

Tricks of the Trade

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By 25th September 1965, Radio 390 was on the air and 31st December 2015 marks the fiftieth anniversary of the start of the offshore station Radio Scotland. The only remaining station to launch with RCA 10 kW Ampliphase transmitters was Radio 270 from 4th June 1966, on-air some three months later than originally planned.

Member's contribution

After reading the last three ToTT, VMARS Member Tony Rock G3KTR/AD1X contacted the author (DP) with the following information on the 1965 build of Radio Scotland.

Tony writes; I read with interest the article you and Alan put together on Ampliphase transmitters. In the mid-1960s I was working out of the RCA Broadcast & Communications Division at Sunbury-on-Thames. At this time RCA had sold several transmitters to offshore 'pirate' radio stations. While Marconi and other European companies could be subjected to sanctions by the Government RCA, being an American company, was immune to this type of pressure.

Having participated in the installation of Radio Scotland's transmitters and the combiner on the old Comet Lightship in Guernsey CI, I recall that Tony Utendale spent the whole night before the mast was to be put in place, setting up the combiner with a signal generator and impedance bridge. The next morning, for the first time, a shipwright became involved in the project. The mast had been lying on the dock waiting to be lifted. He quickly determined that with the mast of that size (c.180 foot) in place, the old ship would spend much of its time on its beam ends and would require a further thirty tons of ballast in the bilges to counteract this. The additional ballast would give the old girl a calm weather freeboard of about six inches. Thus fifty feet was taken off the mast and all Tony's work had to be repeated the following night.

However, fifty years ago there was one other project that was still in the build stage and this was an ambitious twin station concept with a pair of Continental Electronics 317C Doherty 50 kW transmitters. The stations were to be called Swinging Radio England and Britain Radio. This was the 'all-American dream' and the launch was at a prestigious press conference at the London Hilton hotel on 20th April 1966. It was announced that transmissions were to be expected at the end of that month but, in fact, on-air tests did not happen until 3rd May 1966. The three men behind both stations were all former Radio London executives Don Pierson, William Vick and Tom Danaher who had parted company from Radio London after some fundamental boardroom differences early in 1965.

During 1965 in the United States, they (Pierson, Vick and Danaher) had obtained the ship, the M/V Olga Patricia (**Figure 1**) and commissioned Continental Electronics on a complete turn-key T-K project to install in separate pre-built containers, the transmitters, studios, generators and mast/antenna matching/combining systems. These were lowered into the ship's hold and connected up. It is

understood that, whilst CE was used to these T-K arrangements, mainly for Government contracts, the need to effect a quick turn-around with minimal delays was not quite their norm. With time slipping by, the decision was made to leave the USA without the systems being totally commissioned and to complete *en-route*. Also, during this trip, it was discovered that one of the planned operating frequencies, namely 650 kHz, was actually occupied in the UK by a certain high-power station on 647 kHz, the 150 kW BBC Third Programme. It was understood that an early 'recce' by the Americans to the UK to check for 'spare channels' resulted in a monitoring time when the Third Programme was not scheduled on air. They did not have much luck either with their other allocation of 850 kHz as that was not a recognised European channel and a late revision was made to 845 kHz. The CE317C tuned to 650 kHz was wavechanged to 1332 kHz.

Regrettably, the tubular mast collapsed on the outward journey and CE arranged for an appraisal in Puerto Rico and then to the Azores and later Lisbon where a new one was to be rigged. After a fortnight of delays, the ship sailed to its position off the coast at Harwich where the new mast parts from Dallas and West Germany were rigged at sea.

There was another delay after the test transmissions on 3rd May when the main HT transformer on one of the 317Cs failed and a pair of replacements had to be shipped from the USA. It was not until 16th June 1966 that both stations were on the air. Catastrophic failure of the Main HT transformer in early CE 317Cs was a known fact and a re-design by CE and the transformer manufacturer effected a complete cure. The UK DWS/FCO 317C at the BBC Central Africa Relay Station Francistown, Bechuanaland and later Orfordness, suffered the same fate as will be explained later.

