Regional Administrative LF/MF Broadcasting Conference

REPORT OF THE FIRST SESSION

(Geneva, 1974)

General Secretariat
of the
International Telecommunication
Union
Geneva

FIRST SESSION OF THE REGIONAL ADMINISTRATIVE LF/MF BROADCASTING CONFERENCE

Geneva, 25 October 1974

The Chairman of the Second Session
of the Regional Administrative
LF/MF Broadcasting Conference

Sir,

Pursuant to Resolution D, adopted unanimously at the First Session of the Regional Administrative LF/MF Broadcasting Conference (Geneva, 1974), I have the honour to transmit to you herewith the Report of the First Session to the Second Session of the Conference.

F. LOCHER

Chairman of the First Session

Annex : as mentioned

Regional Administrative LF/MF

Broadcasting Conference

REPORT OF THE FIRST SESSION

(Geneva, 1974)

<u>Note by the General Secretariat</u>

Further to Resolution No. D adopted by the first session of the Regional Broadcasting Conference, this report is being sent to the Administrations of Regions 1 and 3 (two copies per Administration).

Additional copies will be provided upon request to the General Secretariat of the I.T.U.

The report will be supplemented by a booklet containing the C.C.I.R. texts which are of interest for the second session of the Conference.

The booklet is now being printed and will shortly be sent to Administrations.

M. MILI
Secretary-General

Geneva, 14 November 1974

TABLE OF CONTENTS

CHAPTER 1

DEFINITIONS

Necessary bandwidth

For a given class of emission, the necessary bandwidth is the minimum value of the occupied bandwidth sufficient to ensure the transmission of information with the quality required for the system employed, under specified conditions.

Channel (in AM broadcasting)

Part of the frequency spectrum, the width of which is equal to the necessary bandwidth of the broadcasting emission, and which is characterized by the nominal value of carrier frequency.

Channel spacing (in AM broadcasting)

The frequency difference between the nominal carrier frequencies of two succesive channels. This concept is of practical interest only if the difference is constant in a given frequency band.

Low-power channel (LPC)*)

Channel to be used by medium frequency broadcasting stations employing a maximum e.m.r.p. of 1 kW (c.m.f. of 300 V) and for which simplified planning and coordinating methods may be used.

*) These low-power channels are intended to replace the International Common Frequencies defined in the 1948 Copenhagen Plan and referred to in the African Plan, Geneva, 1966.

Audio-frequency signal-to-interference ratio

Ratio between the values of the voltage of the wanted signal and the voltage of the interference, measured under specified conditions, at the audio-frequency output of the receiver.

This ratio is generally expressed in dB, and corresponds closely to the difference in volume of sound (expressed in dB) between the wanted programme and the interference.

Audio-frequency protection ratio

Agreed minimum value of the audio-frequency signal-to-interference ratio considered necessary to achieve a subjectively defined reception quality.

This ratio may have different values according to the type of service desired.

Radio-frequency wanted-to-interfering signal ratio

Ratio between the values of the radio-frequency voltage of the wanted signal and the interfering signal, measured at the input of the receiver under specified conditions.

This ratio is generally expressed in dB.

For example, in the case of wanted and interfering transmissions of the classical type (full carrier with double sideband), the chosen values will be the effective radio-frequency voltages that correspond to the wanted and interfering carriers.

Radio-frequency protection ratio

Value of the radio-frequency wanted-to-interfering signal ratio that enables, under specified conditions, the audio-frequency protection ratio to be obtained at the output of a receiver.

These specified conditions include such diverse parameters as spacing Δf of the wanted and interfering carrier, emission characteristics (type of modulation, modulation depth, etc.), receiver input and output levels as well as the receiver characteristics (selectivity and susceptibility to cross-modulation, etc.).

Usable field strength (E_u)

The minimum value of the field strength necessary to permit satisfactory reception, under specified conditions, in the presence of natural noise, man-made noise and interference in a practical situation (or in one resulting from a frequency plan).

Where the wanted or unwanted signal is fluctuating, or both are fluctuating, the percentage of the time during which the value E_u is exceeded shall be specified.

Nominal usable field strength (E_{nom})

The agreed minimum value of the field strength necessary to permit satisfactory reception, under specified conditions, in the presence of natural noise, man-made noise and interference from other transmitters.

Where the wanted or unwanted signal is fluctuating, or both are fluctuating, the percentage of the time during which the value of E_{nom} is exceeded shall be specified.

The value of the nominal usable field strength is taken as a reference for planning purposes.

Service area (of a broadcasting transmitter)

The area in which the field strength of a transmitter is equal to or greater than the usable field strength.

Nominal service area (of a broadcasting transmitter)

The area within which the field strength of a transmitter is equal to or greater than the nominal usable field strength.

Cymomotive force (in a given direction) (c.m.f.)
(See Report 618 of the C.C.I.R.)

The product formed by multiplying the electric field-strength at a given point in space, due to a transmitting station, by the distance of the point from the antenna. This distance must be sufficient for the reactive components of the field to be negligible; moreover the finite conductivity of the ground is supposed to have no effect on propagation.

The cymomotive force (c.m.f.) is a vector; when necessary it may be expressed in terms of components along axes perpendicular to the direction of propagation.

The c.m.f. is expressed in volts; it corresponds numerically to the field strength in mV/m at a distance of 1 km.

Effective monopole radiated power (e.m.r.p.)
(See Report 618 of the C.C.I.R.)

The power supplied to an antenna, multiplied by its gain in a given direction, referred to that of a short vertical antenna in the horizontal direction.

Gain of an antenna (in a given direction) referred to a short vertical antenna

The radiation may be expressed either in effective monopole radiated power (e.m.r.p.) or in cymomotive force (c.m.f.); to define the gain of an antenna in a given direction referred to a short vertical antenna either of the two following definitions should be adopted :

- the ratio between the cymomotive force of the actual antenna in a given direction and the cymomotive force in the horizontal plane of a short vertical antenna without losses on a perfectly conducting plane, the two antennae being supplied with the same power;

- the ratio of the power required at the input of a short vertical antenna without losses situated on perfectly conducting horizontal plane to produce the reference effective monopole radiated power (e.m.r.p.) of 1 kW (cymomotive force of 300 V) in the horizontal direction, to the power supplied to the actual antenna to produce the same e.m.r.p. (c.m.f.) in the given direction.

The ratio, expressed in dB, is the same for the two definitions.

Synchronized network

A group of transmitters whose carrier frequencies are identical or differ only slightly, usually by a fraction of a Hz, and which broadcast the same programme.

CHAPTER 2

PROPAGATION

2.1 Ground-wave propagation

2.1.1 The curves of C.C.I.R. Recommendation 368-2 should be used to determine the ground-wave field strength.

In the case of a mixed path (i.e., with different values of ground conductivity), the method described in C.C.I.R. Recommendation 368-2 should be used*). Appendix A contains a simplified graphical procedure which enables a more rapid approximate calculation to be made.

2.1.2. In the absence of detailed information on ground conductivity or any other relevant information, (for example, the map included in the Final Acts of the African Broadcasting Conference, Geneva, 1966) the value of 10^{-2} S/m should be used.

C.C.I.R. Report 229-2 contains information on the electrical characteristics of the surface of the Earth and on their measurement.

2.2 Sky-wave propagation

Within Region 1 and for Australia and New Zealand**), the sky-wave propagation prediction method described in Appendix B should be used. In Region 1 the basic propagation formula is given by Equation (1) of that Appendix. In Australia and New Zealand the basic propagation formula is given by Equation (13) of the same Appendix. Some examples of the use of this method are given in the Annex to this Appendix.

Within the Asian part of Region 3**), the Cairo North-South curve, given in Appendix E, or a mathematical formula which gives the same result, should be used. No corrections should be made for sea gain. Polarization coupling loss should be calculated according to the method described in Appendix E.

*) A computer programme has been given to the I.F.R.B.

**) For sky-wave field strength prediction, the boundary between Australia and New Zealand, on the one hand, and the Asian part of Region 3, on the other hand, shall be described by geographic latitude 11° South.

For paths which pass from one region to another, the method used should be that which applies at the mid-point of the great-circle path.

Within the whole of Regions 1 and 3 the radiation in a given direction is expressed in dB with reference to 300 V cymomotive force or 1 kW e.m.r.p. The powers are expressed in dB relative to 1 kW.

2.3 Ionospheric cross-modulation*)

For planning no account should be taken of the influence of ionospheric cross-modulation.

*) Information on ionospheric cross-modulation is to be found in the C.C.I.R. texts, particularly in Recommendation 498 and Report 460.

CHAPTER 3

AMPLITUDE MODULATION BROADCASTING STANDARDS

3.1 Channel spacing and carrier frequency of each channel

See Resolution C.

3.2 Class of emission

The work of the Broadcasting Conference shall be based on a system with double sideband amplitude modulation with Full carrier.

3.3 Necessary bandwidth

For a broadcasting station, the Administration responsible for the transmitter should select a value within the range 9 kHz (audio-frequency bandwidth 4.5 kHz) to 20 kHz (audio-frequency bandwidth 10 kHz).

The necessary bandwidth of the emission is one of the parameters that influence the adjacent channel protection ratio as indicated by the curves of Appendix C. This is one of the parameters that may in certain cases be the subject of negotiations between the Administrations concerned in the second session of the Conference.

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

CHAPTER 4

TRANSMISSION CHARACTERISTICS

4.1 Power

The power of a transmitter shall be specified as carrier power in the absence of modulation.

C.C.I.R. Recommendation 326-1 gives useful information on the definition and the measurement of power.

4.2 Directional antennae

Present knowledge shows that there are no particular technical difficulties in constructing antennae with reduced radiation over a wide range of angles in the horizontal and vertical planes.

Thus it has been possible to obtain with a three-mast antenna a front-to-back ratio of over 25 dB over a conical sector, with a horizontal axis, subtending an angle of 80° in the horizontal plane and 40° in the vertical plane. For planning purposes, a maximum value of 20 dB would appear to be reasonable for radiation in the horizontal plane and 15 dB for radiation in the vertical plane, provided the antenna is situated on level ground. Administrations could, however, agree to other values of protection in special cases.

Present techniques also make it possible to obtain a variety of radiation diagrams for use in certain cases.

Antennae with low radiation at high elevation angles can also be built, which, for a ground-wave service at night, enable the area affected by fading to be farther away from the transmitter.

Notes : 1. Radiation in the horizontal plane concerns primarily the ground wave.

2. Radiation in the vertical plane concerns the sky wave.

4.3 Radiated power of transmitting stations

To express the radiated power of a transmitting station the two concepts of cymomotive force (c.m.f.) and effective monopole radiated power (e.m.r.p.), defined in Chapter 1, should be used together.

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

CHAPTER 5

RADIO-FREQUENCY PROTECTION RATIOS

5.1 Co-channel protection ratios

For planning purposes, the following values of the co-channel protection ratio should be used :

a) - 30 dB for a stable wanted signal interfered with by a stable or fluctuating signal,

- 27 dB for a fluctuating wanted signal interfered with by a stable or fluctuating signal.

b) However, upon agreement between the Administrations concerned, the following values may be used :

- up to 40 dB (when the conditions permit) for a stable wanted signal interfered with by a stable or fluctuating signal,
- up to 37 dB (when the conditions permit) for a fluctuating wanted signal interfered with by a stable or fluctuating signal.

These values apply to countries where MF is the principal means of providing a broadcasting service.

Note : In the case of fluctuating wanted or unwanted signals, the values of the co-channel protection ratio apply for at least 50% of the nights of the year at midnight.

5.2 Adjacent channel protection ratios

The curves in Appendix C enable the adjacent channel protection ratio to be determined. At the second session of the Conference planning should be based on curve A of this Appendix i.e. using an audio-frequency bandwidth of 10 kHz. On completion of the first draft of the Plan, curves B, C and D may be used, subject to agreement between the Administrations concerned.*)

*) The delegation of Australia stated that where Administrations considered it necessary to provide a high quality medium frequency broadcasting service, an appropriate value of adjacent channel relative protection ratio cannot be taken from the curves of Appendix C. A value of up to 0 dB may be adopted, following agreement between the Administrations concerned.

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

CHAPTER 6

MINIMUM VALUES OF FIELD STRENGTH

6.1 In order to reduce the number of variables, it was decided not to take account of man-made noise in evaluating the "minimum value of field strength".*)

6.2 Information on atmospheric noise available in C.C.I.R. Report 322 and values resulting from experience and measurements in the countries concerned were used as a basis for establishing "minimum values of field strength" for the three zones A, B and C in Regions 1 and 3.

6.2.1 The dividing line between zones A and B begins at the point of intersection of parallel 20°N with the western border of Region 1 (No. 126 of the Radio Regulations). Thence it follows the parallel 20°N up to the point of intersection with meridian 20°E; thence by great circle arc to the intersection of meridian 44°E with the Equator; thence it follows the Equator up to the intersection with meridian 80°E; thence by great circle arc to the point with coordinates 100°E, 20°N; thence it follows the parallel 20°N up to the point of intersection with the eastern border of Region 3 (No. 128 of the Radio Regulations).

6.2.2 The dividing line between zones B and C begins at the point of intersection of parallel 6°S with the western border of Region 1 (No. 126 of the Radio Regulations); thence it follows the parallel 6°S up to the point of intersection with meridian 20°E; thence by great circle arc to the point with coordinates 46°E, 26°S; thence by great circle arc up to the point with coordinates 80°E, 20°S; thence it follows the parallel 20°S up to the point of intersection with the eastern border of Region 3 (No. 128 of the Radio Regulations).

6.3 The limits of the three zones are given in the map which follows.

6.4 The following "minimum values of field strength" necessary to overcome natural noise (at 1 MHz) have been adopted :

Zone A : 60 dB/1μVm

Zone B : 70 dB/1μVm

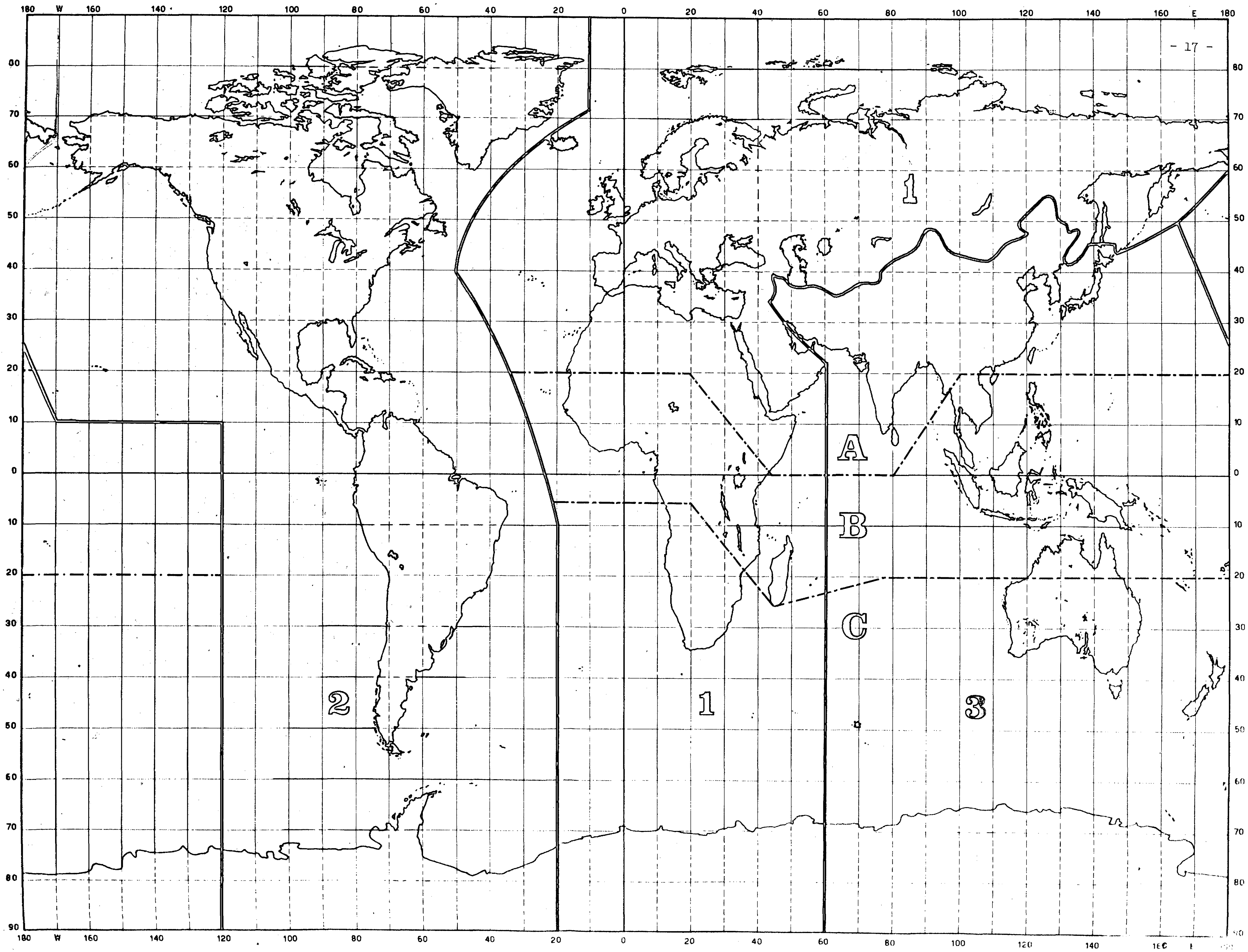
Zone C : 63 dB/1μVm

*) The "minimum value of field strength" corresponds to the minimum usable field strength defined in C.C.I.R. Recommendation 499, except that man-made noise has not been taken into account.

6.5 Frequency dependence of "minimum value of field strength"

The correction value Δa to be added to the "minimum value of field strength" to overcome natural noise for frequencies other than 1 MHz may be derived from the curve in Appendix D.*)

*) The delegations of Finland, France and Sweden consider that this curve is not valid for LF and that lower "minimum values of field strength" can be accepted.


1
1
2
3
A
B
C

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

CHAPTER 7

RECEIVERS

It is noted that by selecting integral multiples of the channel spacing for use as the intermediate frequency or frequencies of future receivers, some advantage may be gained by reducing interference generated internally in these receivers (see C.C.I.R. Report 458-1, item 3.2.4). Such an arrangement is of value only when the carrier frequencies are themselves integral multiples of their spacing.

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

CHAPTER 8

BANDS SHARED BETWEEN BROADCASTING SERVICE AND OTHER RADIOCOMMUNICATION SERVICES

8.1 The existing provisions relating to the conditions of sharing among services which are established by the texts in force should be kept in mind.

The various cases encountered are listed below.

8.1.1 150 - 160 kHz band (Region 1) : shared between the maritime mobile and broadcasting services :

- Nos. 174 and 175 of the Radio Regulations
- European Broadcasting Convention, Copenhagen, 1948 (Article 2, paragraph 2a; Article 6, paragraph 3a)
- Procedure of Article 9 of the Radio Regulations.

8.1.2 255 - 285 kHz band (Region 1) : shared among the maritime mobile, broadcasting and aeronautical radionavigation services :

- Nos. 174, 176 (alternative allocation), 177 and 178 of the Radio Regulations
- Document annexed to the Additional Protocol to the Final Acts of the International Radio Conference, Atlantic City, 1947, paragraph 7
- European Broadcasting Convention, Copenhagen, 1948 (Article 2, paragraph 2a; Article 6, paragraph 4(2))
- Service range of radiobeacons : Nos. 435, 436, 437 of the Radio Regulations
- Protection of radiobeacons against interference : Nos. 433 and 434 of the Radio Regulations (at least 10 dB).

  (Note : I.C.A.O. prescribes 15 dB in Annex 10 to the Chicago Convention)
- Procedure of Article 9 of the Radio Regulations.

8.1.3 525 - 535 kHz band (Region 3) : shared between the mobile and broadcasting services (broadcasting service is a permitted service) :

- No. 138 of the Radio Regulations for the broadcasting service
- Procedure of Article 9 of the Radio Regulations

8.2 In addition, the provisions of Nos. 116 and 117 of the Radio Regulations (protection of band-edges and coordination between Regions) are applicable.

8.3 Finally, at the second session of the Broadcasting Conference, which will be required to establish a Plan, the conditions for putting into use any new assignments in the shared bands will have to be laid down in the form of an appropriate coordination procedure (Article 9 of the Radio Regulations).

8.3.1 However, the present Conference has no powers to fix technical criteria concerning radiocommunication services other than the broadcasting service in the LF/MF bands for Regions 1 and 3.

8.4 The First Session of the Broadcasting Conference considers that, during the next revision of the Table of Frequency Allocations (at the World Administrative Radio Conference scheduled to be held in 1979), it would be desirable to avoid allocations which provide for sharing between broadcasting service and other services, such as the maritime mobile and aeronautical radionavigation services.

CHAPTER 9

METHODS OF PLANNING

9.1 Planning principles

The Regional Administrative LF/MF Broadcasting Conference will draw up a new LF/MF frequency assignment Plan in Regions 1 and 3.

The Plan will be drawn up in accordance with the principle that all countries, large and small, have equal rights. It should also be based on the needs of administrations and should bring about satisfactory reception conditions for all peoples, having regard to the different conditions of the countries in Regions 1 and 3 and, in particular, the needs of the developing countries.*)

The Plan will be drawn up having regard to ground-wave service areas and, in certain cases, of sky-wave service areas. The ground-wave may be used to cover large or small areas.

It is extremely desirable that the channel spacing should be uniform over the whole area covered by the Plan. (The ideal would obviously be for this principle to apply throughout the world.)

It is desirable that the nominal carrier frequencies be integral multiples of the channel spacing (see Resolution C).

In order to facilitate planning, it should be noted that in some cases directional transmitting antennae can be used.

The Plan should be drawn up without taking into account the directivity of receiving antennae.

*) The Administrations of Austria, Belgium, Vatican City, Denmark, Spain, Ireland, Italy, Norway, Netherlands, Sweden and Switzerland expressed a preference for basing this planning principle on a definition of a coverage unit.

9.2 Planning methods

The plan must be established in the spirit of the planning principles, but account should be taken of the following facts:

a) the available frequency spectrum is limited, as are the capital and human resources;

b) the problem of providing a fair and rational allocation of channels and adequate powers is particularly difficult in those regions of the world where there is a large number of countries or population groups in relatively close proximity.

A rational planning method is needed to maximize the number of programmes and the quality of coverage that is given to the radio broadcasting listener.

9.2.1 Basic considerations

When planning, it is necessary to observe the following basic considerations :

a) the use of identical carrier frequencies, with uniform channel spacing, throughout Regions 1 and 3;

b) the retention and, possibly, improvement of the coverage of the existing broadcasting stations to the maximum extent possible, having regard to the commitments of many countries;

c) the reduction to a minimum, of changes in existing frequencies;

d) the endeavour to meet to the maximum extent possible, the requirements of all administrations for the broadcasting services taking into account administrative subdivisions and the number of languages involved;

e) the technical parameters adopted by this session of the Conference for different broadcasting areas;

f) the taking into account of the specific needs of certain countries, in view of the insufficient availability of alternative means in other frequency bands (for example VHF-FM), noting that the LF/MF bands are particularly suitable as an economic medium for mass communication over large areas;

g) the setting aside of a certain number of low-power channels for exclusive use by stations using powers of 1 kW or less (Chapter 9.6).

9.2.2 Practical aspects of planning

a) A theoretical lattice for frequency channel distribution should assist in the basic planning approach adopted in certain very large areas;

b) however, in view of the existing broadcasting systems and their frequencies in use, some changes may, nevertheless, have to be introduced to modify the theoretical lattice distribution configuration. In areas at the limits of a theoretical lattice plan, simplified coordination procedures could be adopted, in the form of coordination distances and powers, within the limits of which additional transmitters would not significantly affect the service of planned stations;

c) when a draft plan is prepared, the existing frequencies in use in Region 3 shall first be aligned to the nearest multiple of the channel spacing;

d) the theoretical network should be supplemented with other transmitters having different technical parameters in order to provide the service required, as described in paragraph 9.2.1;

e) using the above method of frequency assignment, it is in the common interest that Administrations should exercise goodwill and mutual understanding in coordinating national requirements to obtain the best possible result.

