AGREEMENT BETWEEN THE GOVERNMENT OF THE UNITED STATES OF AMERICA AND THE GOVERNMENT OF THE UNITED MEXICAN STATES FOR THE USE OF THE BAND 1605 TO 1705 KHZ IN THE AM BROADCASTING SERVICE

The Government of the United States of America and the Government of the United Mexican States, the Parties, desiring to continue their mutual understanding and cooperation concerning AM broadcasting and recognizing the sovereign right of both countries to manage their telecommunications; taking into account the provisions of Article 31 of the International Telecommunication Convention, Nairobi, 1982, and Article 7 of the Radio Regulations (1982 Edition) considered an annex to the above-mentioned convention, and Article 7 of the 1988 Rio de Janeiro Agreement; endeavoring to protect the broadcasting stations in the two countries; and desiring to ensure efficient and equitable utilization of the frequency band 1605-1705 kHz allocated to this service; and seeking to ensure compatibility with AM broadcasting stations on 1590-1600 kHz;

Have agreed as follows:

ARTICLE 1

Definitions

1. For the purpose of this Agreement, the terms defined in the Radio Regulations (1982 Edition) shall apply except for the following specific definitions:

1.1 Administration: The Federal Communications Commission of the United States of America and the Direccion General de Normas de Sistemas de Difusion de la Secretaria de Comunicaciones y Transportes of the United Mexican States.

1.2 Agreement: This Agreement and its Annexes.

1.3 Allotment: Entry in the Plan of a broadcasting channel designated for use by an administration for the AM broadcasting service in an allotment area. Each allotment included in the Plan may be used for an assignment as specified in Articles 4 and 5 of the Agreement.

1.4 Allotment Area: Specifically defined geographical area within a country, to which a channel is allotted, as indicated in the Plan (Annex 4).

1.5 Assignment: An assignment can be classified into one of the two following categories:

(a) an allotment from the Plan that has been brought into operation;

(b) a non-allotted station that has undergone the coordination process and which fully meets the spacing requirements of Annex 2 and protects the allotments of the other administration but receives no protection from those allotments.

1.6 1986 U.S./Mexico Agreement: Agreement Between the Government of the United States of America and the Government of the United Mexican States relating to the AM Broadcasting Service in the Medium Frequency Band, Mexico City, 1986.

1.7 Plan: The Allotment Plan in Annex 4 and the associated provisions of the Agreement.

1.8 Radio Regulations: The Radio Regulations of the International Telecommunication Union (1982 Edition).

1.9 1988 Rio de Janeiro Agreement: Regional Agreement for the Use of the Band 1605-1705 kHz in Region 2, Rio de Janeiro, 1988.

1.10 Standardized Parameters: The parameters shown in Annex 2 which were used as the basis for the development of the Plan and are the standard used in determining the acceptability of an assignment.

1.11 Coordination Zone : The land area of each party included within a band of 450 km on either side of the common border and the islands located within 450 km of the nearest point of the border of the other party.

ARTICLE 2

Frequency Bands and Services

2.1 The provisions of the Agreement shall be applied to the broadcasting service in the frequency band 1605-1705 kHz. They shall also be applied to ensure compatibility between broadcasting stations in the above-noted band and in the 1585-1605 kHz band segment.

2.2 The 1605-1705 kHz band shall be used exclusively for the AM broadcasting service. However, existing non-broadcast stations (e.g., U.S. Travelers Information Stations operating on 1610 kHz) in the 1605-1705 kHz band may continue to operate on the basis of not causing interference to and not receiving protection from broadcasting stations. New or modified stations of this type that propose to operate under this provision must protect broadcast stations in accordance with the criteria in Annex 1 and are not entitled to protection from interference from broadcasting stations.

ARTICLE 3

Adoption of the Plan

3.1 Broadcasting station assignments shall be brought into service only when in conformity with the Plan and under the conditions specified in the Agreement.

3.2 The Plan was developed based upon standardized parameters given in Annex 2. The Plan appears in Annex 4 to the Agreement and consists of a table showing the allotments as defined in Article 1.

ARTICLE 4

Implementation of the Plan, Procedures for the Notification of Assignments Corresponding to the Allotment Plan and Reciprocity for Non-Allotted Stations, and Associated Coordination Procedures

4.1 To implement the Plan, an administration may at any time:

4.1.1 Make an assignment corresponding to an allotment, at a guaranteed location (see Chapter 1 of Annex 1) within the respective allotment area, with standardized parameters given in Chapter 1 of Annex 2.

4.1.2 Make an assignment corresponding to an allotment, at a guaranteed location (see Chapter 1 of Annex 1) within the respective allotment area, with non-standardized parameters, provided that adjustments are made to the proposed assignment in accordance with the terms of Chapter 3 of Annex 2 to insure that the other administration is not affected, subject to the application of the procedure contained in 4.4 of this Article.

4.1.3 Make an assignment corresponding to an allotment at a location outside the site tolerance but within 225 km of the allotment center point which meets or exceeds the separation distances of Chapter 1 of Annex 2 and the criteria of Chapter 2 of Annex 2, relative to an allotment of the other administration, subject to the application of the procedure contained in Article 5.

4.2 An administration, intending to bring into use an assignment to a station of the broadcasting service in conformity with this Agreement, shall notify that fact to the other administration and the information listed in Annex 3, first ensuring that:

4.2.1 Assignments corresponding to allotments, meet the provisions of 4.1 of this Article.

4.2.2 Assignments corresponding to non-allotted stations, which are proposed meet the provisions of Annex 2 and are coordinated under the provisions of this Article.

To insure that this Agreement provides for equitable distribution of broadcasting stations, the following provisions shall apply:

Twenty-one (21) allotments are designated for use by each administration and are specified in Annex 4.

4.3.2 Any notification by an administration for the assignment of a station which is in addition to the allotments must supply sufficient documentation to show that compliance with the following provisions has been achieved and must comply with the procedures for coordination described as follows:

4.3.2.1 The station must comply with the technical criteria for non-allotted stations specified in Chapter 1 of Annex 2.

4.3.2.2 In accordance with the principle of reciprocity an equitable opportunity for potential use by the other, non-initiating administration must be identified and submitted along with the request for coordination of the proposing administration. Equitable opportunity as used herein involves the following considerations:

-- the population of the communities must be within 20%;

at least the same amount of radiating capacity (RMS with similar number of towers);

-- For each community under consideration, equity shall be based upon the community within the border area of the notifying administration with the greatest population within a 20 kilometer radius from the center point coordinates of the specified community.

4.3.3 If after application of the procedure described in Articles 4.3.2 and 4.4, the response to the non-allotted station and the reciprocal station is positive, then both stations would be recorded as secondary entries into a Plan supplement and be protected from any subsequently notified non-allotted stations, but not be subject to protection from any of the allotment stations, except as provided in Chapter 2, Annex 2. Should the response be negative, the non-initiating administration shall provide information defining the nature of the objection.

4.4 Assignments subjected to coordination must comply with the following:

4.4.1 The administration receiving the request shall reply to the proposing administration within a period of 30 days to commence upon the date of the receipt of the request, for the purpose of affirming such proposal or to object to it, basing its reply in this latter event on the fact that the use of the allotment restricts its allotment in an undue manner.

If, for any reason the affected administration does not answer within said period, then the proposing administration will effect a new requirement in writing through the most expeditious and convenient means available for both parties, in order for the affected administration to reply within a new 30 day period to commence at the end of the first period or in any case to state whether it desires an additional term to render its answer. This additional term shall not exceed:

(a) 30 days for assignments proposing standardized parameters; or

(b) 60 days for assignments proposing non-standardized parameters.

4.4.3 In the event that the Administration being affected does not answer within the new 30 day period, nor request the additional term (either 30 or 60 days), then at the end of this last period, the proposal for amendment shall be considered to have been accepted and shall be included in the Plan.

ARTICLE 5

Procedure for the Coordination of Assignments Arising Out of Allotments Located Outside of their Site Tolerance, in Conformity With Chapter 2, Annex 2

5.1 An administration proposing to bring into use an assignment which corresponds to an allotment but is to be located outside of the prescribed siting tolerance and is also to be located within a 225 km distance from the allotment center point must meet the provisions specified in Chapter 2 of Annex 2 and shall obtain the agreement of the other administration.

5.2 The administration proposing to bring the assignment into use shall send the information listed in Annex 3 of the Agreement.

5.3 The date on which the other administration receives the request for agreement shall be considered as the date of commencement of this procedure.

5.4 The administration receiving this information shall examine it with a view to ensuring that the use of its allotment would not be adversely affected. The receiving administration may object to the proposed assignment on the basis established in this Agreement and its annexes. This will insure that the use of the allotments or assignments would not be unduly restricted.

5.5 Assignments subjected to coordination must comply with the following:

5.5.1 The administration receiving the request shall reply to the proposing administration within a period of 30 days to commence upon the date of the receipt of the request, for the purpose of affirming such proposal or to object to it, basing its reply in this latter event on the fact that the use of the allotment restricts its allotment in an undue manner.

5.5.2 If, for any reason the affected administration does not answer within said period, then the proposing administration will effect a new requirement in writing through the most expeditious and convenient means available for both parties, in order for the affected administration to reply within a new 30 day period to commence at the end of the first period or in any case to state whether it desires an additional term to render its answer. This additional term shall not exceed:

(a) 30 days for assignments proposing standardized parameters; or

(b) 60 days for assignments proposing non-standardized parameters.

5.5.3 In the event that the Administration being affected does not answer within the new 30 day period, nor request the additional term (either 30 or 60 days), then at the end of this last period, the proposal for amendment shall be considered to have been accepted and shall be included in the Plan.

ARTICLE 6

New Assignments Not Corresponding to Allotments

No stations will be assigned that do not correspond to an allotment until two years from the date of signing of this Agreement.

ARTICLE 7

Requirements to Ensure Compatibility Between Broadcasting Assignments and Allotments in the Adjacent Bands 1585-1605 kHz and 1605-1705 kHz

7.1 Proposed assignments on 1610 or 1620 kHz shall provide protection to assignments on 1590 and 1600 kHz using the technical criteria of the 1986 U.S./Mexico Agreement.

7.2 Proposed assignments on 1590 or 1600 kHz shall provide protection to assignments on 1610 and 1620 kHz using the technical criteria of the 1986 U.S./Mexico Agreement.

7.3 Groundwave field strength calculations shall be based on Graph 19 in the 1986 U.S./Mexico Agreement for assignments on 1590 to 1600 kHz and on either Figure 2.1 or the associated Tables in Annex 1 to this Agreement for assignments on 1610 to 1620 kHz.

ARTICLE 8

Resolution of Conflicts

In the case of any discrepancy between the provisions of this Agreement and the provisions of other bilateral or regional agreements relating to broadcasting in the frequency band 1605-1705 kHz, the provisions of this Agreement will prevail in regard to mutual relations between the two Parties.

ARTICLE 9

Amendment of Agreement and the Annexes

This Agreement may be amended by agreement of the Parties. Amendments shall enter into force on the date on which both Parties have notified each other by exchange of diplomatic notes that they have complied with the requirements of their respective national legislation. The Annexes hereto may also be amended by exchange of letters directly between the administrations. The adoption of such amendments shall be notified to the Department of State of the

United States of America and the Secretariat of External Relations of the United Mexican States by the administration of each country.

ARTICLE 10

Entry into Force and Duration of the Agreement

This Agreement shall enter into force on the date on which both Parties have notified each other by exchange of diplomatic notes that they have complied with the requirements of their respective national legislation. It shall remain in force until it is replaced by a new agreement or until it is terminated by either Party in accordance with Article 11 of this Agreement.

ARTICLE 11

Termination of the Agreement

This Agreement may be terminated by mutual agreement of the Parties or by either Party by a written notice of termination to the other Party through diplomatic channels. Such notice of termination shall enter into effect one year after receipt of the notice.

IN WITNESS WHEREOF, the respective representatives have signed the present Agreement.

DONE in the city of Queretaro, Mexico, this eleventh day of the month of August of the year nineteen hundred and ninety two, in duplicate, in the English and Spanish languages, both texts being equally authentic.

FOR THE GOVERNMENT OF THE UNITED STATES OF AMERICA:	FOR THE GOVERNMENT OF THE UNITED MEXICAN STATES:

ANNEX 1

Technical data to be used in the application of the Agreement

CHAPTER 1

DEFINITIONS, SYMBOLS AND UNITS

1.1 Definitions

The following definitions and symbols are in addition to or supersede those given in the Radio Regulations (1982 Edition) and supplement those given in the Agreement.

1.1.1 Broadcasting channel (AM)

A part of the frequency spectrum, equal to the necessary bandwidth of AM sound broadcasting stations, and characterized by the nominal value of the carrier frequency located at its center.

1.1.2 Audio-frequency (AF) signal-to-interference ratio

The ratio (expressed in decibels) between the values of the voltage of the wanted signal and the voltage of the interfering signal, measured under specified conditions, at the audio-frequency output of the receiver. These specified conditions include various parameters such as the frequency separation between the wanted carrier and the interfering carrier, the emission characteristics (type and percentage of modulation, etc.), levels of input and output of the receiver and its characteristics (selectivity, sensitivity to intermodulation, etc.).

Equivalent Protection

An adjustment in the facilities of an assignment required in order to insure that allotments or assignments of the other administration are protected to at least the equivalent of an assignment that is spaced the standard distance and that operates with standard facilities.

1.1.4 Daytime operation

Operation between the times of sunrise and sunset at the transmitter site.

1.1.5 Nighttime operation

Operation between the times of sunset and sunrise at the transmitter site.

1.1.6 Station power

Unmodulated carrier power supplied to the antenna.

1.1.7 Groundwave

Electromagnetic wave which is propagated along or near the surface of the earth and which has not been reflected by the ionosphere.

1.1.8 Skywave

Electromagnetic wave which has been reflected by the ionosphere.

1.1.9 Skywave field strength, 50% of the time

The skywave field strength during the reference hour which is exceeded for 50% of the nights of the year. The reference hour is the period of one hour beginning one and a half hours after sunset and ending two and a half hours after sunset at the midpoint of the short great-circle path.

1.1.10 Standard Facilities

The station parameters mutually agreed to be those which provide the proper balance between service and interference for operations in this frequency band and that were used to create the Plan of Allotments. They are used as a reference when examining proposed assignments for possible departure from the basic protection principles established in the Plan. For the purposes of this Agreement, they are: power of 10 kW day, 1 kW night; non-directional antenna, 90 electrical degrees in height, with a ground system of 120 radials, 90 electrical degrees in length.

1.1.11 Standard Allotment Spacings

The distances mutually agreed to be those that provide the proper balance between service and interference for operations in this frequency band and that were used to create the Plan of Allotments. Used in conjunction with Standard Facilities (1.1.10), they provide a reference for the examination of proposed assignment for possible departure from the basic protection principle established in the Plan. For the purposes of this Agreement, they are:

Co-channel: 450 kilometers
First Adjacent Channel: 80 kilometers
Second Adjacent Channel: 53 kilometers

1.1.12 Siting Tolerance

The distance an assignment (using standard facilities) may be located from a reference point corresponding to an allotment in the Plan. This distance is a maximum of 45 km in all directions from the coordinates given in the Plan of Allotments. Since there may be instances where the use of siting tolerance may significantly alter the protection principles of the Plan, the following minimum separations shall apply:

Co-channel: 360 kilometers
First Adjacent Channel: 64 kilometers
Second Adjacent Channel: 42 kilometers

When, because of the requirement of an administration to utilize the siting tolerance provision to locate an assignment, the resultant separation between allotments of the two administration is less than a standard allotment spacing, the administration making the initial assignment relative to an unused allotment of the other administration under this circumstance shall not locate its assignment at any point that results in any spacing less than:

Co-channel: 405 km
First adjacent channel: 72 km
Second adjacent channel: 47.5 km

1.1.13 Characteristic field strength (E_c)

The field strength (at a reference distance of 1 km in a horizontal direction) of the groundwave propagated along perfectly conducting ground for 1 kW station power, taking into account losses associated with a standardized operating antenna.

Note 1 - The gain (G) of the transmitting antenna relative to an ideal short vertical antenna is given in dB by the equation:

$$G = 20 \log \frac{E_c}{300}$$

where: E_c is expressed in mV/m.