The elegant 160 foot antenna mast on the M/V Olga Patricia supported a sausage-like multi-wire antenna with a bent-back top-loading section. Reports over the years detail that two separate antennas were used, one for each service, on the ship but careful observation of the available photographs and later knowledge appear to suggest that this single antenna was powered by duplexed RF on the two frequencies. If so, this was quite an achievement for the time. What is also evident is that the mast was most likely stayed by the then newly-introduced Parafil™ rope [1] as there are no ceramic stay insulators to be seen.

The above and the previous ToTT essentially cover the engineering and modulation systems on most of the 1960s offshore stations but, to ensure completeness, the authors have decided to include a *pot-pourri* of associated engineering stories.

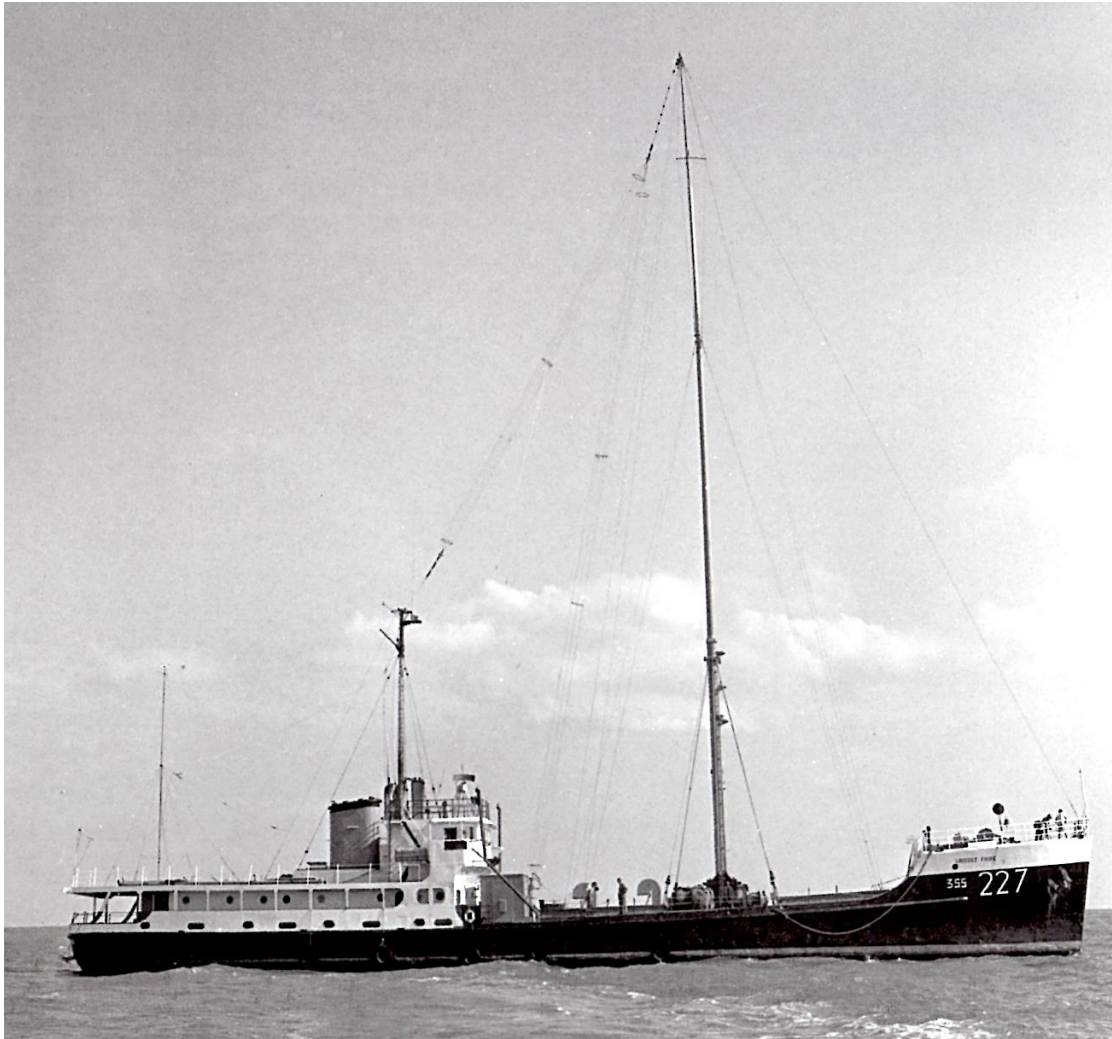


Figure 1. M/V Olga Patricia, the home of Swinging Radio England and Britain Radio

