THE CRYSTAL PALACE

B B C
CRYSTAL PALACE TRANSMITTER
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## APPENDICES

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1. **CRYSTAL PALACE TRANSMITTING STATION AND SITE: SIGNIFICANT DATES**

1851 Crystal Palace Exhibition opened in Hyde Park, London

1854 Enlarged Crystal Palace Exhibition opened in Sydenham, London.

1934 Experimental (Baird System) TV transmissions from Crystal Palace. Search for permanent London site.

1936 London TV service begins in November from Alexandra Palace, North London. EIC Mr. Birkinshaw.

1936 Crystal Palace Exhibition Centre destroyed by fire.

1939 Alexandra Palace ceases TV transmission with start of World War II.

1946 Alexandra Palace resumes TV transmission.

1954 Crystal Palace site selected.

1956 Alexandra Palace closes and TV transmission starts from Crystal Palace. EIC Mr. W.G.R. Smith (ex AP) and AEIC Mr. F.A. Thompson.

The tower was only half complete as construction had been held up due to negotiations with the ITA over their possible sharing. This did not happen. The initial BBC transmissions were thus from a temporary stayed mast on the adjacent Thames Water site.

Experimental 405-line colour transmissions were transferred from AP where they had been transmitted earlier using a Marconi 5kW transmitter.

1957 Mr. F.A. Thompson A/EIC.

1958 Mr. A.W. Busby EIC.

Experimental Band V transmissions commenced using EMI transmitters fitted with Eimac Klystrons and an elliptical waveguide approx. 700' long feeding a helical aerial at the top of the mast.

1962 Ian Blanthorn AEiC

1964 BBC-2 625 line service started on 20th April. The experimental EMI transmitters converted to band IV (vision transmitters) and a pair of Pye 2kw FM sound transmitters added.

Experimental 625 line colour transmissions began using all three colour systems ie. NTSC, SECAM and PAL as part of the programme to attempt to achieve a common European system.
1965 BBC-2 transmitters replaced by 2 x 25kw Marconi. New antenna and feeders.
1967 BBC-2 625 line 4 colour service starts (June).
1969 BBC-1 625 line colour service service starts (15th November) 2 x 40kw Marconi transmitters. Standards converter (625-405) installed to feed BBC-1 405 service. BBC 2 replaced by 2 x 40kw Marconi. Old 25kw Tx.'s sent to Divis for BBC 1.
1969 Building extended to accommodate IBA UHF colour service.
1979 Norman Shacklady STM
    Chris Gill TM(O) and Ian Blanthorn TM(M). Team base established.
1981 Ged Thompson A/STM.
1982 Monitoring and Information Centre established (17th January) to cover South and East.
    Breakfast TV begins and MIC hours extended to cover.
1983 Norman Shacklady STAM.
1984 BBC-1 405 line service closes.
    Experimental digital stereo sound transmitted.
1985 Graeme Keys TM(O)
1986 Radio One FM service starts.
    All UK MIC introduced overnight.
1987 Brian Haseler TAM
    Eric Picketts TM
1990 George Bath TM
    Melvyn Pickworth ATM.
    New Outside Broadcast Room completed.
    Klystron efficiency experiments continue.
    Enhanced PAL test transmissions.
1992 BBC select, scrambled transmissions begin regularly, at night.
    Experimental Digital Audio Broadcasting tests in Bands III and IV.
    In-band transmissions of sound bearers.

GNB/W/BG
CPdates  
- 3 -
2. HISTORY AND ENGINEERING PROGRESS

THE BEGINNING AND ALEXANDRA PALACE.

Crystal Palace nearly became the world's first highpower television station when the BBC started looking for a site in the London area in 1934. Indeed, some of Baird's early experiments were from one of the towers of the original Crystal Palace building. However, Alexandra Palace in North London was eventually chosen for the combined studios/transmitters (very fortunate with hindsight in view of the catastrophic fire in 1936) and continued, apart from the war years, until the end of its 21 year lease in 1956.

