

CEEF

ENG INF

The Quarterly For BBC Engineering Staff

SSC OPENS 1,000th TV TRANSMITTER

On Friday 7th November, the one-thousandth uhf colour television transmitter came into operation at Hedleyhope, in County Durham.

The opening was performed by Mike Neville, famous as the presenter of the magazine programme, 'Look North', from our Newcastle studios. He was accompanied by George MacKenzie, Chief Engineer, Transmission.

The Hedleyhope relay station was built to provide uhf colour television services for about 1,000 residents of Waterhouses, Esh Winning and East Hedleyhope in the Deerness valley, County Durham.

The engineers in Transmitter Capital Projects Department have been building transmitting stations for the colour services of BBC 1 and BBC 2 television for thirteen years. The first station which opened the 625-line service of BBC 2' back in 1964 was Crystal Palace. Other transmitting stations were added in the following years, and the first colour transmissions started on 625-lines in 1967. In 1969



Mike Neville connects the aerial to the transmitters at Hedleyhope, while George MacKenzie makes sure that it is not cross-threaded

the BBC 1 service was duplicated on 625-lines and in colour.

During the '70's the pace of uhf television transmitter building increased. TCPD engineers adapted their techniques to build smaller and smaller stations to cover the small remaining areas not served by the original high-power stations. Many hundreds of stations were needed, and the engineers gradually moved from the individual construction of the big stations to the production-line techniques needed for the seventy relay stations which come on the air every year.

Cordon Bowhay, the engineer who installed the transmitters at the Hedleyhope station, says he is on the road for nearly 40 weeks in the year just installing transmitters. The other members of the teams are equally dedicated. Our rigging teams have built the steel towers and fitted the aerials at



The Hedleyhope mast and transmitter cubicle being filmed as a possible TV news story

AWARD For CEEFAX PAPER

John Chambers, Head of Special Projects Section at Research Department, has won the American Institute of Electrical and Electronics Engineers (IEEE) "outstanding paper of 1980" award, for a paper entitled "ENHANCED UK TELETEXT MOVES TOWARDS STILL PICTURES".

John presented the paper at the IEEE Spring Conference held in Chicago earlier this year. The paper has been published as Research Report number 1980/4, and in "IEEE Transactions". The award from the IEEE comes in the form of a commemorative plaque and three hundred dollars cash.



stations throughout the length and breadth of the country. There are specialist aerial engineers, all keeping the relay programme going. To save time and expense at the sites of the new stations, much of the construction work is done at the TCPD base, at Brookmans Park in Hertfordshire. The transmitters are tested, the aerials assembled and the cubicles, which eventually house the equipment, are wired and fitted before being taken to site.

The total capital cost of a relay station to the broadcasters is about £50,500. This represents about £50 per person in the service area. The cost is shared between the BBC and the IBA. When the fourth channel transmitter has been installed by the IBA, the shares will be roughly 50-50.

| Breakdown of costs (£000's): | |
|-------------------------------|-------------|
| Steel Tower | 6.0 |
| Site (purchase & preparation) | 4.8 |
| Cubicle | 1.9 |
| Electricity supply | 4.4 |
| Aerial system | 5.2 |
| Transport | 0.5 |
| Wiring, ancillary etc. | 1.1 |
| BBC transmitters | 7.4 |
| IBA transmitter (estimated) | 4.0 |
| BBC staff effort | 15.2 |
| Total | 50.5 |

The cost of the Hedleyhope station is typical for a straightforward relay where there were no particularly difficult problems. At stations serving fewer people or where long access tracks or expensive towers are needed the cost per person can rise to £100 or £150 or even more.

ACE comes up trumps

The BBC and McMichael Ltd., have reached an agreement licensing McMichael Ltd. to manufacture the new digital four-field standards converter.

ACE was developed by engineers in Designs Department following fundamental work on the interpolation process carried out by engineers at Research Department. The Converter offers superb movement portrayal and provides a standard of performance not matched by any other commercially available equipment.