Radio City on 299 metres

Radio City, based on the Thames Estuary Shivering Sands Fort complex from September 1964, was the successor to the Radio Sutch enterprise from May 1964. Unlike the previous amateur-type operation with scaffold pole antennas and low power ex-beacon and communications transmitters, Radio City erected a 200 foot mast on top of one of the towers with the three insulated guys extending to the other towers. With a considerable degree of programme compression and limiting, a relatively clear channel on 1034 kHz, a good earth plane and, as they quoted, "The Tower of Power", the meagre 5 kW from the home-made plate-modulated transmitter punched above its weight and enabled the station management to quote an output power nearing 10 kW.

The author (DP) is obliged to fellow 1960s offshore radio enthusiast Stuart Craigan G4GTX of Sunderland for sight of correspondence he received some 40 years later from one of the transmitter engineers, Ian West G3SZC (now SK), on Radio City. There was second engineer on City, also licenced, Phil Perkins G3OUV.

Ian wrote as follows: **Figure 2** is a very rough approximation of how I remember the Radio City 5 kW TX. The pair of QY4-400s in the modulator and the pair of QY5-500s in the RF PA were mounted in pressurised

chassis enclosures driven by squirrel cage fans. There were chimneys around the valves and holes in the chassis to force the air between chimney and the glass envelope. The two high-voltage, 4 kV Mod and 5 kV RF, power supplies were full-wave bridge circuits and the valves were 866A mercury vapour jobs. A five minute delay was incorporated between the heaters being turned on and the HV AC being applied to the plates of the 866As. The ancillary 250 V, 350 V and 750 V power supplies were standard full-wave affairs using 5R4s and hefty ex-Admiralty transformers. The modulation transformer was about the size of a small fridge.

Looking at the rest of Ian's circuit, it can be seen that the crystal oscillator was a 6V6 with a tuned anode circuit driving into an 807 and thence into the grids of the paralleled QY5-500's. Ian did not detail any bias supplies or indeed a clamp valve. The output of the PA section was via a pi-network with a vacuum variable capacitor for PA Tune and then into length of coaxial cable to the L-Match ATU, again with a vacuum variable capacitor for tuning. The modulation chain (**Figure 3**) appears straightforward with an unbalanced input (they were lucky) into voltage amplifiers and a phase splitter stage. There appears to be no negative feedback chain which may explain why the overall sound of this service was somewhat concentrated in the middle register and not completely professional.

