-week placements during the summer vacation.

The number of women students on this scheme varies from year to year but has always been fairly low, reflecting the proportion of women students studying electronic engineering (approximately 8%).

### Publicising the new scheme

Over the years, Eng TOR has developed extensive contacts with staff in engineering departments and Careers Services at institutions of higher education, through various activities such as the BBC Undergraduate Clubs, careers fairs and the milkround. To publicise the positive action initiative, Recruitment Officers made approaches to those institutions which were known to have a significant number of women engineering students.

Extra publicity was sent to these colleges, encouraging women students to apply. With our good connections, our publicity was given a high profile within the Universities and Polytechnics and the scheme was positively promoted to the students. It was aimed at encouraging more women students to apply — it was not a 'back way in' to the BBC, as the selection criteria and standards remained the same.

### Results

The positive action initiative has been a success. The number of women applicants this year was almost double compared with previous years and there was a corresponding increase in the number of women offered vacation placements.

One of this year's Radio vacation trainees, Kirsti Samson, comments:

*"I wasn't at all sure what to expect during my vacation training and I was really amazed by how friendly and helpful everyone was. Most of the time I shadow an engineer and do whatever he does on a normal shift. He explains what he' doing and lets me have a go at almost everything. Today we had a fault report from a Radio 4 studio — the talkback unit wouldn't work. I've also spent some time in the Engineering Operations Centre doing operational work, connecting lines for outside sources."*

*"We're each given our own project to do in any spare time we have. I'm building a portable PPM meter. I work the same hours as the engineer so I do nights as well. They're a bit quieter so we have time to do routine maintenance and safety checks, and I also use the training manual to find out how the sound desk works."*

*"We've been shown round other engineering departments which was interesting and it has helped me to be sure which area I'd like to work in when I graduate. I'm really enjoying my time here and I've learned a lot. The only problem is that the time is flying by too fast; I've only got two weeks left."*

The scheme has been followed up in several ways. Students have been involved in discussions with Recruitment Officers, and the Equal Opportunities Officer for Network Radio, about their perception of the BBC both before and during their placement. Women vacation trainees in particular are being encouraged and resourced to return to their former secondary schools to give talks to younger students about broadcast engineering as a career.

In this way we are trying to undermine traditional stereotypes and dispel the commonly held perception of engineering as a male preserve. We hope this will motivate and encourage more girls to take subjects such as Physics and Electronics. (This is just one aspect of our outreach into schools with the long-term aim of increasing the number of women studying electronics.)

We are already making arrangements for next year's vacation training scheme, and aim to repeat and extend the enhanced publicity drive. Students who have performed well during their vacation training period and who wish to pursue a career in broadcast engineering are encouraged to apply for permanent positions.

The recruitment statistics will be monitored closely in future years to see if we have an increased response from women students and if this response correlates with the areas of our positive action initiative. Results to date indicate that this scheme will be a very positive factor in redressing the under-representation of women in engineering areas.

Rachel Smiley
Recruitment Officer
Eng TOR

M.R.M.

*Sarah Canham in the control room of a Radio 5 studio*

# TEL OBs
## Cameras with no strings attached

**Jeff Baker examines the production requirement for five cameras to roam the golf fairways – unencumbered by cables – and how Tel OBs satisfied this demand in time for the 1991 Open Championship at Royal Birkdale.**

For the last twenty-three years, BBC golf coverage has been enhanced by the use of mobile cameras which could operate over much of the course and were connected back to the main mobile control room by radio-link.

Before 1989, the camera — originally a Philips Mini-Cam, then an LDK 514 and latterly a Sony 330 — had to be cabled back to a modified golf caddycar, from where the signals were transmitted on to the mobile control room.

The caddycar contained: the camera remote control equipment; a radio receiver for camera control data; a radio-link transmitter with pannable directional aerial, and a large battery supply. When operating on a reasonably flat course, the caddycar signals were received on remotely-panned aerials on 30m masts. On heavily wooded and undulating courses like Wentworth, it was often necessary to have a receiver on each hole to ensure line-of-sight reception.

Although capable of excellent results, the constraints for the cameraman were considerable. The (41-way) cable back to the caddycar had to be coiled and loaded into the caddycar after each shot. Then both cameraman and car had to follow the same route as the players to the next tee, arriving hopefully before the player had tee'd off.