Standards Converters are used by the Television Service to convert television pictures from the 525-line, 60-field NTSC standard used in the USA and Japan, to the 625-line, 50-field PAL standard used in the United Kingdom and much of Europe. The Converter is equally good for conversion in either direction and is used extensively in the 625/525 mode to export BBC programmes to America.

McMichael Ltd. is a Company within the GEC group, which has concentrated on professional electronic engineering for the military market, and has developed considerable expertise in both analogue and digital electronics.

In recent years, McMichael Ltd. has provided television signal coding equipment to British Telecom, Data Collection Platforms for various users of the Meteosat meteorological satellite, and is providing advanced VHF transmitters to the British Home Office for use by Police and Fire services.

Granville Cooper, Technical Director of McMichael Ltd. says:

"McMichael Ltd. believe the agreement to manufacture ACE is an important step for the company, since it allows us to bring our background of high reliability engineering to the professional broadcast market".



Editorial

In this edition of "Eng Inf" we feature the work of Transmitter Department. Much of their work goes on behind the scenes, and to many the transmitters are often described as being only the "load on the end of the line".

We have visited three different areas of Transmitter Department to see how they operate. A Monitoring and Information Centre, a remote maintenance team, and an External Services high-power transmitting station. In each area the staff cheerfully carried out their duties often in the extremes of operational environments. Credit must be given to the high degree of engineering skill shown by engineers in Transmitter Department, that enables BBC programmes to be seen and heard throughout the UK and rest of the world.

Thanks are due to the many engineers too numerous to mention personally, who allowed us to question and photograph them for this series of articles, and to all of the others who keep the services going.

Have you got an interesting engineering story to tell? contact Alan Lafferty on BH 5432/3 or room 701 HWH.



The Standards Converter licensed to McMichael Ltd. (L-R): Alan Wheldon McMichael; Tim Shelton, DD; Sid Casson, HES; Steve McGuinness, McMichael; Nigel Rolfe and Roger Robinson, DD; Mike Oevely, McMichael; Derek Simmons, DD; Peter Rainger, DDE; and Granville Cooper, McMichael

CAR FAX goes to COURT

The BBC sought an injunction against Talbot Cars Ltd., to prevent their intended use of the trademark "Carfax", and this was granted on the 19th December 1980. Talbot Cars Ltd., wished to use the name "Carfax" for their spare-parts operation, although "Carfax" has, since 1977, been used by the BBC as the registered name for their proposed broadcast traffic information service.

The Carfax traffic information service was developed by Research Department. The system allows motorists to listen to their favourite radio programmes or in-car entertainment, automatically interrupting when there is local traffic information which will affect them.

For a country-wide service, a grid of low-power transmitters would provide local traffic information throughout the country on a single frequency in the medium wave band.

The service could provide information on alternative routes after accidents or traffic jams, and particular groups of road users, such as lorry drivers or foreign visitors, could be specifically addressed by special coding.

Engineering trials, which have proved to be successful, have been run from five transmitting stations in Greater London for the past year or so. The trials are being conducted by the BBC in association with the Transport and Road Research Laboratory.

Transmitters opened

The following UHF TV relay stations have opened since November 1980:

| | |
|--------------------------|----------|
| Kenmore (Tayside) | 7.11.80 |
| Baltasound (Shet Is.) | 3.12.80 |
| Mallaig (Highland) | 6.12.80 |
| Ravenscraig (Strath.) | 12.12.80 |
| Lydbrook (Glos.) | 7.11.80 |
| Hedleyhope (Cty. Durham) | 7.11.80 |
| Forest Row (E. Sussex) | 21.11.80 |
| Alten (Hants.) | 5.12.80 |
| Brighstone (I.O.W.) | 12.12.80 |
| Bristol (Avon) | 19.12.80 |

ELECTRONIC NEWS GATHERING back in service



The ENG unit rehearses a story at TVC

The BBC News ENG unit returned to full operational service on November 1st. Since then it has made a considerable impact on the way the news is gathered, edited and transmitted. ENG - electronic news gathering - uses lightweight television cameras instead of the more conventional film cameras, allowing the transmission of news stories without the delay of chemical processing.