Note 2 - The effective monopole radiated power (e.m.r.p.) is given in dB (kW) by the following equation:

$$e.m.r.p. = 10 \log P_t + G$$

where: P_t is station power (kW).

1.1.14 Guaranteed Location

An allotment that is converted into an assignment and conforms to the standard parameters and is within the siting tolerance (1.1.12). Other locations are permitted in conformity with the provisions of Chapter 2, Annex 2.

1.2 Symbols and units

Hz:	Hertz
kHz:	kilohertz
W:	Watt
kW:	kilowatt
mV/m:	millivolt/meter
μV/m:	microvolt/meter
dB:	decibel
dB(μV/m):	decibels with respect to 1 μV/m
dBW:	decibels with respect to 1 Watt
dB(kW):	decibels with respect to 1 kW
mS/m:	millisiemens/meter
σ:	ground conductivity

CHAPTER 2

PROPAGATION

2.1 Groundwave propagation

2.1.1 Ground conductivity

When required in the application of Annex 2 for groundwave propagation calculations in the band 1605-1705 kHz, use shall be made of the current edition of the Atlas of Ground Conductivity as described in the 1986 U.S./Mexico Agreement.

2.1.2 Field strength curves for groundwave propagation

The curves shown in Figure 2.1 shall be used for determining groundwave propagation in the frequency range 1605-1705 kHz; these curves are computed for 1655 kHz.

The curves are labelled with ground conductivities in millisiemens/meter. All curves, except the 5000 mS/m (sea water) curve, are derived for a relative dielectric constant of 15. The sea water curve is derived for a relative dielectric constant of 80.

2.1.3 Calculation of groundwave field strength

When necessary, using the Atlas of Ground Conductivity, the relevant conductivity or conductivities for the chosen path are determined. If only one conductivity is representative, the method for homogeneous paths is used. If several conductivities are involved, the method for non-homogeneous paths is used.

2.1.3.1 Homogeneous paths

The vertical component of the field strength for a homogeneous path is represented in Figure 2.1 as a function of distance, for various values of ground conductivity.

The distance in kilometers is shown on a logarithmic scale on the abscissa. The field strength is shown on a linear scale on the ordinate in decibels above 1 µV/m. The graph is standardized for a characteristic field strength of 100 mV/m corresponding to an effective monopole radiated power (e.m.r.p.) of -9.5 dB relative to 1 kW. The straight line marked "100 mV/m at 1 km" is the field strength on the assumption that the antenna is erected on a surface of perfect conductivity.

For omnidirectional antenna systems having a different characteristic field strength, correction must be made according to either of the following equations:

$$E = E_0 \times \frac{E_c}{100} \times \sqrt{P}$$

if field strengths are expressed in mV/m, or:

$$E = E_0 + E_c - 100 + 10\log P$$

if field strengths are expressed in dB (µV/m)

For directional antenna systems, correction must be made according to either of the following equations:

$$E = E_0 \times \frac{E_R}{100}$$

if field strengths are expressed in mV/m, or:

$$E = E_0 + E_R - 100$$

if field strengths are expressed in dB (µV/m),

where:

E : resulting field strength
E_0 : field strength read from Figure 2.1
E_R : actual field strength at a particular azimuth at 1 km
E_c : characteristic field strength
P : station power in kW.

Figure 2.2 consists of a pair of scales to be used with Figure 2.1. One scale is labelled in decibels and another in millivolts per meter and can be cut out and trimmed as a unit to be used as sliding ordinate scales. The scales allow graphical conversion between decibels and millivolts per meter, and are used to make graphical determinations of field strengths. Other methods of making calculations on Figure 2.1 may be used, including the use of dividers to adjust for values of E_R that differ from 100 mV/m at 1 km. However, any method used will follow steps similar to those described below.

For both omnidirectional and directional antenna systems the value of

E_R must be found. For omnidirectional systems, E_R can be determined by using either of the following equations:

$$E_R = E_c\sqrt{P}$$

if field strengths are expressed in mV/m, or:

$$E_R = E_c + 10\log P$$

if field strengths are expressed in dB (μV/m)

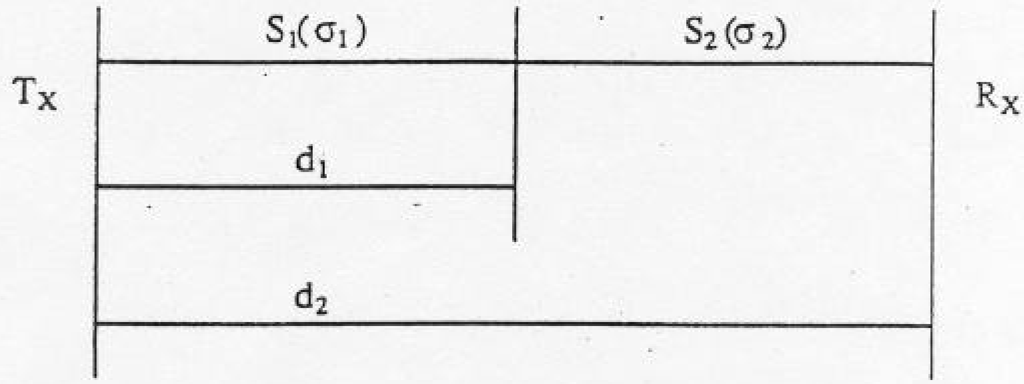
To determine the field strength at a given distance, the scale is placed at that distance with the 100 dB(μV/m) point of the scale resting on the appropriate conductivity curve. The value of E_R is then found on the scale and the point on the underlying graph (which lies underneath the E_R point of the scale) yields the field strength at the given distance.

To determine the distance at a given field strength, the E_R value is found on the sliding scale and that point is placed directly at the level of the given field strength on the graph. The scale is then moved horizontally until the 100 dB(μV/m) point of the scale coincides with the applicable conductivity curve. The distance may then be read from the abscissa of the graph.

2.1.3.2 Non-homogeneous paths

In this case, the equivalent distance or Kirke method shall be used. To apply this method, Figure 2.1 can also be used.

Consider a path whose sections S_1 and S_2 have lengths d_1 and $(d_2 - d_1)$, and conductivities σ_1 and σ_2 respectively, as shown on the following figure:



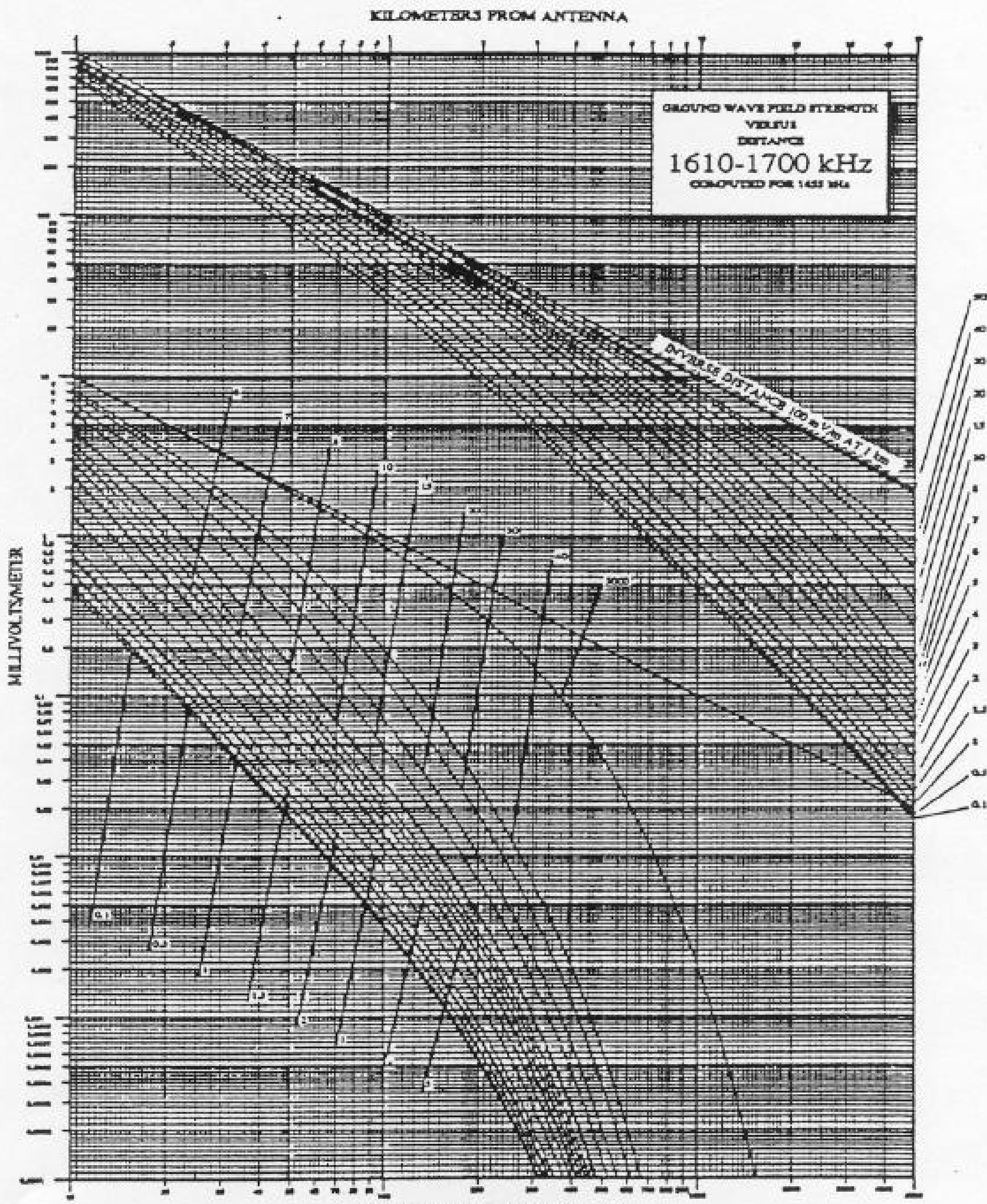
The method is applied as follows:

a) taking section S_1 first, we read the field strength corresponding to conductivity σ_1 at distance d_1 on Figure 2.1;

b) as the field strength remains constant at the point of discontinuity, the value immediately after the discontinuity must be equal to that obtained in a) above. As the conductivity of the second section is σ_2, the curve corresponding to conductivity σ_2 gives the equivalent distance to that which would be obtained at the same field strength arrived at in a). This equivalent distance is d. Distance d is larger than d_1 when σ_2 is larger than σ_1. Otherwise d is less than d_1;

c) the field strength at the real distance d_2 is determined by taking the corresponding curve for conductivity σ_2 and reading off the field strength obtained at the equivalent distance $d + (d_2 - d_1)$;

d) for successive sections with different conductivities, procedures b) and c) are repeated.



KILOMETERS FROM ANTENNA
FIGURE 2.1

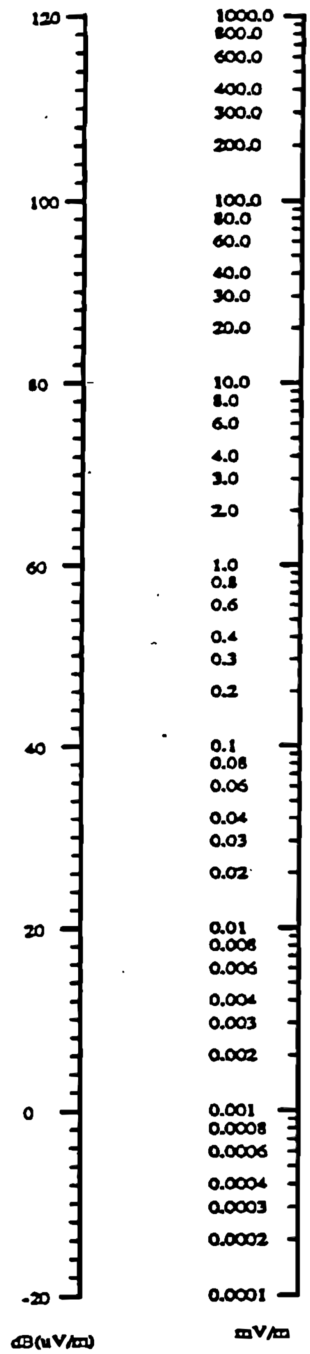


FIGURE / FIGURA 2.2

Table 2.I - Groundwave Field Strength
Cuadro 2.I - Tablas de la Intensidad de Campo de la onda de Superficie

Frequency: 1655 kHz Soil Conductivity: .1 Dielectric Constant: 15
Frecuencia: 1655 kHz Conductividad Del Suelo: .1 Constante Dielectrica: 15

Distancia Distancia (km)	Upper Curves Curvas Superiores (mV/m)	(dBu)	Distance Distancia (km)	Lower Curves Curvas Bajas (mV/m)	(dBu)
0.1000	671.5292	116.5413	10.0000	0.4558	53.1759
0.1333	473.8304	113.5125	13.3400	0.2569	48.1936
0.1778	331.0027	110.3966	17.7800	0.1442	43.1790
0.2371	228.8721	107.1919	23.7100	0.0804	38.1082
0.3162	156.3652	103.8828	31.6200	0.0446	32.9771
0.4217	105.4046	100.4572	42.1700	0.0244	27.7616
0.5623	70.0206	96.9045	56.2300	0.0132	22.4233
0.7499	45.7504	93.2079	74.9900	0.0070	16.8887
1.0000	29.3740	89.3593	100.0000	0.0036	11.0480
1.3330	18.5234	85.3544	133.3500	0.0017	4.7405
1.7780	11.4482	81.1747	177.8300	0.0008	-2.2950
2.3710	6.9455	76.8341	237.1400	0.0003	-10.4474
3.1620	4.1385	72.3368	316.2300	0.0001	-20.2974
4.2170	2.4264	67.6994	421.7000	0.0000	-32.6703
5.6230	1.4039	62.9465	562.3400	0.0000	-48.6601
7.4990	0.8032	58.0967	749.8900	0.0000	-69.6169
10.0000	0.4558	53.1759	1000.0000	0.0000	-97.1934
13.3400	0.2569	48.1936	1333.5200	0.0000	-133.5566
17.7800	0.1442	43.1790	1778.2800	0.0000	-181.6306
23.7100	0.0804	38.1082	2371.3701	0.0000	-245.3206
31.6200	0.0446	32.9771	3162.2800	0.0000	-329.8369
42.1700	0.0244	27.7616			
56.2300	0.0132	22.4233			
74.9900	0.0070	16.8887			
100.0000	0.0036	11.0480			

Frequency: 1655 kHz Soil Conductivity: .5 Dielectric Constant: 15
Frecuencia: 1655 kHz Conductividad Del Suelo: .5 Constante Dielectrica: 15

Distancia Distancia (km)	Upper Curves Curvas Superiores (mV/m)	(dBu)	Distance Distancia (km)	Lower Curves Curvas Bajas (mV/m)	(dBu)
0.1000	710.0494	117.0258	10.0000	0.4966	53.9199
0.1333	504.4378	114.0562	13.3400	0.2777	48.8726
0.1778	354.9733	111.0039	17.7800	0.1550	43.8047
0.2371	247.3473	107.8661	23.7100	0.0860	38.6914
0.3162	170.3385	104.6263	31.6200	0.0475	33.5277
0.4217	115.7451	101.2701	42.1700	0.0260	28.2880
0.5623	77.4844	97.7843	56.2300	0.0140	22.9321
0.7499	50.9845	94.1488	74.9900	0.0074	17.3850
1.0000	32.9272	90.3511	100.0000	0.0038	11.5363
1.3330	20.8506	86.3824	133.3500	0.0018	5.2240
1.7780	12.9116	82.2196	177.8300	0.0008	-1.8133
2.3710	7.8280	77.8730	237.1400	0.0003	-9.9650
3.1620	4.6482	73.3457	316.2300	0.0001	-19.8117
4.2170	2.7092	68.6567	421.7000	0.0000	-32.1788
5.6230	1.5554	63.8369	562.3400	0.0000	-48.1604
7.4990	0.8824	58.9130	749.8900	0.0000	-69.1060
10.0000	0.4966	53.9199	1000.0000	0.0000	-96.6677
13.3400	0.2777	48.8726	1333.5200	0.0000	-133.0111
17.7800	0.1550	43.8047	1778.2800	0.0000	-181.0588
23.7100	0.0860	38.6914	2371.3701	0.0000	-244.7138
31.6200	0.0475	33.5277	3162.2800	0.0000	-329.1833
42.1700	0.0260	28.2880			
56.2300	0.0140	22.9321			
74.9900	0.0074	17.3850			
100.0000	0.0038	11.5363			