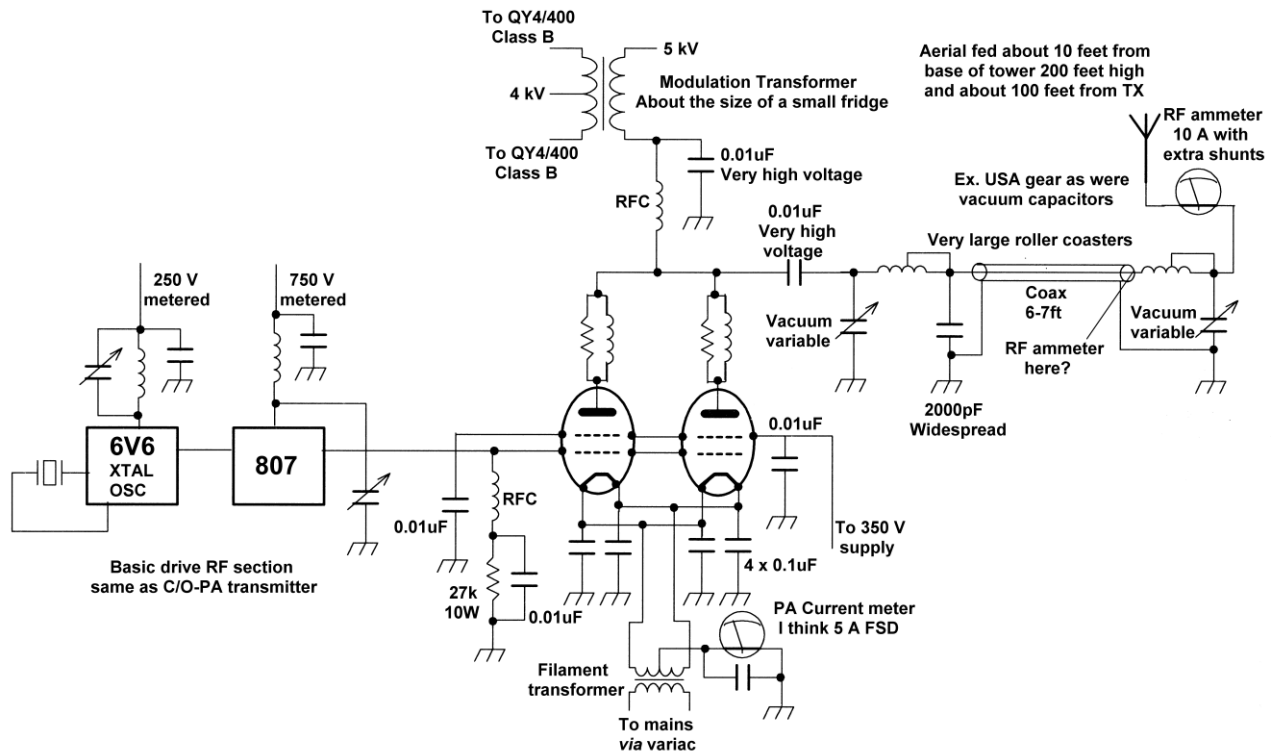


Figure 2. Schematic of the RF section of the 5 kW Radio City Transmitter

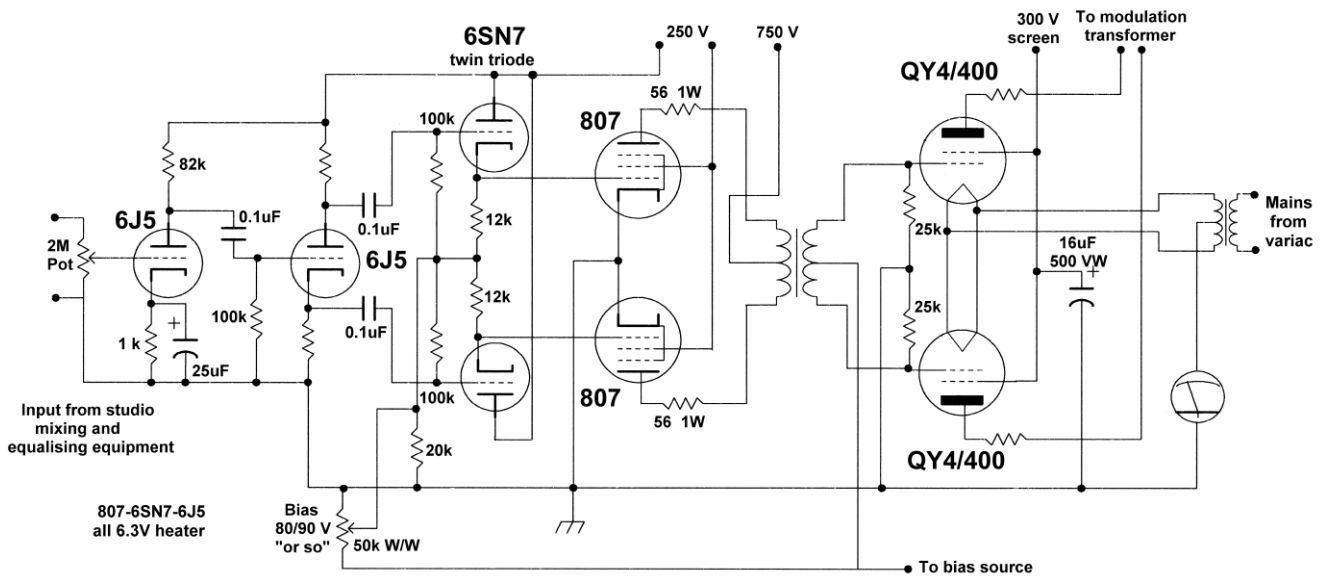


Figure 3. Schematic of the modulator of the 5 kW Radio City Transmitter

Other ships, other transmitters

The above heading is the title of a piece written in 2003 by G1BXG and is reproduced here with additional items and updates as discovered over the intervening time.

The Voice of America Floating Relay Station

The USCGC Courier 'Project Vagabond' was fitted out for use as a floating Voice of America (VoA) relay station in 1951. For all of its life it served in the Eastern Mediterranean, although it was originally conceived to be able to sail to world trouble-spots carrying its 'Cargo of Truth'. Some reports say it was possibly docked and

coupled into a land-based antenna system whilst others say it was moored off the coast of Rhodes in Greece. It carried a helium balloon to hold its own 0.625 inch diameter antenna wire if required – an idea unsuccessfully adopted by Laser 730/558 on the M/V Communicator 30 years later. As well as a water-cooled RCA BTA-150A 150 kW MW transmitter, it also had a pair of Collins 207-B1 shortwave transmitters and normally received SSB feeds *via* HF for rebroadcast. This seems to be the first publicised successful attempt at what we would recognise today as 'offshore radio', though the ship only broadcast from within territorial waters with the permission of the Government concerned. The signal was widely received

and was heard as far away as Australia. The ship was approximately 5000 tonnes and was reportedly manned by a crew of over 100.

RCA Transmitter imports into the UK

A surprising number of RCA transmitters were imported into the UK during the War years and used by both Government agencies and the BBC.

