A COBRA MIST GALLERY

[D. J. Emery, January 2022]

The Cobra Mist Over-the-Horizon radar system employed an extremely ambitious antenna design – one that on completion covered an area of some 140 acres. Although essentially just an array of 18 log-periodic dipole antennas (both vertically and horizontally polarised), these were arranged in a fan shape, spaced radially 7° apart. To look in a particular direction a sub-set of six adjacent antenna strings was selected and phased appropriately.

Since at any particular operating frequency each log-periodic string was resonant only for two or three of the many dipoles present, the active part of the string would move closer or further from the hub of the fan array as the frequency was increased or decreased respectively. In this way the effective aperture was kept roughly constant, making the beamwidth independent of frequency. In addition the fan shape allowed a wider overall coverage sector (more than 90°) to be provided than would have been possible with a more conventional linear array.

An article[1] describing the manufacture and structural design (but not the electrical performance) of the antenna appeared in the open literature at the time of its completion, though of course Cobra Mist was not directly mentioned. A staggering amount of material was used in its construction, with more than 12,000 dipole arms (these formed the active part of each antenna string) and more than 32,000 individual fibre-glass rods for the suspension system being used. The total length of fibre-glass rods used exceeded 235 miles. There were 171 asbestos cement pipe towers to mount the antenna suspension system, and each of the 18 strings started at its own 190' tall steel mast on the outer side of the fan.

The following photographs were taken during the construction of the antenna system and illustrate various elements of its design. They are reproduced here by kind permission of the photographers and copyright holders (Frank Bartram for photos 1 to 5, and Alexander MacLean courtesy of Yamini Maclean for photos 6 to 10).

Photo 1: A rigger working at the top of one of the asbestos pipe towers. On the right hand side the horizontal dipoles along a particular antenna string are visible, with a neat circular feed arrangement from the central open transmission lines. At the end of each dipole arm the anti-corona devices ("slinky-spring" rings) are visible (also see Photo 9).

On the left-hand side both the horizontal and vertical dipoles of an adjacent string are visible.

1 "World's Largest Log-Periodic Antenna", Yen. H. Dong, Journal of the Structural Division, Proceedings of the American Society of Civil Engineers, September 1971. I am grateful to Len Thomas for alerting me to the existence of this paper.

Photo 2: A close-up of a rigger showing four dipoles (both horizontal and vertical arms visible), the central open transmission lines (which feed the dipoles) and the attendant suspension system.

The rigger's left arm is above an additional support ring for the transmission lines.

Photo 3: A general view of the antenna array looking out to sea.

Some idea of the scale of the endeavour can be obtained from the vehicles in the middle distance.

Photo 4: Taken near the focal point of the array, almost three complete antenna strings are visible in the background on the left hand side of this photo. Bottom left the feeder lines are emerging from the roof of the underground switching vault.

The switching vault was used to select the appropriate six antenna strings (and their polarisation).

Photo 5: Also taken near the focal point of the array, five rows of asbestos concrete towers stretch into the distance in this photo. In the foreground are the balun transformer feeder lines.

Photo 6: A view along a single antenna string looking outwards (see the steel lattice mast at the end).

Final tensioning has yet to be performed, explaining the undulating antenna centres.

Photo 7: A general view of the array, taken from the west. Two of the 190’ steel lattice towers are in the foreground.

Photo 8: Detail of the transmission lines and circular feeders to the dipole arms.

In order for a log-periodic antenna to work properly, adjacent elements must be fed in opposite phase.

This is why the curved sections within the central ring alternate in design from one element to the next.

Photo 9: Detail of a short (higher frequency) dipole fitted with anti-corona discharge devices ("slinky-spring" rings).

At very high transmit powers, antennas can sometimes suffer from coronal discharge, significantly impacting their performance.

The two pairs of almost horizontal aluminium tubes were used as open transmission line feeders for the dipole elements (one pair being used for the horizontal dipoles and the other pair for the vertical dipoles).

Photo 10: Accidents were almost inevitable on a construction of this scale, and this photo shows a toppled crane near one of the concrete pipe towers.

In 1971 there was also a fire in one of the contractor's cabins, and in September of the same year an upper catenary fibre-glass support rod failed, necessitating repair work.

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