The two planning methods mentioned above are described in general terms in Appendix G, and in detail in Annexes 1 and 2 to this Appendix.

9.3 Planning of the band 525-1 605 kHz

9.3.1 Planning criteria

Some delegations favoured the use of the sky-wave for night-time coverage, and, of these, some also thought that a certain number of channels should be reserved for this service so that the sky-wave fields might be suitably protected. Channels for sky-wave services should preferably be located in the higher part of the band; the lower part of the band should be used for ground-wave services as the lowest frequencies are most suitable for the coverage of very large areas by ground-wave.

Other delegations held the view that the band should not be split into sub-bands and felt that the whole band should be used both for the ground-wave and sky-wave services. These delegations considered that this would allow the possibility of planning in an optimum manner thus satisfying the needs of the various countries.

Both criteria for the planning of the MF band could be used by the Second Session of the Conference and coordination between countries using different criteria could take place at that time.

9.3.2 Nominal usable field strength

9.3.2.1 Sky-wave service

The sky-wave service is generally intended for rural areas where the man-made noise is low. The nominal usable field strength (E_{nom}) for the service provided by the sky-wave shall be E_m + 6 dB*). This value of E_{nom} is considered adequate and takes into account the fluctuation of the received signal.

9.3.2.2 Ground-wave service

In daytime, the service area will in general be limited by natural noise. Accordingly, under these conditions, the value of E_{nom} will be identical to that assigned to E_m. However, in the presence of interference by ground-wave due to other transmitters E_{nom} will be E_m + 3 dB. In the presence of severe man-made noise the value of E_{nom} could be higher.

At night, two cases can occur :

*) The values of E_m given in paragraphs 9.3 and 9.4 are those given in Chapter 6 for 1 MHz.

a) Where the ground-wave service area is not limited by the onset of fading caused by the sky-wave of the same transmitter, the nominal usable field strength is :

$$E_{nom} = E_m + X \text{ dB}$$

X = 11 dB for rural areas*)

X = 17 dB for urban areas

b) Where the transmitter power is sufficiently great for the ground-wave service area to be limited by fading due to the sky-wave of the same transmitter, the nominal usable field strength may be chosen to be greater than the value given above. It should not, however, be made greater than the ground-wave field strength at the beginning of the fading zone.

The usable field strength at the beginning of the fading zone is a function of the transmitter power, the antenna characteristics**) and the ground conductivity. The fading zone may be defined by taking the protection ratio between the ground-wave and the sky-wave to be equal to the internal protection ratio applicable to a synchronized network, i.e. 8 dB.

9.4 Planning of the band 150-285 kHz

9.4.1 Planning criteria

The LF band should be used for the coverage of extensive areas, mainly by ground-wave. Where used, its use should be planned jointly with the lower part of the MF band.

9.4.2 Nominal usable field strength

Assuming that the LF service is not affected by man-made noise and taking account of the correction factor Δa for natural noise at frequencies other than 1 MHz (paragraph 6.5 and Appendix D) :

$$E_{nom} = E_m + 17 \text{ dB}^{***)}$$

*) Some delegations considered a nominal usable field strength of 65 dB to be suitable for rural areas in their countries.

**) The use of an anti-fading antenna reduces the probability of occurrence of this case.

***) Certain delegations considered a value of E_{nom} of the order of 73 dB to be appropriate in non-tropical rural areas.

9.5 Synchronized Network

For the purposes of planning and for determining the probabilities of harmful interference, a network of synchronized transmitters may generally be represented by an equivalent single transmitter the characteristics of which are calculated according to the method described below*).

9.5.1 Calculation of interference in the case of a synchronized network

9.5.1.1 Interference caused by a synchronized network

In the simple but frequent case in which the transmitters of the synchronized network use omnidirectional antennae and in which the transmitters are sufficiently close together, the interference can be calculated by replacing the transmitters by an equivalent single transmitter. This transmitter will be located at the "centre of gravity" of the network. This centre is determined as that of various masses, the mass in this case being the square of the c.m.f. of each of the transmitters (or the e.m.r.p. of each transmitter). The radiation of this equivalent transmitter will be the sum of the radiations of each transmitter of the network (i.e. the sum of the squares of the c.m.f.'s or the arithmetical sum of the e.m.r.p.'s).

If the transmitters of the network are equipped with directional antennae, the same rules apply for the calculation of the interference in a given direction (that of the transmitter to be protected). In this case, the centre of gravity and the radiated power of the equivalent transmitter will depend on the direction considered. The calculation of the centre of gravity must be effected with the masses proportional to the radiated power of the transmitters in the direction considered. In the same way, the radiated power of the equivalent single transmitter will be determined by adding up the radiated powers of each transmitter in the direction considered.

*) More details can be found in C.C.I.R. Reports Nos. 459 and 616.

Let D be the distance between any transmitter of the network and any transmitter not belonging to the group and suffering interference, and D' the distance of the centre of gravity of the network from this transmitter. It is assumed that the previous method is acceptable only if :

$$|D - D'| \leq 0.15D$$ in the case of co-channel interference

$$|D - D'| \leq 0.25D$$ in the case of adjacent channel interference

If the conditions described above for the distances are not fulfilled, the general method will be applied, which consists of calculating the interference caused by each transmitter in the synchronized network and adding up the squares of the interference fields. This method is clearly valid in all cases, and can be applied systematically if the validity of the equivalent transmitter method is challenged.

The radio-frequency protection ratio to be applied for interference caused by a synchronized network suffered by the service of any other transmitter is the same as for a single transmitter.

9.5.1.2 Interference suffered by a transmission of a synchronized network

The interference suffered by a transmission belonging to a synchronized network may be due to :

- the other transmitters of the synchronized network (internal interference);
- other transmitters (external interference).

In the case of external interference, the radio-frequency protection ratio is considered to be the same as in the case of a single transmitter.

In the case of internal interference, the radio-frequency protection ratio is regarded as a problem specific to each country. However, in order to compare different frequency plans, it is necessary to calculate the coverage of the transmitters of a synchronized network. This coverage is determined in the same way as in the general case, namely by calculating for each transmitter the usable field strength by the formula :

$$E_u = \sqrt{\Sigma(a_e\ E_{be})^2 + \Sigma(a_i E_{bi})^2 + E_{min}^2}$$

where E_{be} and E_{bi} are the external and internal interference fields,

a_e and a_i are the corresponding protection ratios, and

E_{min} is the minimum usable field strength which is defined in Recommendation 499 of the C.C.I.R., and which at the same time takes into account natural and man-made noise.

This formula corresponds to that given in C.C.I.R. Recommendation 499.

In this calculation, the internal protection ratio a_i for planning purposes is taken as 8 dB.

9.5.2 Recommendation AA deals with the use of synchronized networks.

9.6 Low-power channels

9.6.1 Principles of planning

It is recommended :

- that simplified methods should be used for the preparation of the Plan and also for coordination of any subsequent additions or modifications;
- that low-power channels (LPCs) should not be adjacent to channels used by transmitters providing a service in the same area with low usable field strengths;
- that LPCs should be sufficiently separated from each other in frequency in order to allow simultaneous use in the same area;
- that LPCs should be reserved for transmitters which cannot form part of a synchronized network on another channel.

The value of the nominal usable field strength in low-power channels should be 88 dB(μV/m). However, the resultant field strength of a low-power transmitter network at the boundary of the territory of any other country should not exceed 0.5 mV/m except by agreement with the Administration concerned. In cases where countries are separated by sea water, the 0.5 mV/m field strength shall, in principle, not be exceeded at the mid-point of the over-water path, unless other agreement between the Administrations concerned is achieved.

Paragraph 9.6.2 shows the method of calculating this field strength.

9.6.2 Methods of planning low-power channels

9.6.2.1 Method of planning*)

The nominal usable field strength in these channels is limited to 88 dB(μV/m). To ensure that this value is not exceeded as a result of interference from transmitters in other countries, the transmitter network of each country should be so regulated that the resultant field strength at the border of any neighbouring country or at the mid-point of an over-water path does not exceed 0.5 mV/m in any LPC.

The resultant field strength in mV/m is calculated according to the formula $\sqrt{E_1^2 + E_2^2 + E_3^2 + \ldots}$, where E_1, E_2, E_3, ... are the values of field strength in mV/m due to each individual transmitter in a country operating in a given LPC. Only field strengths due to stations within 500 km of the border of a neighbouring country or at the mid-point of an over-water path will be included in the calculation.

*) It may be of assistance to Administrations when drawing up their requirements for LPC assignments to note that an approximate indication of their quota of assignments in these channels may be assessed on the basis of uniform power density. The total power used in a country of area A km^2 is then approximately A times 50 mW in any LPC. The exact total power will depend upon local conditions and will, in any case, be less if transmitters are concentrated near the borders with other countries.

These values of field strength E_1, E_2, E_3, etc. are to be calculated according to the curves shown in following figure, taking account of the radiated power of the transmitter and the distance from the border of the neighbouring country, or at the mid-point of an over-water path. These curves are for ground wave propagation and an e.m.r.p. of 1 kW (c.m.f. of 300 V) in the horizontal plane, and for a frequency of 1 MHz. Curves A and B are based upon a ground conductivity of 10 mS/m over land and 4 S/m over sea (which are normally used for planning purposes). Where the ground conductivity is known to be significantly greater than 10 mS/m, the Curve C (30 mS/m) should be used for calculation.

Curve D should be used for sky wave propagation; it has been assumed that the transmitting antenna is a short, vertical antenna.

9.6.2.2 Modification of the Plan*)

Subsequent to the Second Session of the Conference, certain administrations may require to modify or add to their requirements for LPCs. In these circumstances, administrations may make changes, coordinating only with those countries whose borders are within a certain distance of the new or modified station. This coordination distance depends upon the radiating characteristics of the new or modified station; it is shown in the table below.

This Table is based on the assumption that the addition of a further transmitter does not increase the nominal usable field strength due to the other transmitters in the same channel by more than 0.2 dB, taking into account both ground-wave and sky-wave propagation.

The simplified coordination should not be used for the addition of synchronized transmitters if the total equivalent power of the group exceeds 1 kW.

Where new requirements are such that the simplified coordination cannot be used, the normal coordination procedure will be applied.

*) This text should be added in the provisions for coordination procedures which will be adopted by the Second Session of the Conference.

TABLE

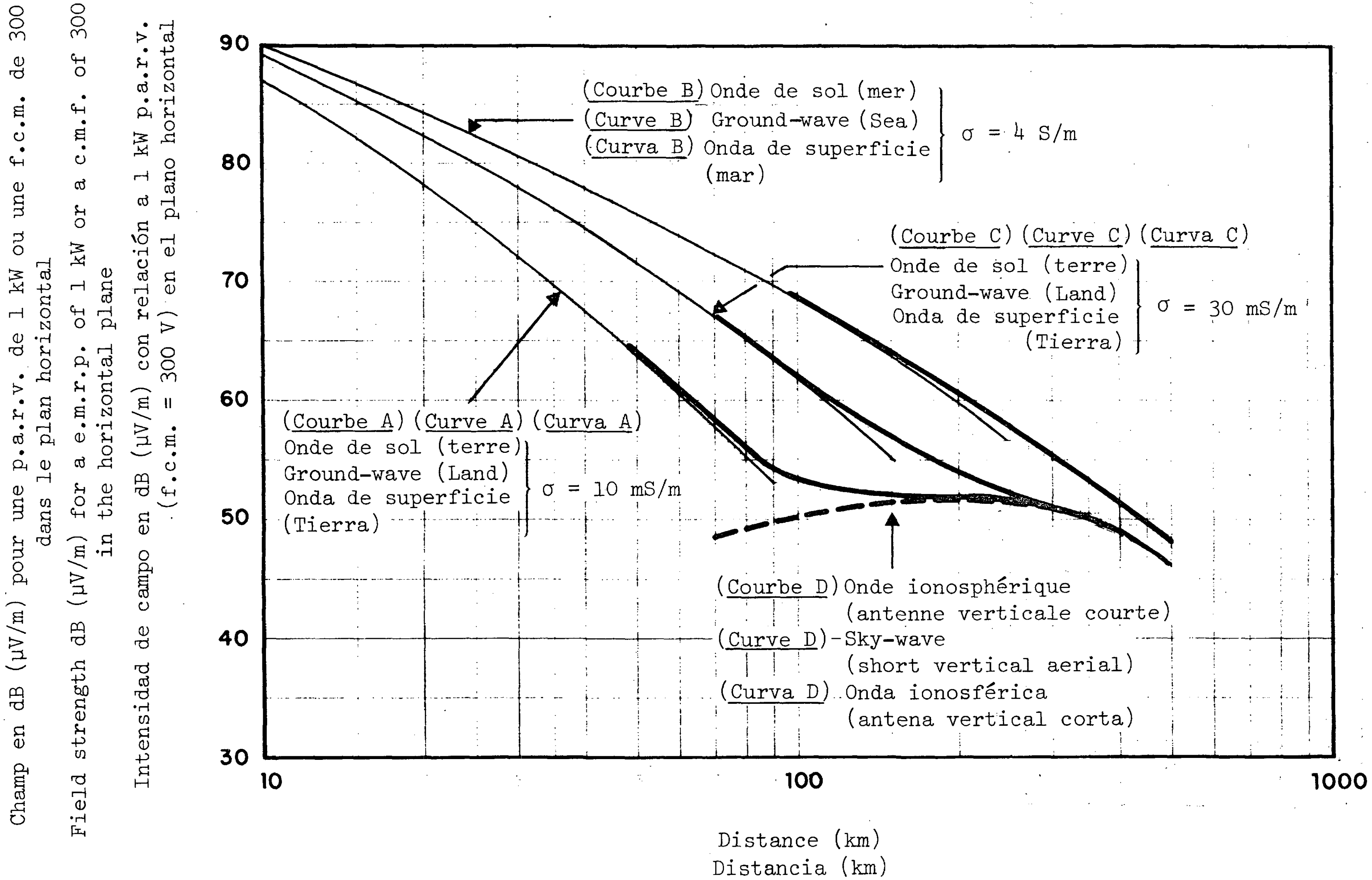
c.m.f. (V)	e.m.r.p. (kW)	Coordination distance (km)
300	1.0	700
260	0.75	500
212	0.5	400
150	0.25	200, 350*)
95	0.1	70, 250*)
67	0.05	50, 200*)

*) Values for a propagation path over sea.

Courbes pour la planification des canaux pour émetteurs de faible puissance (f = 1 MHz)

Curves for planning low-power channels (f = 1 MHz)

Curvas para la planificación de canales de baja potencia (f = 1 MHz)



CHAPTER 10

FORM OF SUBMISSION OF REQUIREMENTS

Frequency requirements must be submitted on the form shown in Appendix F.

The Annex to this Appendix contains detailed instructions concerning the manner in which the form should be completed.

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

APPENDIX A

A GRAPHICAL METHOD FOR ESTIMATION OF PROPAGATION OVER MIXED PATHS

C.C.I.R. Recommendation 368-3 contains a semi-empirical method to be used for the calculation of field-strengths over mixed paths (inhomogeneous smooth earth). This method is generally easy to use, particularly with the aid of a computer.

For planning purposes where the coverage of a certain transmitter has to be determined, a graphical procedure, based on the same method, might be convenient for a rapid estimation of the distance at which the ground-wave field-strength has a given value.

A short description of the graphical method is given here.

Figure 1 applies to a path having two sections, of lengths d_1 and d_2, with different electrical constants σ_1, ε_1 and σ_2, ε_2 respectively. In this example, the complex dielectric constant $\varepsilon(\sigma_1\ \varepsilon_1)$ is assumed to be greater than $\varepsilon(\sigma_2\ \varepsilon_2)$. For distances $d > d_1$, the field-strength curve obtained by the method described in C.C.I.R. Recommendation 368-2. lies between the curves corresponding to the two different electrical properties $E(\sigma_1\ \varepsilon_1)$ and $E(\sigma_2\ \varepsilon_2)$. At the distance 2 d_1 (where d_1 is the distance from the transmitter to the border separating the two sections), the curve is half-way between the curves $E(\sigma_1\ \varepsilon_1)$ and $E(\sigma_2\ \varepsilon_2)$, provided that the field-strength is plotted linearly in dB. In addition, this curve has an asymptote, which differs by m dB from the $E(\sigma_2\ \varepsilon_2)$ curve, as indicated in Figure 1, where m is half the difference in dB, at $d = d_1$, between the curves $E(\sigma_1\ \varepsilon_1)$ and $E(\sigma_2\ \varepsilon_2)$. It is easy to draw the resulting field-strength curve from the point through which it passes at $d = 2d_1$ and its asymptote.

Figure 2 shows the curve obtained for a two-section path with electrical constants now changing from σ_2, ε_2 to σ_1, ε_1, where the complex dielectric constant $\varepsilon(\sigma_1\ \varepsilon_1)$ is greater than $\varepsilon(\sigma_2\ \varepsilon_2)$, as above. The same procedure can be applied here, bearing in mind that the asymptote is now parallel to the $E(\sigma_1\ \varepsilon_1)$ curve.

For paths consisting of more than two sections, each change of constants is dealt with separately, in the same way as the first change. The resulting curve is continuous, each portion being displaced to correspond with the value at the end of the previous section.

Figure 3 indicates how the approximate graphical procedure can be used to determine the distance at which the field-strength is 1 mV/m for a transmitted power of 100 kW over a path having several sections with different values of conductivity.

By means of ground-wave propagation curves for the three different values of conductivity, where the field-strength is given in dB relative to 1 μV/m for a transmitted power of 1 kW, the graphical procedure is repeated for the various sections. The values 1 mV/m and 100 kW correspond to 40 dB relative to 1 μV/m and 1 kW, which gives a distance of 170 km in the example.

For the use of the graphical procedure, it would be convenient, on the same graph, to have ground-wave propagation curves for various electrical constants at each frequency concerned. Examples of such curves are given in Figures 4 and 5 for 200 and 700 kHz; the dashed curves each represent the arithmetic mean of the field strengths in dB (i.e. the geometric mean of the field strengths in absolute terms) corresponding to the two adjacent solid curves. Further sets of curves can easily be prepared for a number of frequencies by means of C.C.I.R. Recommendation 368-2.

The accuracy of this graphical procedure depends on the difference in slope of the propagation curves, and is therefore to an extent dependent on the frequency. For LF frequencies, the difference between the result obtained by the method described in C.C.I.R. Recommendation 368-2 and that obtained by the approximate procedure is normally minimal, but for the highest MF frequencies there may be a difference of up to 3 dB for many paths.

Figure 6 of this Appendix is a comparison between results obtained by computer using the procedure described in C.C.I.R. Recommendation 368-2 and those obtained by the approximate graphical procedure.