During 1954, various options for the new London station were considered, particularly a move to the existing VHF/FM station at Wrotham in Kent. However, various factors, both technical and political, weighed in favour of establishing a completely new station at Crystal Palace in South London.

CRYSTAL PALACE.

Although previous BBC high power TV stations had been based on 750 feet stayed masts, the very restricted site area at Crystal Palace dictated the use of a self supporting tower (construction of which is featured in the BICC information film "The Phoenix Tower"). However, complications arose since when already half built, the design of the top section had to be altered to accommodate a Government requirement that the newly formed ITV service should co-site its Band III transmitters at Crystal Palace.

TEMPORARY MAST.

In view of the delay, a temporary 235ft mast just released from Glencairn (near Belfast) was erected over the reservoir next to the Crystal Palace site and it was this which carried the service on Channel 1 (45MHz) from the opening on 28th March 1956 until the permanent tower was completed the following year. In order to obtain data on the natural resonance of large structures, the National Physical Laboratory fired horizontal rockets on the tower, much to the consternation of local residents! The co-location of the IBA Band III Transmitters did not, in fact, take place although the idea was eventually put into practice at UHF in 1969.

PENGE EFFECT

Various new techniques were featured in the design of the new station such as the use of parallel working to enhance service reliability. Unfortunately, this led to hitherto unsuspected phasing problems (known locally as "Penge effect") which required a redesign of the combining arrangement. Another innovation was the use of a high gain transmitting aerial and (relatively) low power transmitters, the vision output being only 15kw, although provision was made to add a 50kw amplifier stage if required.

STAFF

From the staffing point of view, it was necessary to transfer some of the Alexandra Palace engineers across to Crystal Palace ahead of the starting date in order to gain experience with the new equipment. The Alexandra Palace EIC (a Mr. Smith) unfortunately fell ill at this time and his assistant (Mr. Thompson) became the Crystal Palace EIC until a permanent replacement was appointed the following year.
This was A.W. Busby who continued as EIC, STM etc. until his retirement from the BBC in 1978. Other CP stalwarts were Ernie Morley (from the original AP staff) plus Norman Shacklady and Charles Dearney who were assigned to AP briefly in order to enable the previously mentioned release of engineers to gain experience.

EXPERIMENTS AND DEVELOPMENTS.

Although its primary function was the provision of BBC TV programmes to the public, Crystal Palace soon found itself in the frontline for various experimental projects to investigate new techniques, the most prominent being the introduction of colour and the expansion to UHF bands. To facilitate the latter, experimental EMI 10kw Band V (CH44) equipment was installed together with UHF waveguide (!) and an Antiphase Helical transmitting aerial at the top of the tower. Various tests were conducted in the late fifties and early sixties including both 405 and 625 pictures at UHF and 405 NTSC colour on CH1.

BBC 2.

With the decision to commence a second television service (BBC2 on CH33 with 625 lines) the vision and sound EMI transmitters were modified to become 2 x 10kw vision transmitters and 2 Pye three cavity amplifiers were installed for the (FM) sound. BBC2 started 20th April 1964 although the opening night was ruined due to a severe fault at Battersea power station causing a prolonged mains outage at Television Centre. In order to provide higher power (and with the advent of colour expected shortly), a 2 x 25kw Marconi system with a new aerial/feeder arrangement was commissioned in 1965 and this carried BBC2 until November 1969 (with colour from 1967).

RE-ENGINEERING/BBC1 ON 625 LINES AND IBA.