One of these was the 600 kW 'Aspidistra' transmitter at Crowborough in Sussex, in 1942 the largest MW broadcast transmitter in the world and codenamed from the Gracie Fields song "The Biggest Aspidistra in the World". It was operated initially by MI6/PWE, then by the Foreign Office.

A number of one-kilowatt BTA-1E transmitters were bought by the BBC and used to cover principal cities when all stations were aligned to the same channel as part of the 'Group H' project to prevent enemy bomber direction finding. After the War, many of these found use as relays for the new 'Third Programme' and, in the 1970s, some were used for BBC local radio. Several operated until the mid-1980s. A former Engineer-in-Charge at Woofferton, Peter Loveday, maintained these in his Mobile Team days and said of them "Ah yes the RCA-1E; a hot little thing!"

A very large number of RCA ET4336 HF communications transmitters were also procured, first for Government use but then many were sold as surplus, principally 'for export only', though at least 150 sets went to the BBC. These were modified with full bandwidth audio stages (based on a Leak TL-12/BBC LSM/8A loudspeaker amplifier) and, where necessary, wave-changed to MF and used for many applications such as fixed medium wave relays (some again for the Third Programme), trailer-mounted emergency facilities and even for early television facilities. One of the authors (DP) wrote up the saga in the March and April 2004 Radio Bygones Magazine and it was covered in the "On Air" book [2]. It was an ET4336 which was acquired by Radio Invicta on the Red Sands Fort and modified for MW broadcast use. The PA stage of the ET4336 consisted of a pair of 813s and the transmitter had the flexibility of being tunable over the range of 2–20 MHz. Versions were built with both VFO and crystal-controlled oscillators.

A number of 50 kW RCA BTA-50E plate modulated transmitters were imported, one going to Aspidistra and two were used later for the 247 m (1214 kHz) Light Programme 'fill ins' at Moorside Edge and Westerglen.