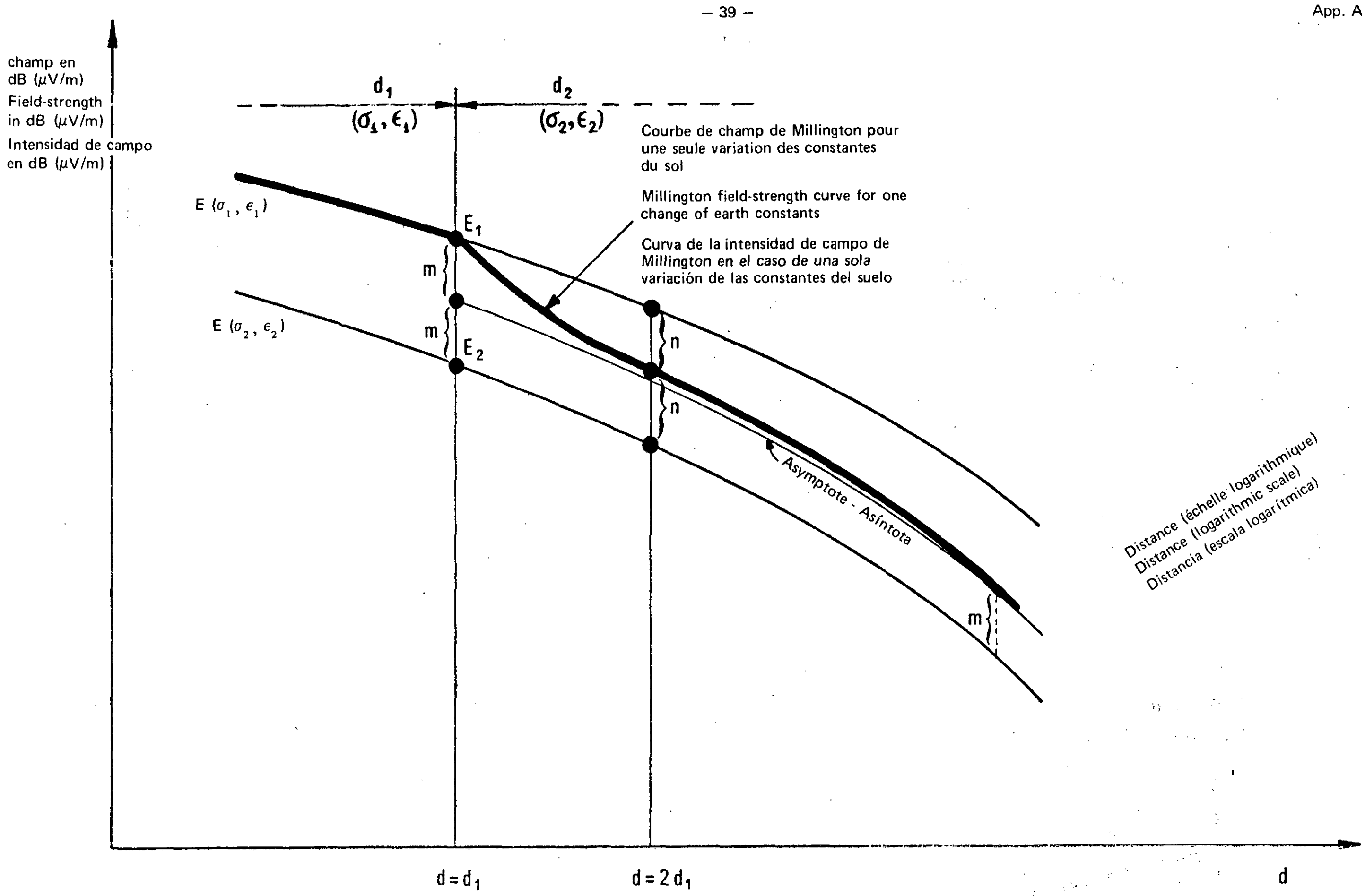


FIGURE 1 – FIGURA 1

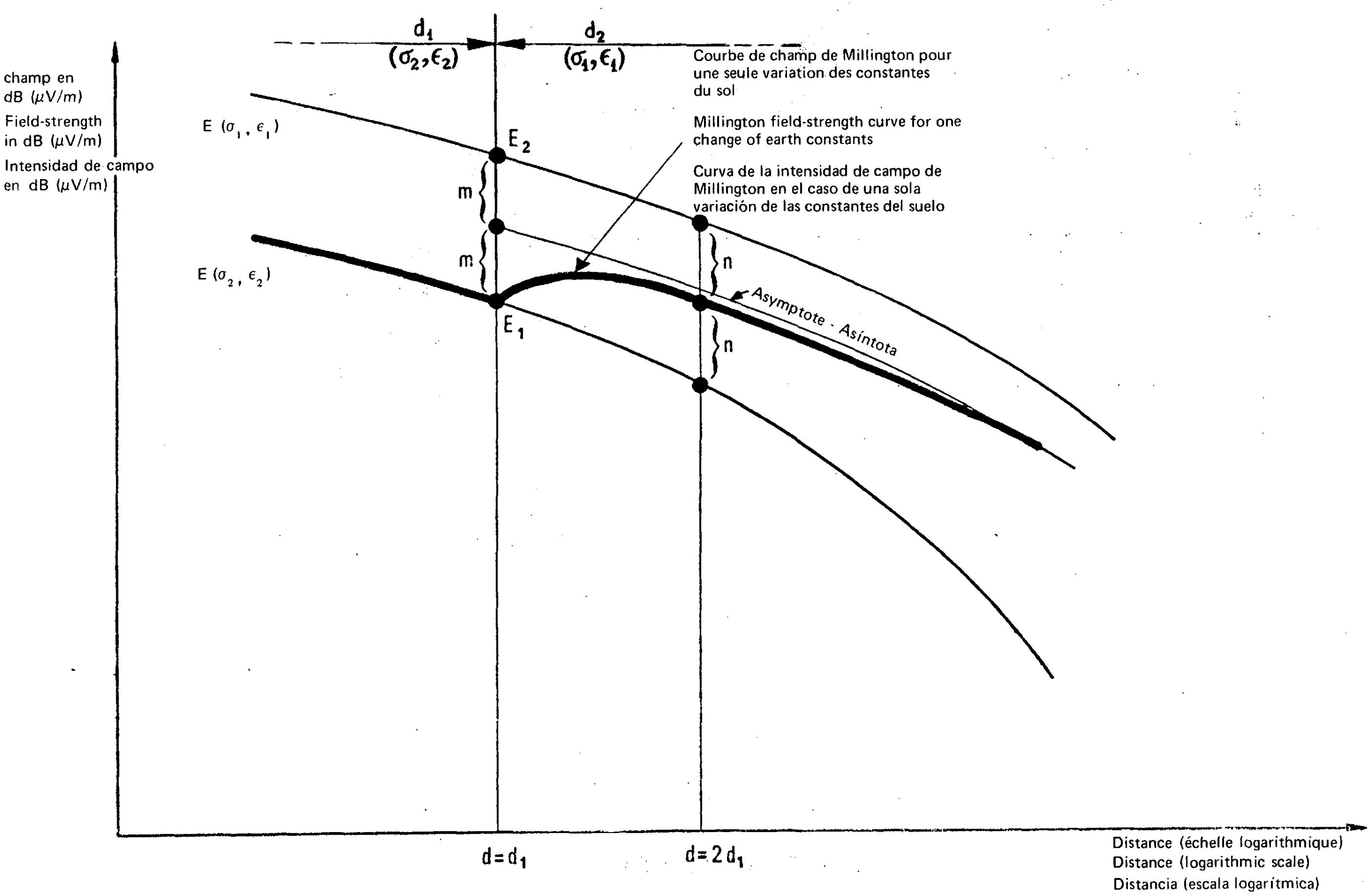
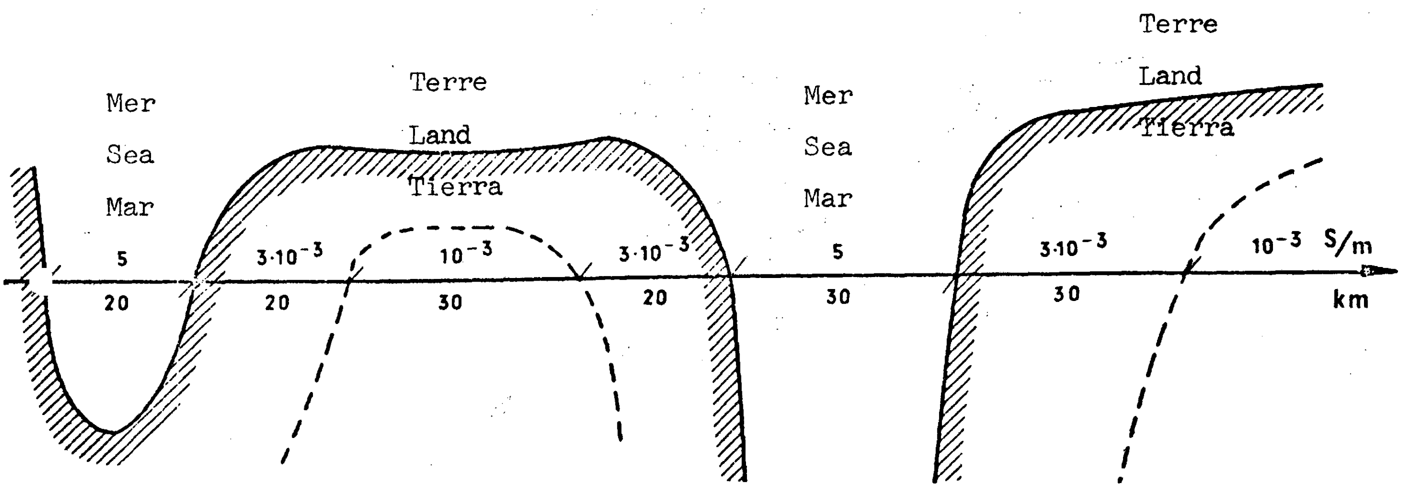
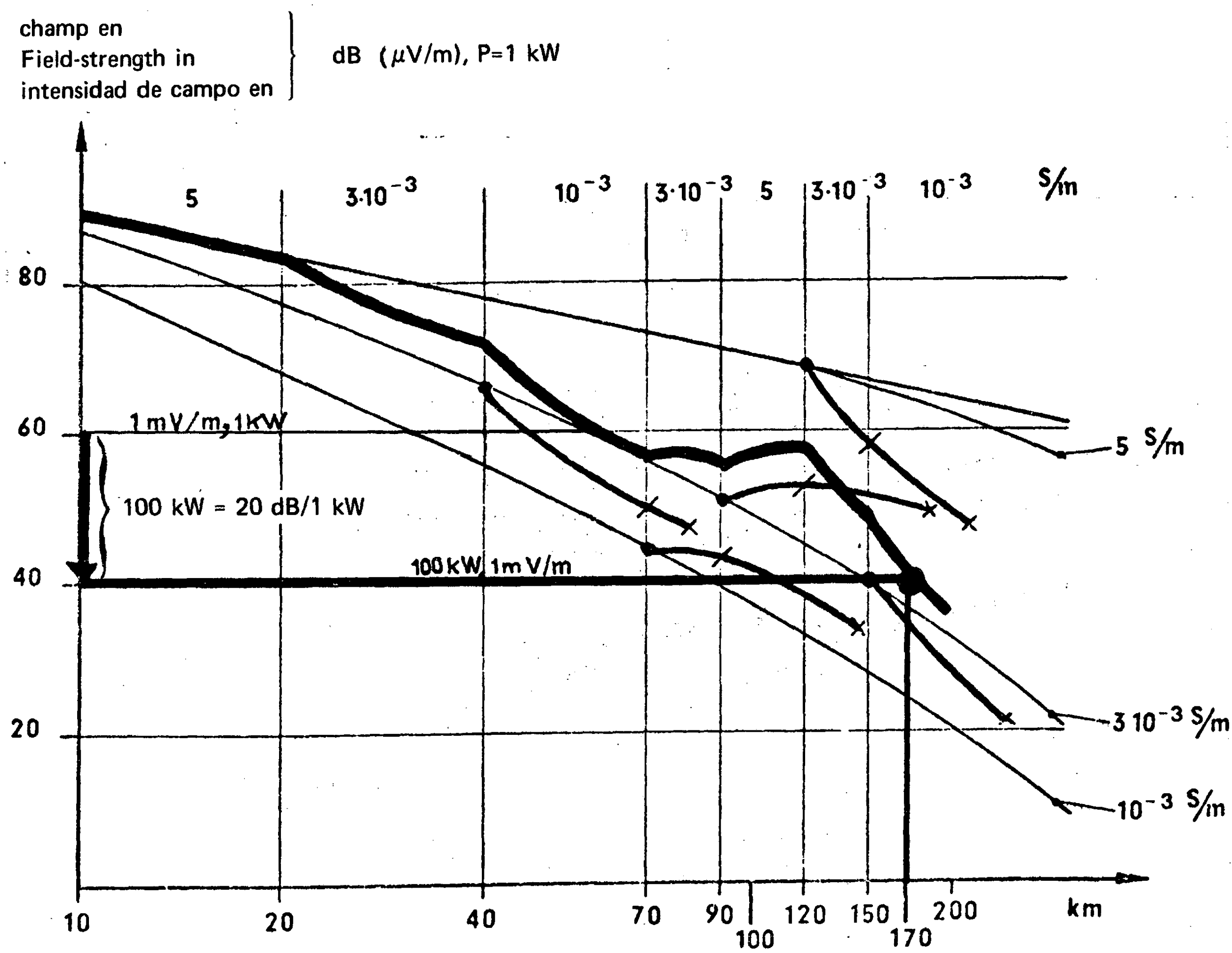


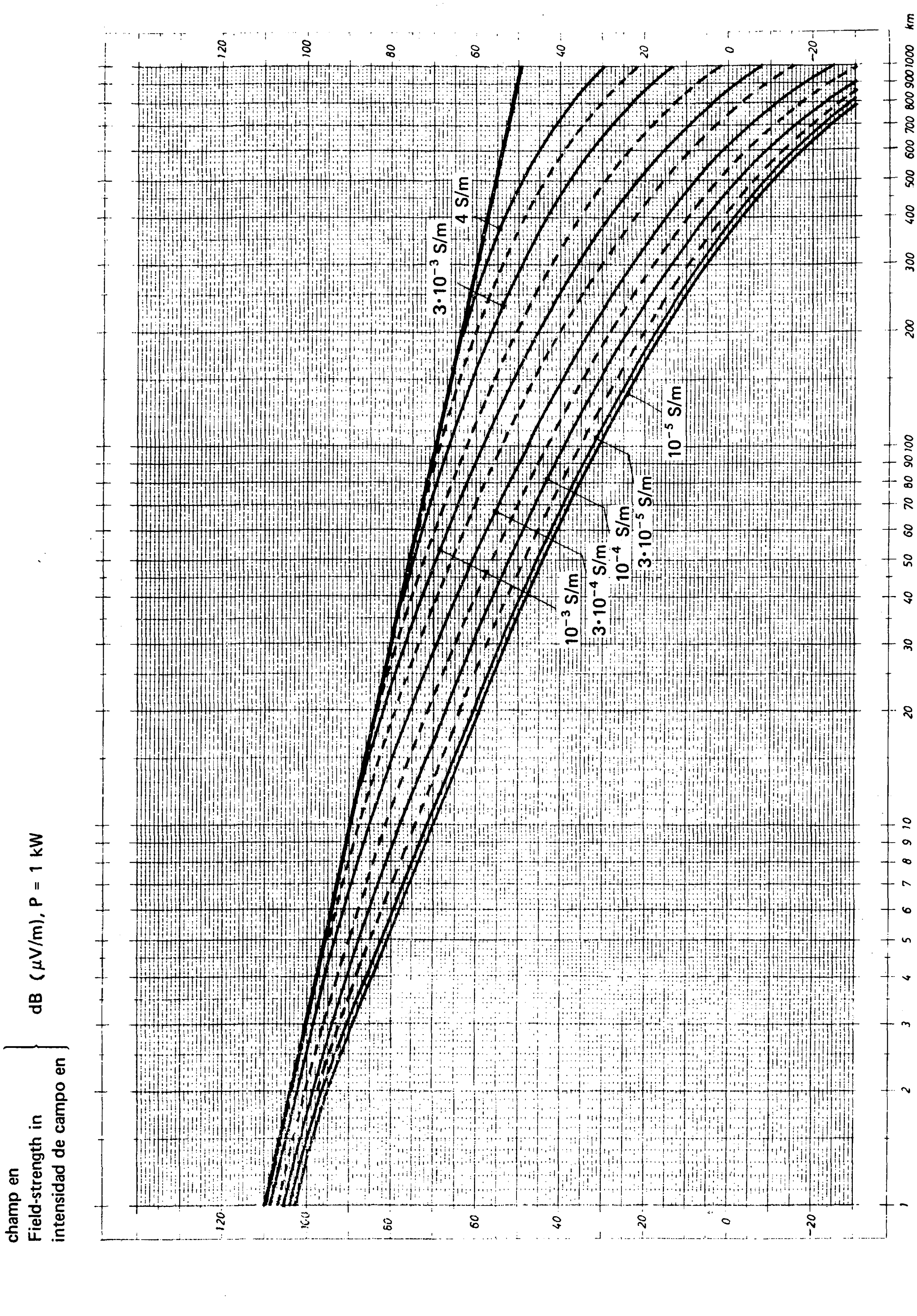
Figure 2 – Figura 2





700 kHz

FIGURE 3 – FIGURA 3



200 kHz.

FIGURE 4 – FIGURA 4

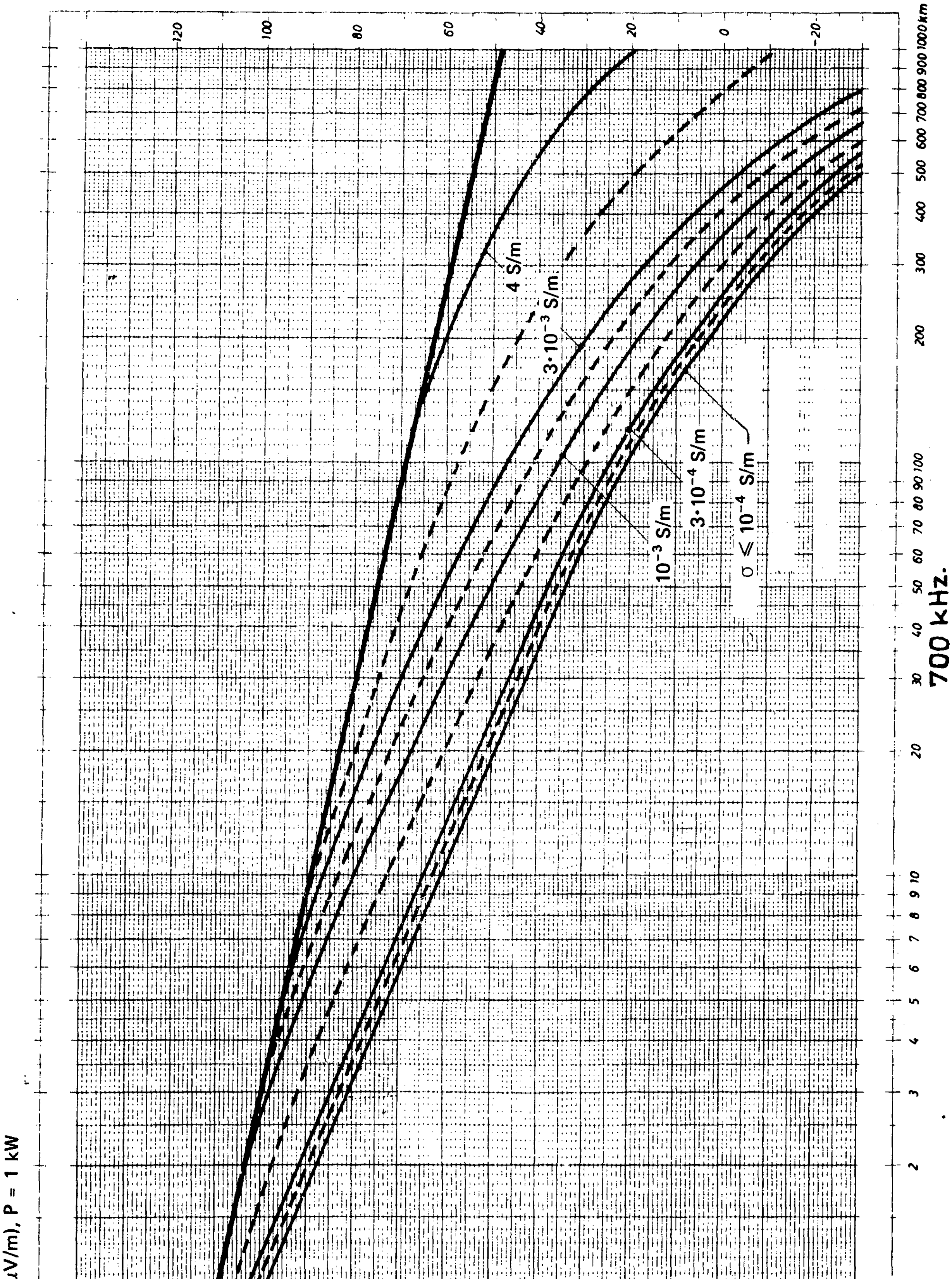
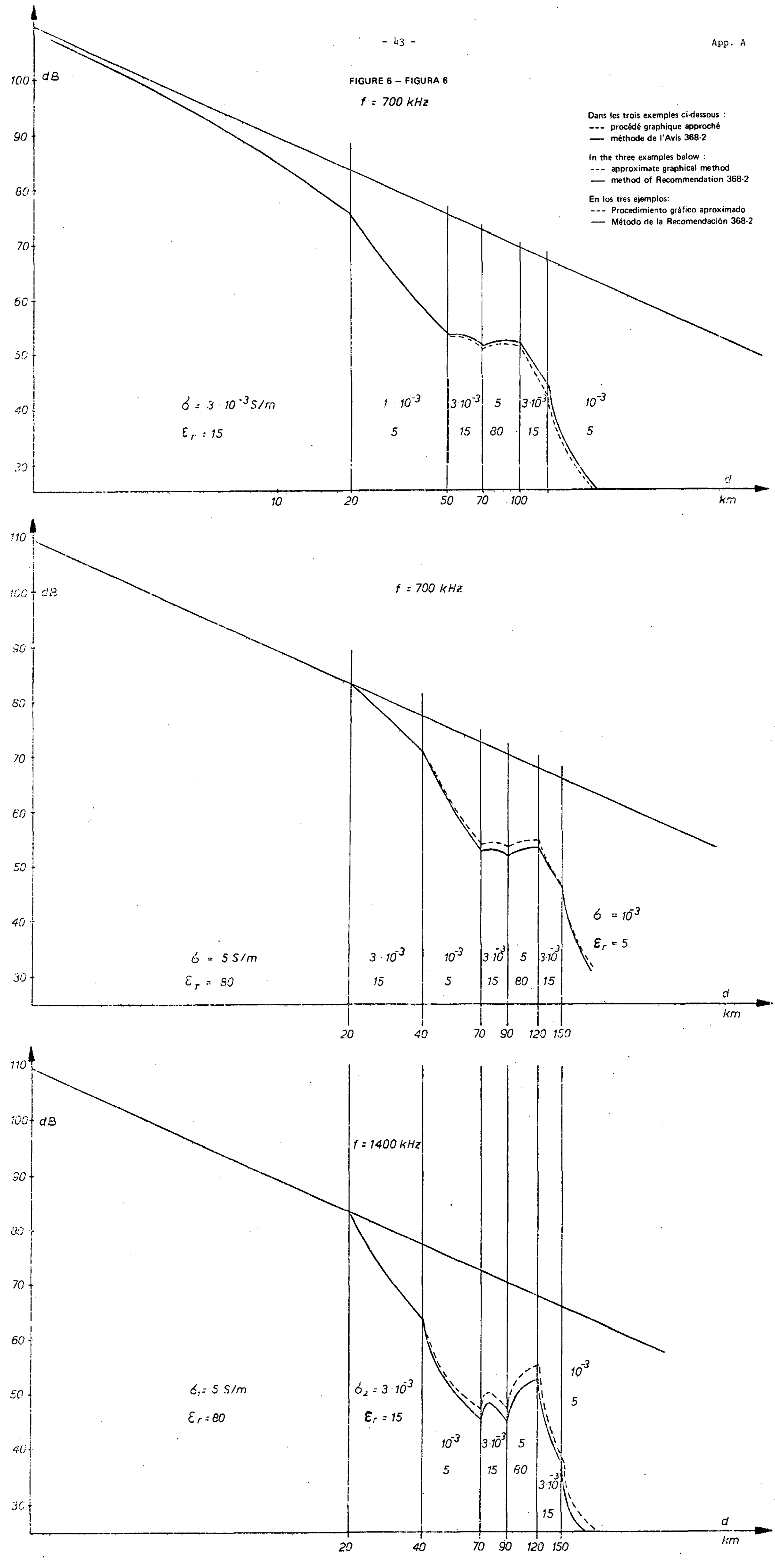


FIGURE 5 – FIGURA 5

FIGURE 6 – FIGURA 6



PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

APPENDIX B

SKY-WAVE FIELD-STRENGTH PREDICTION METHOD FOR THE FREQUENCY RANGE 150 TO 1605 kHz FOR REGION 1, AUSTRALIA AND NEW ZEALAND

List of symbols

b	Solar-activity factor given in Section 2.6
d	Ground distance between transmitter and receiver (km)
F_o	Annual median field strength at the reference time defined in Section 2 (db above 1 μV/m)
F_t	Annual median field strength at time t (dB above 1 μV/m)
f	Frequency (kHz)
f'	A frequency defined in Equation (6) (kHz)
G	Antenna gain referred to a short vertical antenna in the direction of propagation
G_O	Sea gain for a terminal on the coast (dB)
G_S	Sea gain for a terminal near the sea (dB)
h	Transmitting antenna height
h_r	Height of reflecting layer (km)
I	Magnetic dip angle (degrees)
k	Basic loss factor due to the absorption in the ionosphere
k_R	Loss factor due to absorption in the ionosphere
L_P	Excess polarization coupling loss (dB)
L_t	Diurnal loss factor (dB)
P	Radiated power (dB above 1 kW)
p	Slant propagation distance (km)
Q	A sea-gain parameter given in Section 2.3
R	Twelve-month smoothed Zurich sunspot number
s	Distance of terminal from sea, measured along great-circle path (km)
t	Time relative to sunset or sunrise (hours)
V	Transmitter cymomotive force (dB above 300 volts)
θ	Direction of propagation relative to magnetic East-West (degrees)
λ	Wavelength
Φ	A geomagnetic latitude parameter (degrees, positive in northern hemisphere, negative in southern hemisphere)
Φ_T	Geomagnetic latitude of transmitter (degrees, positive in northern hemisphere, negative in southern hemisphere)
Φ_R	Geomagnetic latitude of receiver (degrees, positive in northern hemisphere, negative in southern hemisphere)

1. Introduction

This method of prediction gives the night-time sky-wave field strength produced for a given power radiated from one or more vertical antennae, when measured by a loop aerial at ground level aligned in a vertical plane along the great circle path to the transmitter. It applies for paths of lengths up to 12,000 km. However in band 5 it was only verified for paths of up to 5000 km. The accuracy of prediction varies from region to region and may be improved in certain regions by applying modifications such as those shown in Section 5. In any case the method should be used with caution for geomagnetic latitudes greater than 60° and for distances less than 300 km.

2. Annual median night-time field strength

The predicted sky-wave field strength is given by :

$$F_o = V + G_S - L_P + 105.3 - 20 \log_{10} p - 10^{-3} k_R p \quad (1)$$

where F_o = annual median of half-hourly median field strengths (dB above 1 μV/m) at the reference time defined in Section 2.1.

V = transmitter cymomotive force, dB above a reference cymomotive force of 300 volts

G_S = sea-gain correction, dB

L_P = excess polarization-coupling loss, dB

p = slant-propagation distance, km

k_R = loss factor incorporating effects of ionospheric absorption, focusing and terminal losses, and losses between hops on multi-hop paths

2.1 Reference time

The reference time is taken as six hours after the time at which the sun sets at a point S on the surface of the earth. For paths shorter than 2000 km, S is the mid-point of the path. On longer paths, S is 750 km from the terminal where the sun sets last, measured along the great-circle path.

2.2 Cymomotive force

The cymomotive force V in the azimuth and the elevation of the direction of propagation is calculated by the formula :

$$V = P' + G \tag{2}$$

where P', expressed in dB (kW), is the power supplied by the transmitter to the antenna transmission line, while neglecting for planning purposes various losses in the antenna and its transmission line,

and where G is the gain of the antenna in dB in the direction of propagation referred to a short vertical antenna (see Chapter 1).

For a simple vertical antenna, without losses, this gain is given by Figure 1.

2.3 Sea gain

G_S is the additional signal gain when one or both terminals is situated near the sea. G_S for a single terminal is given by :

$$G_S = G_o - 10^{-3} \frac{Q\, s\, f}{G_o} \quad \text{(dB)} \tag{3}$$

where G_o is the gain when the terminal is on the coast, f is the frequency in kHz and s is the distance in km of the terminal from the sea, measured along the great-circle path. Q = 0.44 in band 5 and 1.75 in band 6. G_o is given in Annex Figure 2 as a function of d for bands 5 and 6. In band 5, G_o = 10 dB when d > 6500 km. Equation (3) applies for values of s such that $G_S > 0$. For larger values of s, $G_S = 0$. If both terminals are near the sea, G_S is the sum of the values of G_S for the individual terminals.