The cameras used by the two-man BBC' ENG unit are IKGAMI HL 79 'one piece' cameras, fitted with zoom lenses, that can be operated from the

mains or from a portable battery power supply. The signal from the camera can be passed back to the Television Centre base via the radio-link vehicle or direct land-line or can be recorded on-site on a Sony BVU 100 U-matic video cassette recorder.

In one lunch-time news broadcast only a few days after the ENG operation restarted there were three stories covered by one ENG unit alone. The sale of goods by the Miss World contestants was pre-recorded on the cassette video-recorder and sent back to Television Centre by dispatch-rider for

RADIO 1 at WOOD NORTON



Peter Powell, Radio 1 D.J., with a group of students and instructor Jim Cook in the Continuity Suite at the Engineering Training Centre, Wood Norton. Peter, with producer Dave Tait, was visiting to talk to students on the T.O. (Radio) Course about the work and problems of a DJ. Because it would have been difficult to get back to London in time for his afternoon show, Peter agreed to stay on and run the show from the local Continuity Suite.

This suite is normally equipped with a fault simulator to train operators how to respond when faults occur and so minimise the effect on the network output. On this occasion the simulator was disconnected and the programme went without a hitch. During the programme Peter interviewed Kevern Oliver, the Course Manager, and a few of the students to give the listeners some idea of the facilities available and the activities that take place at the Training Centre.

editing there; the crew then moved on to cover the meeting of the Firemen's Union discussing their 6% pay award, and this was again recorded on the video cassette recorder, but replayed via the radio-link vehicle on site, at the appropriate point in the news. A last-minute live broadcast via the radio-link vehicle, updated the firemen's story, and proved the flexibility of ENG.

The radio-link equipment is mounted on a specially adapted Range Rover. The roof has been strengthened so that it can be used as a camera platform, but its main purpose is to support a 1.2m dish aerial which is used on the 2.5 GHz vehicle-to-base radio-link system. The dish aerial is permanently installed on the vehicle roof on a small purpose-built tower, which, when not in use, lies flat on the vehicle roof. An electrically-operated ram raises or lowers the tower in only a few seconds. The radio-link can operate directly to the Television Centre, but due to the high frequencies used, a line-of-sight radio path is required, and this is not possible from many sites in Central London; therefore, four Nurd horn aerials have been installed on the 122m high Millbank Tower, one horn covering each aspect of the building, and making it effectively an omni-directional reception point. The receiving equipment is remotely controlled over a landline, by an operator at Television Centre allowing any of the four aerials to be selected. A panning aid is provided on the link vehicle which uses a radio-telephone channel and allows the ENG operator to align the dish aerial for maximum signal strength at Millbank Tower.

In addition to the radio-link equipment, the Range-Rover houses a 12 GHz receiver that can pick up the camera signal transmitted by the cameraman. This removes the need for long trailing cables, and allows the cameraman freer access to buildings. The vehicle has six UHF whip-aerials that are used to provide an off-air feed from the local UHF TV transmitter, and this is fed to a conventional television receiver; this is used by the reporter for cueing purposes.

At Television Centre there are two ENG editing suites, one for 52S-line operation, and one for 62S-line operation, although it is expected that more will be provided as demand increases. The editing suites have Sony BVU 200 video tape recorders with Sony SO-P editing systems. In the event of a late story they can be rush-edited in the transmission suite and then passed straight to the news room, but stories would normally be routed to one of the editing rooms if there is time.

DESIGNS '80 EXHIBITION IN LANGHAM

D.E. addresses Es-i-C



Tim Shelton and David Read, DD, demonstrate the RP 2/10 Disc reproducer to MDR, watched by HDD, Cordon Parker (L), and Don Cummings, Radio 0 & M (behind)

As has been briefly reported in the last edition of Eng Inf, the Engineers-in-Charge met at a conference in October and the Director of Engineering spoke about the cuts in Engineering Division. Parts of his speech are reproduced below:

"You will all be very aware of the economies that have been made during the past year and there is no need to go over them again in detail. With the rest of the BBC, we are all taking our share in one way or another but it is true to say that they have not bitten so deep as to undermine seriously the effectiveness and standards of work in the engineering field.