1969 saw enormous changes at Crystal Palace with a completely new UHF system (2 x 40kw Marconis) to carry BBC1 625 colour on CH26 plus an identical set up to continue the BBC2 service. (The 25kw Marconi equipment was sent to Northern Ireland to carry BBC1 from Divis). Since BBC1 was now originated on 625 lines, standard converters were installed to provide 405 lines to the Band 1 transmitters. In addition to all this activity, co-siting with the IBA at last became a reality. To accommodate the ITV equipment a large building project was undertaken resulting in a physically attached but separate installation of transmitters, feeders and aerial system. The IBA used vision klystrons with 5 integral cavities in order to be able to amplify the output of completely solid state drives up to 55kw peak sync and claimed that this was the world's highest powered unattended transmitting station (being remotely controlled from their Croydon Band III station a short distance away).
A QUIETER TIME.

With engineering effort concentrated on the spread of BBC1 UHF across the country plus the completion of the BBC2 network, the seventies were, perhaps, the quietest time in Crystal Palace's history. Apart from the establishment of a central maintenance area to service various types of equipment sent in from other stations, the biggest change was the introduction of integrated working in 1979 (the previous small mobile team having moved to Heathfield in 1970).

LOCAL RADIO FM.

The eighties opened with the transfer of the Radio London FM service from Wrotham to Crystal Palace from which a better signal could be achieved into Central London with lower power. Then in 1982, an enormous change in the working environment occurred with the introduction of the South-East MIC and all its attendant equipment and operating procedures. Within a few months Breakfast Television started and the MIC was used in an "All UK" mode with dayshifts starting at 0500.

CLOSURE OF BBC1 405 LINES.

With an ever dwindling audience, and equipment nearly 30 years old, the Band I transmitters were finally retired in January 1984 and a large number of staff (past and present) witnessed the event at a special party. The Band I hall was then cleared to form a large area to house station and group spares.

FURTHER EXPERIMENTS.

A long term investigation to improve klystron efficiency came to fruition in the mid-eighties with the introduction of pulsed operation and (later) gridded klystrons.

MONITORING CENTRE.

With 24 hour radio and ever longer television hours, Crystal Palace became the overnight "All UK" MIC in 1986 and later became responsible for the whole network from 2000. At this time the HF stations at Hong Kong and Seychelles also came on stream and worked on a semi-attended basis with data fed by satellite to CP.

STEREO SOUND ON TV.

Another long term investigation into 2 channel sound with TV went through several stages until eventually the NICAM 728 system was chosen. As part of the UHF re-engineering, new "stereo capable" drives were introduced in 1987 along with new combining units and stereo sound radiated thereafter. A service started in 1991.

NOW.

The latest developments at Crystal Palace include the introduction of a communication channel radiated below vision carrier, the construction of a new OB control room and expansion of the "other users" facility and the operational point of contact for commercial contracts.

PS/hjw
Wd/BG
14.03.91.
APPENDIX 'A'

A TECHNICAL GUIDE TO BBC CRYSTAL PALACE

SITE
The Crystal Palace site was chosen in the early fifties after investigating various possibilities including Wrotham, Reigate Hill, Shooters Hill and Southwark. The final choice was a compromise which gave the best population coverage (13 million) for the lowest power and without wasteful overlap into the service areas of adjacent stations.

The site is approx. 2 acres and is 362ft. above sea level. In accordance with the original planning permission, the building is mostly underground, being constructed into the upper level of Crystal Palace public park.

TELEVISION TRANSMISSION
BBC 1 and BBC 2 programmes come to the station as stereo sound-in-syncs format signals on the 7GHz SHF link from Television Centre with a similar signal on BT underground tubes as reserve. The signals are equalised and amplified as necessary before being fed to the drive bays where they are pre-corrected and modulated onto UHF carriers (CH26 for BBC 1 and CH33 for BBC 2). Pre-correction is necessary to compensate for the inevitable distortion caused by the high power UHF amplifiers. These amplifiers are configured into two parallel pairs of vision and sound klystrons per service and each amplifier produces 40Kw (peak sync), 4Kw mono FM sound and 400w Nicam Digital Sound. The klystrons operate at 23KV and are vapour-phase cooled i.e. the cooling water is deliberately turned to steam and then condensed back into water during part of its journey around the system. Due to the "latent heat of water" phenomenon this results in a much more efficient cooling system. Much effort has recently been expended to reduce the mains input power of the vision klystrons. New gridded klystrons in conjunction with Pulser operation have improved efficiency from typically 30% to 65% by switching the operating conditions between the picture and sync periods.