2.4 Excess polarization coupling loss

L_P is the excess polarization coupling loss. In band 5, L_P = 0. In band 6 at low latitudes, for $|I| \leq 45°$.

$$L_P = 180\ (36 + \theta^2 + I^2)^{-\frac{1}{2}} - 2 \text{(dB/terminal)} \tag{4}$$ (see Figure 7)

where I is the magnetic dip in degrees at the terminal and θ is the path azimuth measured in degrees from the magnetic E-W direction, such that $|\theta| \leq 90°$. For $|I| > 45°$, $L_P = 0$. L_P should be evaluated separately for the two terminals, because of the different θ and I that may apply, and the two L_P values added. The most accurate available values of magnetic dip and declination should be used in determining θ and I (see Figures 8 and 9).

2.5 Slant propagation distance

For paths longer than 1000 km, p is approximately equal to the ground distance d (km). For shorter paths

$$p = (d^2 + 4h_r^{\,2})^{\frac{1}{2}} \tag{5}$$

where h_r = 100 km if $f \leq f'$ and 220 km if $f > f'$, where f' (in kHz) is given by

$$f' = 350 + [(2.8d)^3 + 300^3]^{1/3} \tag{6}$$

Equation (5) may be used for paths of any length with negligible error.

2.6 Loss factor due to absorption in the ionosphere

The loss factor due to absorption in the ionosphere k_R is given by

$$k_R = k + 10^{-2}\, bR \qquad (7)$$

where R = twelve-month smoothed Zurich sunspot number. In band 5, b = 0. In band 6, b = 1 for Europe and Australia and 0 elsewhere.

$$k = 1.9f^{0.15} + 0.24f^{0.4}(\tan^2\Phi - \tan^2 37^\circ) \qquad (8)$$

where f = frequency (kHz)

For paths shorter than 3000 km

$$\Phi = (\Phi_T + \Phi_R)/2 \qquad (9)$$

where Φ_T and Φ_R are the geomagnetic latitudes (see Figure 10) at the transmitter and receiver respectively, determined by assuming an earth-centred dipole field model with northern pole at 78.5°N, 69°W geographic coordinates. Φ_T and Φ_R are taken as positive in the northern hemisphere and negative in the southern hemisphere. Paths longer than 3000 km are divided into two equal sections which are considered separately. The value of Φ for each half-path is derived by taking the average of the geomagnetic latitudes at one terminal and at the mid-point of the whole path, the geomagnetic latitude at the mid-point of the whole path being assumed to be the average of Φ_T and Φ_R. As a consequence

$$\Phi = (3\Phi_T + \Phi_R)/4 \qquad (10)$$

for the first half of the path and

$$\Phi = (\Phi_T + 3\Phi_R)/4 \qquad (11)$$

for the second half. The values of k calculated from Equation (8) for the two half-paths are then averaged and used in Equation (7).

If $|\Phi| > 60^\circ$, Equation (8) is evaluated for $\Phi = 60^\circ$

3. Nocturnal variation of annual median field strength

$$F_t = F_o - L_t \qquad (12)$$

where F_t = annual median field strength at time t, dB above 1 µV/m

F_o = annual median field strength at reference time defined in Section 2.1, dB above 1 µV/m, given by Equation (1)

L_t = diurnal loss factor, dB, given in Fig. 3

Fig. 3 shows the average of the annual median nocturnal variations for Europe and Australia, derived from Fig. 8 of C.C.I.R. Report 264 and Fig. 5 of C.C.I.R. Report 431 respectively; the time t is the time in hours relative to the sunrise or sunset reference times as appropriate. These are taken at the ground at the midpath position for d < 2000 km and at 750 km from the terminal where the sun sets last or rises first for longer paths.

4. Day-to-day and short-period variations of field strength

The field strength exceeded for 10% of the total time on a series of nights, during short periods centred on a specific time is :

8 dB greater in band 5

10 dB greater in band 6

than the values of F_o and F_t given above.

5. Accuracy of the method

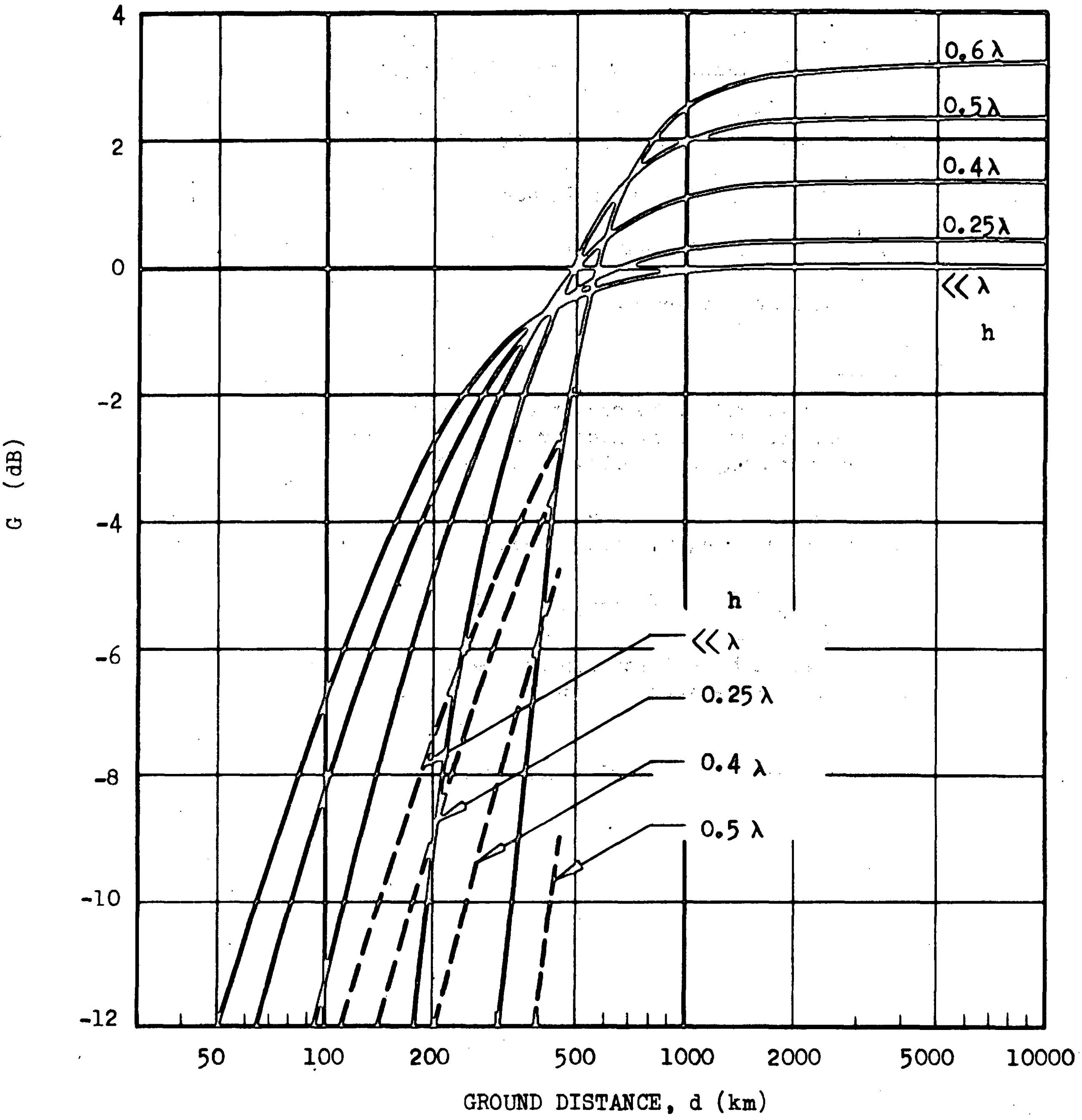
This method is believed to be reasonably accurate in Regions 1 and 3. Comparison of predicted and measured values shows, however, that its accuracy in certain regions may be further improved by making the following corrections.

Since field strengths measured in Australia and New Zealand are 4 to 7 dB higher than those predicted by the method, a better prediction formula for this area is

$$F_o = V + G_S - L_P + 108 - 20 \log_{10} p - 0.8 \times 10^{-3} k_R p \qquad (13)$$

The field strength exceeded on band 6 for 10% of the total time on a series of nights, during short periods centred on a specific time, is only 7 dB greater than the annual median in this area.

6. The Annex to the Appendix contains some examples of the use of this method.



h = Aerial height

——— h_r = 100 km (E layer reflection)

– – – h_r = 220 km (F layer reflection)

FIGURE 1

Transmitting antenna gain for
a simple vertical antenna

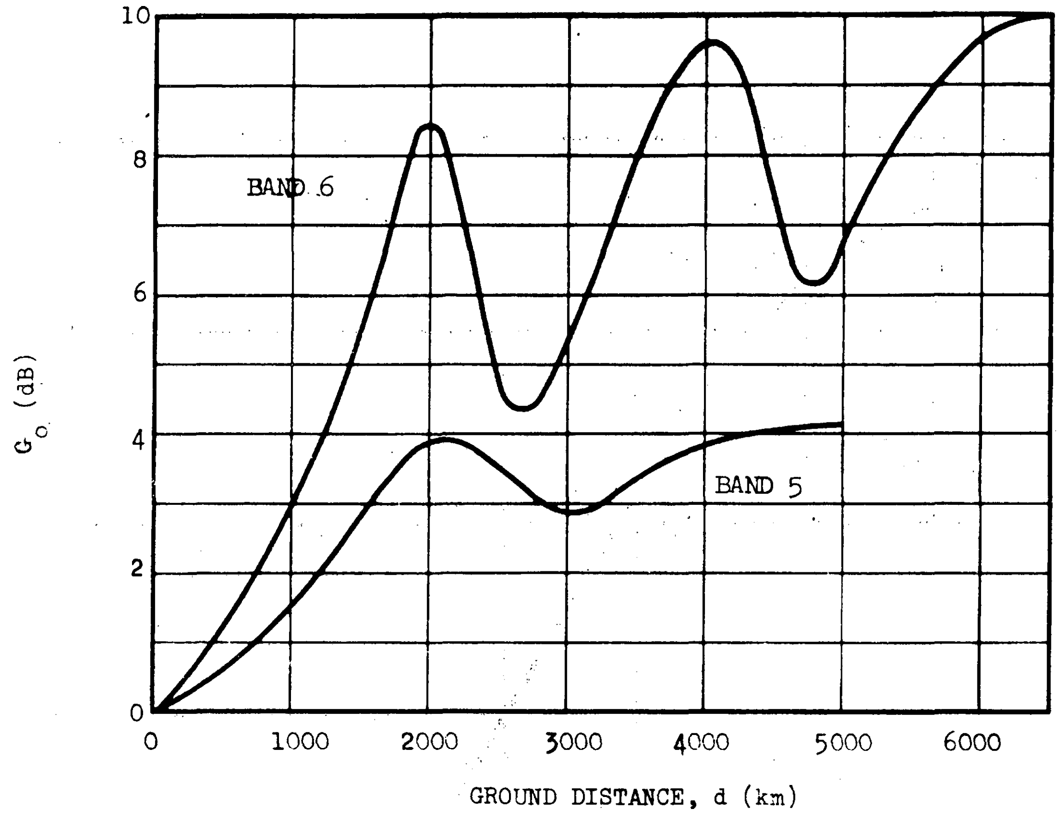


FIGURE 2

Sea gain (G_o) for a single terminal on the coast

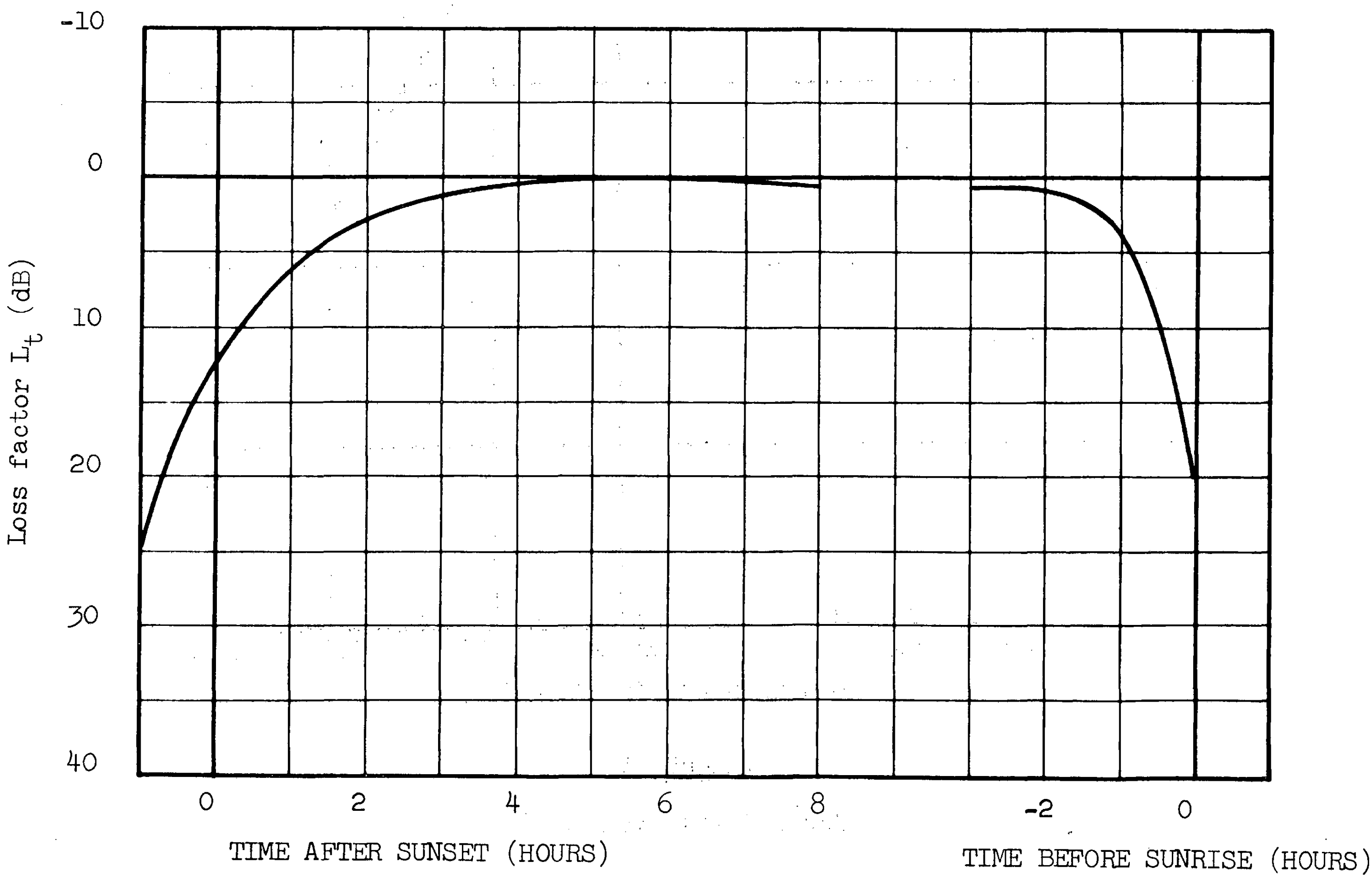


FIGURE 3

Diurnal loss factor (L_t)

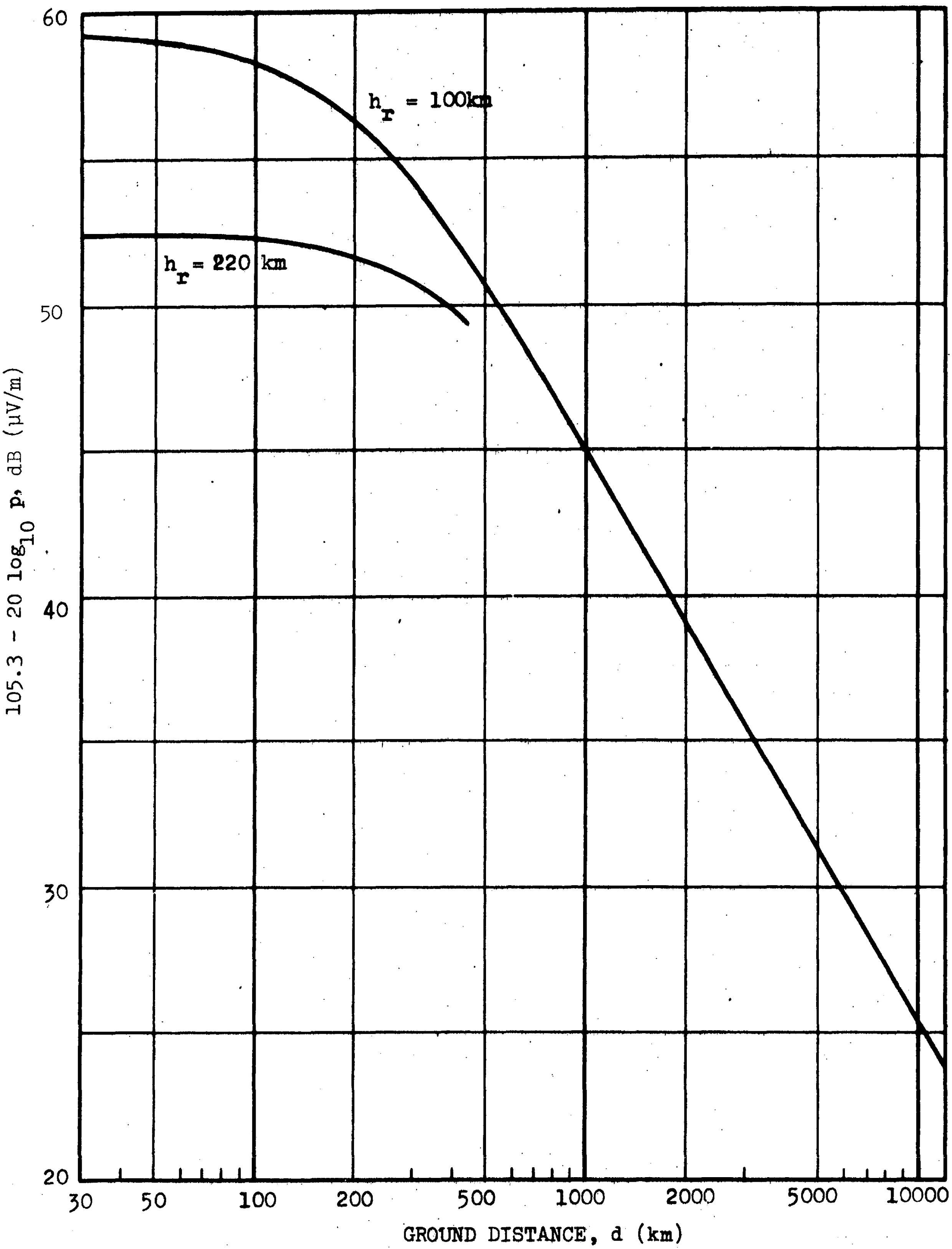


FIGURE 4

Basic field strength

The curves show $105.3 - 20 \log_{10} p$
where $p = (d^2 + 4h_r^2)^{\frac{1}{2}}$

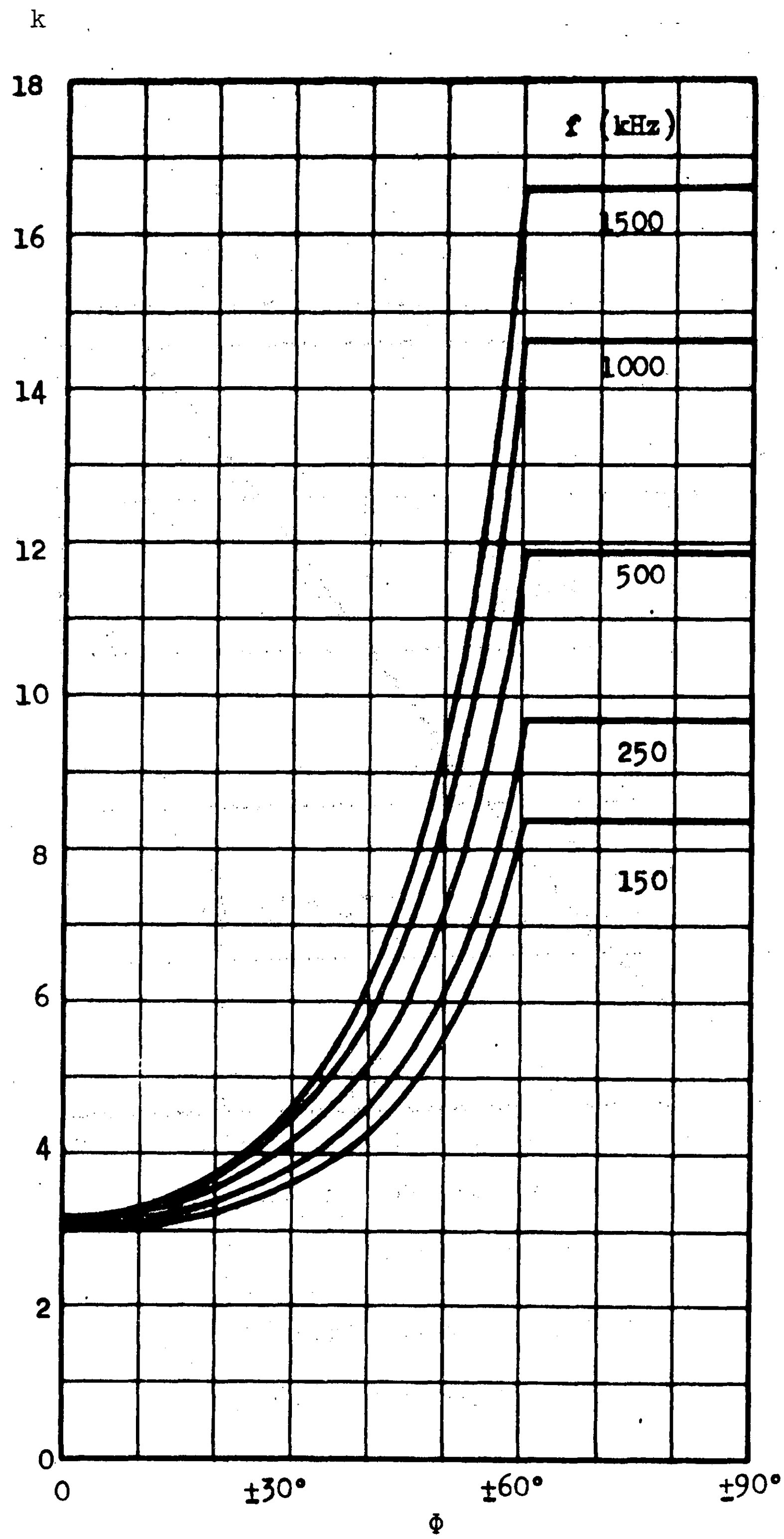


FIGURE 5

Basic loss factor due to ionospheric absorption

$$k = 1.9f^{0.15} + 0.24f^{0.4} (\tan^2 \Phi - \tan^2 37^\circ)$$

$$(0 \leq \Phi \leq 60^\circ)$$

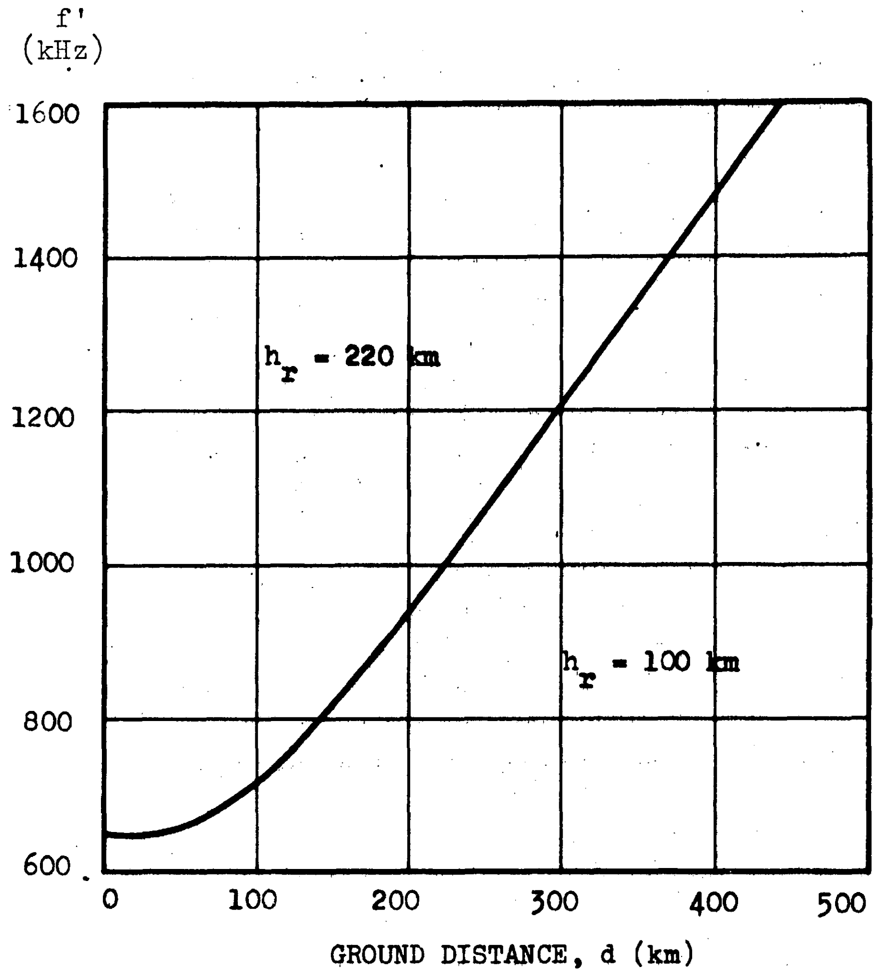


FIGURE 6

Frequency defined in equation (6)