Frequency: 1655 kHz Soil Conductivity: 1 Dielectric Constant: 15
Frecuencia: 1655 kHz Conductividad Del Suelo: 1 Constante Dielectrica: 15

Distancia Distancia (km)	Upper Curves Curvas Superiores (mV/m)	(dBu)	Distance Distancia (km)	Lower Curves Curvas Bajas (mV/m)	(dBu)
0.1000	764.5436	117.6680	10.0000	0.5940	55.4756
0.1333	548.5934	114.7850	13.3400	0.3289	50.3422
0.1778	390.3278	111.8286	17.7800	0.1820	45.2017
0.2371	275.2793	108.7955	23.7100	0.1004	40.0310
0.3162	192.0558	105.6685	31.6200	0.0551	34.8244
0.4217	132.3149	102.4322	42.1700	0.0300	29.5535
0.5623	89.8530	99.0706	56.2300	0.0162	24.1757
0.7499	59.9798	95.5601	74.9900	0.0085	18.6141
1.0000	39.2765	91.8827	100.0000	0.0043	12.7568
1.3330	25.1829	88.0221	133.3500	0.0021	6.4412
1.7780	15.7528	83.9472	177.8300	0.0009	-0.5949
2.3710	9.6145	79.6585	237.1400	0.0004	-8.7408
3.1620	5.7225	75.1517	316.2300	0.0001	-18.5770
4.2170	3.3275	70.4424	421.7000	0.0000	-30.9281
5.6230	1.8979	65.5656	562.3400	0.0000	-46.8876
7.4990	1.0666	60.5597	749.8900	0.0000	-67.8037
10.0000	0.5940	55.4756	1000.0000	0.0000	-95.3262
13.3400	0.3289	50.3422	1333.5200	0.0000	-131.6174
17.7800	0.1820	45.2017	1778.2800	0.0000	-179.5953
23.7100	0.1004	40.0310	2371.3701	0.0000	-243.1573
31.6200	0.0551	34.8244	3162.2800	0.0000	-327.5029
42.1700	0.0300	29.5535			
56.2300	0.0162	24.1757			
74.9900	0.0085	18.6141			
100.0000	0.0043	12.7568			

Frequency: 1655 kHz Soil Conductivity: 1.5 Dielectric Constant: 15
Frecuencia: 1655 kHz Conductividad Del Suelo: 1.5 Constante Dielectrica: 15

Distancia Distancia (km)	Upper Curves Curvas Superiores (mV/m)	(dBu)	Distance Distancia (km)	Lower Curves Curvas Bajas (mV/m)	(dBu)
0.1000	812.9316	118.2011	10.0000	0.7357	57.3341
0.1333	588.5620	115.3958	13.3400	0.4033	52.1132
0.1778	423.0358	112.5275	17.7800	0.2212	46.8945
0.2371	301.7650	109.5934	23.7100	0.1211	41.6613
0.3162	213.2272	106.5769	31.6200	0.0661	36.4085
0.4217	148.9773	103.4624	42.1700	0.0359	31.1047
0.5623	102.7256	100.2336	56.2300	0.0193	25.7045
0.7499	69.7023	96.8649	74.9900	0.0101	20.1287
1.0000	46.4257	93.3352	100.0000	0.0052	14.2640
1.3330	30.2776	89.6224	133.3500	0.0025	7.9467
1.7780	19.2480	85.6877	177.8300	0.0011	0.9143
2.3710	11.9126	81.5201	237.1400	0.0004	-7.2224
3.1620	7.1634	77.1024	316.2300	0.0001	-17.0433
4.2170	4.1869	72.4380	421.7000	0.0000	-29.3724
5.6230	2.3866	67.5555	562.3400	0.0000	-45.3015
7.4990	1.3333	62.4983	749.8900	0.0000	-66.1772
10.0000	0.7357	57.3341	1000.0000	0.0000	-93.6458
13.3400	0.4033	52.1132	1333.5200	0.0000	-129.8651
17.7800	0.2212	46.8945	1778.2800	0.0000	-177.7473
23.7100	0.1211	41.6613	2371.3701	0.0000	-241.1815
31.6200	0.0661	36.4085	3162.2800	0.0000	-325.3567
42.1700	0.0359	31.1047			
56.2300	0.0193	25.7045			
74.9900	0.0101	20.1287			
100.0000	0.0052	14.2640			

Frequency: 1655 kHz Soil Conductivity: 2 Dielectric Constant: 15
Frecuencia: 1655 kHz Conductividad Del Suelo: 2 Constante Dielectrica: 15

Distancia Distancia (km)	Upper Curves Curvas Superiores (mV/m)	(dBu)	Distance Distancia (km)	Lower Curves Curvas Bajas (mV/m)	(dBu)
0.1000	850.6132	118.5946	10.0000	0.9136	59.2151
0.1333	620.1671	115.8502	13.3400	0.4963	53.9141
0.1778	449.3580	113.0518	17.7800	0.2696	48.6143
0.2371	323.5117	110.1978	23.7100	0.1464	43.3137
0.3162	231.0124	107.2727	31.6200	0.0795	38.0108
0.4217	163.3427	104.2620	42.1700	0.0430	32.6719
0.5623	114.1537	101.1498	56.2300	0.0230	27.2483
0.7499	78.6225	97.9109	74.9900	0.0121	21.6579
1.0000	53.2296	94.5231	100.0000	0.0062	15.7863
1.3330	35.3246	90.9616	133.3500	0.0030	9.4680
1.7780	22.8635	87.1828	177.8300	0.0013	2.4405
2.3710	14.3997	83.1671	237.1400	0.0005	-5.6854
3.1620	8.7946	78.8844	316.2300	0.0002	-15.4888
4.2170	5.2012	74.3221	421.7000	0.0000	-27.7928
5.6230	2.9830	69.4931	562.3400	0.0000	-43.6876
7.4990	1.6658	64.4325	749.8900	0.0000	-64.5173
10.0000	0.9136	59.2151	1000.0000	0.0000	-91.9247
13.3400	0.4963	53.9141	1333.5200	0.0000	-128.0625
17.7800	0.2696	48.6143	1778.2800	0.0000	-175.8360
23.7100	0.1464	43.3137	2371.3701	0.0000	-239.1254
31.6200	0.0795	38.0108	3162.2800	0.0000	-323.1073
42.1700	0.0430	32.6719			
56.2300	0.0230	27.2483			
74.9900	0.0121	21.6579			
100.0000	0.0062	15.7863			

Frequency: 1655 kHz Soil Conductivity: 3 Dielectric Constant: 15
Frecuencia: 1655 kHz Conductividad Del Suelo: 3 Constante Dielectrica: 15

Distancia Distancia (km)	Upper Curves Curvas Superiores (mV/m)	(dBu)	Distance Distancia (km)	Lower Curves Curvas Bajas (mV/m)	(dBu)
0.1000	899.6621	119.0816	10.0000	1.3522	62.6210
0.1333	661.9413	116.4164	13.3400	0.7268	57.2287
0.1778	484.7718	113.7107	17.7800	0.3882	51.7822
0.2371	353.3743	110.9647	23.7100	0.2074	46.3371
0.3162	256.0190	108.1654	31.6200	0.1112	40.9212
0.4217	184.0981	105.3010	42.1700	0.0596	35.5044
0.5623	131.1906	102.3581	56.2300	0.0317	30.0297
0.7499	92.4078	99.3142	74.9900	0.0166	24.4083
1.0000	64.1852	96.1487	100.0000	0.0084	18.5218
1.3330	43.8391	92.8372	133.3500	0.0041	12.2016
1.7780	29.2916	89.3349	177.8300	0.0018	5.1845
2.3710	19.0858	85.6142	237.1400	0.0007	-2.9184
3.1620	12.0665	81.6316	316.2300	0.0002	-12.6851
4.2170	7.3708	77.3503	421.7000	0.0001	-24.9362
5.6230	4.3393	72.7485	562.3400	0.0000	-40.7588
7.4990	2.4610	67.8223	749.8900	0.0000	-61.4919
10.0000	1.3522	62.6210	1000.0000	0.0000	-88.7709
13.3400	0.7268	57.2287	1333.5200	0.0000	-124.7374
17.7800	0.3882	51.7822	1778.2800	0.0000	-172.2825
23.7100	0.2074	46.3371	2371.3701	0.0000	-235.2672
31.6200	0.1112	40.9212	3162.2800	0.0000	-318.8431
42.1700	0.0596	35.5044			
56.2300	0.0317	30.0297			
74.9900	0.0166	24.4083			
100.0000	0.0084	18.5218			

Frequency: 1655 kHz Soil Conductivity: 4 Dielectric Constant: 15
Frecuencia: 1655 kHz Conductividad Del Suelo: 4 Constante Dielectrica: 15

Distancia Distancia (km)	Upper Curves Curvas Superiores (mV/m)	(dBu)	Distance Distancia (km)	Lower Curves Curvas Bajas (mV/m)	(dBu)
0.1000	927.6260	119.3475	10.0000	1.8597	65.3888
0.1333	686.0919	116.7276	13.3400	1.0040	60.0347
0.1778	505.5796	114.0758	17.7800	0.5317	54.5140
0.2371	371.2528	111.3934	23.7100	0.2798	48.9375
0.3162	271.3192	108.6696	31.6200	0.1479	43.3965
0.4217	197.1216	105.8947	42.1700	0.0784	37.8892
0.5623	142.1974	103.0578	56.2300	0.0415	32.3554
0.7499	101.6199	100.1396	74.9900	0.0216	26.6991
1.0000	71.7984	97.1223	100.0000	0.0110	20.7955
1.3330	50.0283	93.9843	133.3500	0.0053	14.4721
1.7780	34.2129	90.6838	177.8300	0.0024	7.4646
2.3710	22.8914	87.1934	237.1400	0.0009	-0.6161
3.1620	14.9058	83.4671	316.2300	0.0003	-10.3467
4.2170	9.3959	79.4588	421.7000	0.0001	-22.5457
5.6230	5.7063	75.1271	562.3400	0.0000	-38.2969
7.4990	3.3249	70.4355	749.8900	0.0000	-58.9346
10.0000	1.8597	65.3888	1000.0000	0.0000	-86.0866
13.3400	1.0040	60.0347	1333.5200	0.0000	-121.8839
17.7800	0.5317	54.5140	1778.2800	0.0000	-169.2034
23.7100	0.2798	48.9375	2371.3701	0.0000	-231.8872
31.6200	0.1479	43.3965	3162.2800	0.0000	-315.0618
42.1700	0.0784	37.8892			
56.2300	0.0415	32.3554			
74.9900	0.0216	26.6991			
100.0000	0.0110	20.7955			

Frequency: 1655 kHz Soil Conductivity: 5 Dielectric Constant: 15
Frecuencia: 1655 kHz Conductividad Del Suelo: 5 Constante Dielectrica: 15

Distancia Distancia (km)	Upper Curves Curvas Superiores (mV/m)	(dBu)	Distance Distancia (km)	Lower Curves Curvas Bajas (mV/m)	(dBu)
0.1000	944.7784	119.5066	10.0000	2.3882	67.5613
0.1333	701.0363	116.9148	13.3400	1.3101	62.3459
0.1778	518.5879	114.2964	17.7800	0.6959	56.8504
0.2371	382.5627	111.6541	23.7100	0.3629	51.1951
0.3162	281.1319	108.9782	31.6200	0.1891	45.5343
0.4217	205.6088	106.2608	42.1700	0.0991	39.9237
0.5623	149.5051	103.4931	56.2300	0.0520	34.3234
0.7499	107.8709	100.6581	74.9900	0.0270	28.6270
1.0000	77.0973	97.7408	100.0000	0.0137	22.7035
1.3330	54.4661	94.7225	133.3500	0.0066	16.3752
1.7780	37.8665	91.5651	177.8300	0.0029	9.3757
2.3710	25.8339	88.2438	237.1400	0.0012	1.3158
3.1620	17.2073	84.7143	316.2300	0.0004	-8.3805
4.2170	11.1294	80.9294	421.7000	0.0001	-20.5294
5.6230	6.9506	76.8404	562.3400	0.0000	-36.2121
7.4990	4.1656	72.3936	749.8900	0.0000	-56.7581
10.0000	2.3882	67.5613	1000.0000	0.0000	-83.7880
13.3400	1.3101	62.3459	1333.5200	0.0000	-119.4227
17.7800	0.6959	56.8504	1778.2800	0.0000	-166.5252
23.7100	0.3629	51.1951	2371.3701	0.0000	-228.9198
31.6200	0.1891	45.5343	3162.2800	0.0000	-311.7086
42.1700	0.0991	39.9237			
56.2300	0.0520	34.3234			
74.9900	0.0270	28.6270			
100.0000	0.0137	22.7035			

Table 2.I (Continued)
Cuadro 2.I (Continuacion)

Frequency: 1655 kHz Soil Conductivity: 6 Dielectric Constant: 15
Frecuencia: 1655 kHz Conductividad Del Suelo: 6 Constante Dielectrica: 15

Distancia Distancia (km)	Upper Curves Curvas Superiores (mV/m)	(dBu)	Distance Distancia (km)	Lower Curves Curvas Bajas (mV/m)	(dBu)
0.1000	956.0600	119.6097	10.0000	2.9030	69.2569
0.1333	710.9257	117.0365	13.3400	1.6267	64.2261
0.1778	527.2564	114.4404	17.7800	0.8744	58.8343
0.2371	390.1606	111.8249	23.7100	0.4557	53.1730
0.3162	287.7866	109.1814	31.6200	0.2350	47.4220
0.4217	211.4276	106.5032	42.1700	0.1217	41.7065
0.5623	154.5797	103.7831	56.2300	0.0633	36.0287
0.7499	112.2769	101.0058	74.9900	0.0327	30.2871
1.0000	80.8982	98.1588	100.0000	0.0165	24.3406
1.3330	57.7153	95.2258	133.3500	0.0079	18.0054
1.7780	40.6072	92.1721	177.8300	0.0036	11.0122
2.3710	28.1053	88.9758	237.1400	0.0014	2.9714
3.1620	19.0451	85.5957	316.2300	0.0005	-6.6923
4.2170	12.5698	81.9865	421.7000	0.0001	-18.7936
5.6230	8.0337	78.0984	562.3400	0.0000	-34.4106
7.4990	4.9377	73.8705	749.8900	0.0000	-54.8688
10.0000	2.9030	69.2569	1000.0000	0.0000	-81.7819
13.3400	1.6267	64.2261	1333.5200	0.0000	-117.2609
17.7800	0.8744	58.8343	1778.2800	0.0000	-164.1558
23.7100	0.4557	53.1730	2371.3701	0.0000	-226.2735
31.6200	0.2350	47.4220	3162.2800	0.0000	-308.6931
42.1700	0.1217	41.7065			
56.2300	0.0633	36.0287			
74.9900	0.0327	30.2871			
100.0000	0.0165	24.3406			

Frequency: 1655 kHz Soil Conductivity: 7 Dielectric Constant: 15
Frecuencia: 1655 kHz Conductividad Del Suelo: 7 Constante Dielectrica: 15