On the other hand we have not yet experienced the full effects of cutbacks. Budgets have been pruned to the required levels, but we are only part way along the road of turning budget intentions into actual economies. We

'continued on page 5

Coincident with the Es.i.C. Meeting in October, Designs Department staged a two-day exhibition "Designs 80" which showed some of the latest products being handled by the Department.

On the first day the exhibition was open to senior staff and members of the Es.i.C meeting. The second day the exhibition was organised for members of the technical press and representatives from industry wishing to visit it.

During the second day there were ninety visitors from outside organisations and some five-hundred and sixty BBC staff. The exhibits showed the total range of work covered by the Department from audio through to video and RF to digital.

Many of the exhibits showed the extensive use being made of micro-computers in current designs. A very important aspect of the exhibition was the display of manufacturing techniques which have been developed by the Department to ensure that the ideas can be processed into equipment having a high reliability. A specific example of equipment with a high reliability was the newly developed low-cost transposer known as "silver streak". This equipment will be made in very large numbers, both by Equipment Department as well as being licensed to outside firms for manufacture for sale to other broadcast organisations. Details appear elsewhere in "Eng Inf".

Television production tools were on display, including an improved method of colour separation overlay. The new network clock symbol used on BBC 2 was on show, a good example of digital applications to television production. The various electronically generated logos were shown, as well as the development of an electronic test card F which is now becoming an important project due to the difficulty in obtaining consistent slides from outside sources.

In the field of audio, the use of digits in transmission was highlighted by a demonstration of NICAM3 whilst the

studio end of the business was shown by the continuity equipment being developed for Cardiff.

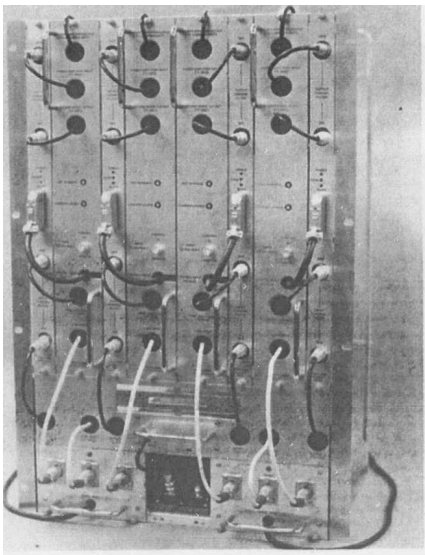
Another interesting exhibit was that of Palantype subtitling via CEEFAX for the hard-of-hearing. This exhibit is an example of the continuing efforts by the BBC to try and help the three million of our viewers who cannot enjoy full BBC programmes due to hearing deficiencies.

The exhibition was a definite success and the staff marning the stands much enjoyed the opportunity to discuss their work and the application with the visitors to the exhibition.



The new Radio continuity studio desk is demonstrated to MDR by Ian Millar of Designs Department, watched by David Smart (L) and HDD (R)

SILVER STREAK LAUNCHED



The 'Silver Streak' prototype four-channel transposer

The new UHF Television Transposer, known as Silver Streak, was shown for the first time at Designs '80. Designed to meet the BBC's requirements for inexpensive relay stations to serve small communities, it will supersede the Blue Streak which has now been in production for five years. The new transposer takes advantage of developments over that period to incorporate many features that minimise the overall cost of providing a television service; low manufacturing cost, simple installation, high reliability, quick replacement of faulty modules, easy maintenance, and lightweight construction.

The heart of the transposer is a broad-band active module which consists of two mixers, two oscillators, and IF unit, and a power amplifier. The module has no integral controls, but its parameters are set when it is plugged into a passive personality module. Thus, the transposer modules at all similarly equipped relay stations are identical, minimising the number of spares required. The personality module is entirely passive and consists of two UHF band-pass filters tuned to the input and output channels, and a simple system of wire links which enable the synthesised local oscillator frequencies to be set on site.

Up to four transposers may be driven from a single low-noise distribution amplifier and two transposers are driven from a single power supply. Thus, a total of three active modules, the heaviest of which is less than 9 kg, are required as spares.