$$f' = 350 + \left[(2.8\ d)^3 + 300^3\right]^{\frac{1}{3}}$$

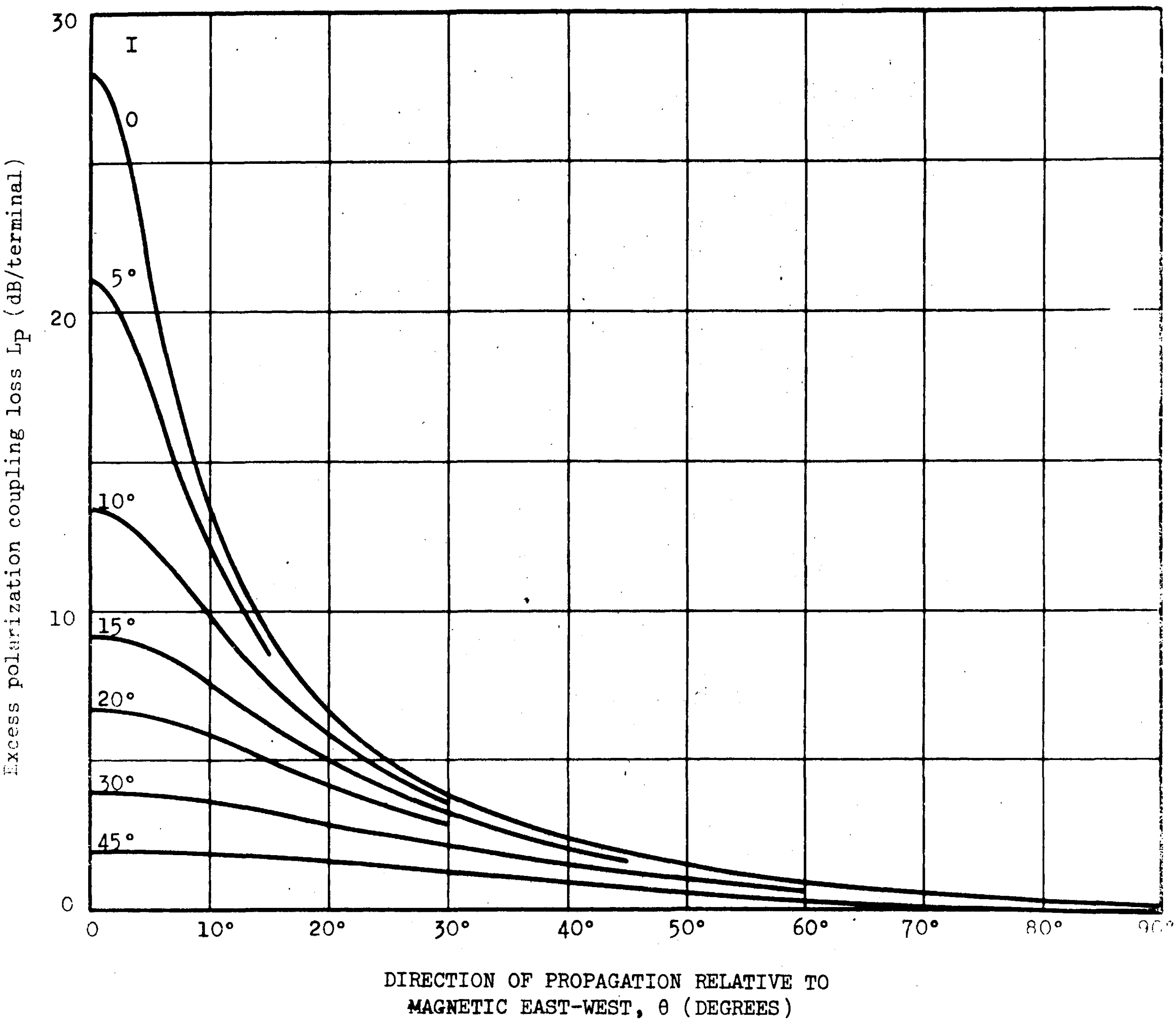
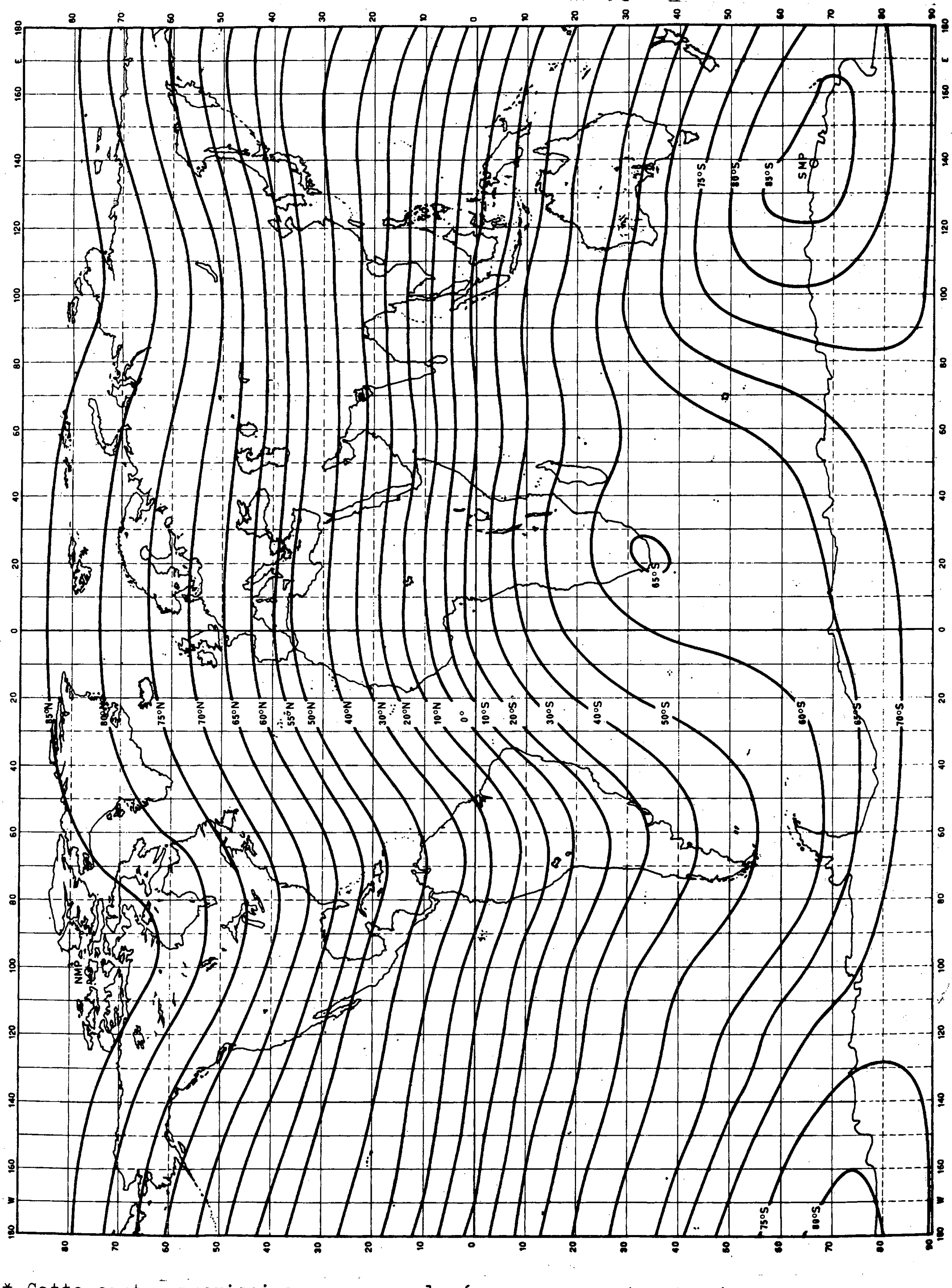


FIGURE 7

Excess polarization coupling loss L_P

FIGURE 8* - FIGURA 8*

Map of magnetic dip - Carte de l'inclinaison magnétique - Mapa de la inclinación magnética



* Cette carte, provisoire, sera remplacée par une carte mise à jour.
A provisional map to be replaced by on up dated map.
Este mapa, provisional, será sustituido por un mapa puesto al día.

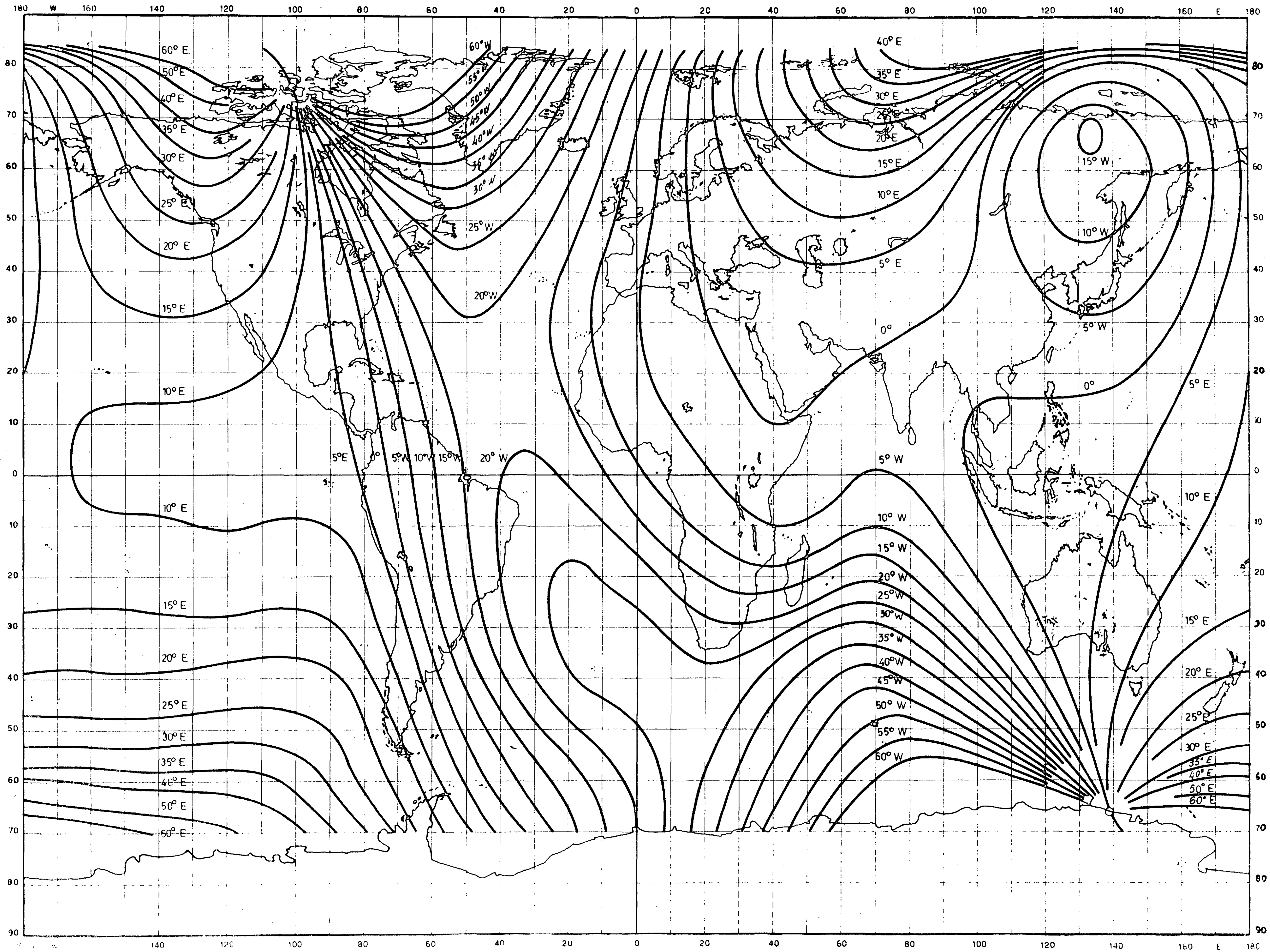


FIGURE 9 - FIGURA 9

Carte de déclinaison magnétique - Map of magnetic declination - Mapa de declinación magnética

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

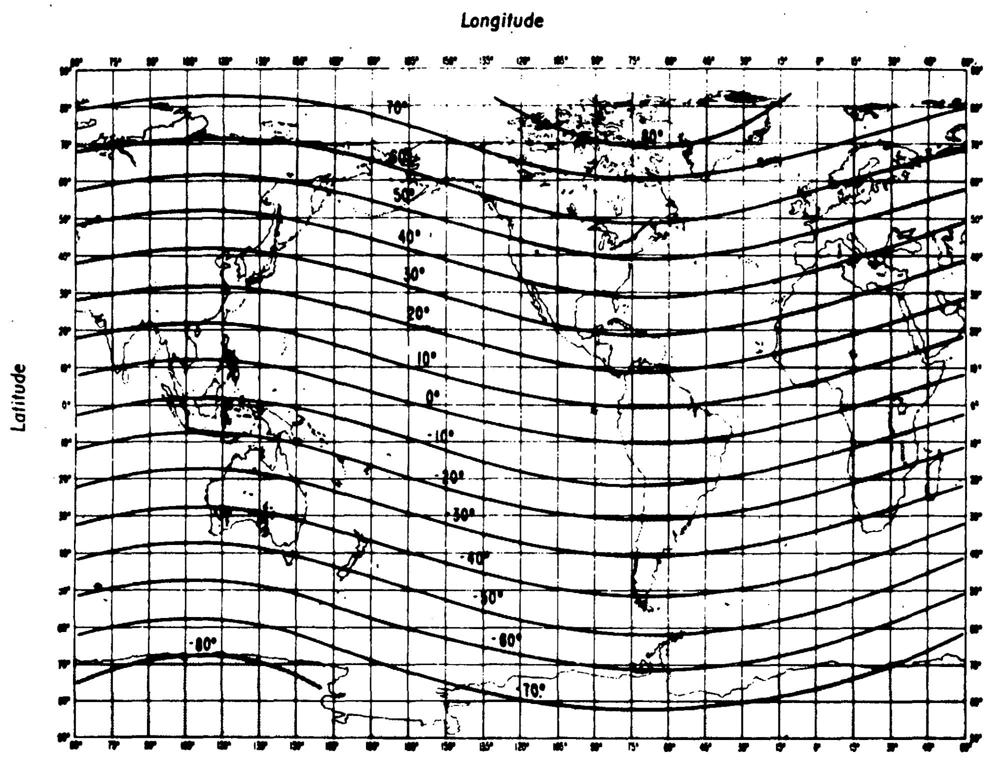


FIGURE 10

Map of geomagnetic latitudes

ANNEX TO APPENDIX B

Example of the use of the sky-wave field-strength prediction method

1) Short-distance path

Data

Transmitter	Rome (Italy)
Receiver	Darmstadt (Federal Republic of Germany)
Great-circle distance	950 km
Frequency	845 kHz
Basic field strength (Fig. 4)	45.5 dB(μV/m)
Geomagnetic latitude of transmitter	$\Phi_T = 44°$ (Fig. 10)
Geomagnetic latitude of receiver	$\Phi_R = 52°$ (Fig. 10)
Geomagnetic latitude parameter	$\Phi = \frac{\Phi_T + \Phi_R}{2} = 48°$
Basic loss factor (Fig. 5)	7.2

Attenuation contributed by loss factor = $7.2 \times 950 \times 10^{-3} = 6.9$ dB

Annual median field strength = 45.5 - 6.9 = 38.6 dB(μV/m)

2) Long-distance path with one terminal near the sea and the other in the tropical region

Data

Transmitter	Riyad (Saudi Arabia)
Receiver	Helsinki (Finland) (2 km from sea)
Great-circle distance	4,280 km
Frequency	587 kHz
Basic field strength (Fig. 4)	32.5 dB(μV/m)
Geomagnetic latitude of transmitter	$\Phi_T = 18°$ (Fig. 10)
Geomagnetic latitude of receiver	$\Phi_R = 58°$ (Fig. 10)

	First half of path	Second half of path
Geomagnetic latitude parameter	$\frac{3\Phi_T + \Phi_R}{4} = 28°$	$\frac{\Phi_T + 3\Phi_R}{4} = 48°$
Basic loss factor (Fig. 5)	4.1	6.9

Average loss factor = $\frac{4.1 + 6.9}{2} = 5.5$

Attenuation contributed by loss factor $= 5.5 \times 4{,}280 \times 10^{-3} = 23.5$ dB

Dip latitude of transmitter, I (Fig.8) = 30°

Direction of propagation relative to magnetic east-west at transmitter, θ = 70°

Polarization coupling loss at transmitter (Fig. 7) = 0.5 dB

Sea-gain :

for terminal on the coast, G_o (Fig. 2) = 9.0 dB

reduction because receiver is 2 km from sea $= \frac{10^{-3} \times 1.75 \times 2 \times 587}{9.0} = 0.2$ dB

resultant gain, G_s = 9.0 - 0.2 = 8.8 dB

Annual median field-strength = 32.5 - 23.5 + 8.8 - 0.5 = 17.3 dB(μV/m)

Note : These two examples give the field-strength produced by a source radiating with a c.m.f. of 300 V or an e.m.r.p. of 1 kW in the direction of propagation. Corrections for antenna gain (Fig. 1) and for transmitter power are not included. The reference time is 6 hours after sunset. For other times, use should be made of Fig. 3.

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

APPENDIX C

RELATIVE RADIO-FREQUENCY PROTECTION RATIO CURVES

(Based on C.C.I.R. Recommendation 449)

The relative values of the radio-frequency protection ratio, expressed as a function of the carrier-frequency spacing, are given by the curves of Fig. 1 :

- curve A, when a limited degree of modulation compression is applied at the transmitter input, such as in good quality transmissions, and when the bandwidth of the audio-frequency modulating signal is of the order of 10 kHz;

- curve B, when a high degree of modulation compression (at least 10 dB greater than in the preceding case) is applied by means of an automatic device and when the bandwidth of the audio-frequency modulating signal is of the order of 10 kHz;

- curve C, when a limited degree of modulation compression (as in the case of curve A) is applied and when the bandwidth of the audio-frequency modulating signal is of the order of 4.5 kHz;

- curve D, when a high degree of modulation compression (as in the case of curve B) is applied by means of an automatic device and when the bandwidth of the audio-frequency modulating signal is of the order of 4.5 kHz.

The curves A, B, C and D are valid only when the wanted and unwanted transmissions are compressed to the same extent.

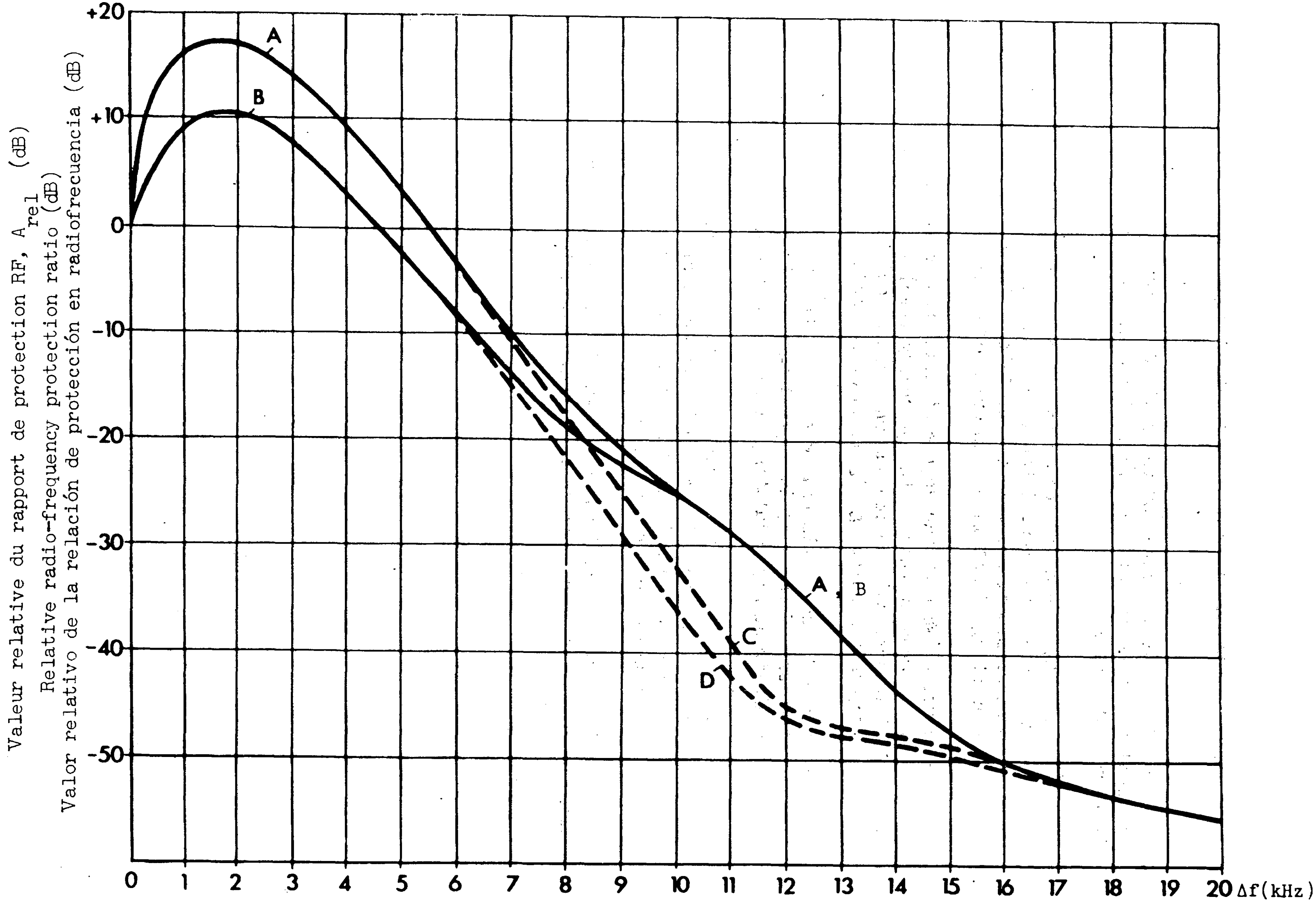
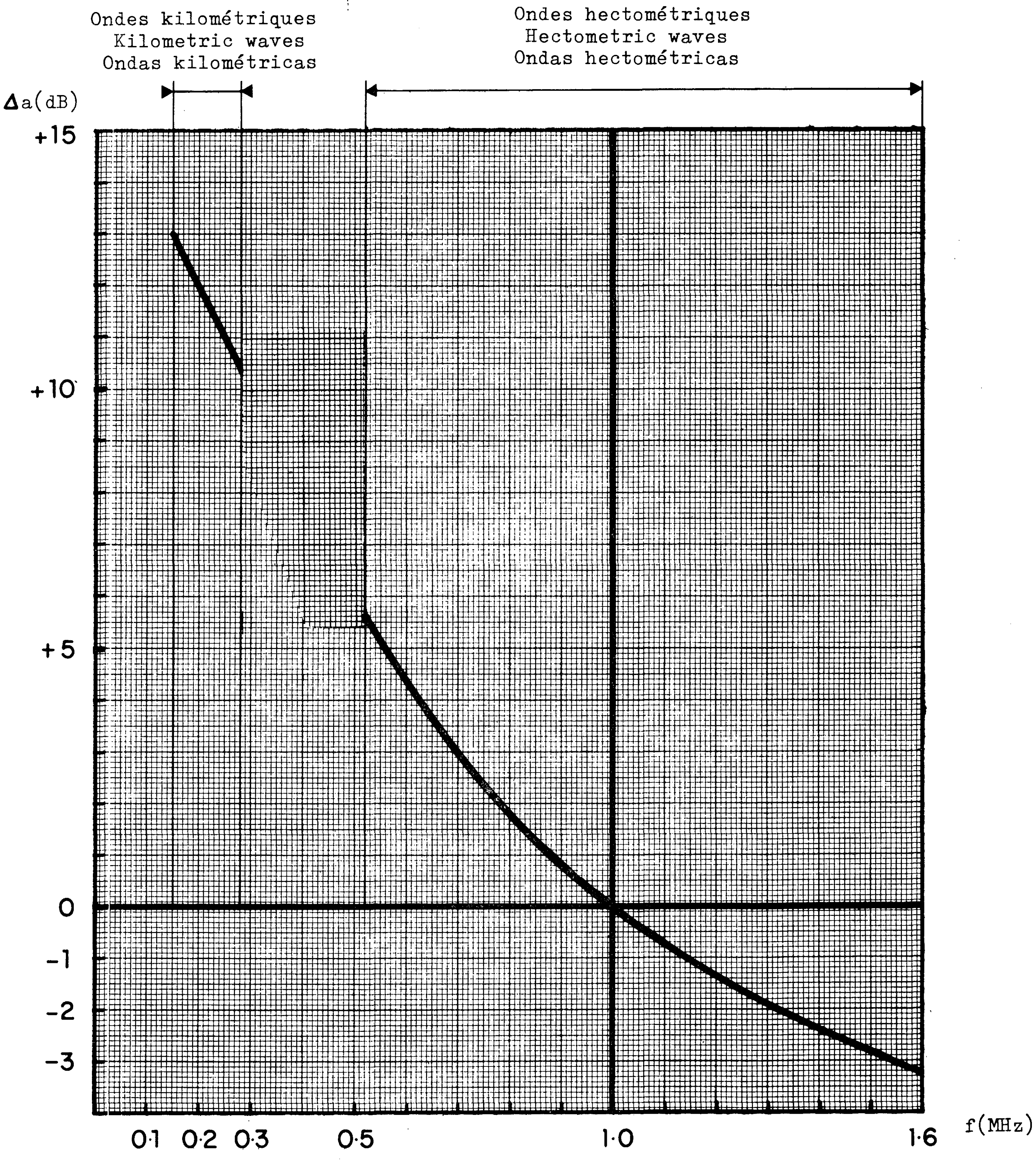