The vision and sound from each amplifier is combined and the resultant combined with the similar signal from the other half of the parallel pair. This is then split and the two services combined before being sent on the main feeders to the transmitting aerial at the top of the tower. This aerial is divided into four parts, the upper two for BBC 1 and 2, the lower two for ITV and CH4. The effective radiated power is nominally 1000Kw per service omni-directional. A reserve transmitting aerial for each organisation is provided complete with separate feeder. This can be manually selected and enables transmission to continue (at reduced power) in the event of a catastrophic failure of the main aerial or top part of the tower.
RADIO TRANSMISSION

Local Radio for London (within the circle of the M25) is provided by GLR (Greater London Radio) and radiated on 94.9MHz with a power of 4Kw from a slant polarised aerial mounted on the tower at 450ft. The stereo programme is fed to Crystal Palace on a pair of BT lines from the studio in Marylebone Road with a mono UHF link as the reserve. Solid state transmitters of the BBC design are arranged in 4 modules of 500w output to give the necessary diversity and the signal is fed to the split aerial system by two main feeders. RDS is provided on this service, dynamically updated from the Wrotham Radio 2 transmission. Programmes are radiated 24 hours per day and, as with television, the whole system is designed for unattended operation, faults being signalled automatically to the MIC.

MONITORING AND INFORMATION CENTRE

The MIC receives data from the larger radio and TV stations in the south east of England and presents any abnormalities in the form of "plain text" captions to the operator. Information from automatic fault reporters comes into the MIC on subcarriers (23KHz on the TV sound or 76KHz on FM Radio Transmissions), dedicated BT lines or over the public telephone network as appropriate. This data is given a priority status on the operators VDU so that action can be taken as required. This generally means identifying the location of the problem so that the appropriate mobile engineers can be informed and also sending details of the fault to various people so that apologies can be broadcast if necessary. Highest possible quality vision and sound from stations in the area is also available to the operator but it should be emphasised that the main function of the MIC is the processing of data rather than continuous "Quality Monitoring" of pictures as originally undertaken in the days before automatic unattended operation. The MIC is responsible for approx. 300 Radio and TV services at 150 stations in the South-East.

Five MIC's are strategically sited around the country and each is responsible for its local area during the daytime. From 8 o'clock each evening until 8 o'clock the following morning, the other 4 MIC's are destaffed and feed their data into the Crystal Palace MIC which is staffed 24 hours per day. Thus during the evening and overnight, the Crystal Palace MIC operates in the "All-UK" mode and is responsible for all BBC radio and television transmissions throughout the British Isles i.e. about 2000 services at over 1000 stations.
MAINS SUPPLY

Power enters the building at 11kV on two underground cables which are fed from different parts of the National Grid for maximum reliability of service, change-over between them being under automatic control. Four feeds are taken from the 11kV busbars, two for our use and two to the part of the building with the ITV and CH4 Transmitters. The BBC feeds are transformed down to 415 volts and then, after regulation, distributed through switch fuses to various parts of the station. On average (during TV transmission hours) the BBC section of the station takes approx. 350Kw.

OUTSTATIONS

The Crystal Palace staff also look after 13* relay stations in the South London area and there is a Test Room where a Central Maintenance Area has been set up to cater for the needs of the department nationwide and some work for other BBC Departments.

*Crystal Palace (broadcast plant) TV.
Reigate TV
Woolwich TV
Kenley TV
Croydon Old Town TV
Near Addington TV
Poplar TV
Greenwich TV
World's End Chelsea TV
Biggin Hill TV
Cane Hill TV
Hammersmith TV
Lot's Road Chelsea MF