E's.I.C. meeting:

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are going to have to live within our reduced budgets and every individual manager must watch his expenditure very carefully. If individual budgets are exceeded, there is no bottomless pit or rescue fund for baling out and the consequences of over-spending can only be further cuts in staffing.

But with careful management we can continue with very active development on most engineering fronts. The past year, and our plans for the future, certainly bear this out.

Last year the BBC spent £46M on Capital Developments - in real terms the most we have ever spent and we are planning to spend £56M this year. In both cases this does not include expenditure for External Services which is another £3.7M last year and £5M this year.

Earlier this year when we were considering the cuts that had to be made, I was concerned, as were other members of BoM, that this was merely Stage I and that further reductions, perhaps even more severe, would be required next year. This would have been difficult to achieve without very serious cut-backs across the board as any fat has now gone. I am now confident, however, that further cuts will not be necessary' and I expect D.G. will confirm this later in the meeting."

DE then reviewed the achievements of the previous year, and

A particular feature of the transposer is the two synthesised local oscillators which can be set by wire links to generate the frequencies required for any UHF channel and offset. The generation of one-third line frequency offsets could lead to a highly expensive and complex synthesiser design. However, this equipment uses a novel approach which, as well as being cheap, gives a transposer output frequency which is independent of input frequency drift. This is an advantage for long chains of transposers where, using conventional techniques, the overall frequency error can be quite large. The output frequency of this transposer is solely determined by its internal, oven-controlled crystal oscillator.

The first production batch of the new transposer is due from Equipment Department in August, and it will start to replace the Blue Streak in new installations in 1982.

concluded by saying a few words about satellites, he said,

"During the last few months we have been very active in developing proposals for the use of satellites both for direct broadcasting and for point-to-point contribution links. Earlier this year we used an up-link hired from Ferranti and the Satellite OTS, for the contribution link for an OB from Glencoe. This was on trial only and the terrestrial link was used for programme purposes, but the trial was highly successful. A further use of OTS is planned from Ben Nevis for next Spring. Later next year we will have our own up-link which is being designed by Research Department. It will be in the form of a trailer to be towed behind a standard radio-link vehicle. Agreement has yet to be obtained from the B.T. (British Telecom) for the broadcaster to operate its own satellite links - the difficulties here must not be underestimated.

On the use of satellites for Direct Broadcasting to the home, France and Germany and other countries have plans to provide a service by about 1986. We have been pressing the Home Office for a DBS service in the UK by the mid 80's and a Home Office committee has been set up to consider this subject. We have made a major contribution to this committee including a proposal that two satellite channels should be made available for BBC services - one a Subscription service and the second a repeat best of BBC1/2 service. This second service we would later programme in its own right to allow the terrestrial services to be available more for regional contributions. "

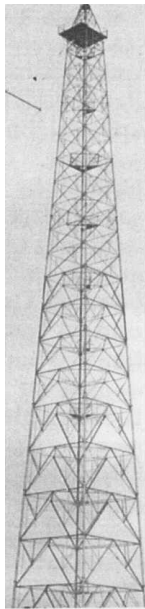
50 Years ago

From the BBC Handbook 1931

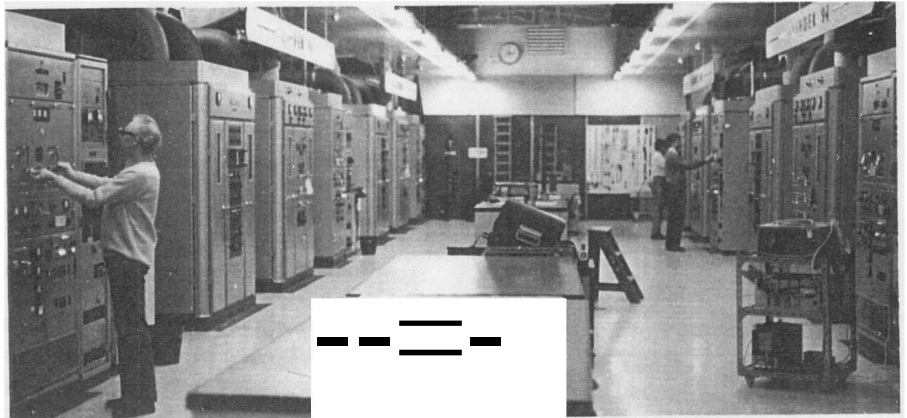
The event of the year par excellence has been the completion of Broadcasting House. Unfortunately the decoration and fitting of its twenty-two studios has not advanced beyond the preliminary stages at the time of going to press, and many finishing touches remained to be added to various parts of the building. It has not, therefore, been possible to give a really full account of Broadcasting House in this Year-Book and many of the illustrations show the building in an incomplete form. The BBC, however, hopes to issue a souvenir of Broadcasting House early in 1932, and the BBC Year-Book of 1933 will repair the omissions of the present year.