FIGURE 1 FIGURA 1

VALEURS RELATIVES DU RAPPORT DE PROTECTION AUX FREQUENCES RADIOELECTRIQUES EN FONCTION DE L'ECARTEMENT DES PORTEUSES
RELATIVE VALUE OF THE RADIO-FREQUENCY PROTECTION RATIO AS A FUNCTION OF THE CARRIER FREQUENCY SEPARATION
VALORES RELATIVOS DE LA RELACIÓN DE PROTECCIÓN EN RADIOFRECUENCIA EN FUNCIÓN DE LA SEPARACIÓN ENTRE LAS PORTADORAS

APPENDICE D - APPENDIX D - APÉNDICE D

"VALEUR MINIMALE DU CHAMP" EN FONCTION DE LA FREQUENCE
FREQUENCY DEPENDENCE OF "MINIMUM VALUE OF FIELD-STRENGTH"
"VALOR MÍNIMO DE LA INTENSIDAD DE CAMPO" EN FUNCIÓN DE LA FRECUENCIA



PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

APPENDIX E

SKY-WAVE FIELD STRENGTH PREDICTION METHOD FOR THE FREQUENCY RANGE 525 TO 1605 kHz FOR THE ASIAN PART OF REGION 3 NORTH OF 11°S

1. Symbols

d	Ground distance between transmitter and receiver (km)
F_o	Annual median field strength at midnight (dB above 1 µV/m)
F_c	Field strength, in dB, derived from the Cairo curve (Figure 1)
F_t	Annual median field strength at time t (dB above 1 µV/m)
f	Frequency (kHz)
I	Magnetic dip angle (degrees)
L_p	Excess polarization coupling loss (dB)
L_t	Diurnal loss factor (dB)
P	Radiated power (dB above 1 kW)
t	Time relative to sunset or sunrise (hours)
V	Transmitter cymomotive force (dB above 300V)
Θ	Direction of propagation relative to magnetic East-West (degrees)

2. Propagation curve

In the Asian area of the Region 3 situated to the north of 11°S the "Cairo North-South" propagation curve referred to the annual midnight median value should be used for sky wave predictions. This curve appears in Figure 1 of this Appendix. This curve refers to an effective radiated power (e.m.r.p.) of 1 kW or a c.m.f. of 300 V of a short vertical antenna. The field F_o, in dB, is given by the formula

$$F_o = F_c - L_p \qquad (1)$$

where F_c is the field strength, in dB, derived from the Cairo curve (see Figure 1) or deduced from an equivalent mathematical formula

L_p is the excess polarization coupling loss, in dB

3. Excess polarization coupling loss (L_p)

L_p is the excess polarization coupling loss. In band 6 at low latitudes for $|I| \leq 45^{\circ}$

$$L_p = 180\ (36 + \theta^2 + I^2)^{-\frac{1}{2}} - 2\ (\text{dB/terminal}) \qquad (2)\ (\text{see Figure 2})$$

where I is the magnetic dip in degrees at the terminal and θ is the path azimuth measured in degrees from the magnetic E-W direction, such that $|\theta| \leq 90^{\circ}$. For $|I| > 45^{\circ}$, $L_p = 0$. L_p should be evaluated separately for the two terminals, because of the different θ and I that may apply, and the two L_p added. The most accurate available values of magnetic dip and declination should be used in determining θ and I (see Figures 3 and 4).

4. Nocturnal variation of annual median field strength

$$F_t = F_o - L_t \qquad (3)$$

where F_t = annual median field-strength at time t, dB above 1 μV/m

F_o = annual median field strength at midnight, dB above 1 μV/m, given by formula 1

L_t = diurnal loss factor, dB, given in Figure 5

In Figure 5 time t is the time in hours relative to the sunrise or sunset reference times as appropriate. These are taken at the ground at the midpath position for d < 2000 km and at 750 km from the terminal where the sun sets last or rises first for longer paths.

5. Day-to-day and short-period variations of field strength

The field strength exceeded for 10% of the total time on a series of nights, during short periods centred on a specific time is 10 dB greater than the median value.

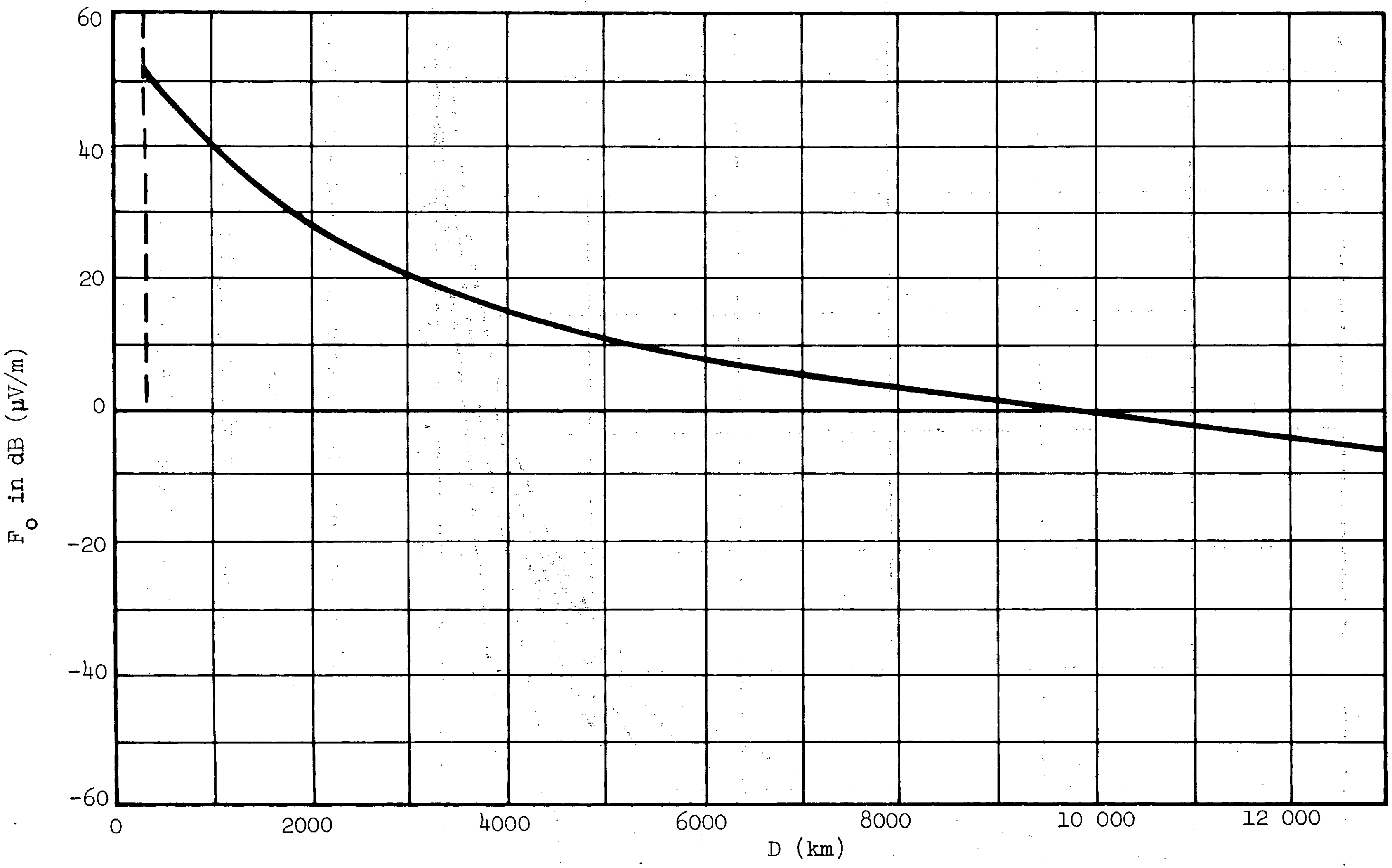
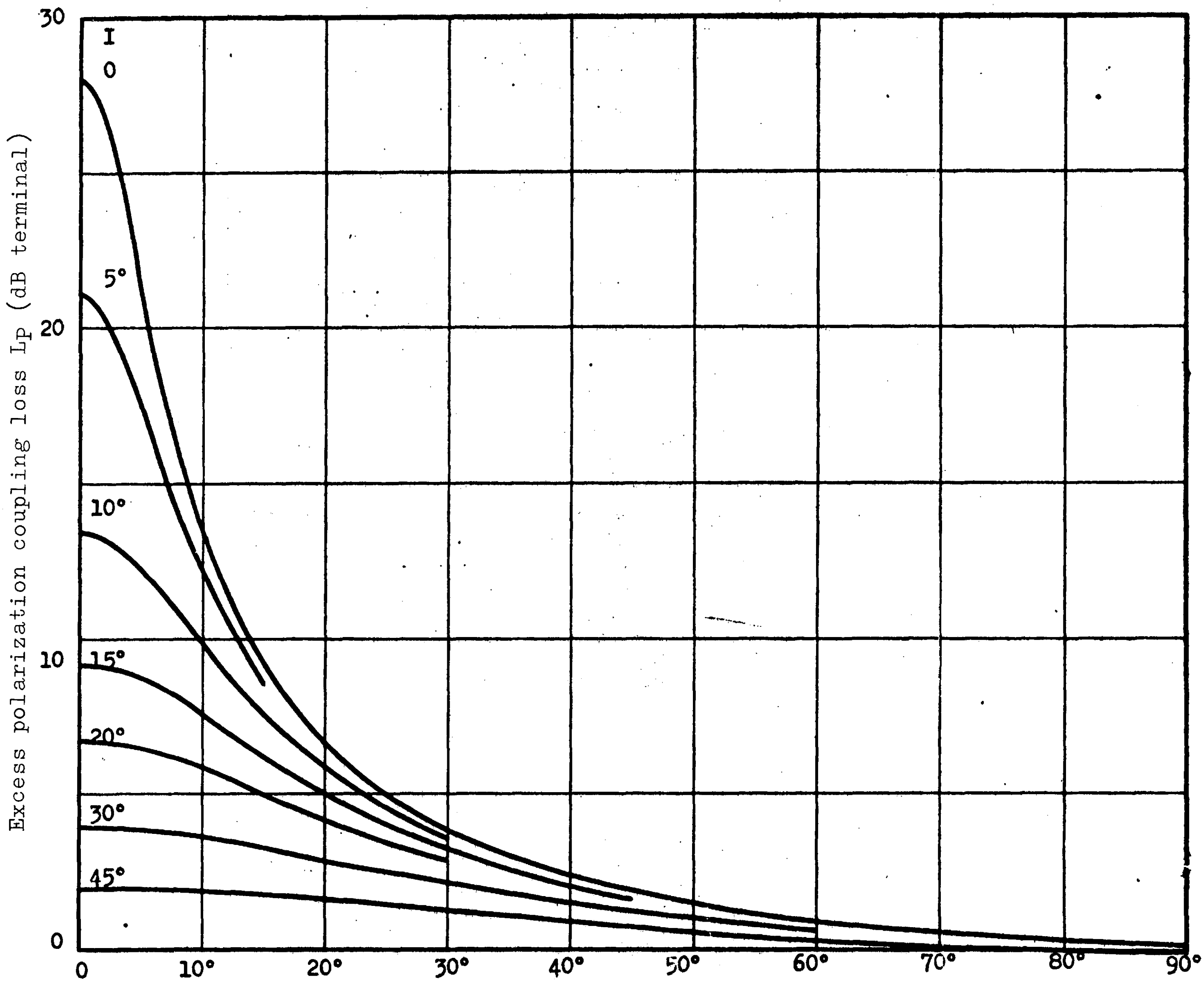


FIGURE 1

Annual midnight median value of ionospheric field strength of Cairo North/South curve



Direction of propagation relative to magnetic east-west θ (degrees)

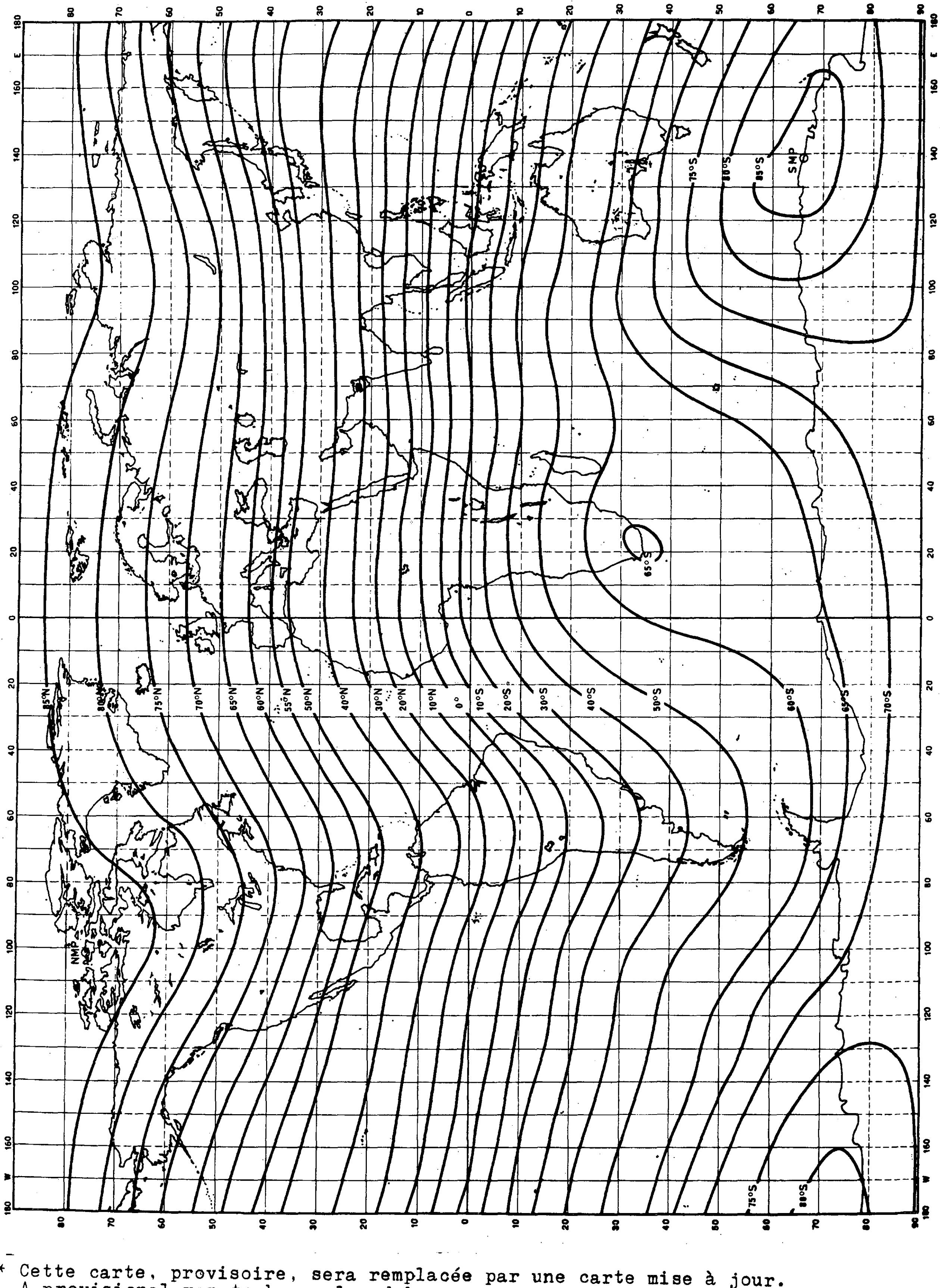
FIGURE 2

Excess polarization coupling loss L_p

$$L_p = 180\,(36 + \theta^2 + I^2)^{-\frac{1}{2}} - 2$$

FIGURE 3* - FIGURA 3*

Map of magnetic dip - Carte de l'inclinaison magnétique - Mapa de la inclinación magnética



* Cette carte, provisoire, sera remplacée par une carte mise à jour.
A provisional map to be replaced by on up dated map.
Este mapa, provisional, será sustituido por un mapa puesto al día.

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

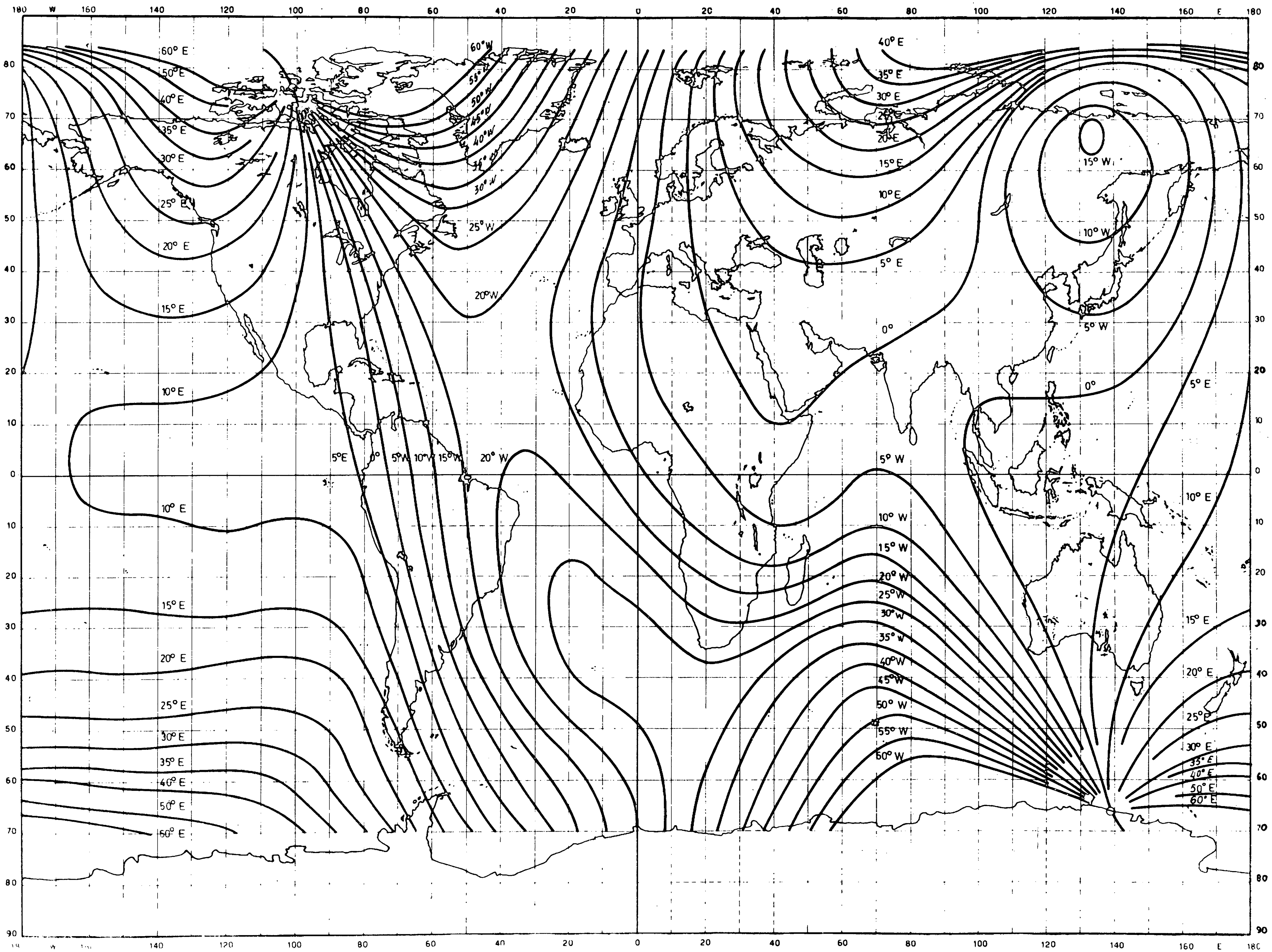


FIGURE 4 - FIGURA 4

Carte de déclinaison magnétique - Map of magnetic declination - Mapa de declinación magnética

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

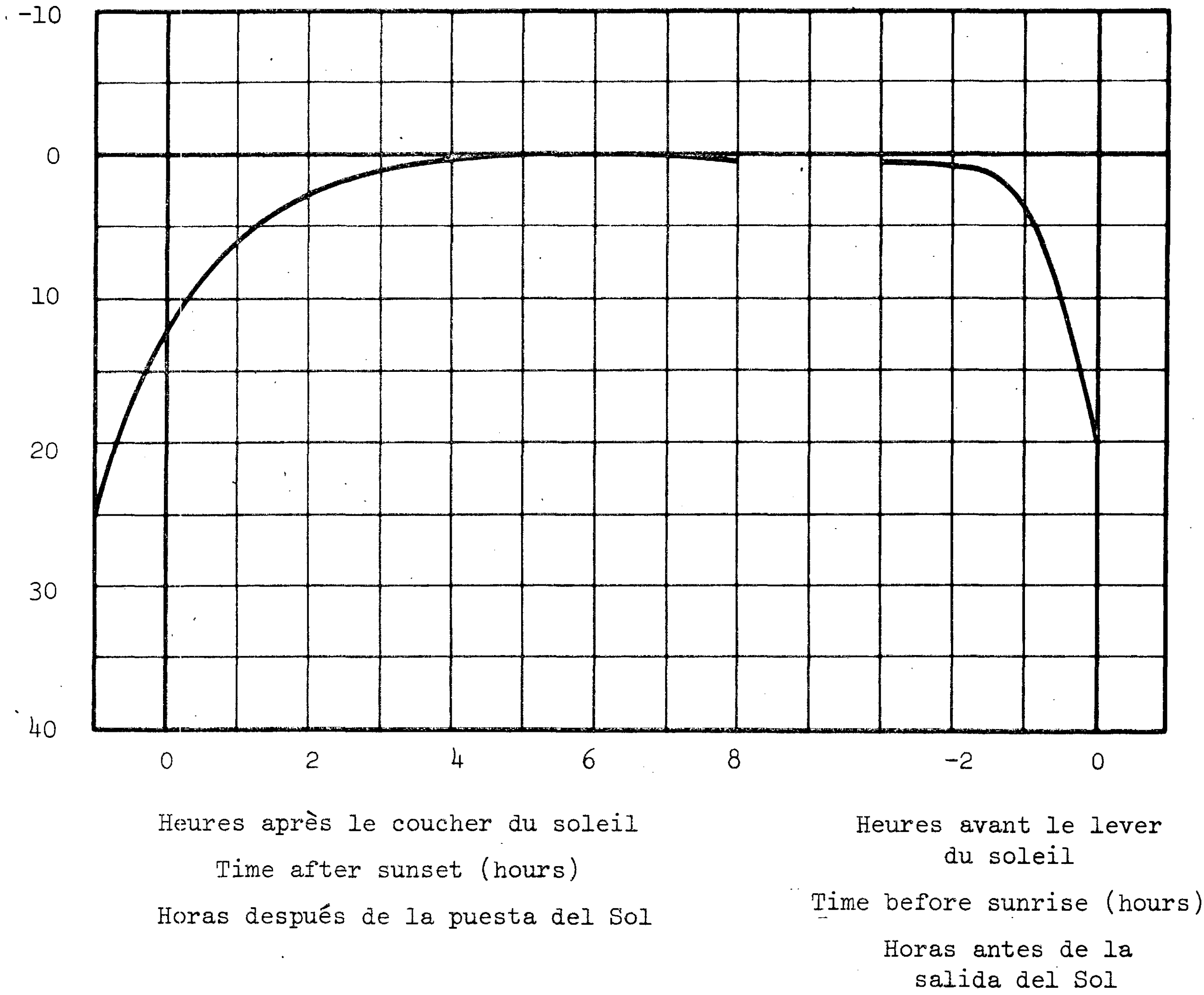


FIGURE 5 - FIGURA 5

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

APPENDIX F

FORM FOR THE SUBMISSION OF A FREQUENCY ASSIGNMENT REQUIREMENT

(see detailed instructions in Annex)

Regional Administrative Conference for LF/MF Broadcasting (Geneva, 1975)

01) Administration	Requirement sheet No.