When built in 1943, the BBC Overseas Station Extension Number 10 (OSE 10) site at Woofferton in Shropshire was equipped with six 50 kW shortwave transmitters, RCA SW-50, also known as MI-7330. However, they did not immediately go into service as, upon their installation, the BBC was 'persuaded' to loan them to the Government and four were promptly removed and shipped to Crowborough where their high-voltage power supplies and RCA 880 water-cooled PA triodes were used to provide power for a broadband VHF jamming transmitter intended to block remote radio control of the then-new German V2 rockets. However, it later transpired that the rockets were not in fact radio controlled, unlike prototypes captured in Sweden and Poland, and the SW-50s were returned to Woofferton where they lived happily ever after until four were removed in 1963 and the final two in 1981.

Mr Wilson and his radio requests

Now here is an interesting story...it was late 1965. Caroline South was struggling against Radio London (Figure 4) whose lower frequency and more powerful transmitter were giving much better coverage and taking a large share of Caroline's audience. Plans were hatched for a revamp in format, a new frequency and a new 50 kW Doherty transmitter was ordered from Continental Electronics in Dallas.



Figure 4. The Radio London ship *MV Galaxy* in 1966. The ATU box and output termination are visible on the roof of the transmitter room

Meanwhile, thousands of miles away, Prime Minister Ian Smith of Rhodesia made a Unilateral Declaration of Independence (UDI) on 11th November 1965, withdrew from the Commonwealth and broke diplomatic relations with London. In the House of Commons, responding to MP's questions, Prime Minister Harold Wilson (who within two years had introduced the Marine etc. Broadcasting Offences Act) stated on 13th November 1965 that methods of improving BBC World Service coverage to Rhodesia were to be given the highest priority and that, if necessary, the Government would not hesitate in seeking advice from an organisation known as Radio Caroline.

Extra transmission facilities for the BBC were desperately required but, as Marconi in the UK had no suitable transmitters immediately available, the Government, under the direct orders of Mr Wilson, went abroad to see what could be bought. On the production line at CE in Dallas was a 317C, serial No. 12, as ordered by 'Project Atlanta', at that time the company which still operated Radio Caroline South. No. 13 was also in an advanced state of construction and, by whatever means, the London Government persuaded both Caroline and the other customer to delay their purchase.

These two transmitters were immediately shipped off to Bechuanaland (now Botswana) to broadcast the World Service into Rhodesia, No. 12 going into service on 30th December 1965. Caroline was then allocated transmitter

No. 14 and, presumably, the other customer received No. 15. Within two months of all this happening, the M/V Mi Amigo was washed up on the beach at Frinton and taken to Holland for repairs. She set sail as soon as the new transmitter arrived from the USA which was installed as the ship crossed the North Sea back to her East Coast anchorage.

Several years later, the two transmitters were no longer required for the BBC Central African Relay Station and were taken out of service. No. 13 was shipped to Cyprus where it formed part of a relay for the World Service and operated until c.1987 when it was sold. No. 12 (the one which should have gone on-board the Mi Amigo) was crated up and returned to the UK where it was installed at Crowborough, then the DWS site in Sussex responsible for BBC World Service broadcasts into Europe on Medium Wave where it acted as a standby for 'Aspidistra'. A co-located 10 kW Marconi short-wave transmitter remained in Bechuanaland and was donated to the local government there.

Fast forward five years or so...