TRANSMITTER DEPARTMENT: SPECIAL FEATURE

WOOFFERTON transmits to the world



A multi-band HF aerial array



Engineers John Chantler, Jeff Chant and Phil Sandell adjust the 250 kW transmitters at Woofferton

"Nation shall speak peace unto nation" says the motto, and nowhere is this more evident than at the BBC External Services transmitter stations. In addition to overseas relay bases, there are four stations in England. These are located at Daventry, Rampisham, Skelton and Woofferton, and it is the latter that we examine in more detail.

The station, near Ludlow in Shropshire, houses six Marconi 250 kW high-frequency transmitters, or senders as they are known in External Services. These can be selected to power anyone of 34 curtain arrays or aerials, to provide coverage to the required service areas. Thus the short wave signals can be beamed to many parts of the globe throughout the day and night.

The station not only transmits BBC external service programmes, but acts as a relay station for "Voice of America" programmes. These are relayed by line from the BBC receiving station at Crowsley Park near Reading. The signals originate either directly off-air, or from a satellite link, and sometimes are replayed from a pre-recorded tape.

The four incoming programme lines from Caversham and Bush are monitored and switched in the control room, where the duty engineers also select the correct aerial array for each transmission. The transmitters can also be remotely switched from the control room. Much of the monitoring equipment relies upon old electromagnetic relays for its operation, and these will shortly be replaced by a more sophisticated micro-processor control system.

The new control system, designed by Designs Department and TCPD and now being installed by a team from TCPD, will not only monitor the

programme lines and transmitters, but can also switch the correct programme to the required transmitter at the right time, and select the correct array for that particular transmission. Programme and transmitter switching in the External Services follows a prescribed schedule which involves many switching operations throughout the day and night, and the new system will have the capability of being overridden, to accommodate short notice changes in the schedule.

The six 250 kW HF transmitters in the main hall are manually tuned and frequency-changed, and require the constant attention of the duty-engineers to monitor their performance. At programme junctions they can accommodate small frequency changes, and aerial changes, with an engineer on hand to bring the transmitter back to peak performance. However, if a major frequency change is required, it can take some minutes to manhandle the different tuning coils into place, and change the settings of the vacuum tuning capacitors.

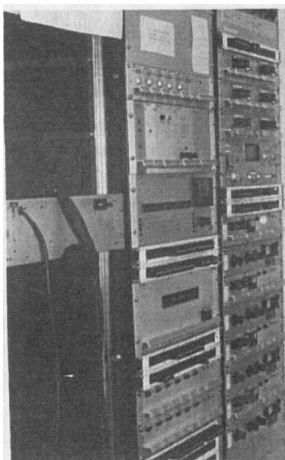
At the far end of the transmitter hall a team from Marconi



Bernie Keenan at the old control desk



STE Percy Winsor checks the final anode coils inside a transmitter



The new microprocessor control equipment under installation



Remote Team keeps *things* going in *the Western Highlands*

Communication Systems Ltd., are installing four of the latest B6124 300 kW SW transmitters. These transmitters have several new features which have been incorporated into their design. The control system can store up to 32 pre-set frequency channels, and this means that frequency changes can be carried out in a mere 12 seconds. A sophisticated "hypervapotron" cooling system allows the 300 kW radiated power to be developed on the anode of a single final tetrode valve. The tuning capacitors, coils and valves are all water and air-cooled making them cold to handle, and doing away with the need for special gloves for handling hot components.