Distancia Distancia (km)	Upper Curves Curvas Superiores (mV/m)	(dBu)	Distance Distancia (km)	Lower Curves Curvas Bajas (mV/m)	(dBu)
0.1000	963.9120	119.6807	10.0000	3.3852	70.5918
0.1333	717.8387	117.1205	13.3400	1.9395	65.7538
0.1778	533.3476	114.5402	17.7800	1.0604	60.5091
0.2371	395.5317	111.9436	23.7100	0.5563	54.9061
0.3162	292.5237	109.3232	31.6200	0.2855	49.1128
0.4217	215.6034	106.6731	42.1700	0.1463	43.3031
0.5623	158.2553	103.9872	56.2300	0.0754	37.5421
0.7499	115.5030	101.2519	74.9900	0.0387	31.7479
1.0000	83.7167	98.4562	100.0000	0.0194	25.7747
1.3330	60.1610	95.5863	133.3500	0.0094	19.4304
1.7780	42.7070	92.6100	177.8300	0.0042	12.4421
2.3710	29.8823	89.5083	237.1400	0.0017	4.4189
3.1620	20.5192	86.2432	316.2300	0.0005	-5.2140
4.2170	13.7600	82.7724	421.7000	0.0001	-17.2697
5.6230	8.9610	79.0472	562.3400	0.0000	-32.8238
7.4990	5.6269	75.0054	749.8900	0.0000	-53.1978
10.0000	3.3852	70.5918	1000.0000	0.0000	-79.9989
13.3400	1.9395	65.7538	1333.5200	0.0000	-115.3286
17.7800	1.0604	60.5091	1778.2800	0.0000	-162.0245
23.7100	0.5563	54.9061	2371.3701	0.0000	-223.8768
31.6200	0.2855	49.1128	3162.2800	0.0000	-305.9425
42.1700	0.1463	43.3031			
56.2300	0.0754	37.5421			
74.9900	0.0387	31.7479			
100.0000	0.0194	25.7747			

Frequency: 1655 kHz Soil Conductivity: 8 Dielectric Constant: 15
Frecuencia: 1655 kHz Conductividad Del Suelo: 8 Constante Dielectrica: 15

Distancia Distancia (km)	Upper Curves Curvas Superiores (mV/m)	(dBu)	Distance Distancia (km)	Lower Curves Curvas Bajas (mV/m)	(dBu)
0.1000	969.6261	119.7321	10.0000	3.8272	71.6577
0.1333	722.8879	117.1814	13.3400	2.2394	67.0026
0.1778	537.8148	114.6127	17.7800	1.2475	61.9209
0.2371	399.4894	112.0301	23.7100	0.6622	56.4203
0.3162	296.0325	109.4268	31.6200	0.3402	50.6349
0.4217	218.7153	106.7976	42.1700	0.1729	44.7553
0.5623	161.0143	104.1373	56.2300	0.0882	38.9095
0.7499	117.9446	101.4336	74.9900	0.0450	33.0576
1.0000	85.8708	98.6769	100.0000	0.0225	27.0535
1.3330	62.0513	95.8550	133.3500	0.0108	20.6979
1.7780	44.3519	92.9382	177.8300	0.0048	13.7128
2.3710	31.2968	89.9100	237.1400	0.0019	5.7057
3.1620	21.7151	86.7353	316.2300	0.0006	-3.8979
4.2170	14.7479	83.3746	421.7000	0.0002	-15.9099
5.6230	9.7521	79.7819	562.3400	0.0000	-31.4035
7.4990	6.2344	75.8959	749.8900	0.0000	-51.6964
10.0000	3.8272	71.6577	1000.0000	0.0000	-78.3898
13.3400	2.2394	67.0026	1333.5200	0.0000	-113.5759
17.7800	1.2475	61.9209	1778.2800	0.0000	-160.0803
23.7100	0.6622	56.4203	2371.3701	0.0000	-221.6773
31.6200	0.3402	50.6349	3162.2800	0.0000	-303.4024
42.1700	0.1729	44.7553			
56.2300	0.0882	38.9095			
74.9900	0.0450	33.0576			
100.0000	0.0225	27.0535			

Frequency: 1655 kHz Soil Conductivity: 10 Dielectric Constant: 15
Frecuencia: 1655 kHz Conductividad Del Suelo: 10 Constante Dielectrica: 15

Distancia Distancia (km)	Upper Curves Curvas Superiores (mV/m)	(dBu)	Distance Distancia (km)	Lower Curves Curvas Bajas (mV/m)	(dBu)
0.1000	977.2822	119.8004	10.0000	4.5890	73.2344
0.1333	729.6813	117.2627	13.3400	2.7841	68.8937
0.1778	543.8513	114.7096	17.7800	1.6086	64.1288
0.2371	404.8649	112.1462	23.7100	0.8801	58.8910
0.3162	300.8265	109.5663	31.6200	0.4590	53.2356
0.4217	222.9960	106.9659	42.1700	0.2322	47.3154
0.5623	164.8388	104.3412	56.2300	0.1165	41.3289
0.7499	121.3598	101.6815	74.9900	0.0585	35.3473
1.0000	88.9149	98.9795	100.0000	0.0291	29.2701
1.3330	64.7555	96.2255	133.3500	0.0139	22.8847
1.7780	46.7390	93.3936	177.8300	0.0062	15.9016
2.3710	33.3847	90.4710	237.1400	0.0025	7.9229
3.1620	23.5169	87.4276	316.2300	0.0008	-1.6263
4.2170	16.2734	84.2296	421.7000	0.0002	-13.5557
5.6230	11.0105	80.8362	562.3400	0.0000	-28.9343
7.4990	7.2366	77.1907	749.8900	0.0000	-49.0732
10.0000	4.5890	73.2344	1000.0000	0.0000	-75.5617
13.3400	2.7841	68.8937	1333.5200	0.0000	-110.4748
17.7800	1.6086	64.1288	1778.2800	0.0000	-156.6152
23.7100	0.8801	58.8910	2371.3701	0.0000	-217.7267
31.6200	0.4590	53.2356	3162.2800	0.0000	-298.8046
42.1700	0.2322	47.3154			
56.2300	0.1165	41.3289			
74.9900	0.0585	35.3473			
100.0000	0.0291	29.2701			

Frequency: 1655 kHz Soil Conductivity: 15 Dielectric Constant: 15
Frecuencia: 1655 kHz · Conductividad Del Suelo: 15 Constante Dielectrica: 15

Distancia Distancia (km)	Upper Curves Curvas Superiores (mV/m)	(dBu)	Distance Distancia (km)	Lower Curves Curvas Bajas (mV/m)	(dBu)
0.1000	986.6335	119.8831	10.0000	5.9276	75.4575
0.1333	738.0281	117.3615	13.3400	3.8191	71.6393
0.1778	551.3222	114.8281	17.7800	2.3626	67.4679
0.2371	411.5699	112.2889	23.7100	1.3885	62.8506
0.3162	306.8606	109.7388	31.6200	0.7707	57.7376
0.4217	228.4387	107.1754	42.1700	0.4041	52.1294
0.5623	169.7575	104.5966	56.2300	0.2026	46.1313
0.7499	125.8101	101.9943	74.9900	0.0991	39.9216
1.0000	92.9423	99.3643	100.0000	0.0480	33.6180
1.3330	68.3962	96.7006	133.3500	0.0227	27.1119
1.7780	50.0193	93.9827	177.8300	0.0101	20.1056
2.3710	36.3242	91.2039	237.1400	0.0041	12.1780
3.1620	26.1278	88.3421	316.2300	0.0014	2.7461
4.2170	18.5623	85.3727	421.7000	0.0004	-8.9974
5.6230	12.9805	82.2658	562.3400	0.0001	-24.1141
7.4990	8.8889	78.9769	749.8900	0.0000	-43.9007
10.0000	5.9276	75.4575	1000.0000	0.0000	-69.9211
13.3400	3.8191	71.6393	1333.5200	0.0000	-104.2107
17.7800	2.3626	67.4679	1778.2800	0.0000	-149.5196
23.7100	1.3885	62.8506	2371.3701	0.0000	-209.5222
31.6200	0.7707	57.7376	3162.2800	0.0000	-289.1214
42.1700	0.4041	52.1294			
56.2300	0.2026	46.1313			
74.9900	0.0991	39.9216			
100.0000	0.0480	33.6180			

Frequency: 1655 kHz Soil Conductivity: 20 Dielectric Constant: 15
Frecuencia: 1655 kHz Conductividad Del Suelo: 20 Constante Dielectrica: 15

Distancia Distancia (km)	Upper Curves Curvas Superiores (mV/m)	(dBu)	Distance Distancia (km)	Lower Curves Curvas Bajas (mV/m)	(dBu)
0.1000	990.8135	119.9198	10.0000	6.7616	76.6010
0.1333	741.7858	117.4056	13.3400	4.5097	73.0830
0.1778	554.7108	114.8813	17.7800	2.9098	69.2772
0.2371	414.6371	112.3534	23.7100	1.7969	65.0903
0.3162	309.6462	109.8173	31.6200	1.0530	60.4487
0.4217	230.9773	107.2714	42.1700	0.5813	55.2884
0.5623	172.0780	104.7145	56.2300	0.3020	49.6014
0.7499	127.9364	102.1399	74.9900	0.1490	43.4636
1.0000	94.8944	99.5448	100.0000	0.0711	37.0359
1.3330	70.1898	96.9255	133.3500	0.0330	30.3820
1.7780	51.6660	94.2641	177.8300	0.0146	23.3117
2.3710	37.8323	91.5573	237.1400	0.0059	15.4079
3.1620	27.5023	88.7874	316.2300	0.0020	6.0724
4.2170	19.8050	85.9355	421.7000	0.0005	-5.5057
5.6230	14.0903	82.9784	562.3400	0.0001	-20.3835
7.4990	9.8628	79.8800	749.8900	0.0000	-39.8474
10.0000	6.7616	76.6010	1000.0000	0.0000	-65.4390
13.3400	4.5097	73.0830	1333.5200	0.0000	-99.1576
17.7800	2.9098	69.2772	1778.2800	0.0000	-143.7049
23.7100	1.7969	65.0903	2371.3701	0.0000	-202.6921
31.6200	1.0530	60.4487	3162.2800	0.0000	-280.9370
42.1700	0.5813	55.2884			
56.2300	0.3020	49.6014			
74.9900	0.1490	43.4636			
100.0000	0.0711	37.0359			

Frequency: 1655 kHz Soil Conductivity: 30 Dielectric Constant: 15
Frecuencia: 1655 kHz Conductividad Del Suelo: 30 Constante Dielectrica: 15

Distancia Distancia (km)	Upper Curves Curvas Superiores (mV/m)	(dBu)	Distance Distancia (km)	Lower Curves Curvas Bajas (mV/m)	(dBu)
0.1000	994.5576	119.9526	10.0000	7.7169	77.7488
0.1333	745.1719	117.4451	13.3400	5.3404	74.5516
0.1778	557.7850	114.9293	17.7800	3.6095	71.1490
0.2371	417.4400	112.4119	23.7100	2.3611	67.4624
0.3162	312.2126	109.8890	31.6200	1.4826	63.4207
0.4217	233.3358	107.3596	42.1700	0.8849	58.9379
0.5623	174.2541	104.8237	56.2300	0.4973	53.9327
0.7499	129.9506	102.2756	74.9900	0.2612	48.3397
1.0000	96.7640	99.7143	100.0000	0.1283	42.1655
1.3330	71.9288	97.1381	133.3500	0.0594	35.4759
1.7780	53.2848	94.5321	177.8300	0.0260	28.2870
2.3710	39.3385	91.8964	237.1400	0.0104	20.3697
3.1620	28.9004	89.2181	316.2300	0.0036	11.1752
4.2170	21.0966	86.4842	421.7000	0.0010	-0.1136
5.6230	15.2743	83.6792	562.3400	0.0002	-14.5534
7.4990	10.9354	80.7767	749.8900	0.0000	-33.4170
10.0000	7.7169	77.7488	1000.0000	0.0000	-58.2100
13.3400	5.3404	74.5516	1333.5200	0.0000	-90.8658
17.7800	3.6095	71.1490	1778.2800	0.0000	-133.9960
23.7100	2.3611	67.4624	2371.3701	0.0000	-191.0933
31.6200	1.4826	63.4207	3162.2800	0.0000	-266.8180
42.1700	0.8849	58.9379			
56.2300	0.4973	53.9327			
74.9900	0.2612	48.3397			
100.0000	0.1283	42.1655			

Frequency: 1655 kHz Soil Conductivity: 40 Dielectric Constant: 15
Frecuencia: 1655 kHz Conductividad Del Suelo: 40 Constante Dielectrica: 15

Distancia Distancia (km)	Upper Curves Curvas Superiores (mV/m)	(dBu)	Distance Distancia (km)	Lower Curves Curvas Bajas (mV/m)	(dBu)
0.1000	996.2284	119.9672	10.0000	8.2402	78.3187
0.1333	746.6926	117.4628	13.3400	5.8127	75.2876
0.1778	559.1752	114.9510	17.7800	4.0262	72.0980
0.2371	418.7168	112.4384	23.7100	2.7174	68.6830
0.3162	313.3902	109.9217	31.6200	1.7746	64.9819
0.4217	234.4272	107.4002	42.1700	1.1111	60.9152
0.5623	175.2696	104.8741	56.2300	0.6602	56.3937
0.7499	130.8994	102.3388	74.9900	0.3680	51.3165
1.0000	97.6533	99.7937	100.0000	0.1907	45.6070
1.3330	72.7649	97.2384	133.3500	0.0914	39.2228
1.7780	54.0721	94.6595	177.8300	0.0405	32.1448
2.3710	40.0806	92.0587	237.1400	0.0163	24.2600
3.1620	29.5994	89.4257	316.2300	0.0057	15.1718
4.2170	21.7535	86.7506	421.7000	0.0016	4.1314
5.6230	15.8888	84.0218	562.3400	0.0003	-9.9042
7.4990	11.5057	81.2182	749.8900	0.0000	-28.1993
10.0000	8.2402	78.3187	1000.0000	0.0000	-52.2321
13.3400	5.8127	75.2876	1333.5200	0.0000	-83.8767
17.7800	4.0262	72.0980	1778.2800	0.0000	-125.6586
23.7100	2.7174	68.6830	2371.3701	0.0000	-180.9580
31.6200	1.7746	64.9819	3162.2800	0.0000	-254.2852
42.1700	1.1111	60.9152			
56.2300	0.6602	56.3937			
74.9900	0.3680	51.3165			
100.0000	0.1907	45.6070			

Table 2.I (Finish)
Cuadro 2.I (Fin)

Frequency: 1655 kHz Soil Conductivity: 5000 Dielectric Constant: 80
Frecuencia: 1655 kHz .Conductividad Del Suelo: 5000 Constante Dielectrica: 80

Distancia Distancia (km)	Upper Curves Curvas Superiores (mV/m)	(dBu)	Distance Distancia (km)	Lower Curves Curvas Bajas (mV/m)	(dBu)
0.1000	999.9745	119.9998	10.0000	9.9379	79.9459
0.1333	750.1624	117.5031	13.3400	7.4271	77.4163
0.1778	562.4041	115.0010	17.7800	5.5471	74.8813
0.2371	421.7372	112.5008	23.7100	4.1312	72.3216
0.3162	316.2292	110.0000	31.6200	3.0658	69.7309
0.4217	237.1082	107.4989	42.1700	2.2631	67.0940
0.5623	177.8126	104.9993	56.2300	1.6575	64.3892
0.7499	133.3215	102.4980	74.9900	1.1991	61.5774
1.0000	99.9687	99.9973	100.0000	0.8517	58.6057
1.3330	74.9853	97.4995	133.3500	0.5883	55.3926
1.7780	56.2072	94.9958	177.8300	0.3897	51.8141
2.3710	42.1376	92.4934	237.1400	0.2424	47.6897
3.1620	31.5834	89.9892	316.2300	0.1374	42.7603
4.2170	23.6675	87.4830	421.7000	0.0682	36.6747
5.6230	17.7334	84.9759	562.3400	0.0281	28.9864
7.4990	13.2791	82.4634	749.8900	0.0091	19.1413
10.0000	9.9379	79.9459	1000.0000	0.0021	6.4251
13.3400	7.4271	77.4163	1333.5200	0.0003	-10.1151
17.7800	5.5471	74.8813	1778.2800	0.0000	-31.7551
23.7100	4.1312	72.3216	2371.3701	0.0000	-60.1952
31.6200	3.0658	69.7309	3162.2800	0.0000	-97.7044
42.1700	2.2631	67.0940			
56.2300	1.6575	64.3892			
74.9900	1.1991	61.5774			
100.0000	0.8517	58.6057			

2.2 Skywave propagation

The calculation of skywave field strength shall be conducted in accordance with the procedure given below. Skywave propagation is considered to be significant at night only.

