Tricks of the Trade

Dave Porter G4OYX

The last couple of ToTT have been dealing with the scheduling requirements of the BBC's (and others') Overseas Services. This ToTT ties up a few loose ends and then introduces the subject of HF antennas as used on the HF sites.

Antennas, Aspidistra and cover

The above was used as the penultimate heading in the last ToTT. Like all good awards ceremonies this will be explained in *reverse order.*

After seeing the examples, in the last ToTT, of broadcast schedules for Skelton (SK), Woofferton (WOF) and Daventry (DX), it is evident that there were times at certain sites when most or all the plant was scheduled to be on the air.

To the engineers on shift, and particularly the Senior Transmitter Engineer (STE) overseeing this operation, this could give cause for concern as there may be just one spare sender available or even no standby plant available on site to carry a service, or rather to cover the service in the event of a plant failure.

Cover

Consider WOF with a ten-sender complement; in the event of a failure, or a shutdown to use the normal phrase, if there was a spare sender available it would be employed to cover the service. However, the decision-making process is not always that clear as, of course, it may be an antenna fault rather than a sender fault. It could also be a programme input fault, with say a BT line failure or, in latter days, a satellite feed failure.

Once the fault had been identified, then the cover process could be implemented. The first port-of-call to the STE was the official printed coloured schedule and a locally-produced Array Availability Schedule to see what sender and array combinations were available.

For a sender fault, then the best cover would be NAB (Normal Array and Bearing) on another sender with the same power output or more. For example WOF is easy as all senders are 250/300 kW whereas Daventry had senders from 80 kW through to 250 kW.

For an array fault then more research is required.

Table 1 shows the full complement of arrays and bearings for WOF for a selection of frequency bands.

MHz	Array	Array Bearing						Array	VOA	Array Type	Mast	S/S
9	**907**	58	70	82	238	250	262	**907**	A9	HRRS 4/4/1	C-D	2
	954	45	75	105				**954**	N3	HRS 4/4/.5	S-EE	1A
	953	45	75	105				**953**	N4	HRS 4/4/1	DD-EE	1A
	922	66	78	90	246	258	270	**922**	B9	HRRS 4/3/.5	X-Y	4
	910	102	114	126	282	294	306	**910**	C9	HRRS 4/4/1	E-F	3
	926	128	140	152	308	320	332	**926**	D9	HRRS 4/4/1	Z-T	4
	951	140	160	180				**951**	N1	HRS 4/4/.5	AA-BB	1A
	914	158	170	182	338	350	2	**914**	E9	HRRS 4/4/1	G-H	3
	929	92	107	122	137	152		**929**		HRS 4/4/.5		4
11	**906**	58	70	82	238	250	262	**906**	A11	HRRS 4/4/1	C-D	2
	954	45	75	105				**954**	N3	HRS 4/4/.5	S-EE	1A
	953	45	75	105				**953**	N4	HRS 4/4/1	DD-EE	1A
	923	66	78	90	246	258	270	**923**	B11	HRRS 4/3/.5	X-Y	4
	909	102	114	126	282	294	306	**909**	C11	HRRS 4/4/1	E-F	3
	925	128	140	152	308	320	332	**925**	D11	HRRS 4/4/1	Z-T	4
	951	140	160	180				**951**	N1	HRS 4/4/.5	AA-BB	1A
	913	158	170	182	338	350	2	**913**	E11	HRRS 4/4/1	G-H	3
	929	92	107	122	137	152		**929**		HRS 4/4/.5		4
13	**953**	45	75	105				**953**	N4	HRS 4/4/1	DD-EE	1A
	929	92	107	122	137	152		**929**		HRS 4/4/.5		4
	930	120	135	150	165	180		**930**		HRS 4/4/.5		4

Table 1. An extract from a table giving the full complement of arrays and bearings for WOF. The full table includes data for the 6, 7, 15, 17, 21 and 26 MHz bands

In addition, the Voice of America (VoA) reference number is shown, as is the situation in the antenna field to show between which masts the antenna is slung. S/S refers to the RF matrix switch station that feeds the particular array. Until 2009, most arrays were trifurcated, that is, each array could be made available to a maximum of three senders.

So, to cover a service say on 9 MHz using array 910 on 126°, then from **Table 1**, an alternative array, A925 on 128°, would appear to be fine (at least bearing-wise). However, a couple more checks need to be made.

The column Array Type would be consulted and it can be seen they are both HRRS 4/4/1 (this term will be explained later). All that remains now is to check whether Array 925 is available on the required sender and for how long. Will there be enough time to cover the entire scheduled transmission? Will A925 be required on regular schedule soon?