In the Spring of 1970, Radio North Sea International was broadcasting from the M/V Mebo 2 off the UK's East Coast, much to the dislike of Harold Wilson's Government which, for the first time in history, decide to jam broadcasts of a station to prevent British listeners hearing its output. Initially, a low-power 2 kW jammer on 1612 kHz from a naval station at Rochester was used but this was soon replaced by a 10 kW caravan-mounted transmitter, borrowed from the BBC at Brookmans Park under the agreement that in no way was the BBC to be linked with its use. However, in the run-up to the June general election, the decision was made to use an even more powerful jamming transmitter. RNI now started identifying on-air as "Radio Caroline International" and adopting a pro-Conservative campaign and reminding the newly-registered-to-vote 18–21 year olds that it was Harold Wilson's Labour Government which closed the offshore stations three years earlier. Quietly and mysteriously, one Continental Electronics type 317C 50 kW transmitter, serial No. 12 was removed one night from Crowborough for top-secret purposes. All the evidence suggests that this was quickly installed at an old 'Chain Home' radar site at Canewdon in Essex, allegedly causing much local TV and radio interference and this transmitter was used to jam RNI during the election week. Following the election, with no immediate sign of the jamming ceasing, the M/V Mebo 2 weighed anchor and headed for Scheveningen in Holland and the jamming stopped. Equally mysteriously, after the cessation of the jamming, the missing transmitter 'magically' returned to Crowborough and resumed its former duties. In the late 1970s, No.12 was once again packed up and shipped, this time to the recently vacated US Over-the-Horizon (OTH) military radar site at Orfordness, off the Suffolk coast, which was previously codenamed "Cobra Mist". Test transmissions carried out from there on 648 kHz prove this site is much more effective at mainland European coverage than the existing site at Crowborough and, accordingly, plans were made to install a new high-power 600 kW AEG-Telefunken transmitter at Orfordness and the 1930s vintage 600 kW RCA transmitter, codenamed 'Aspidistra', originally used for propaganda broadcasts to Germany, made its last broadcast from Crowborough in September 1982 and was dismantled. The 317C remained as standby for much of

the 1980s until, in the aftermath of the October 1987 'hurricane' when much of the East Coast was without electricity, the CE-317C made a 'triumphant' return to the air. It ran from a skid-mounted Petbow generator set for four or five days while National Grid supply was restored to Orfordness – the generator being incapable of powering the main 600 kW set. As of 2003, the well-travelled 'with history' Continental Electronics 317C, serial No. 12, once destined for use on the Mi Amigo but diverted to Africa and later used to jam RNI, resides at Orfordness, a mere short nautical distance from the resting place of the Mi Amigo. It has since been scrapped.

As a postscript to his earlier contribution, Tony Rock G3KTR/AD1X added the following piece about the RCA 100 kW HF senders in the previous ToTT [3]. *I spent the next 26 months doing modifications to a pair of BHF100 short-wave Ampliphase transmitters in Pakistan. The BHF100 transmitter was a complete fiasco for RCA and resulted in the company leaving the short-wave market altogether. To begin with, the transmitter was sold off the drawing board before a fully working prototype had been built. One was sold to Vatican Radio, one to Bangkok, two to Pakistan and I believe that four went to Nigeria. All were to be installed by the customers and would be checked out by an RCA engineer when the installation was completed. Vatican Radio was the only customer with sufficient engineering expertise to complete the installation and their transmitter became, in essence, the first working prototype. A further transmitter was built at the RCA facility at Meadowlands PA as a test bed for modifications and it is believed that this eventually finished up in South America to be operated by a religious organization. During my time in Pakistan, along with a senior RCA engineer, I installed 47 major modifications on the two transmitters, finally signing them off in May 1967.*

In retrospect, it would seem that the fixed frequency MW Ampliphase transmitters, once correctly set up, were relatively stable. The short-wave transmitters, however, had to be frequency agile and setting the correct phase angle was a constant nightmare for the unfortunate transmitter staff. Fortunately, for the remainder of my employment with RCA, I was working on television transmitters and TV studio equipment.

Conclusion

With Radio 270, Radio England and Britain Radio stations coming on air in mid-1966, we have reached the point of the maximum number of the first tranche of UK offshore stations. The various modulation types and systems have been covered and this will lead neatly on to the development of more AM systems during the 1970s and beyond. Here operating efficiency and power consumption were the main instigators of change. These will be started upon next time.

Reference

1. <http://www.geofabrics.co.nz/products/tendons-and-strapping/parafil/>.
2. N Shacklady and M Ellen. On Air: A History of BBC Transmission. Orpington, Kent: Wavechange Books 2003. ISBN: 0-9544077-1-7.
3. D Porter G4OYX and A Beech G1BXG. Tricks of the Trade. *Signal* 2015, 36 (August), 24–30.