2.2.1 List of symbols

d: short great-circle path distance (km);
E_c: characteristic field strength (mV/m at 1 km for 1 kW);
$f(\theta)$: ratio of vertical to horizontal plane field strength at elevation angle θ;
f: frequency (kHz);
F: unadjusted annual median skywave field strength, in dB (μV/m);
F_c: field strength read from Figure 2.8 or Table 2.III for a characteristic field strength of 100 mV/m;
F(50): skywave field strength, 50% of the time, in dB(μV/m);
P: station power (kW);
θ: elevation angle from the horizontal (degrees).

General procedure

Radiation in the horizontal plane of an omnidirectional antenna fed with 1 kW (characteristic field strength E_c) is determined from design data.

Figure 2.3 which shows the characteristic field strength of an antenna based on a 1 ohm resistance loss, shall be used for calculations to determine the realistice value of E_c.

Elevation angle θ is given by

$$\theta = \arctan\left(0.00752 \cot \frac{d}{444.54}\right) - \frac{d}{444.54} \quad \text{degrees}$$

$$0° \le \theta \le 90°$$

It is assumed that the Earth is a smooth sphere with an effective radius of 6,367.6 km and that reflections occur from an ionospheric height of 96.5 km.

The ratio $f(\theta)$ for a pertinent elevation angle θ is calculated by means of equation 2 of Appendix 1.

The product $E_c f(\theta)\sqrt{P}$ is thus determined for an omnidirectional antenna. For a directional antenna $E_c f(\theta)\sqrt{P}$ may be determined from the radiation pattern. $E_c f(\theta)\sqrt{P}$ is the field strength at 1 km at the appropriate elevation angle and azimuth.

The unadjusted annual median skywave field strength F is given by:

$$F = F_c + 20 \log \frac{E_c f(\theta)\sqrt{P}}{100} \quad db(\mu V/m)$$

where F_c is taken from Figure 2.8 and Table 2.III, using, if necessary, linear interpolation of the field strength expressed in µV/m.

Note: Values of F_c in Figure 2.8 and Table 2.III are normalized to 100 mV/m at 1 km, corresponding to an effective monopole radiated power (e.m.r.p.) of -9.5 dB(kW).

For distances greater than 4250 km, it should be noted that F_c can be expressed by:

$$F_c = \frac{231}{3 + \frac{d}{1000}} - 35.5 \quad dB(\mu V/m)$$

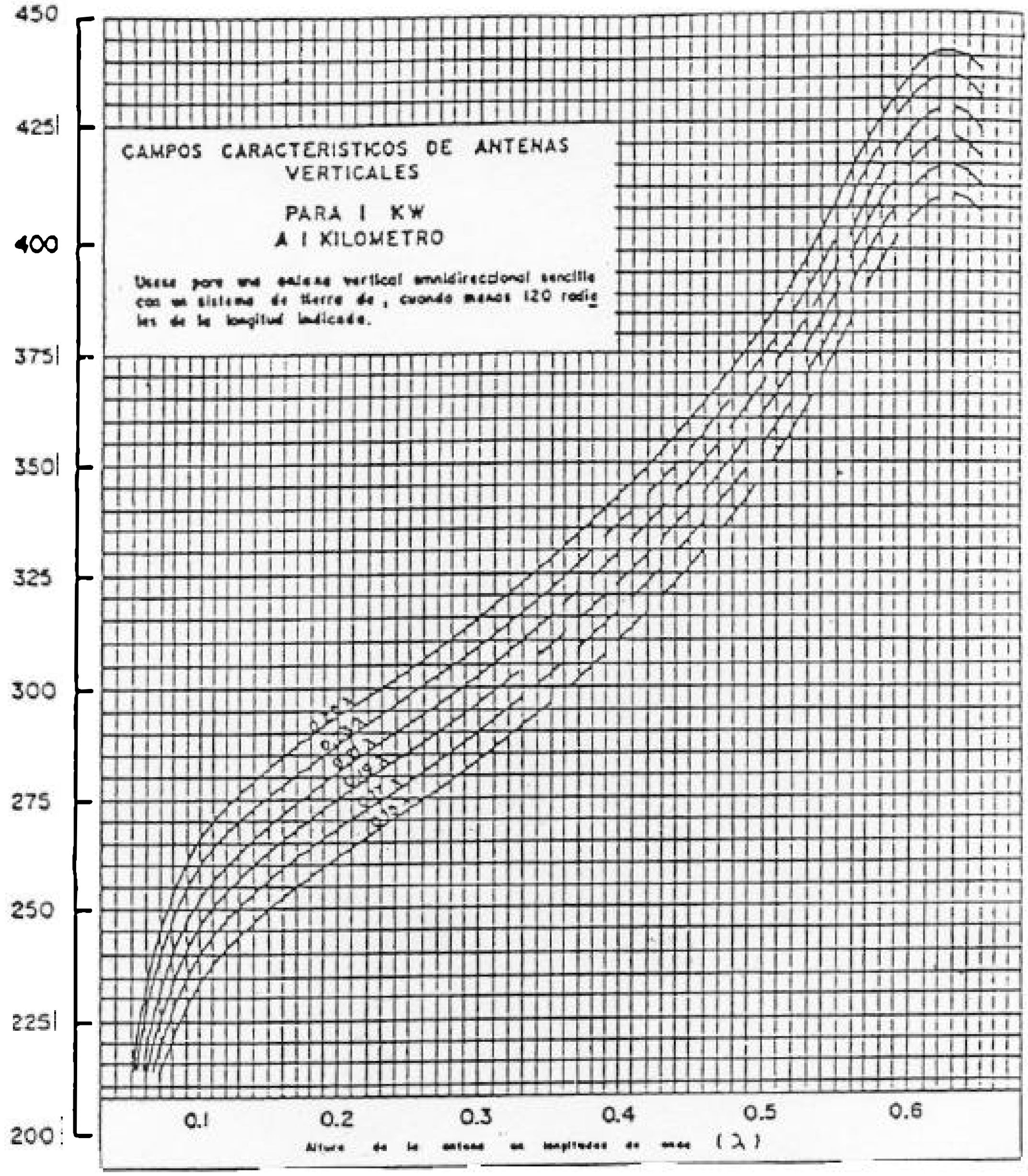
<u>Skywave field strength, 50% of the time</u>

This is given by:

$$F(50) = F \quad dB(\mu V/m)$$

<u>Sunrise and sunset time</u>

The local time of sunrise and sunset shall be determined from Figure 2.9 for various geographical latitudes and for each month of the year. The time is the local meridan time at the point concerned and shall be converted to the appropriate standard time.


CAMPOS CARACTERISTICOS DE ANTENAS
VERTICALES
PARA 1 KW
A 1 KILOMETRO
450
425
400
375
350
325
300
275
250
225
200
0.1
0.2
0.3
0.4
0.5
0.6
(λ)

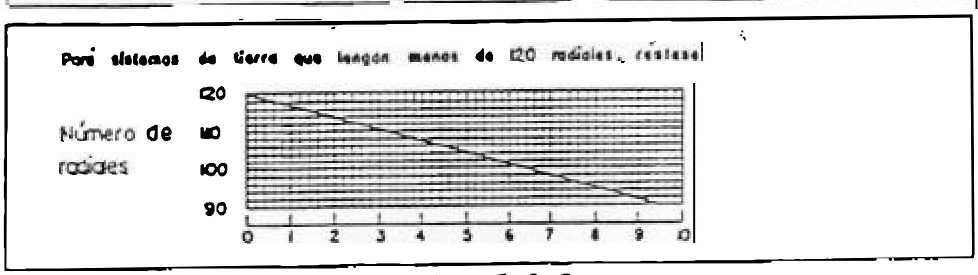
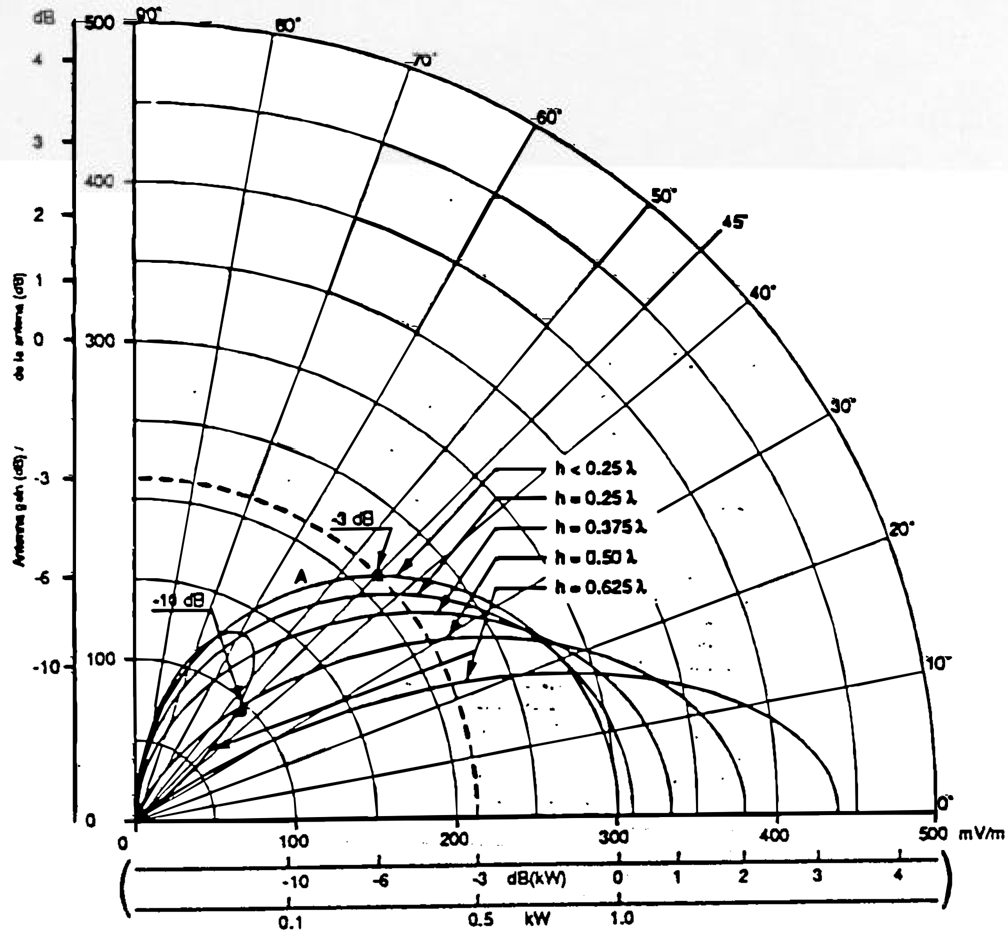

Para sistemas de tierra que tengan menos de 120 radiales, réstese
Número de
radiales
120
110
100
90
0
1
2
3
4
5
6
7
8
9
10

FIG RE 2 3



A: Short vertical antenna / Antena vertical corta

FIGURE 2.4 - Effective monopole radiated power (e.m.r.p) and field strength at a distance of 1 km as a function of elevation angle, for different heights of vertical antennas, assuming a transmitter power of 1 kW

FIGURA 2.4 - Potencia radiada aparente referida a una antena vertical corta (p.r.a.v.) e intensidad de campo a una distancia de 1 km en funcion del angulo de elevacion para antena verticales de alturas diferentes. Se supone una potencia de transmision de referencia de 1 kW

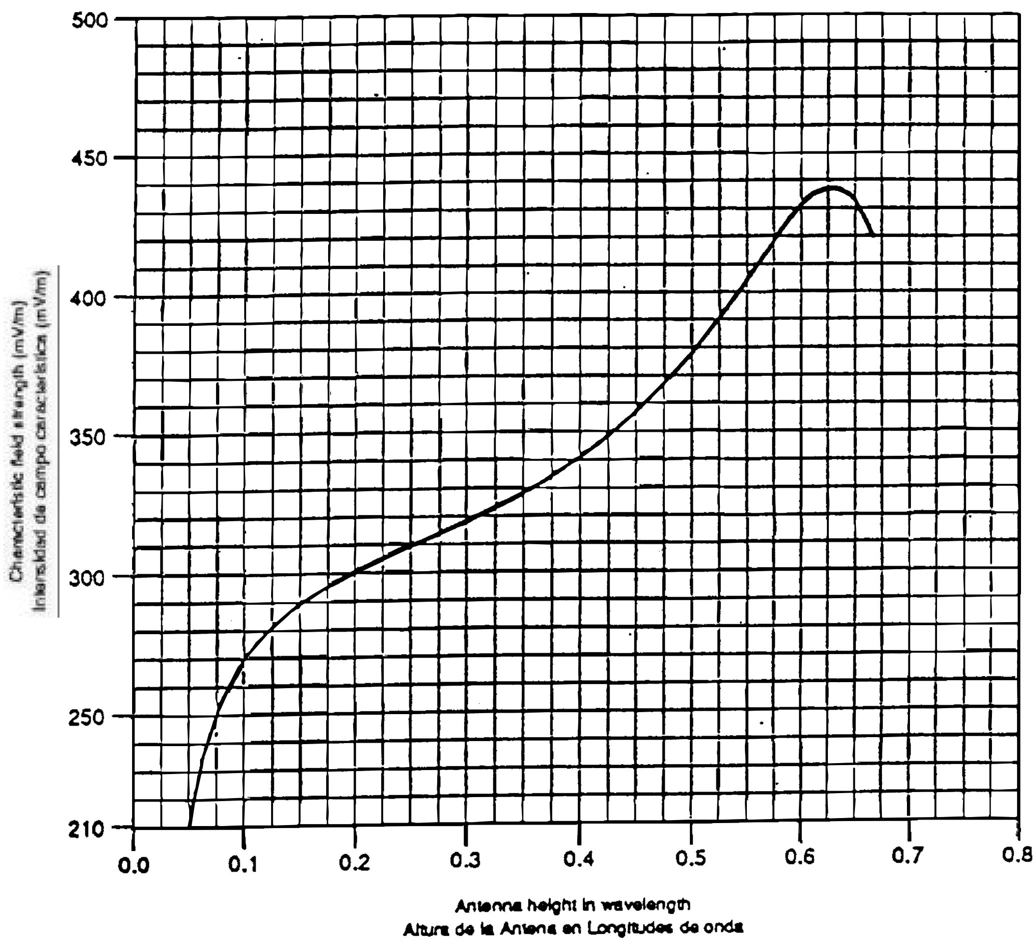


FIGURE 2.5 - Characteristic field strength of an antenna, based on a 1 ohm resistance loss

FIGURA 2.5 - Intensidades de campo características de una antena para una perdida resistiva de 1 ohmio

TABLE 2.II - Elevation angle vs distance
CUADRO 2.II - Angulo de elevacion en funcion de la distancia

Distance Distancia (km)	Elevation Angle Angulo de Elevacion (degrees/grados)	Distance Distancia (km)	Elevation Angle Angulo de Elevacion (degrees/grados)
50	75.3	1250	5.9
100	62.2	1300	5.4
150	51.6	1350	5.0
200	43.3	1400	4.6
250	36.9	1450	4.3
300	31.9	1500	3.9
350	27.9	1550	3.5
400	24.7	1600	3.2
450	22.0	1650	2.9
500	19.8	1700	2.6
550	18.0	1750	2.3
600	16.3	1800	2.0
650	14.9	1850	1.7
700	13.7	1900	1.5
750	12.6	1950	1.2
800	11.7	2000	1.0
850	10.8	2050	0.7
900	10.0	2100	0.5
950	9.3	2150	0.2
1000	8.6	2200	0.0
1050	8.0	2250	0.0
1100	7.4	2300	0.0
1150	6.9	2350	0.0
1200	6.4	2400	0.0