In case of a shot into the 'rough', reception of the signal often meant that the cameraman could not get close enough to the ball to give a real idea of the difficulty faced by the golfer. A longer camera cable to the caddycar would have eased this problem but, on other occasions, would have been an even bigger encumbrance. Clearly, it was very desirable to have a totally cordless camera.

This possibility materialised in 1990 with the advent of 'one man radio-camera' operation, pioneered by Tel OBs and using the special transmit aerial designed by Research Department (see ***Eng Inf*** No 34). This system achieved a Royal Television Society award during that year and uses a miniature 2GHz transmitter mounted on the back of a handheld camera. It has been used extensively at football grounds and on other occasions, and does need a very directional receive aerial to avoid multipath problems.

Phil Sheldon Photos

*The radio-camera with its associated caddycar at Royal Birkdale*

Tests were conducted at Wentworth using the same transmit system but with a small widebeam receive aerial that could be mounted on a caddycar. The absence of reflecting surfaces gave good results, but it was apparent that careful positioning was necessary when used adjacent to the metal audience seating on the final holes. Although it looked possible to have a cordless camera transmitting to a caddycar, the need remained to control its exposure and match its output to the other fixed cameras on the golf course. This would leave the cameraman 'free' to concern himself with getting the required pictures!

### The new development

A system was developed to meet this need by a team at Kendal Avenue led by Norman Riggs (Senior Facilities Engineer). Essentially, the system allows remote control of iris, master lift, red and blue lift, red and blue gain, cues in two groups of four, and a 4-bit switch function. Additionally, by using assignable controls and some data compression, it is possible to control these functions in up to fifteen sources.

At the base end, the vision control supervisor has the normal camera controls on a master control panel, and up to two subsidiary operational control panels which are connected to a specially-designed 'podule' in an Archimedes computer. This enables all functions to be controlled directly by software. The data output is usually transmitted by a standard radio talk-back transmitter, with a bandwidth of 3kHz.

At the camera, the data receiver is interfaced with a decoder which serves all standard camera types. The decoder consists of a modern line receiver, UART serial-to-parallel convertor, an address decoder, eprom data chips, switch latches and digitally-controlled attenuators to act as d/a convertors. Provision has been made to maintain balance on battery changes.

The interfacing requirements do vary somewhat depending upon source type. To date, the Remote Assignable Control System (known as RACS) has been used in conjunction with a coded colour corrector, Sony 330 and Sony

# – CAMERAS WITH NO STRINGS ATTACHED –

*Continued from previous page*

BVP 7/70 series camera, as well as the LDK 90 and the now-superseded LDK 14 Helitele camera. The BVP 7/70 has the most sophisticated interface, being inside a modified Triax adaptor camera-back that mates to the camera like a recorder. It houses the RACS system, an audio amplifier (for an interview, or Fx microphone) and the outgoing link transmitter. The only external equipment is the tiny data receiver which clips onto the camera. This enables a choice of receiver to suit the required frequency.

### The system in use

Two LDK 90 cameras were used for the 1990 golf season as a cordless operation in conjunction with Sony 330 cameras. The 330s used the same datastream but operated as conventional cabled cameras. The experience gained from 1990 was used to improve the RACS software and, from the start of the 1991 golf season, the standard radio-camera commitment has been three cordless LDK 90 cameras.

For the Open Championship, this was increased to five LDK 90 cameras, all using the same datastream. Both operational control panels, and the master control panel, were engineered to use the vision preview matrix to assign the camera addressed. Thus, the one and only set of controls could be assigned to whatever camera had been selected by the vision control operator.

The caddycar has, in effect, become a radio link 'midpoint' and this provides several benefits to the cameraman and producer. The cameraman can now walk with the players whilst the caddycar finds its best way between receiving positions. As long as the camera can 'see' the midpoint caddycar and the caddycar its receiving point, a stable picture is now available before the director requires it.

