

## RECOMMENDATION ITU-R BS.139-3\*

**Transmitting antennas for sound broadcasting  
in the Tropical Zone**

(1953-1978-1986-1990)

The ITU Radiocommunication Assembly,

*considering*

- a) that it is desirable to use transmitting antennas for sound broadcasting in the Tropical Zone that cause a minimum of interference outside the service area;
- b) that the antennas should be economical in design and simple in operation;
- c) that Annex 1 to this Recommendation gives the principles on which antennas for sound broadcasting in the Tropical Zone should be designed and constructed as well as a description of the antennas commonly used for sound broadcasting in the Tropical Zone,

*recommends*

- 1** that Administrations and organizations operating sound broadcasting services in the Tropical Zone should use antenna systems so designed that:
  - the power radiated is as large as possible at the high angles of elevation required to meet the needs of the service area,
  - a sufficient value of radiation is maintained at angles of elevation necessary to serve the fringe of the service area,
  - the power radiated at angles of elevation lower than those used to serve the fringe of the service area is as low as possible;
- 2** that Administrations provide to the ITU-R practical operational data concerning these antennas.

## ANNEX 1

**1 Selection of site**

The transmitting antenna should be situated as near to the centre of the service area as possible. For antennas relying on ground reflection for their vertical directivity, the site should be chosen where the soil is of good conductivity. Where this is not possible, an earth mat can be used. This should consist of a number of paralleled wires spaced not more than one tenth of a wavelength apart, parallel to the dipoles and extending for half a wavelength beyond the extremities of the antenna array.

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\* Radiocommunication Study Group 6 made editorial amendments to this Recommendation in 2002 in accordance with Resolution ITU-R 44.

When it is not possible to locate the antenna at the centre of the service area, the beam should be suitably slewed using multi-element transmitting antenna to cover the desired service area. Angles of slew greater than about  $15^\circ$  often produce large side-lobes which may cause interference outside the reception area.

If there are no adjacent reception areas, for example, where the area to be served is an isolated island, a central location is less important.

## 2 Slewing

If it is desired to site a station away from the centre of the service area, the direction of the vertical beam can be slewed by dividing each row of dipoles of the array into two halves with currents in different phases. This method of slewing is most easily applicable to arrays of two or four dipoles per row.

## 3 Antennas for vertical incidence

The arrays commonly used by different organizations for the purpose of sound broadcasting in the Tropical Zone include the Trinidad antenna, the Jamaica antenna, the 16-element array, and a high incidence array consisting of four full-wave dipoles arranged in the form of a square.

The schematic and the radiation pattern of the Trinidad antenna are described in Figs. 20 and 21 of the publication *Broadcasting in band 7 (HF) in the Tropical Zone, ex-CCIR (1969)*.

The Jamaica antenna consists of four half-wave end-fed dipoles in the same horizontal plane. All the elements are  $0.2 \lambda$  above ground. This parameter is not critical. The elements are fed with currents in the same phase and magnitude. The Jamaica antenna, sometimes also designated as type TRO/ $n/h$  antenna has an azimuthal radiation pattern which is approximately omnidirectional. The radiation pattern for the TRO/2/0.2 type is given in Fig. 16 of the publication *Broadcasting in band 7 (HF) in the Tropical Zone, ex-CCIR (1969)*.

The schematic and the radiation pattern of the 16-element array are given in Fig. 17 of the publication *Broadcasting in band 7 (HF) in the Tropical Zone, ex-CCIR (1969)*.

Some organizations use a high incidence array which gives adequate high frequency coverage over a circular area of up to 1 000 km radius. The array consists of four full-wave dipoles arranged in the form of a square and fed in such a manner that the currents in any two adjoining elements are in phase and are of the same magnitude. The average height above ground is  $0.15 \lambda$  but this does not seem to be critical. The radiating elements are built up of a four-wire cage, resulting in an impedance of  $2200 \Omega$  each, which, when paralleled at the centre, gives a good match to a  $550 \Omega$  feeder. A quarter-wave matching stub is included in the design. The schematic of the antenna and its power distribution diagram are given in Figs. 18 and 19 of the publication *Broadcasting in band 7 (HF) in the Tropical Zone, ex-CCIR (1969)*. The gain of the array, relative to an isotropic radiator, is 8 dBi. At any angle of elevation below  $30^\circ$ , the radiation from the high incidence array is 16 dB below the maximum radiated by a dipole at that elevation. The high-angle radiation of the array is greater than that of a dipole in broad-side direction at angles of elevation between  $50^\circ$  and

75°, representing improved signal strength between 100 and 400 km. In the end-on direction at angles of elevation between 25° and 75°, improved signal strength is available between 100 and 1 000 km.

A simple two-tier dipole array, H 1/2, with a standard  $0.5 \lambda$  spacing may also be used with a view to giving adequate coverage up to 800 km. An H 1/2/0.5 antenna fed out-of-phase, gives an angle of fire of 41°. Field trials on an antenna system H 1/2/0.4 fed out-of-phase have shown that at distances below 600 km the field strength laid down by the antenna is higher than that from a single dipole. At distances above 600 km, the field strength laid down by the antenna is low compared to the dipole.

#### **4 General consideration in design of antenna**

While designing an antenna for night-time operation, the field due to higher order modes such as 2-F should be taken into account. During day-time, ionospheric absorption is considerable, resulting in propagation being limited to only 1 hop. The absorption also increases with the obliquity of the incidence and an antenna suitable for day-time should have maximum gain corresponding to the angle required at the fringe of the service area. At angles below this, there should be sharp cut-off. At night, however, multi-hop propagation is possible due to lower absorption. Fields due to 2-F mode should, therefore, be taken into account when designing such antenna systems.

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