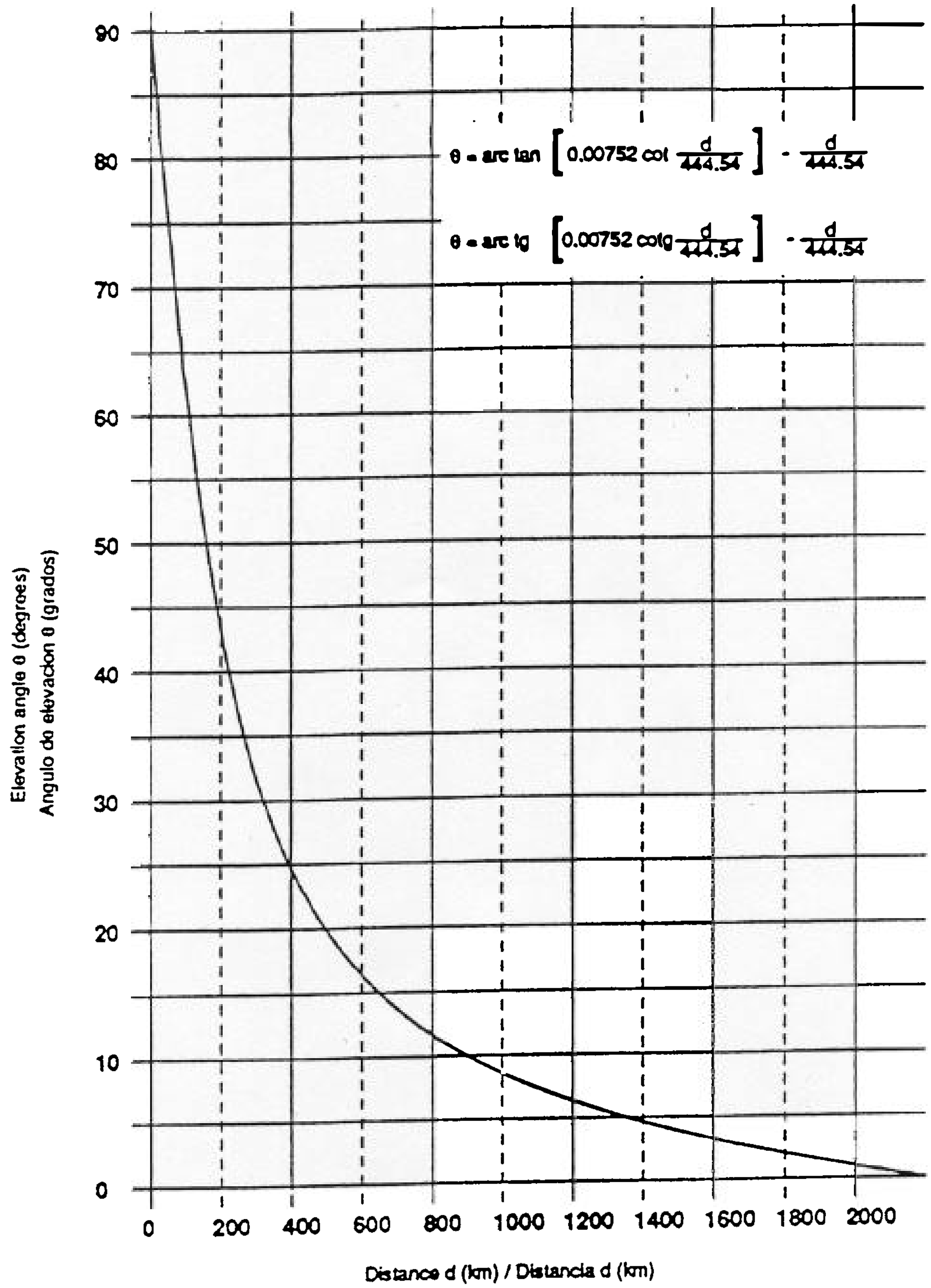


FIGURE / FIGURA 2.6

Elevation angle versus distance / Angulo de elevacion en funcion de la distancia

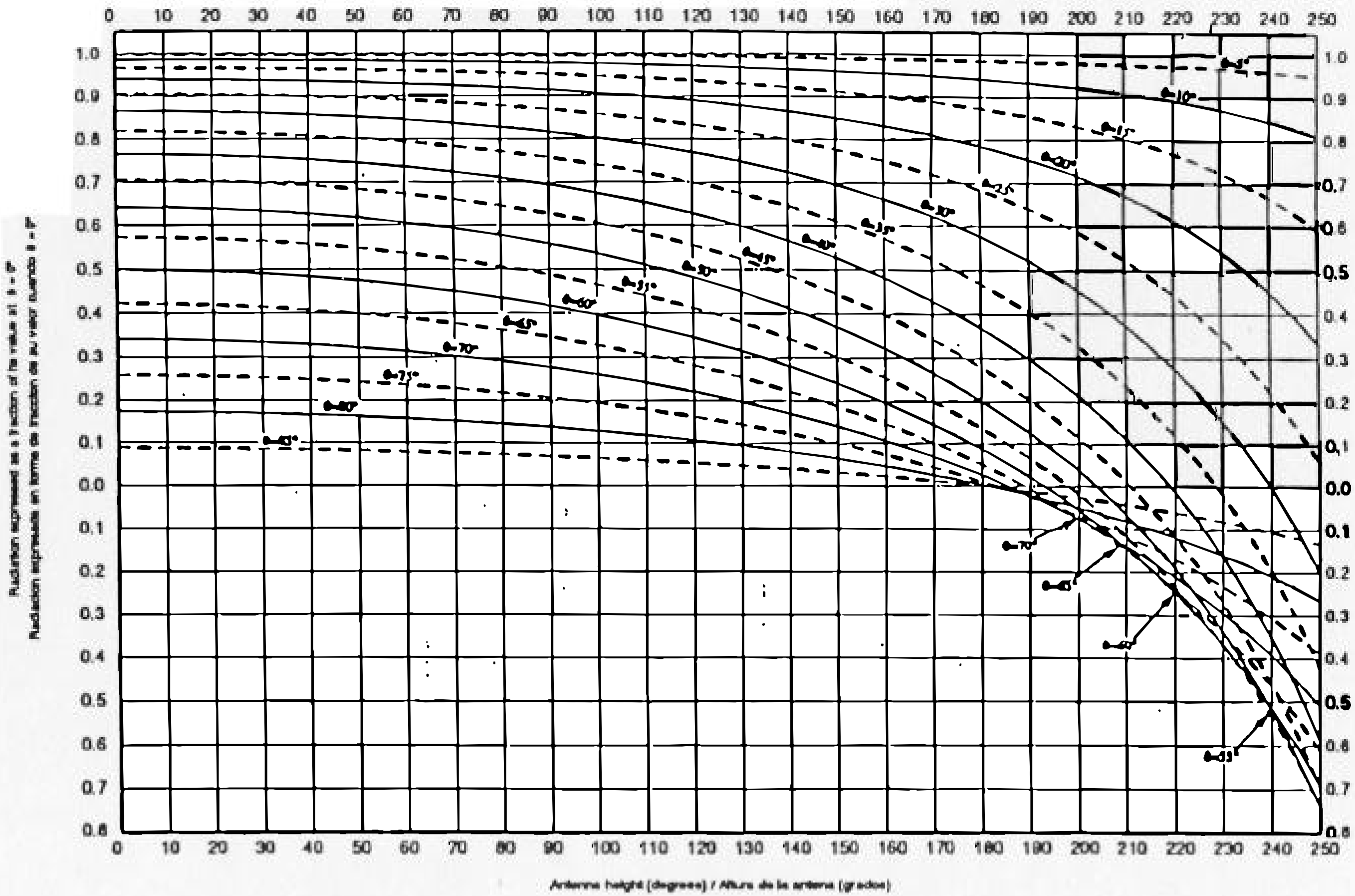


FIGURE 2.7 - Vertical plane radiation of simple vertical antennas as a function of electric tower height for various values of elevation angle (θ)

FIGURA 2.7 - Radiacion en el plano vertical de antenas verticales simples en funcion de la altura electrica de la torre, para diferentes valores del angulo de elevacion (θ)

TABLE 2.IV - f(θ) Values for simple vertical antennas as a function of electrical tower for different values of elevation angle θ

CUADRO 2.IV - Valores de f(θ) para antenas verticales en funcion de la altura electrica de la torre para diferentes valores del angulo de elevacion θ

Elev. Ang. (degrees) (grados)	Electrical Tower Height / Altura electrica de la torre					
	0.110λ	0.130λ	0.160λ	0.170λ	0.190λ	0.210λ
0	1.000	1.000	1.000	1.000	1.000	1.000
1	1.000	1.000	1.000	1.000	1.000	1.000
2	0.999	0.999	0.999	0.999	0.999	0.999
3	0.999	0.998	0.998	0.998	0.998	0.998
4	0.997	0.997	0.997	0.997	0.997	0.997
5	0.996	0.996	0.996	0.995	0.995	0.995
6	0.994	0.994	0.994	0.993	0.993	0.993
7	0.992	0.992	0.991	0.991	0.991	0.990
8	0.989	0.989	0.989	0.988	0.988	0.987
9	0.987	0.986	0.986	0.985	0.985	0.984
10	0.984	0.983	0.983	0.982	0.981	0.980
11	0.980	0.980	0.979	0.978	0.977	0.976
12	0.976	0.976	0.975	0.974	0.973	0.971
13	0.972	0.972	0.971	0.969	0.968	0.967
14	0.968	0.967	0.966	0.965	0.963	0.961
15	0.963	0.962	0.961	0.959	0.958	0.956
16	0.958	0.957	0.956	0.954	0.952	0.950
17	0.953	0.952	0.950	0.948	0.945	0.943
18	0.947	0.946	0.944	0.942	0.940	0.937
19	0.941	0.940	0.938	0.935	0.933	0.930
20	0.935	0.933	0.931	0.929	0.926	0.922
22	0.922	0.920	0.917	0.914	0.911	0.907
24	0.907	0.905	0.902	0.898	0.894	0.890
26	0.892	0.889	0.885	0.882	0.877	0.872
28	0.875	0.872	0.868	0.864	0.858	0.852
30	0.857	0.854	0.849	0.844	0.839	0.832
32	0.838	0.834	0.830	0.824	0.818	0.811
34	0.819	0.814	0.809	0.803	0.795	0.789
36	0.798	0.793	0.788	0.781	0.774	0.766
38	0.776	0.771	0.765	0.758	0.751	0.742
40	0.753	0.748	0.742	0.735	0.725	0.717
42	0.730	0.724	0.718	0.710	0.702	0.692
44	0.705	0.700	0.693	0.685	0.676	0.666
46	0.680	0.674	0.667	0.659	0.650	0.639
48	0.654	0.648	0.641	0.633	0.623	0.612
50	0.628	0.621	0.614	0.606	0.596	0.585
52	0.600	0.594	0.587	0.578	0.568	0.557
54	0.572	0.566	0.559	0.550	0.540	0.529
56	0.544	0.537	0.530	0.521	0.512	0.501
58	0.515	0.508	0.501	0.493	0.483	0.472
60	0.485	0.479	0.472	0.463	0.454	0.443

TABLE 2.IV (continued)
Cuadro 2.IV (continuacion)

Elev. ang. (degrees) (grados)	Electrical Tower Height / Altura electrica de la torre					
	0.230λ	0.250λ	0.270λ	0.290λ	0.311λ	0.350λ
0	1.000	1.000	1.000	1.000	1.000	1.000
1	1.000	1.000	1.000	1.000	1.000	1.000
2	0.999	0.999	0.999	0.999	0.999	0.999
3	0.998	0.998	0.998	0.998	0.998	0.997
4	0.997	0.996	0.996	0.996	0.996	0.995
5	0.995	0.994	0.994	0.994	0.993	0.992
6	0.992	0.992	0.991	0.991	0.990	0.989
7	0.990	0.989	0.988	0.988	0.987	0.985
8	0.987	0.986	0.985	0.984	0.983	0.980
9	0.983	0.982	0.981	0.980	0.979	0.976
10	0.979	0.978	0.977	0.976	0.973	0.969
11	0.975	0.973	0.972	0.970	0.968	0.963
12	0.970	0.968	0.966	0.964	0.962	0.955
13	0.965	0.963	0.961	0.958	0.955	0.949
14	0.959	0.957	0.955	0.952	0.948	0.941
15	0.953	0.951	0.948	0.945	0.941	0.932
16	0.947	0.944	0.941	0.937	0.933	0.924
17	0.941	0.937	0.934	0.930	0.925	0.914
18	0.934	0.930	0.926	0.921	0.916	0.904
19	0.926	0.922	0.918	0.913	0.907	0.894
20	0.919	0.914	0.909	0.904	0.898	0.883
22	0.902	0.897	0.891	0.885	0.877	0.861
24	0.885	0.879	0.872	0.865	0.856	0.837
26	0.866	0.859	0.852	0.843	0.833	0.811
28	0.846	0.838	0.830	0.820	0.809	0.785
30	0.825	0.816	0.807	0.797	0.784	0.758
32	0.803	0.794	0.784	0.772	0.759	0.729
34	0.780	0.770	0.759	0.747	0.732	0.701
36	0.756	0.746	0.734	0.721	0.705	0.671
38	0.732	0.720	0.708	0.694	0.677	0.642
40	0.706	0.695	0.681	0.667	0.649	0.612
42	0.681	0.668	0.654	0.639	0.621	0.582
44	0.654	0.641	0.627	0.611	0.593	0.552
46	0.628	0.614	0.600	0.583	0.564	0.523
48	0.600	0.587	0.572	0.555	0.536	0.494
50	0.573	0.559	0.544	0.527	0.507	0.465
52	0.545	0.531	0.516	0.498	0.479	0.436
54	0.517	0.503	0.487	0.470	0.451	0.408
56	0.488	0.474	0.459	0.442	0.423	0.381
58	0.460	0.446	0.431	0.414	0.395	0.354
60	0.431	0.418	0.403	0.387	0.368	0.328

TABLE 2.IV (continued)
Cuadro 2.IV (continuacion)

Elev. Ang. (degrees) (grados)	Electrical Tower Height / Altura electrica de la torre					
	0.400λ	0.450λ	0.500λ	0.528λ	0.550λ	0.625λ
0	1.000	1.000	1.000	1.000	1.000	1.000
1	1.000	1.000	0.999	0.999	0.999	0.998
2	0.998	0.998	0.998	0.997	0.997	0.995
3	0.997	0.996	0.995	0.994	0.993	0.989
4	0.994	0.992	0.990	0.989	0.988	0.981
5	0.991	0.988	0.985	0.983	0.981	0.970
6	0.986	0.983	0.979	0.975	0.972	0.957
7	0.982	0.977	0.971	0.967	0.962	0.941
8	0.976	0.970	0.962	0.957	0.951	0.924
9	0.970	0.963	0.953	0.945	0.938	0.904
10	0.963	0.954	0.942	0.933	0.924	0.882
11	0.955	0.945	0.930	0.919	0.909	0.859
12	0.947	0.934	0.917	0.905	0.893	0.834
13	0.938	0.923	0.903	0.889	0.875	0.807
14	0.929	0.912	0.889	0.872	0.857	0.773
15	0.918	0.899	0.873	0.855	0.837	0.748
16	0.908	0.886	0.857	0.836	0.815	0.717
17	0.897	0.873	0.840	0.817	0.795	0.684
18	0.885	0.859	0.823	0.797	0.772	0.651
19	0.873	0.844	0.804	0.776	0.749	0.617
20	0.860	0.828	0.785	0.755	0.726	0.582
22	0.833	0.796	0.746	0.710	0.677	0.510
24	0.805	0.763	0.705	0.665	0.625	0.436
26	0.776	0.728	0.663	0.618	0.574	0.363
28	0.745	0.692	0.621	0.570	0.522	0.290
30	0.714	0.655	0.577	0.522	0.470	0.219
32	0.682	0.619	0.534	0.475	0.419	0.151
34	0.649	0.582	0.492	0.428	0.368	0.085
36	0.617	0.545	0.450	0.383	0.321	0.025
38	0.584	0.509	0.409	0.340	0.275	-0.031
40	0.552	0.473	0.370	0.298	0.231	-0.083
42	0.519	0.438	0.332	0.258	0.190	-0.129
44	0.488	0.405	0.296	0.211	0.152	-0.170
46	0.457	0.372	0.262	0.187	0.117	-0.205
48	0.427	0.341	0.230	0.155	0.085	-0.235
50	0.397	0.311	0.201	0.126	0.056	-0.259
52	0.369	0.283	0.174	0.099	0.031	-0.278
54	0.341	0.257	0.149	0.076	0.009	-0.291
56	0.315	0.232	0.126	0.055	-0.010	-0.300
58	0.289	0.208	0.105	0.037	-0.026	-0.304
60	0.265	0.186	0.087	0.021	-0.039	-0.304

Elev. Ang (degrees) (grados)	Electrical Tower Height / Altura electrica de la torre					
	0.400λ	0.450λ	0.500λ	0.528λ	0.550λ	0.625λ
62				0.003	-0.049	-0.300
64				-0.003	-0.056	-0.292
66				-0.011	-0.062	-0.281
68				-0.017	-0.064	-0.267
70				-0.022	-0.065	-0.250
72				-0.025	-0.064	-0.231
74				-0.026	-0.061	-0.210
76				-0.026	-0.056	-0.138
78				-0.024	-0.051	-0.163
80				-0.022	-0.044	-0.138

Note - When the negative sign (-) appears in the Table, it signifies only the existence of a secondary lobe having the opposite phase from the main lobe in the vertical radiation pattern. In order to perform the calculation, ignore the negative (-) and use only the absolute value f(-0) from the Table.