The above example of allocating an alternative array to a sender is that of a *single shuffle*. Sometimes with the constraints of trifurcation and timings, it was necessary to transfer first an already running service to a spare sender/NAB array combination to release a sender that had the array needed to cover a shutdown. This was then a *double shuffle.* Some certain, brave, one could say cavalier, STEs would contemplate and execute a *triple shuffle,* but such actions could be fraught with danger such as putting the incorrect programme on one or more of the senders or missing a service finish with it running on, with plain carrier, *etc*. The possibilities are endless. It is rumoured in the WOF legends that ex-Ottringham, OSE5 staffer STE Tom Smart did a *quad shuffle* at WOF on one occasion, but not proven.

Of course, at the end of the fault, all this has to be switched back to return to the regular schedule… and in the correct order.

Aspidistra

From the end of WWII to 1984, the BBC had five HF sites in the UK: Daventry, Rampisham, Skelton, Woofferton and Crowborough. BBC staff operated the first four. Crowborough was operated by the Diplomatic Wireless Service, later the Communications Engineering Department (CED) of the FCO. It was known for many years under its wartime name of Aspidistra. The HF senders at Aspi were identified as A3 and A4 and were General Electric 100 kW sets. DWS/CED staff also operated the British East Mediterranean Relay Station, BEMRS at Zygi, Cyprus.

During the 1960s and 70s, it was not uncommon at Daventry for all the plant to be radiating most of the time and, as such, on-site local cover was not possible. Procedures were in place at all the HF stations about the course of action to cover a non-radiating service under shutdown. The STE would contact the Technical Operations Manager (TOM) in Bush House and ask for cover. Aspi was a popular choice as there was a good selection of arrays and often a spare, non-scheduled, sender for times during the day. As a lowly Technical Assistant on the control desk at Daventry, I well recall being across the phone line when the TOM was asking Aspi for cover. The staff member at Aspi said “Hold on Old Boy we’ll take a look and see what we can do” They were always very obliging! WOF was another choice, being dubbed by the Americans in the World Radio and TV Handbook as *The Voice of America Relay Station in the United Kingdom;* VoA transmissions ceased at 0730 or so resuming at 1400, so a good gap was available there for daytime cover. The VoA also ran few services at WOF from 2200 through to 0200/0300 so further cover opportunities presented themselves in that period.

The TOM and his staff had access to all the schedules, for all the sites as well as the array information. This was crucial in the decision-making process for reasons which will be explained now.

Antennas (1)

Many VMARS Members will be familiar with the old HF term of *Beam Stations,* as many of the GPO and Marconi sites in the 1920s were known by that name. The HF signal transmitted would be on a beam heading due to the directional antennas employed.

Table 2 is an extract from one produced for the Bush House Control Room that shows azimuthal bearings in European language areas from UK/Cyprus sites. It was vital that the TOM consulted this document prior to setting up cover at a different site to ensure that the beam heading was going to actually target the signal to the correct country.

Skelton, Woofferton and Rampisham are all about on the same line of Longitude so, if they were used to target countries south of the UK, then the antenna bearing required was about the same. Consider Portuguese from SK at 197°, from WOF at 201° and RMP at 203°. Daventry (DX) was 205°. Aspi (Crowborough), being the most easterly in the UK, was 210°. So, with beam widths of typically ±17°, it was important to ensure the correct heading was requested to ensure maximum signal in the target area.

For transmissions in an easterly direction, it is much more critical; none so much as for Poland with RMP and Aspi both beaming at 76°, WOF at 81°, DX at 82°, and SK at 91°. It was absolutely crucial here to specify the correct bearing to the cover station and not use the bearing of that on the schedule from the station that was shutdown. With the spread being 76° through 91°, that is 15°, the Polish language service could easily have ended up in Hungary or Czechoslovakia.

Language	Principal City	Daventry	Rampisham	Skelton	Woofferton	Crowborough	Cyprus
Italian	Rome	134	126	137	130	132	300
Polish	Warsaw	82	76	91	81	76	340
Portuguese	Lisbon	205	202	197	201	210	290
Russian	Baku (Azerb.)	89	86	92	88	86	60

Table 2. A selection of azimuthal bearings in European language areas from UK/Cyprus sites

Luckily for the TOM, cover for European services was possible from Cyprus and beam headings were provided also.

As Dave Gallop G3LXQ said last time in ToTT, synchronised transmissions were employed using a single frequency, some examples being 9410, 12095 and 15070 kHz for BBC English World Service where the UK sites would send the same programme on up to three different bearings, say 80°, 130° and 170°. Any cover run here on an incorrect bearing could impact on another beam and cause self-inflicted QRM.