The new transmitters have been designed with ease of access in mind, and rapid valve changing will be possible with the self-sealing hose connection incorporated in the cooling circuits. Being fully automatic, the transmitters can be monitored from the control room, with local I.e.d.'s providing a diagnostic aid should a fault develop. The first of the four new transmitters is currently being power-tested; the remaining three are due for completion in March 1981.

The mains-power requirements for a station such as Woofferton provide the local electricity board with a few problems, since the station consumes 3.5 MVA of power at normal transmitter operating levels. Any increase in maximum electricity demand can produce an enormous 'increase' in the final electricity bill and consequently every effort is made to keep electricity charges down.

The engineering staff on the station are required to develop a multiplicity of skills ranging from plumbing and metal work to first line maintenance on vacuum circuit breaker switchgear and microprocessor systems. Considerable support is given to the operational shift engineers by skilled and fully equipped maintenance sections and rigging teams. ~



The new Marconi transmitter

The Melvaig transmitting station

Even in the remoter parts of the U.K., transmitter-maintenance teams work under considerable pressure to keep our services on the air. The team at Gairloch, in the western highlands of Scotland, has some extra headaches to cope with.

"The biggest problem maintaining transmitters in western Scotland is one of sheer distance" said team manager, Arthur Morris. "For example, it is 218 miles to the Kilbride transmitter on South Uist and, because the journey involves ferry crossings and single-track roads, it can sometimes take up to 24 hours to get to the station and that's for a potential 700 viewers!"

The maintenance team has a tough job maintaining the twelve stations that are scattered around the Outer Hebrides, Skye and western coast of Scotland. Apart from the main vhf radio and Band I television station at Melvaig, their patch includes the Eitshal high-powered uhf tv station and Ness relay station on Lewis, three uhf tv transmitters on North and South Uist three relays on Skye, and three uhf t-relay stations on the mainland. In addition they are responsible for the shf link distribution equipment at Glen Docherty, Melvaig and Eitshal.

The five-man team at Gairloch take it in turns to be away from base, and before they leave their Range Rover

is checked to make sure that it contains emergency rations, water, and blankets.

"You never know where or when you could get stranded" said senior transmitter engineer Syd Garrioch. "Just before Christmas we were stranded for eight hours, without food, on the jetty at Stornoway waiting for the ferry back to Ullapool. None of the hotels could accommodate us because they were full, and the guest-houses wouldn't take us in because landladies dislike being woken by guests leaving at 4.30 a.m. to catch ferries. As a result we now carry emergency supplies."

Bad weather can also cause problems for the maintenance team. lightning strikes recently caused five transmitter shutdowns in five weeks. Unfortunately even a minor strike can cause problems, because it can bring the phone lines down for weeks on end; this means that no information can be sent back to the Monitoring Information Centre (MIC) at Kirk O'Shotts. Often the team has a 12-hour journey just to reset a transmitter stabilized power supply which has shut down because of 'local mains voltage variations.

The team spend a lot of time on the islands, and a spare parts store has been established at the Cletraval station. As Arthur Morris says, "It is no use going all the way to Kilbride to find that you have forgotten a simple thing like a fuse." The ferry charges for the Range Rovers are expensive, costing over £2,000 a year. Sometimes a plane has to be chartered to take faulty parts back to base if the ferry-crossing is too rough.

Being a member of the team has its advantages though, because the western highlands have some of the most spectacular scenery in the U.K. and the team members gain considerable satisfaction from providing a service for the isolated communities in the area. The engineers are all members of the small community of Gairloch, and the sight of one of their two white Range Rovers always provokes a friendly wave from passers-by. However, facilities in the hamlet are few, with only two shops and a garage, and bread and milk deliveries twice a week. Hotel bars are always full, though, mainly with fishermen who, even in the depths of winter, cast nets upon the icy waters. A trip to the dentist can mean a days journey to Inverness, 70 miles away, and the news on Ceefax often beats the newspapers by more than a day. The
'continued on page 8'