Nota - El signo negativo (-) indica la presencia de un lobulo secundario, cuya fase es la opuesta a la del lobulo principal en el diagrama de radiacion vertical. A los fines del calculo, no es necesario tener en cuenta el signo negativo (-) y basta con utilizar solo el valor absoluto de f(θ).

TABLE 2.IV (End)
TABLE 2.IV (Fin)

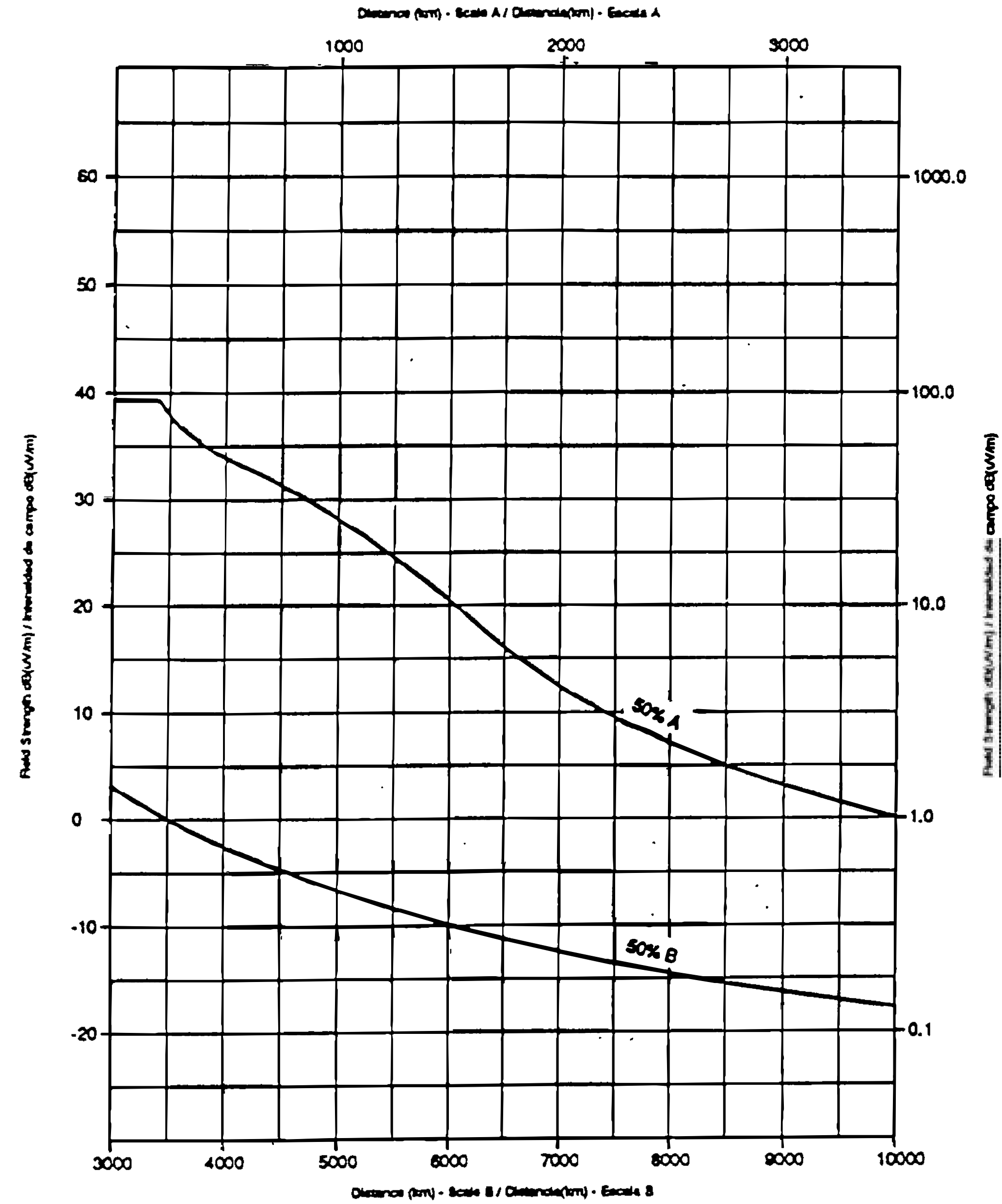


FIGURE 2.8 - Skywave field strength versus distance for a characteristic field strength of 100 mV/m

FIGURA 2.8 - Intensidad de campo de la onda ionosferica en funcion de la distancia para una intensidad de campo caracteristica de 100 mV/m

TABLE 2.III - Skywave field strength vs distance (0 to 10000 km) for a characteristic field strength of 100 mV/m

CUADRO 2.III - Intensidad de campo de la onda ionosferica en funcion de la distancia (de 0 a 10000 km) para una intensidad de campo caracteristica de 100 mV/m

d (km)	F_s(dB(V/m)) 50%	F_s(V/m) 50%
0-200	39.28	92.06
250	37.79	77.54
300	36.75	68.82
350	35.86	62.06
400	35.13	57.08
450	34.46	52.86
500	33.92	49.65
550	33.40	46.78
600	32.94	44.36
650	32.45	41.95
700	31.94	39.54
750	31.32	36.81
800	30.73	34.40
850	30.18	32.30
900	29.51	29.89
950	28.83	27.63
1000	28.14	25.54
1050	27.44	23.56
1100	26.79	21.84
1150	25.98	19.91
1200	25.25	18.30
1250	24.50	16.78
1300	23.71	15.32
1350	22.90	13.97
1400	22.08	12.71
1450	21.25	11.55
1500	20.42	10.50
1550	19.59	9.53
1600	18.66	8.57
1650	17.75	7.72
1700	16.87	6.98
1750	16.04	6.34
1800	15.28	5.80
1850	14.52	5.32
1900	13.78	4.89
1950	13.05	4.49
2000	12.34	4.14
2100	11.15	3.61
2200	10.05	3.18
2300	8.92	2.79
2400	8.13	2.55
2500	7.09	2.26
2600	6.16	2.03
2700	5.32	1.85
2800	4.58	1.69
2900	3.81	1.55

TABLE 2.III (end)
CUADRO 2.III (fin)

d (km)	F.(dB(V/m)) 50%	F.(V/m) 50%
3000	3.11	1.43
3100	2.45	1.33
3200	1.78	1.23
3300	1.18	1.15
3400	0.57	1.07
3500	0.02	1.00
3600	-0.53	0.94
3700	-1.08	0.88
3800	-1.59	0.83
3900	-2.08	0.79
4000	-2.52	0.75
4100	-3.01	0.71
4200	-3.46	0.67
4300	-3.90	0.64
4400	-4.33	0.61
4500	-4.74	0.58
4600	-5.15	0.55
4700	-5.54	0.53
4800	-5.93	0.51
4900	-6.30	0.48
5000	-6.67	0.46
5100	-7.02	0.45
5200	-7.37	0.43
5300	-7.71	0.41
5400	-8.04	0.40
5500	-8.37	0.38
5600	-8.68	0.37
5700	-8.99	0.36
5800	-9.29	0.34
5900	-9.59	0.33
6000	-9.88	0.32
6200	-10.43	0.30
6400	-10.97	0.28
6600	-11.48	0.27
6800	-11.97	0.25
7000	-12.44	0.24
7200	-12.90	0.23
7400	-13.33	0.22
7600	-13.75	0.21
7800	-14.15	0.20
8000	-14.54	0.19
8200	-14.92	0.18
8400	-15.28	0.17
8600	-15.63	0.17
8800	-15.97	0.16
9000	-16.29	0.15
9200	-16.61	0.15
9400	-16.91	0.14
9600	-17.21	0.14
9800	-17.50	0.13
10000	-17.77	0.13

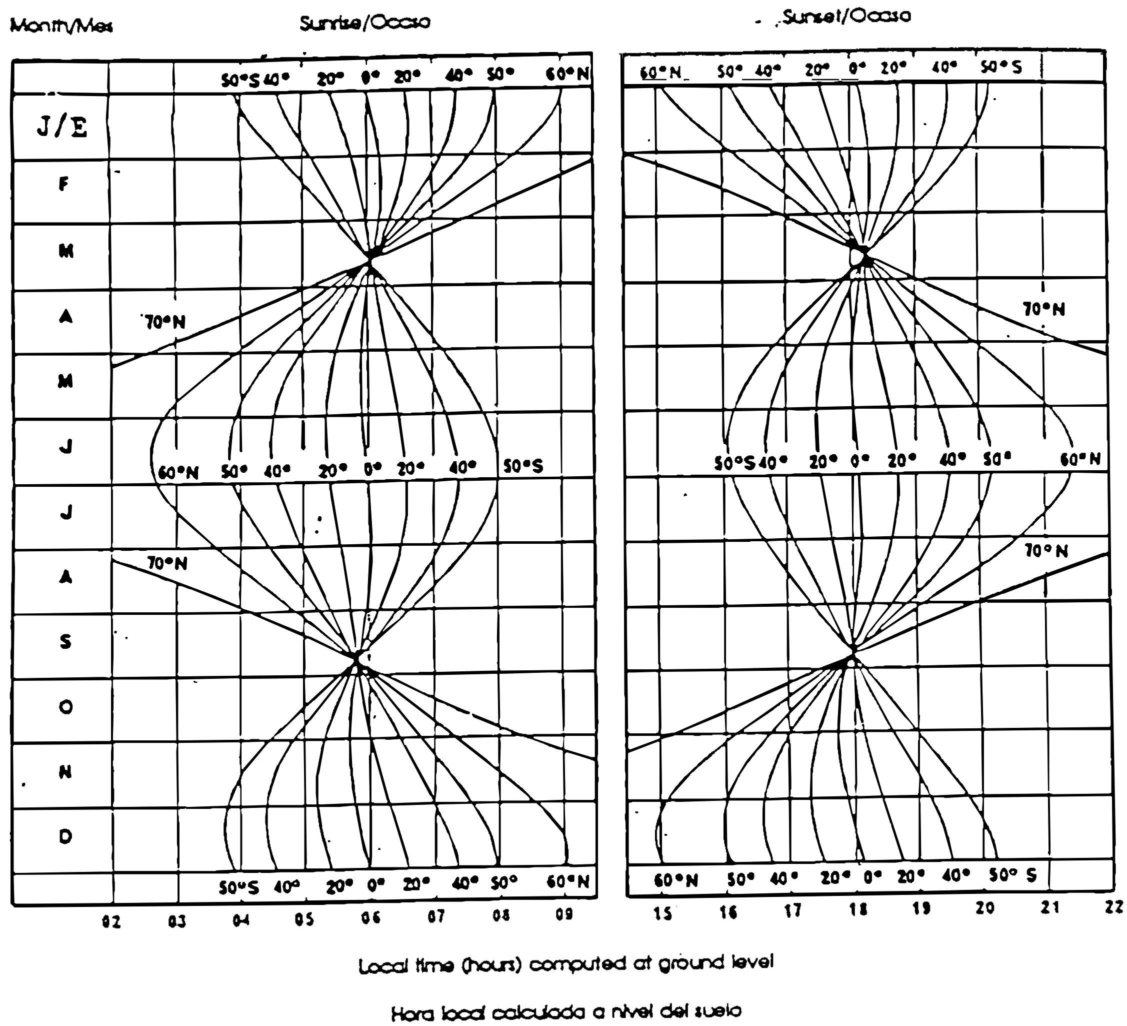


FIGURE 2.9 - Times of sunrise and sunset for various mounts and geographical latitudes

FIGURA 2.9 - Horas de salida y puesta del sol (orto y ocaso) para los distintos meses y para distintas latitudes geográficas

CHAPTER 3

BROADCASTING STANDARDS AND TRANSMISSION CHARACTERISTICS

3.1 Channel spacing

The Plan is based on a channel spacing of 10 kHz and carrier frequencies which are integral multiples of 10 kHz, beginning at 1 610 kHz.

3.2 Class of emission

The Plan is based on double-sideband amplitude modulation with full carrier A3E.

Classes of emission other than A3E may also be used, for instance to accommodate stereophonic systems, on condition that the energy level outside the necessary bandwidth does not exceed that normally expected in A3E emission.

3.3 Bandwidth of emission

The Plan is based on a necessary bandwidth of 10 kHz for which only 5 kHz audio bandwidth can be obtained. However, the protection ratios selected allow operation with 20 kHz occupied bandwidth without an appreciable increase in interference. Stations operating on the frequency 1700 kHz shall take into account No. 343 of the Radio Regulations.

Frequency tolerance

The frequency tolerance shall be 10 Hz.

Nominal usable field strength (E_{nom})

	Nominal Usable Field Strength (E_{nom})
Daytime	0.5 mV/m
Nighttime	3.3 mV/m

3.6 Protection ratios

3.6.1 Co-channel protection ratio

The co-channel protection ratio is 26 dB.

3.6.2 Adjacent channel protection ratio

- the protection ratio for the first adjacent channel is 0 dB
- the protection ratio for the second adjacent channel is -29.5 dB.

CHAPTER 4

RADIATION CHARACTERISTICS OF TRANSMITTING ANTENNAS

In carrying out the calculations indicated in Chapter 2, the following shall be taken into account.

4.1 Omnidirectional antennas

The characteristic field of a simple vertical antenna as a function of its height in wavelength and of the radius of the ground system shall be taken from Figure 2.5.

4.2 Considerations relating to the radiation patterns of directional antennas

The procedures for calculating theoretical, expanded and augmented (modified expanded) directional antenna patterns are given in Appendix 1.

4.3 Top-loaded or sectionalized antennas

4.3.1 Calculation procedures are given in Appendix 2.

4.3.2 Stations may employ top-loaded or sectionalized towers, either because of space limitations or to vary the radiation characteristics from those of a simple vertical antenna. This may be done to achieve the desired coverage or to reduce interference.

4.3.3 An administration using top-loaded or sectionalized antennas shall supply information concerning the tower structure of the antennas. One of the equations in Appendix 2 should be employed to determine the vertical radiation characteristics of the antennas. Other equations may also be proposed by an administration for determining the vertical radiation characteristics of the antennas of that administration, subject to the agreement of the other administration.

APPENDIX 1

(to Annex 1)

Calculation of directional antenna patterns

Introduction

This Appendix describes methods to be employed in calculating the field strength produced by a directional antenna at a given point.

1. *General equations*

The theoretical directional antenna radiation pattern is calculated by means of the following equation, which sums the field strength from each element (tower) in the array:

$$E_T(\varphi, \theta) = \left| K_L \sum_{i=1}^{n} F_i f_i(\theta) \angle \psi_i + S_i \cos\theta \cos(\varphi_i - \varphi) \right| \quad (1)$$

where:

$$f_i(\theta) = \frac{\cos(G_i \sin\theta) - \cos G_i}{(1 - \cos G_i)\cos\theta} \quad (2)$$

where:

$E_T(\varphi, \theta)$: theoretical inverse distance field strength at 1 km in mV/m for the given azimuth and elevation;

K_L : multiplying constant in mV/m which determines the pattern size (see Section 2.5 below for derivation of K_L);

n : number of elements in the directional array;

i : denotes the ith element in the array;

F_i : ratio of the theoretical field strength due to the ith element in the array relative to the theoretical field strength due to the reference element;

θ : vertical elevation angle, in degrees, measured from the horizontal plane;

$f_i(\theta)$: ratio of vertical to horizontal plane field strength radiated by the ith element at elevation angle θ;

G_i : electrical height of the ith element, in degrees;

S_i : electrical spacing of the ith element from the reference point in degrees;

φ_i : orientation of the ith element from the reference element (with respect to True North), in degrees;

φ : azimuth with respect to True North, in degrees;

ψ_i : electrical phase angle of field strength due to the ith element (with respect to the reference element), in degrees.