Transmitting station				
02) Name	03) Country	04) Co-ordinates of antenna site		
		Longitude (degrees and minutes)		Latitude (degrees and minutes)
		E W		N S

05) Desired frequency	
	kHz

06) Frequency ranges desired for alternative frequencies (kHz)							
from		to		or from		to	

07) Necessary bandwidth in kHz	
	A3

08) Carrier power Pc (kW)	
	kW

09) Hours of operation GMT				
from		to		GMT

Required service area		
10) Ground-wave	a) Approximate co-ordinates of the centre of the area	b) Radius in km
	E W / N S	
11) Sky-wave	a) Approximate co-ordinates of the centre of the area	b) Radius in km
	E W / N S	

12) Ground conductivity in service area (S/m)			
2	3	4	5
3×10^{-2}	10^{-2}	3×10^{-3}	10^{-3}
6	7	8	9
3×10^{-4}	10^{-4}	3×10^{-5}	10^{-5}

Antenna characteristics

Simple vertical antenna
13) Height (metres)
14) Gain in dB

Antenna other than simple vertical antenna			
15) Attach the radiation diagrams in the horizontal and/or vertical planes			
16) Horizontal Plane	a) azimuth of maximum radiation (in degrees)	b) angular width of the main lobe (in degrees)	c) gain (in dB)
17) Vertical Plane	a) angle of elevation of maximum radiation (in degrees) where other than zero	b) angular width of the main lobe (in degrees)	c) gain (in dB)

18) For stations less than 100 km from the sea, attach a map showing the antenna site relative to the coastline

19) Synchronized network	Total number of stations :
If the station forms part of a synchronized network, list below other stations forming part of the network (if necessary, continue on the back) and for each such station complete a separate requirement sheet	
Name of the station	Name of the station

20) If this requirement covers an assignment in use indicate the frequency and the power		kHz		kW

21) If this requirement covers an assignment contained in the African Plan, Geneva, 1966, but which is NOT in service, indicate the frequency appearing in the Plan		kHz

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

ANNEX 1 TO APPENDIX F

Instructions for completing the form

Box No.		
1.	Administration	Name of the Administration.
2.	Name of transmitting station	Indicate the name of the locality by which the station is (or will be) known or in which it is (or will be) situated. Use the name shown in the International Frequency List where this exists. Limit the number of letters and numerals to a total of 14.
3.	Country	Indicate the country in which the station is (or will be) located. Use the symbols in Table 1 of the Preface to the International Frequency List (seventh edition, together with the latest Recapitulative Supplement).
4.	Coordinates of the antenna	Indicate the geographical coordinates of the site of the transmitter antenna (longitude and latitude, in degrees and minutes).
5.	Frequency desired	Indicate : - either the assigned frequency of the channel (see No. 85 of the Radio Regulations) your Administration would prefer to use. For this purpose, indicate the centre frequency of the channels adopted at the present Session of the Conference; - or enter in the next box the frequency ranges within which the most suitable frequency could be selected during planning. If the requirement is for a low-power transmitter channel, insert the symbol "LPC" in this box, in place of the desired frequency.

6. Frequency range desired

If a frequency has been indicated in the preceding box, indicate here the frequency range(s) within which an alternative frequency could be selected.
Example : 680 - 740 kHz or 1200 - 1300 kHz

7. Necessary bandwidth

Indicate the necessary bandwidth of the emission as defined in No. 91 of the Radio Regulations. The value of this bandwidth should be between 9 kHz (AF-bandwidth: 4.5 kHz) and 20 kHz (AF-bandwidth: 10 kHz).

8. Carrier Power

Indicate the power supplied to the antenna transmission line by the transmitter, as defined in No. 97 of the Radio Regulations. The last column in this box is for the decimal.

9. Hours of operation (GMT)

Indicate the daily hours of operation of the transmitter (GMT), to the nearest hour. The first pair of figures should show the time the first emission of the day begins, and the second the time the last emission ends.

Example :

from	0	7	to	2	3

10. and 11. Required service area

Indicate the radius of the proposed service area round the transmitter, in km, specifying whether the area is to be served by ground-wave and/or sky-wave. If a directional antenna is used, indicate the approximate co-ordinates of the centre of the required service area and its radius, in km.

12. Ground conductivity in the required service area

Give particulars, in the greatest possible detail, of ground conductivity, preferably rounded off to the nearest values for which the curves in C.C.I.R. Recommendation 368-2 are plotted, namely :

3×10^{-2}, 10^{-2}, 3×10^{-3}, 10^{-3}, 3×10^{-4}, 10^{-4},

3×10^{-5}, 10^{-5} (in S/m)

Put a cross in the appropriate box.

Antenna characteristics

13. and 14. Simple vertical antenna (see Annex 2).

13. Indicate the height of the antenna (in metres)

14. Indicate the gain (in dB) of the antenna in a given direction referred to a short vertical antenna.

The radiation may be expressed either in effective monopole radiated power (e.m.r.p.) or in cymomotive force (c.m.f.); to define the gain of an antenna referred to a short vertical antenna in a given direction, either of the two following definitions should be adopted :

- the ratio between the cymomotive force of the actual antenna in a given direction and the cymomotive force in the horizontal plane of a short vertical antenna without losses on a perfectly conducting plane, the two antennae being supplied with the same power;

- **the ratio of the power required at the input of a short vertical antenna without losses situated on perfectly conducting horizontal plane to produce the reference effective monopole radiated power (e.m.r.p.) of 1 kW (cymomotive force** 300 V**)** in the **horizontal direction, to the power supplied to the actual antenna to produce the same e.m.r.p. (c.m.f.) in the given direction.**

The ratio, expressed in dB, is the same for the two definitions.

15. to 17. Antenna other than a simple vertical antenna

15. The form should be accompanied by radiation diagram(s) of the antenna in the horizontal and/or vertical plane(s).

Or, if this is impossible, indicate :

16. in the horizontal plane:

a) the azimuth of maximum radiation, in degrees, (clockwise) from True North;

b) the total angle, in degrees, within which the power radiated in any direction does not fall more than 6 dB below the power radiated in the direction of maximum radiation;

c) the gain (in dB) (see item 14 above).

17. in the vertical plane:

    a) the angle of elevation, in degrees, of maximum radiation;

    b) the total angle, in degrees, within which the power radiated in any direction does not fall more than 6 dB below the power radiated in the direction of maximum radiation;

    c) the gain (in dB) (see item 14 above).

    When the antenna diagram shows substantial secondary lobes, indicate on a separate sheet for each lobe the azimuth and the angle of elevation of the lobe axis and the gain, in dB.

18. Stations less than 100 km from the sea

    If the station is less than 100 km from the sea, attach a map (on a scale not smaller than 1/1.000.000) showing the site of the antenna, the scale of the map and the direction of True North.

19. Synchronized network

    If the transmitter forms part, or is intended to form part, of a synchronized network, indicate the name and the corresponding requirement sheet number of the other transmitters in the network. A separate form must be filled in for each of these stations.

20. If the **requirement corresponds to a frequency** already in service, that frequency together with its carrier power should be indicated irrespective whether the Administration wishes to retain the frequency or agrees to its transfer.

21. If the requirement corresponds to a frequency assignment contained in the African Plan, Geneva, 1966, but NOT yet in service, the frequency appearing in the Plan should be indicated.

The Administration may supply, on a separate sheet and in a simplified form, if possible, suitable for electronic processing, such additional information as it may consider useful.

ANNEX 2 TO APPENDIX F

Vertical antennae

The following description of radiation patterns of vertical antennae is based on the C.C.I.R. publication entitled "Antenna Diagrams".

Figure No. 1 gives curves drawn so that the radius vector is proportional to the field in a given direction in a vertical plane at 1 km distance for a radiated power of 1 kW.

Figure No. 2 gives the maximum field expected in any horizontal direction as a function of the length of the antenna, the total power radiated being kept constant at 1 kW.

The formulae used for calculating these curves are given below. It is assumed that the antennae are on perfectly conducting ground and that one kilowatt is radiated.

1. *Uniform current element* (short vertical antenna)

   $E = 300 \cos\theta$, in mV/m at one kilometre distance where

   θ = elevation angle (latitude)

   $(Ed)_{max} = 300$ mV/m $\sqrt{P}$ $(\theta = 0^0$ on horizon$)$ $(\theta = 90^0$ in zenith$)$

2. *Quarter wave antenna*

   $$E = 313.6 \frac{\cos(90^0 \sin\theta)}{\cos\theta}$$ in mV/m at one kilometre distance

   $(Ed)_{max} = 313.6$ mV/m $\sqrt{P}$

3. .311 *wave antenna*

   $$E = 234.21 \frac{\cos(112^0 \sin\theta) + 0.3740}{\cos\theta}$$ in mV/m at one kilometre distance

   $(Ed)_{max} = 321.8$ mV/m $\sqrt{P}$

4. *Half wave antenna*.

   $$E = 190.26 \frac{\cos(180^0 \sin\theta) + 1}{\cos\theta}$$ in mV/m at one kilometre distance

   $(Ed)_{max} = 380.52$ mV/m $\sqrt{P}$

5. .625 *wave antenna*

   $$E = 261 \frac{\cos(225^0 \sin\theta) - \cos 225^0}{\cos\theta}$$ in mV/m at one kilometre distance

   $(Ed)_{max} = 445$ mV/m $\sqrt{P}$

Notes - 1. E in the above equations is the same in value as the cymomotive force expressed in volts in Figure 1

2. d is the distance (taken as 1 km in the above equations)

3. P is the transmitter power in kW fed to the input of the antenna ignoring losses along the transmission line.

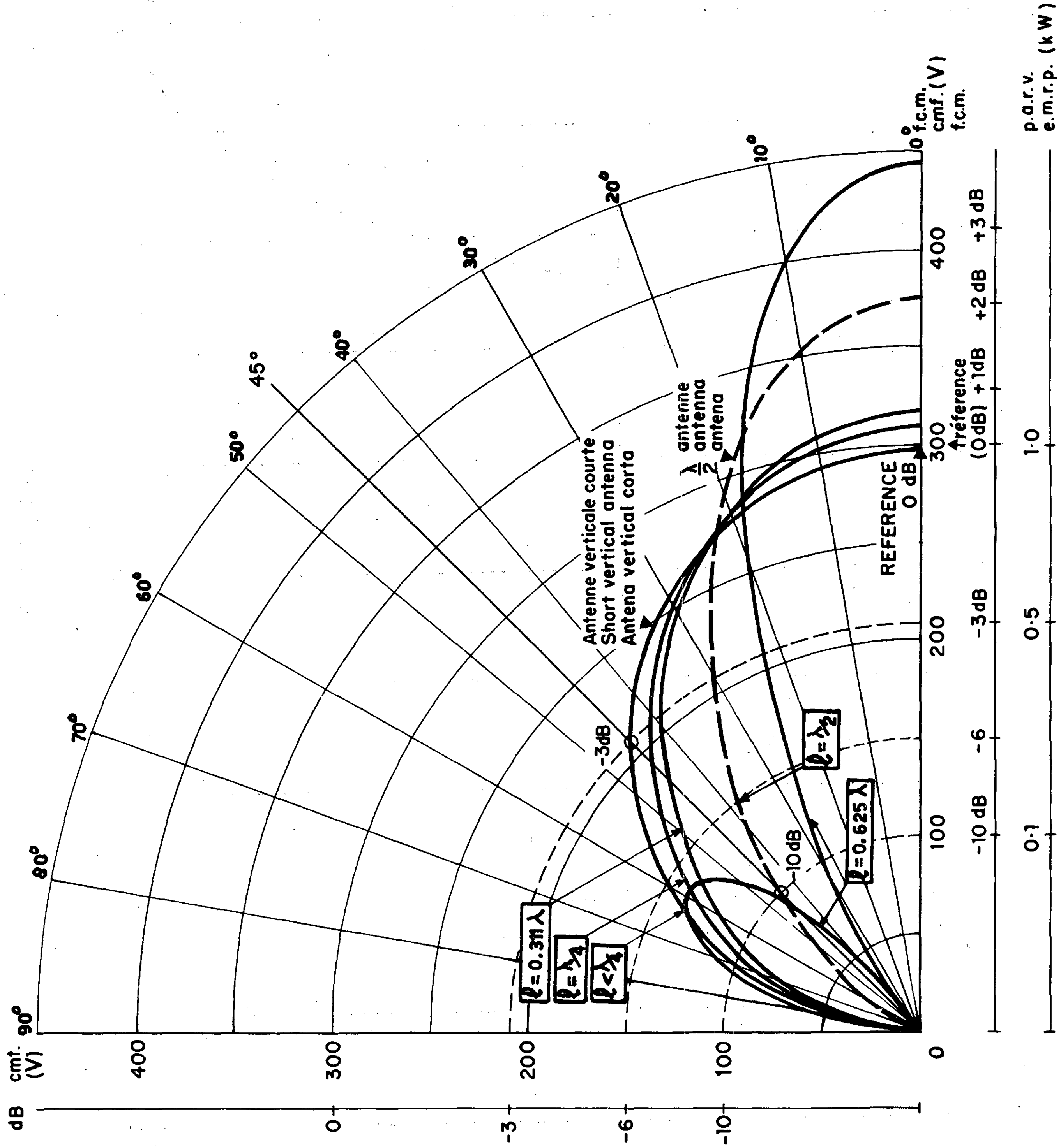


Figure 1 - Figura 1

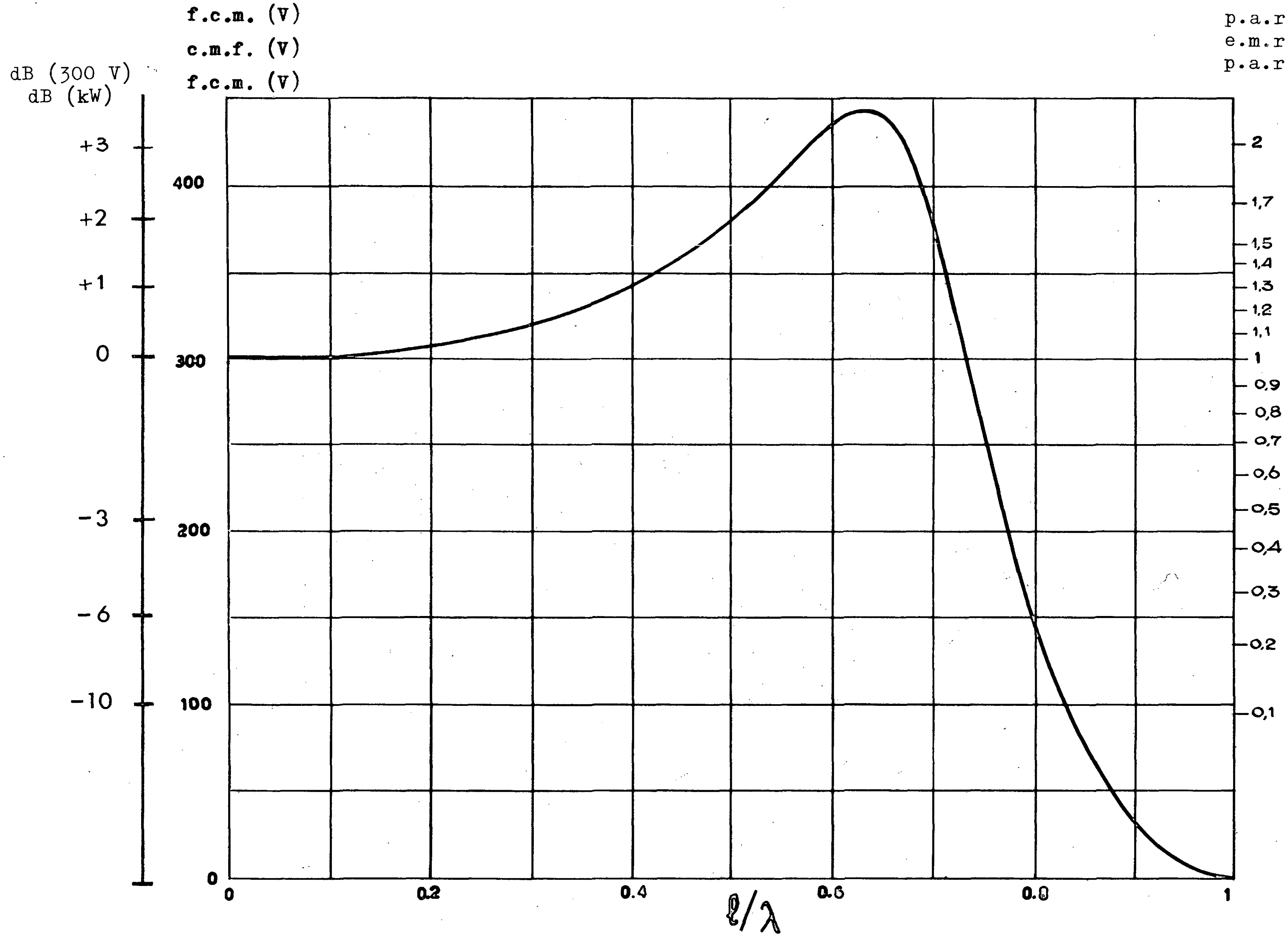


Figure 2 - Figura 2

APPENDIX G

LATTICES AND OTHER METHODS OF PLANNING

1. In a congested area, high-power stations are distributed throughout the band in virtually every channel. A planning method must be able to cope with this situation and take account of the great importance attached by various administrations to maintaining the essential form of their existing services and the need to keep the cost of any changes to a minimum.

2. There are several aspects of planning methods. It is noted that :

a) there is a minimum power level that is required to overcome noise levels,

b) there is a limitation on powers used in particular channels if they are to be used many times over in different parts of the world for different programmes.

3. World-wide, three major power categories may be distinguished - high, medium and low, with an extension upwards to super-power and an extension downwards to very low power. The power level in these three groupings varies from one congested region to another. In this context, as a generalization, low power can be defined as below 10 kW, medium power 10 kW to below 50 kW, and high power as 50 kW and above. It is noted that the maximum powers used in different parts of the world vary quite widely, but it is desirable that these maximum powers should merge smoothly from one area to another or be the same.

4. Four complementary techniques can be used to improve the efficiency of an assembly of transmitting stations :

a) The coverage of all stations can be maximized by ensuring that they all provide coverage to roughly the same usable field strength. This implies that stations of similar power should be associated in frequency blocks.

b) The coverage of all stations should be maximized by ensuring that adjacent channels do not contain stations too widely differing in power levels.

c) The systematic spacing of co-channel stations according to the power level. If account is taken of paragraph a), this leads to equilateral triangular configurations.

d) A certain minimum number of stations should be grouped in a block of channels having transmitters of similar power, such that linear channel distribution schemes can be used to arrange the adjacent channel frequencies into a pattern that minimizes adjacent channel interference.

5. The question which then arises is, can some of the above components of the full lattice grid planning method be applied to the MF band and still retain mixed transmitter powers distributed throughout it? This is indeed possible, and would give some adjacent channelling improvements. However the penalty for mixing different transmitter powers is that the lower-power stations would have to accept a higher usable field strength.

6. To improve this situation further, it could be argued that all the powers could gradually be adjusted to the same level; this would equalize the usable fields but it would mean that the powers would tend to be either too low or too high for the service required.

7. If, on the other hand, the transmitter powers were separated into different frequency blocks for each power class, each station would still be tailored to do its particular job, and the lower-power stations could then be working with much lower usable fields, with the result that their coverage would be noticeably increased. This advantage could require more frequency changes.

8. Many countries consider that, in situations where transmitters of different power levels share the same channel, the higher usable field strengths of the lower-power stations are acceptable because of the higher man-made noise levels in their service areas. In such situations, low-power transmitters can be integrated into the high-power lattice. However, it might be necessary to increase the spacing between high-power stations to accommodate this.

9. As a compromise, it might be possible to group together channels containing transmitters of similar power into blocks of, say, three channels for each power class in accordance with the requirements submitted. This idea should be applied only where practicable. Although this would be an improvement over existing mixed systems, adjacent channel interference would be present between power blocks. This may not be ideal, because it would still leave large numbers of power block transitions. However, this compromise would render larger frequency changes unnecessary.

10. A fuller application of a lattice approach could ease the adjacent channel interference problem, and the use of larger power blocks should reduce the usable field strengths. However, recognizing at least three power categories and the need to avoid placing low-power groups next to high-power groups and a minimum number of channels in a group (about 9 or 12), it will be seen that advantages cannot be gained without some frequency shifting equal to one or more block-widths.

11. As a practical approach, it may be necessary to leave the pattern of stations below a frequency of about 1 000 kHz, as it exists at present. In this part of the frequency band, a computer analysis could be carried out to see whether some minor frequency changes might produce any significant improvements.

12. Taking into account existing systems and the requirements of Administrations, a computer analysis could be carried out to show the advantages and disadvantages of the four method components outlined above, and any other methods that come to light.