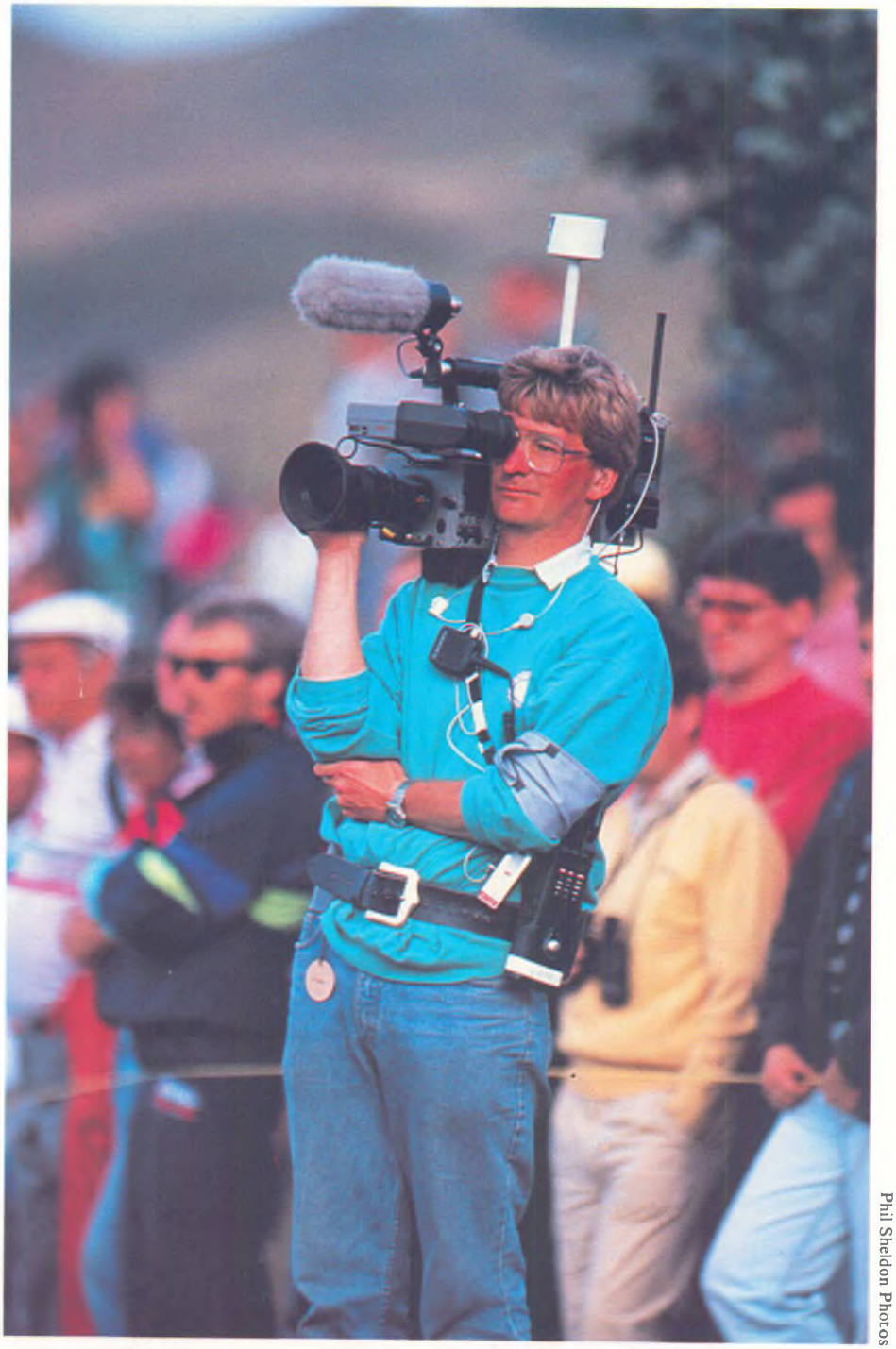
The caddycar carries a small container which houses the transmitter, receiver, filters and a small colour monitor. Two aerial panning poles are fitted, with the receive aerial close to the driver's hand. This needs very accurate panning to prevent multipath. Nevertheless, it is now easier to position the caddycar out of shot from other cameras, whilst still being able to 'see' its own camera and the receive aerial.

At Birkdale, nine 2GHz frequencies and one 3GHz channel were used for the cameras and, with careful allocation, there were no interference problems on picture or sound. Communication with cameramen and caddycar drivers — for production and engineering talkback — was provided by portable RT sets, this function using fifteen of the ninety-eight sets used for the entire operation.

The 1991 golf season represents the culmination of several years development in this direction. Portable cameras can now roam freely among many programme types and can also be controlled to exactly match other cabled cameras looking at the same scene. Truly, cameras with no strings attached!

Jeff Baker
A.H.O.B.Ops
Tel OBs

*(from material provided by Mike Jordan, Dave Jennings and Bruce Miller of Tel OBs)*



Phil Sheldon Photos

*The cordless camera in action*



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