One other point the TOM had to consider was that of take-off angle**. Table 1** illustrates this point. Consider a couple of the WOF 11 MHz suite of arrays, A906 and A954. Array 906 is classed as a HRRS 4/4/1 and A954 as HRS 4/4/.5. Ignoring at present all except the last number, this represents A906's lowest dipole at one wavelength above the ground with that of A954's being 0.5, *i.e*., half a wavelength above the ground. This height affects the take-off angle and, as such, the coverage. Best DX is afforded by a seven degree take-off angle as from one wavelength above the ground with half a wavelength producing typically nine degrees.

These decisions, often made under pressure with the seconds of shutdown programme ticking by, were critical to the apparent seamless running of an international broadcast service.

Not only were transmitter site staff always grateful for the Bush House Ops team's efforts but they also realised that the Bush Control Room staff often had to switch the correct programme to the cover site as that supplied to the site that was shut down.

It was appreciated by Bush if as much notice as possible was given particularly if the site staff knew that, say following maintenance that had over-run, they were not going to make the start of service time.

Dave G3LXQ, in the last ToTT, also alluded to *planned cover* where the scheduling office would arrange cover for predetermined outages but, as can be seen from the above, only the urgent, operational, almost out of hours events have been described. However, the same rules applied.

Where the necessity of cover, which may be started over a weekend, extended into the following week, it was not unusual to see an official service message be issued on the Monday from the Schedule Unit (SU) to formalise the arrangements. Sometimes the previous covers would be changed as the SU would see a better, maybe more elegant, way of managing the outages.

The spring and autumn equinox periods would often call for cover due to the unpredictable winds, characteristic of that time of the year. RMP would sometimes be the first site to suffer antenna damage, being head-on to south westerly gales, closely followed by DX in its exposed position on Borough Hill at 600' asl. In those situations, it mostly fell on WOF and SK to take the hit for cover.

Regrettably, with the main transmission schedules also changing at those equinox periods, it could be a fairly stressful time on the sites with emergency cover just for the last couple of days of the old schedule.

With the closure of Aspi in 1984, that site was lost for cover followed by Daventry in 1992. During the modernisation of Rampisham from 1986 to 1988, much cover was run as their ten new 500 kW senders and many antennas, let's say … er… *bedded in!*

Now with the closure of Rampisham in 2011 and the recently announced closure of BEMRS Cyprus, opportunities for cover are much reduced for the UK's remaining SK and WOF sites. With the modernisation of the control system at WOF in 2009, trifurcation is no longer an issue as arrays can now have as many as ten senders available to them provided RF matrix switches are fitted. This eases the situation for on-site cover.

In addition, the new WOF control system is able to facilitate its own cover automatically, allowing the site to be staffed only from 0800 to 1800 daily. Whether it will try for a quad shuffle remains to be seen.

Antennas (2)

A little has been written in this ToTT about antenna parameters and, by way of introduction to the next ToTT in which the full story will be documented, here is a guide as to what to expect…

Since the start of HF broadcasting at Daventry in 1933, the design of the antennas has evolved to the almost standard designs used around the world.

Originally, and up to about the late 1950s, single-band antennas were the norm. Usually they were built with two curtains of horizontal dipoles; one curtain was driven and the other was the reflector. By switching, the reflector curtain could be energised, with what was originally the driven curtain now being the reflector to permit reverse bearings to be used. The classic use of the reflector technique was at Daventry for European coverage on 79° and Central/Southern America on 259°.

Also, they could incorporate more switching to allow slews of the beam from the natural, *bore-sight*, condition by up to ±12°. And, of course, the height above ground of the lowest dipole could be adjusted during the array build to specify the take off angle for long-range (DX) or short-hop services.

By the 1960s, the designs had been amended to make a dual-band array and, typically, 6 and 7 MHz combinations were popular, no doubt because of the Cold War, with the need to use these popular bands in the evening for single-hop services into the USSR and Warsaw Pact countries from the Western nations.

With the advent of computer-aided design technology in the 1980s, four-band designs became available. In **Table 1**, reference to A951, 953 and 954 shows them to be four-band designs with slews available of up to ± 30°; these are TeleCommunications International (TCI) 611 types from the USA

Referring again to **Table 1**, A929 and A930 illustrate Thomson arrays dating from 2009 that can accommodate five bands and multiple slews of five different bearings.

Next time

Archive photographs and up-to-date prediction patterns will be presented to complement the start of the antenna design explanations.