13. In applying the lattice grid concepts, it should be noted that additional methods may be needed to make the results correspond more closely to the particular objectives. There may be some merit in distorting the map to take account of other factors e.g. geomagnetic characteristics. A fuller description of the lattice grid theory is given in Annex 1 to this Appendix.

14. For areas remote from regions of high population density, in which low- and medium-power stations are involved, simplified coordination procedures can be contemplated. One such method is described in Annex 2 to this Appendix.

ANNEX 1 TO APPENDIX G

FREQUENCY PLANNING METHOD FOR LF/MF BROADCASTING BASED ON GEOMETRICALLY REGULAR LATTICES AND LINEAR CHANNEL DISTRIBUTION SCHEMES

In geometrically regular lattices, it is possible to use linear channel distribution schemes in such a way that mutual interference is reduced to a minimum. In principle, the lattice consists of a sufficient number of equilateral or nearly equilateral spherical triangles having sides corresponding to the distance necessary between transmitters sharing the same channel (the co-channel distance). In the ideal case, the number C of channels available in the whole band, or, if desired, in a part of it, is evenly distributed over the surface of any pair of triangles having one side in common (a rhombus in the case of equilateral triangles). Thus, all channels used are allocated to elementary areas of identical size (see Figure 1).

In linear channel distribution schemes, channels are arranged in such a way that, in any direction considered, frequency spacings between channels allocated to equally spaced areas are constant (on the condition that channel numbers n and (C + n) are considered to be identical). The use of linear channel distribution schemes, therefore, ensures that interference conditions are identical in any channel involved throughout the network. Differences between interference in different channels are due solely to the effects of frequency on propagation. The utility of any linear channel distribution scheme can thus easily be checked by computing, for instance, the interference caused to the channel assigned to the apices of the quadrilateral. It is obvious that interference other than co-channel interference will be lowest when the relevant channels, e.g., the adjacent channels, are assigned to areas close to the centres of gravity of the two triangles constituting the equilateral. In the case of a rhombus, the distance of the centres of gravity from the apices is $1/\sqrt{3}$ times the co-channel distance.

The application of geometrically regular lattices and linear channel distribution schemes in practical planning is fairly easy. It presupposes, however, that planning is not restricted by numerous existing frequency assignments that have to be respected within very close limits. In the latter case, this planning method would not be appropriate because the adaptation of the regular lattice, including its channel distribution, to actual transmitter sites, while simultaneously respecting existing assignments, would seriously affect coverage.

In all other cases, this method would lead to satisfactory results when, by means of distortion of the regular lattice's channel positions, channels are adapted to actual transmitter sites (see Figure 2). Although it would be desirable that the distortions be small they may be quite large and numerous. The method would still be applicable in these circumstances provided that the same amount of care is exercised in these circumstances as would have been necessary if this method had not been applied. Normally, the effects of lattice distortions on interference tend to cancel each other out.

In order to facilitate the adaptation of the regular lattice channel positions to actual transmitter sites, it is useful to subdivide the planning area into quadrilaterals (of rhombic or near-rhombic shape) having sides corresponding to the predetermined co-channel distance. If different co-channel distances have to be respected in different parts of the area in question, this may well be covered by suitable adaptation of the subdividing lattice to the particular needs of any of these parts.

Should, after adequate subdivision of the planning area, one or more quadrilaterals contain a number of transmitters greater than the number C of channels available in any quadrilateral, then channels can only be assigned when the excess transmitters in the quadrilaterals are grouped together to form synchronized networks. Difficulties that would arise in cases where excess transmitters cannot be accommodated in synchronized groups would also occur if the planning procedure were not based on the method described here. Agreement will then have to be reached on either a modification of the technical parameters or a reduction in the number of requirements in the area where the difficulties occur.

It should be stressed that the planning method outlined above is primarily intended to give guidance in the planning procedure. It facilitates the assignment of frequency channels starting with the most suitable. The planning method can, however, never supersede the negotiations required between the Administrations concerned to determine the radiated power or antenna radiation patterns of the transmitters concerned.

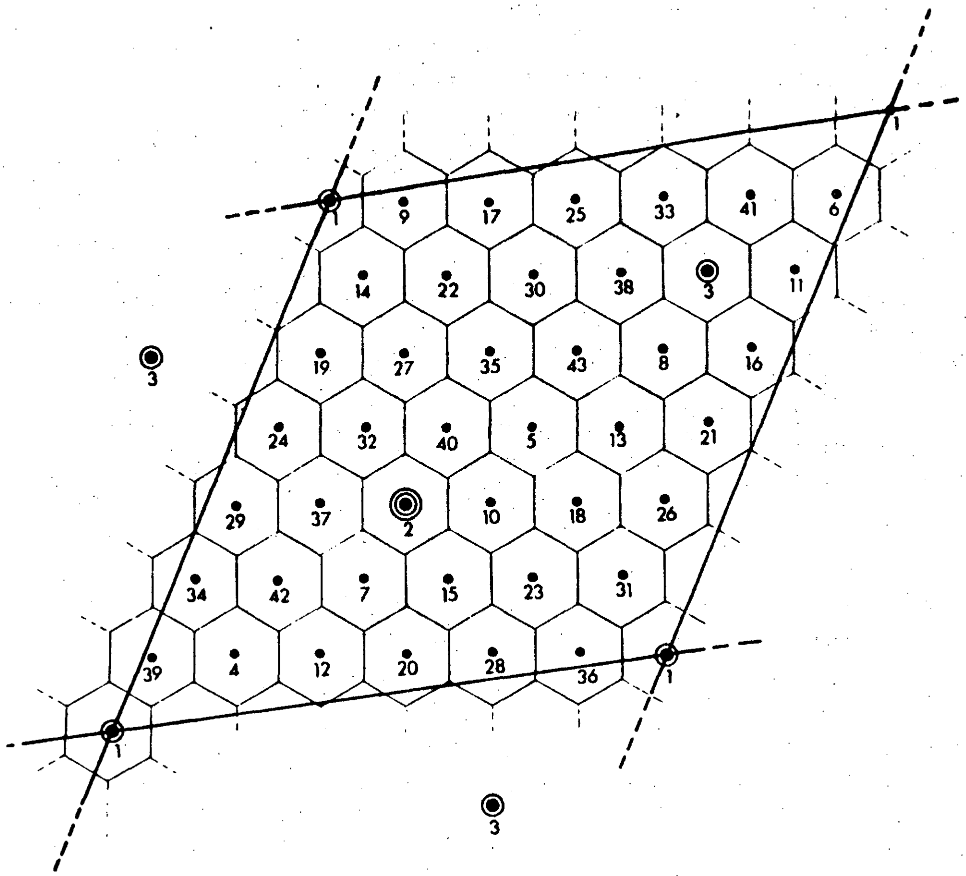


Fig. 1. - Example of a linear distribution of 43 channels.

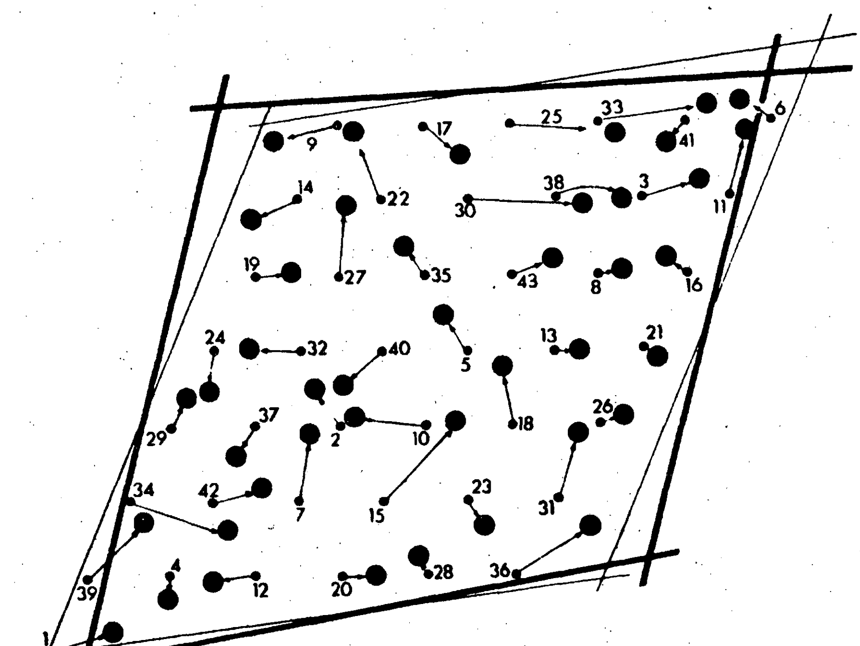


Fig. 2. - Application of a linear distribution to a network of real transmitters.

Numbered points = sites of the transmitters in the ideal network of Fig. 1

● = real positions of the transmitters

ANNEX 2 TO APPENDIX G

THE USE OF COORDINATION DISTANCES IN PLANNING

At the limits of lattice planning areas where, for instance, irregular concentrations of population exist on widely scattered islands, it would be possible to introduce the concept of coordination distances, as has been done in VHF and UHF planning.

It is obvious that if an assignment is required for a remote Pacific island, it would be illogical to develop a further series of lattices (outside the main area to be covered) just to make such an allocation fit into a particular planning pattern. It is here and in similar areas that the coordinated distance concept is applicable, providing the means by which one or a number of channels could be allocated without affecting a basic lattice plan.

The overall test of the possibility of using coordination distances is that the addition of transmitters to the overall system should not significantly change the planned operating conditions. It is considered, therefore, that where the co-channel station to be protected is situated in area A, as defined in Chapter 6, a nominal usable field strength of 66 dBμ might be considered the limiting field to which additional interference should not be added, with corresponding field strengths of 76 dBμ and 69 dBμ in areas B and C respectively.

Typical powers and distances for each of the areas concerned are given in the table below. The propagation information has been taken from C.C.I.R. Report 264-2 and, although it is appreciated that this basic information is not to be used for final planning purposes, the C.C.I.R. information is suitable for comparison purposes. It is proposed that the maximum permissible interfering field strength yielding a negligible increase in interference in the planned co-channel assignment area should be approximately - 16 dB with respect to that interference.

TABLE

Nominal usable field strength		Power	Coordination distance
Area A	66 dB(μV/m)	10 kW	3300 km
Area B	76 dB(μV/m)	10 kW	2500 km
Area C	69 dB(μV/m)	10 kW	3100 km

It is considered that transmitters meeting the above criteria should be permitted to be established on a non-interference basis.

In the case of multiple transmitters operating in such a channel, the r.m.s. power, taking into consideration any difference in distances, should be the measure of the interfering field. Obviously, lower-power transmitters might be located at shorter distances from the planned co-channel assignment.

RESOLUTION A

Relating to Bandwidth Saving Modulation Systems

The Regional Administrative LF/MF Broadcasting Conference (First Session), Geneva, 1974,

considering

a) the improved efficiency in the use of the frequency bands 5 (LF) and 6 (MF) that might be achieved by the application of bandwidth saving modulation systems;

b) the difficulties associated with transmitters and receivers, and with frequency planning if transition to bandwidth saving modulation systems is contemplated;

invites

the C.C.I.R. to expedite its studies of bandwidth saving modulation methods with particular reference to the technical, operational and economic aspects of single-sideband and independent sideband modulation, taking into account the problems of compatibility with existing receivers;

resolves

to request the next competent World Administrative Radio Conference to decide, in the light of the results of the C.C.I.R. studies, on the feasibility of introducing such techniques in the LF/MF broadcasting service.

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

RESOLUTION B

Relating to studies to be made by the International Frequency Registration Board before the Second Session of the Conference

The Regional Administrative LF/MF Broadcasting Conference (First Session), Geneva, 1974,

considering

that it is essential for the proper conduct of its Second Session on Planning that preparatory work should be carried out by the I.F.R.B. on the basis of the requirements submitted by Administrations and the standards adopted at the First Session;

invites Administrations

to submit their frequency requirements to the I.F.R.B. on the appropriate forms, a model of which is to be found in Appendix F, as soon as possible, after the end of the First Session, so that they are received by the I.F.R.B. not later than 1 May 1975;

instructs the I.F.R.B.

1. to supplement the information it receives by means of the following data:

- carrier power in dB (kW),
- cymomotive force (c.m.f.) in the horizontal plane,
- effective monopole radiated power (e.m.r.p.) in the horizontal plane,
- magnetic dip and declination and geomagnetic latitude at the transmitter;

2. to prepare a list of all the requirements it receives, supplemented by the data listed in paragraph 1 above and to send a copy to each Administration in Regions 1 and 3 not later than 1 June 1975;

3. to study the requirements it receives on the basis of the decisions taken at the First Session, proceeding as follows:

3.1 calculate provisionally, for each transmitter, the usable field strength resulting from the requirements; in cases where the Administration has not indicated a preferred frequency, it chooses the frequency it considers most suitable in the desired frequency range;

3.2 collect this information in statistical form in order to provide a summary of the situation resulting from:

3.2.1 transmitters already in service, taking into account their present frequencies and powers;

3.2.2 transmitters already in service, as in 3.2.1 above, together with those contained in the African Plan, Geneva, 1966, which are NOT in service, taking into account their frequencies and powers;

3.2.3 the total future requirements for transmitters, whether already in service or in the African Plan or not;

3.3 draw up a report containing the foregoing results and send it to all Administrations in Regions 1 and 3, preferably by 1 July 1975, and in any case not later than 15 July 1975;

3.4 make to each Administration individually whatever suggestions it sees fit with a view to eliminating any apparent incompatibilities;

4. to prepare for the Second Session of the Conference a document containing the report sent to Administrations, together with any comments it has received since sending it.

RESOLUTION C

Relating to Channel Spacing

The Regional Administrative LF/MF Broadcasting Conference (First Session), Geneva, 1974,

noting

Resolution No. 4 of the African LF/MF Broadcasting Conference, Geneva, 1966,

considering

a) that the use of a uniform channel spacing throughout Regions 1 and 3 would facilitate the use of the frequency bands allocated for broadcasting in a more rational way than at present;

b) that a majority of administrations is in favour of a plan with 9 kHz channel spacing and with carrier frequencies equal to integral multiples of 9 kHz;

c) that a substantial minority of administrations is in favour of a plan with 8 kHz channel spacing and with carrier frequencies equal to integral multiples of 8 kHz;

d) that, nevertheless, the countries of Regions 1 and 3 have agreed that a new draft plan should be prepared with 9 kHz channel spacing and with carrier frequencies equal to integral multiples of 9 kHz;

e) that the adoption of such a uniform channel spacing would mean changing the carrier frequencies of most stations in Regions 1 and 3;

f) that, although it would be desirable to have in the LF broadcasting band carrier frequencies which are integral multiples of the channel spacing, the adoption of such a relationship, and consequently the displacement of each carrier frequency (of −2 kHz), would give rise to problems with respect to sharing with other radio services;

unanimously resolves

1. that, a draft plan for broadcasting frequency assignments in the MF band for Regions 1 and 3 should be prepared by the Second Session on the basis of a uniform 9 kHz channel spacing, using the carrier frequencies listed in Annex 1;

2. that a draft plan for broadcasting frequency assignments in the LF band for Region 1 should be prepared by the Second Session on the basis of a uniform 9 kHz channel spacing,using the carrier frequencies listed in Annex 2;

3. that when the draft plan is prepared, any frequency that is already being used shall first be replaced by the frequency of the nearest new channel and subsequent changes desired should be negotiated between the administrations concerned or groups of administrations concerned during the Second Session;

4. that, however, if the majority of Administrations represented at the Second Session of the Conference, after careful examination, finds that the draft plan is unsatisfactory, the Conference may consider the possibility of preparing a plan based on a different channel spacing common to Regions 1 and 3. In this case the provision of paragraph 3 above shall also apply;

5. that the Second Session of the Conference shall adopt for the frequency changes required in Regions 1 and 3 a time table which takes into account the special conditions of the developing countries;

invites Administrations

1. to study, taking into account paragraph 8.4 of this Report, the problems of frequency sharing of the LF band allocated to the Broadcasting Service in order to make it possible to change the carrier frequencies appearing in Annex 2 to frequencies which are integral multiples of the channel spacing;

2. to submit, if necessary, proposals to this effect to the next competent World Administrative Radio Conference.

ANNEX 1 TO RESOLUTION C

UNIFORM CHANNEL SPACING OF 9 kHz IN THE MF BAND

Channel No.	Frequency (kHz)	Channel No.	Frequency (kHz)	Channel No.	Frequency (kHz)
1	531*)	41	891	81	1251
2	540	42	900	82	1260
3	549	43	909	83	1269
4	558	44	918	84	1278
5	567	45	927	85	1287
6	576	46	936	86	1296
7	585	47	945	87	1305
8	594	48	954	88	1314
9	603	49	963	89	1323
10	612	50	972	90	1332
11	621	51	981	91	1341
12	630	52	990	92	1350
13	639	53	999	93	1359
14	648	54	1008	94	1368
15	657	55	1017	95	1377
16	666	56	1026	96	1386
17	675	57	1035	97	1395
18	684	58	1044	98	1404
19	693	59	1053	99	1413
20	702	60	1062	100	1422
21	711	61	1071	101	1431
22	720	62	1080	102	1440
23	729	63	1089	103	1449
24	738	64	1098	104	1458
25	747	65	1107	105	1467
26	756	66	1116	106	1476
27	765	67	1125	107	1485
28	774	68	1134	108	1494
29	783	69	1143	109	1503
30	792	70	1152	110	1512
31	801	71	1161	111	1521
32	810	72	1170	112	1530
33	819	73	1179	113	1539
34	828	74	1188	114	1548
35	837	75	1197	115	1557
36	846	76	1206	116	1566
37	855	77	1215	117	1575
38	864	78	1224	118	1584
39	873	79	1233	119	1593
40	882	80	1242	120	1602*)

*) In planning, the provisions of Radio Regulation 116 shall apply.

ANNEX 2 TO RESOLUTION C

UNIFORM CHANNEL SPACING OF 9 kHz IN THE LF BAND

Channel No.	Frequency (kHz)
1	155*)
2	164
3	173
4	182
5	191
6	200
7	209
8	218
9	227
10	236
11	245
12	254
13	263
14	272
15	281*)

*) In planning, the provisions of Radio Regulation 116 shall apply.

RESOLUTION D

Relating to the Report of the First Session

The Regional Administrative LF/MF Broadcasting Conference (First Session), Geneva, 1974,

considering

a) that according to Administrative Council Resolution 743 the agenda of the Second Session of the Conference shall be :

" a) to consider the Report of the First Session of the Regional Administrative LF/MF Broadcasting Conference on technical and operational criteria and methods for frequency planning in the LF/MF broadcasting bands in Regions 1 and 3";

"b) on the basis of these technical and operational criteria and planning methods, to draw up an agreement and an associated frequency plan of assignments in the LF/MF broadcasting bands in Regions 1 and 3 to replace, as appropriate, existing plans for those bands";

b) that many delegations are of the opinion that the Report of the First Session should be signed only by the Chairman of the Conference, and that, on the contrary, a number of delegations feel that individual delegations should sign the Report of this Conference;

c) that compromise results were obtained after difficult discussions, due in particular to the different situations prevailing in Regions 1 and 3;

resolves

that the Second Session apply the technical and other criteria defined in the Report of the First Session;

instructs

1. the Chairman of the Conference to transmit under his signature the Report of the First Session to the Second Session of the Conference;

2. the Secretary-General to transmit the Report of the First Session to all administrations of Regions 1 and 3.

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

RECOMMENDATION AA

Relating to the Use of Synchronized Networks

The Regional Administrative LF/MF Broadcasting Conference (First Session), Geneva, 1974,

considering

that synchronized networks present considerable advantages over an equivalent single transmitter and therefore should be employed in much larger numbers in any frequency assignment plan;

that a synchronized network covers a greater area than the equivalent single transmitter; this increase, which depends on local conditions and the constitution of the network, may be large;

that the population coverage is in most cases increased to an even greater extent, since a synchronized network makes it possible to set up transmitters providing a higher field strength in the most densely populated areas; the population coverage may be more than doubled;

that subject to the rules given in Chapter 9, the interference caused by a synchronized network to signals from transmitters in the same channel or adjacent channels is practically identical to that which would be caused by the equivalent single transmitter;

that in view of the present congestion of the LF and MF bands, transmitter synchronization is one of the few ways of keeping most of the transmitters in operation in a country and reducing the number of channels required; this is a particularly important advantage;

that transmitters can be synchronized on any channel in the LF or MF bands;

that the constitution of a synchronized network may take a wide variety of forms, for example, a small number of high-power transmitters or a large number of low-power transmitters, or a combination of both types of transmitter;

that synchronization methods, which previously called for complex equipment, monitoring centres and a large number of highly skilled technicians, are nowadays simplified; indeed there is no problem at all if atomic oscillators are used since these oscillators provide a more than adequate frequency stability for many years without requiring any maintenance or supervision; various countries are already using such oscillators while others are planning to introduce them;

that the only limitation of the synchronized network is the need to broadcast the same programme; however, when transmitters are sufficiently far apart not to give rise to ground-wave interference with one another, it is not necessary to synchronize them during the day and they can then broadcast different programmes;

recommends

that in developing their broadcasting network in the LF and MF bands administrations use synchronized networks to the maximum extent possible.

Note : Additional technical information of synchronized networks will be found in C.C.I.R. Reports Nos. 459 and 616, and in E.B.U. Publication TECH 3210 "Synchronized groups of transmitters in LF and MF broadcasting".

ANNEX

LIST OF COUNTRIES WHICH PARTICIPATED IN THE FIRST SESSION

1. Delegations from countries of Regions 1 and 3

1.1 Members

Albania (People's Republic of)

Algeria (Algerian Democratic and Popular Republic)

Germany (Federal Republic of)

Saudi Arabia (Kingdom of)

Australia

Austria

Bangladesh (People's Republic of)

Belgium

Byelorussian Soviet Socialist Republic

Bulgaria (People's Republic of)

Burundi (Republic of)

Cameroon (United Republic of)

Central African Republic

China (People's Republic of)

Vatican City State

Congo (People's Republic of the)

Korea (Republic of)

Ivory Coast (Republic of the)

Dahomey (Republic of)

Denmark

Egypt (Arab Republic of)

Group of Territories represented by the French Overseas Post and Telecommunication Agency

Spain

Ethiopia

Finland

France

Gabon Republic

Gambia (Republic of the)

Greece

Hungarian People's Republic

India (Republic of)

Indonesia (Republic of)

Iran

Ireland

Italy

Japan

Jordan (Hashemite Kingdom of)

Kenya (Republic of)

Kuwait (State of)

Laos (Kingdom of)

Lesotho (Kingdom of)

Lebanon

Liberia (Republic of)

Libyan Arab Republic

Liechtenstein (Principality of)

Luxembourg

Malaysia

Malawi

Malagasy Republic

Malta

Morocco (Kingdom of)

Mauritius

Mauritania (Islamic Republic of)

Monaco

Mongolian People's Republic

Nigeria (Federal Republic of)

Norway

New Zealand

Oman (Sultanate of)

Uganda (Republic of)

Pakistan

Netherlands (Kingdom of the)

Philippines (Republic of the)

Poland (People's Republic of)

Qatar (State of)

Syrian Arab Republic

German Democratic Republic

Ukrainian Soviet Socialist Republic

Roumania (Socialist Republic of)

United Kingdom of Great Britain and Northern Ireland

Senegal (Republic of the)

Sierra Leone

Singapore (Republic of)

Sudan (Democratic Republic of the)

Sweden

Switzerland (Confederation of)

Tanzania (United Republic of)

Chad (Republic of the)

Czechoslovak Socialist Republic

Overseas Territories for the international relations of which the Government of the United Kingdom of Great Britain and Northern Ireland are responsible

Thailand

Togolese Republic

Tunisia

Turkey

Union of Soviet Socialist Republics

Viet-Nam (Republic of)

Yugoslavia (Socialist Federal Republic of)

Zaïre (Republic of)

Zambia (Republic of)

1.2 Associated Member

Papua New Guinea

2. Observer from Region 2

Brazil (Federative Republic of)

Printed in Switzerland