Equations (1) and (2) assume that:

- the current distribution in the elements is sinusoidal,
- there are no losses in the elements or in the ground,
- the antenna elements are base-fed, and
- the distance to the computation point is large in relation to the size of the array.

2. *Determination of values and constants*

2.1 *Determination of the multiplying constant K for an array*

The multiplying constant K for the loss-free case may be computed by integrating the power flow over the hemisphere, deriving an r.m.s. field strength and comparing the result with the case where the power is radiated uniformly in all directions over the hemisphere.

Thus:

$$K = \frac{E_r \sqrt{P}}{e_h} \qquad \text{mV/m}$$

where:

K : no-loss multiplying constant (mV/m at 1 km);

E_r : reference level for uniform radiation over a hemisphere, equal to 244.95 mV/m at km for 1 kW;

P: antenna input power (kW);

e_h : root mean square radiation pattern over the hemisphere which may be obtained by integrating $e(\theta)$ at each elevation angle over the hemisphere. The integration can be made using the trapezoidal method of approximation, as follows:

$$e_h = \left[\frac{\pi\Delta}{180}\left\{½[e(0)]^2 + \sum_{m=1}^{N}[e(m\Delta)]^2 \cos m\Delta\right\}\right]^{1/2} \tag{3}$$

where:

Δ : interval, in degrees, between equally-spaced sampling points at different elevation angles θ;

m : an integer from 1 to N, which gives the elevation angle θ in degrees when multiplied by Δ, i.e. $\theta = m\Delta$;

N : **one less than the number of intervals** $\left(N = \frac{90}{\Delta} - 1\right)$;

root mean square radiation pattern given by equation (1) with K equal to 1 at the specified elevation angle θ (the value of θ is 0 in the first term of equation (3) and $m\Delta$ in the second term); $e(\theta)$ is computed using equation (4).

$$e(\theta) = \left[\sum_{i=1}^{n}\sum_{j=1}^{n} F_i f_i(\theta) F_j f_j(\theta) \cos \psi_{ij} J_0(S_{ij} \cos \theta)\right]^{1/2} \tag{4}$$

where:

i: denotes the ith element;

j: denotes the jth element;

n : number of elements in the array;

ψ_{ij} : difference in phase angles of the field strengths from the ith and jth elements in the array;

S_{ij} : angular spacing between the ith and jth elements in the array;

$J_0(S_{ij} \cos \theta)$: the Bessel function of the first kind and zero order of the apparent spacing between the ith and jth elements. In equation (4), S_{ij} is in radians. However, when special tables of Bessel functions giving the argument in degrees are used, the values of S_{ij} should then be in degrees.

2.2 *Relationship between field strength and tower current*

The field strength resulting from a current flowing in a vertical antenna element is:

$$E = \frac{R_c I [\cos (G \sin \theta) - \cos G]}{2\pi r \cos \theta} \times 10^3 \qquad \text{mV/m} \tag{5}$$

where:

E: field strength in mV/m;

R_c: resistivity of free space ($R_c = 120\pi$ ohms);

I: current at the current maximum, in amperes [1];

G: electrical height of the element, in degrees;

r: distance from the element, in metres;

θ: vertical elevation angle, in degrees.

At one kilometre and in the horizontal plane ($\theta = 0°$):

$$E = \frac{120\pi I (1 - \cos G) \times 10^3}{2\pi(1000)} \qquad \text{mV/m} \tag{6}$$

hence:

$$E = 60 I (1 - \cos G) \qquad \text{mV/m} \tag{7}$$

2.3 *Determination of no-loss current at current maximum*

For a tower of uniform cross-section or for a similar type of directional array element, the no-loss current at the current maximum is:

$$I_i = \frac{K F_i}{60(1 - \cos G_i)} \tag{8}$$

I_i: current at current maximum in amperes in the ith element;

K: no-loss multiplying constant computed as shown in Section 2.1 above.

The base current is given by $I_i \sin G_i$.

2.4 *Array power loss*

Power losses in a directional antenna system are of various types, including ground losses, antenna coupling losses, etc. The loss resistance for each antenna element may be assumed to be inserted at the current maximum to allow for all losses. The power loss is:

$$P_L = \frac{1}{1000} \sum_{i=1}^{n} R_i I_i^2 \tag{9}$$

where:

P_L: total power loss, in kW;

R_i: assumed loss resistance, in ohms (one ohm, unless otherwise indicated) for the ith tower [2];

I_i: current at current maximum (or base current if the element is less than 90 degrees in electrical height) for the ith tower.

---

[1] I is the current at the maximum of the sinusoidal distribution. If the electrical height of the element is less than 90°, the base current will be less than I.

[2] The loss resistance shall in no way exceed a value such that the value of K_L (see Section 2.5) differs by more than ten percent from that calculated for a resistance of one ohm.

2.5 *Determination of a corrected multiplying constant*

To allow for power loss in the antenna system, the multiplying constant K can be modified, as follows:

$$K_L = K\left(\frac{P}{P + P_L}\right)^{1/2} \qquad (10)$$

where:

K_L : multiplying constant after correction for the assumed loss resistance;

K : no-loss multiplying constant computed in Section 2.1 above;

P : array input power (kW);

P_L : total power loss (kW).

2.6 *r.m.s. value of radiation to be notified for directional antennas*

The radiation E_r for directional antennas is determined as follows:

$$E_r = K_L\, e(\theta) \qquad \text{mV/m at 1 km}$$

2.7 *Determination of expanded pattern values*

The expanded pattern is determined as follows:

$$E_{EXP}(\varphi, \theta) = 1.05 \left\{[E_T(\varphi, \theta)]^2 + Q^2\right\}^{1/2} \qquad (11)$$

where:

$E_{EXP}(\varphi, \theta)$: expanded pattern radiation at a particular azimuth, φ, and a particular elevation angle θ;

$E_T(\varphi, \theta)$: theoretical pattern radiation at a particular azimuth, φ, and a particular elevation angle θ;

Q : quadrature factor, computed as:

$$Q = Q_0\, g(\theta)$$

where:

Q_0 is the Q on the horizontal plane, and is normally the greatest of the following three quantities:

$$10.0 \qquad 10\sqrt{P} \qquad \text{or} \qquad 0.025\, K_L \left[\sum_{i=1}^{n} F_i^2\right]^{1/2}$$

$g(\theta)$ is computed as follows:

If the electrical height of the shortest tower is less than or equal to 180 degrees, then:

$$g(\theta) = f(\theta) \text{ for the shortest tower.}$$

If the electrical height of the shortest tower is greater than 180 degrees, then:

$$g(\theta) = \frac{\{[f(\theta)]^2 + 0.0625\}^{1/2}}{1.030776}$$

where $f(\theta)$ for the shortest tower is used.

Note – *In* comparing the electrical heights of the antenna towers to determine the shortest tower, the total apparent height (as determined by current distribution) is used for top-loaded and sectionalized towers.

2.8 *Determination of augmented (modified expanded) pattern values*

The purpose of the augmented (modified expanded) pattern is to put one or more "patches" on an expanded pattern. Each "patch" is referred to as an "augmentation". The augmentation may be positive (resulting in more radiation than that of the expanded pattern) or negative (resulting in less radiation than that of the expanded pattern). In no case shall the augmentation be so negative that the augmented (modified expanded) pattern radiation is below the theoretical radiation pattern.

Spans of augmentation may overlap. That is, an augmentation may itself be augmented by a subsequent augmentation. To ensure that the calculations are properly made, the augmentations are handled in increasing order of central azimuth of augmentation, starting at True North. If several augmentations have the same central azimuth, then they are considered in order of decreasing span (i.e. the one with the largest span is handled first). If more than one augmentation has the same central azimuth and the same span, then they are considered in ascending order of their effect.

$$E_{MOD}(\varphi, \theta) = \left\{ [E_{EXP}(\varphi, \theta)]^2 + g^2(\theta) \sum_{i=1}^{a} A_i \cos^2 (180\, \Delta_i / \alpha_i) \right\}^{1/2} \qquad (12)$$

where:

$E_{MOD}(\varphi, \theta)$: augmented (modified expanded) pattern radiation at a particular azimuth, φ, and a particular elevation angle, θ;

$E_{EXP}(\varphi, \theta)$: expanded pattern radiation at a particular azimuth, φ, and a particular elevation angle, θ;

$g(\theta)$: same parameter as described for the expanded pattern (see Section 2.7);

number of augmentations;

Δ_i : difference between the azimuth at which the radiation is desired φ, and the central azimuth of augmentation of the ith augmentation. It will be noted that Δ_i must be less than or equal to one-half of α_i;

α_i : total span of the ith augmentation;

A_i : is the value of the augmentation given by the expression [1]:

$$A_i = [E_{MOD}(\varphi_i, \theta)]^2 - [E_{INT}(\varphi_i, \theta)]^2 \qquad (13)$$

where:

φ_i : central azimuth of the ith augmentation;

$E_{MOD}(\varphi_i, \theta)$: augmented (modified expanded) horizontal plane radiation at the central azimuth of the ith augmentation, after applying the ith augmentation, but before applying subsequent augmentations;

$E_{INT}(\varphi_i, \theta)$: an interim value of radiation in the horizontal plane at the central azimuth of the ith augmentation. The interim value is the radiation obtained from applying previous augmentations (if any) to the expanded pattern, but before applying the ith augmentation.

---

[1] When A_i is negative, there is negative augmentation; when A_i is positive, there is positive augmentation. A_i must not be so negative that $E_{MOD}(\varphi, \theta)$ falls below $E_T(\varphi, \theta)$ of any azimuth, φ, or elevation angle, θ.

APÉNDICE 2

(al anexo 1)

Fórmulas para el cálculo de la relación entre el campo radiado con un ángulo de elevación θ y el campo radiado en el plano horizontal por torres con carga terminal o seccionadas

La fórmula de base es la siguiente:

$$f(\theta) = \frac{E_\theta}{E_0}$$

donde:

E_θ : radiación al ángulo de elevación θ;

E_0 : radiación en el plano horizontal.

A continuación figuran fórmulas específicas para antenas con carga terminal y antenas seccionadas típicas.

En estas fórmulas se utilizan una o más de las cuatro variables, A, B, C y D, cuyas definiciones figuran después de cada fórmula.

1. *Antenas con carga terminal* (antenas de tipo 1)

$$f(\theta) = \frac{\cos B \cos (A \operatorname{sen} \theta) - \operatorname{sen} \theta \operatorname{sen} B \operatorname{sen} (A \operatorname{sen} \theta) - \cos (A + B)}{\cos \theta [\cos B - \cos (A + B)]}$$

donde:

A : altura eléctrica de la torre (antena);

B : diferencia entre la altura eléctrica aparente (basada en la distribución de la corriente) y la altura eléctrica real (A);

θ : ángulo de elevación con respecto al plano horizontal.

Nota – Cuando B es igual a cero (es decir, cuando no se utiliza carga terminal) la fórmula se reduce a la de una antena vertical simple.

2. *Antena seccionada* (antena de tipo 2)

$$f(\theta) = \frac{[\cos B \cos (A \operatorname{sen} \theta) - \cos (A + B)] \operatorname{sen} (C + D - A) + \operatorname{sen} B [\cos D \cos (C \operatorname{sen} \theta) - \operatorname{sen} \theta \operatorname{sen} D \operatorname{sen} (C \operatorname{sen} \theta) - \cos (C + D - A) \cos (A \operatorname{sen} \theta)]}{\cos \theta ([\cos B - \cos (A + B)] \operatorname{sen} (C + D - A) + \operatorname{sen} B [\cos D - \cos (C + D - A)])}$$

donde:

A : altura eléctrica real de la sección inferior;

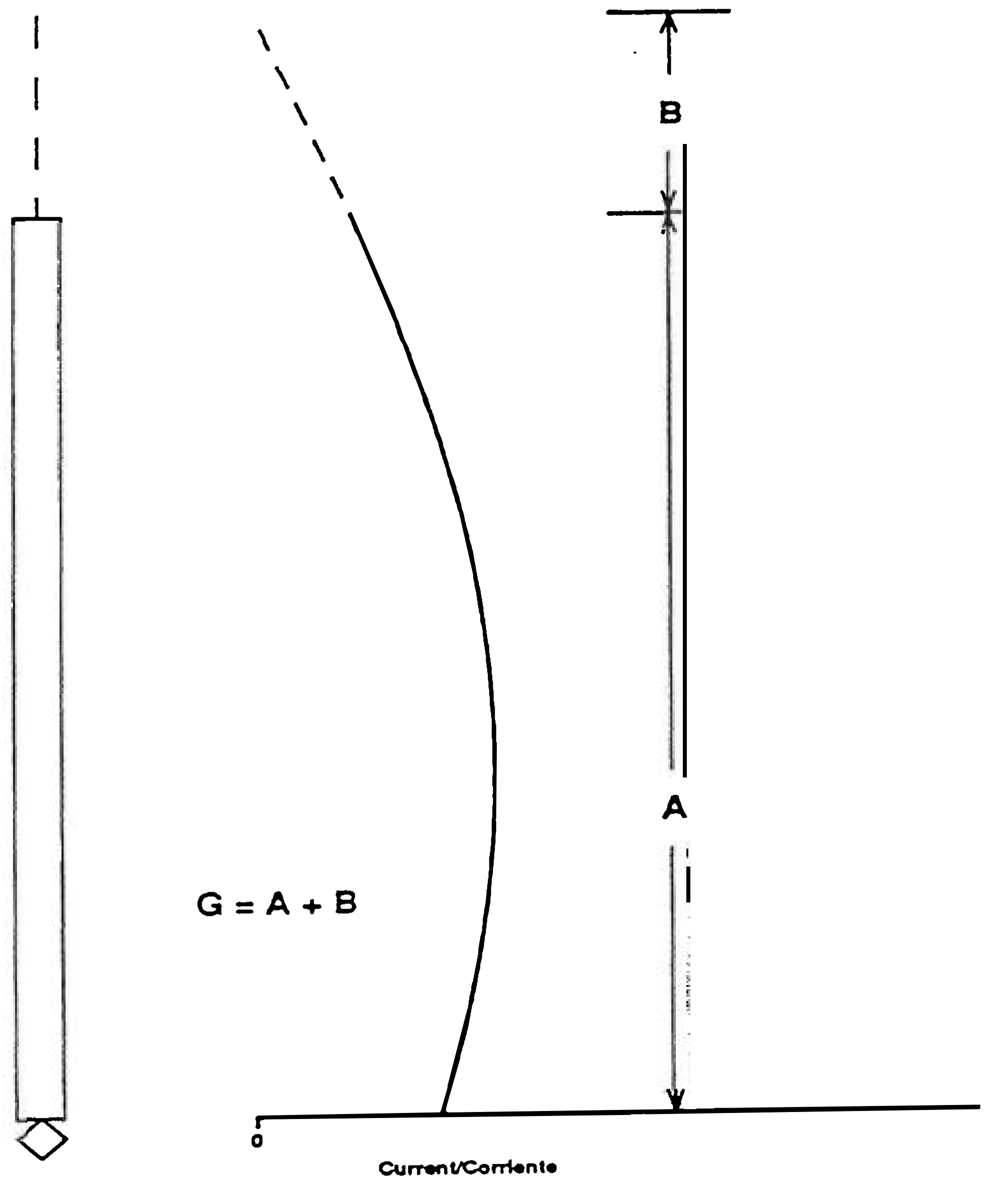
B : diferencia entre la altura eléctrica aparente de la sección inferior (basada en la distribución de la corriente) y la altura eléctrica real de esta misma sección (A);

C : altura eléctrica real total de la torre;

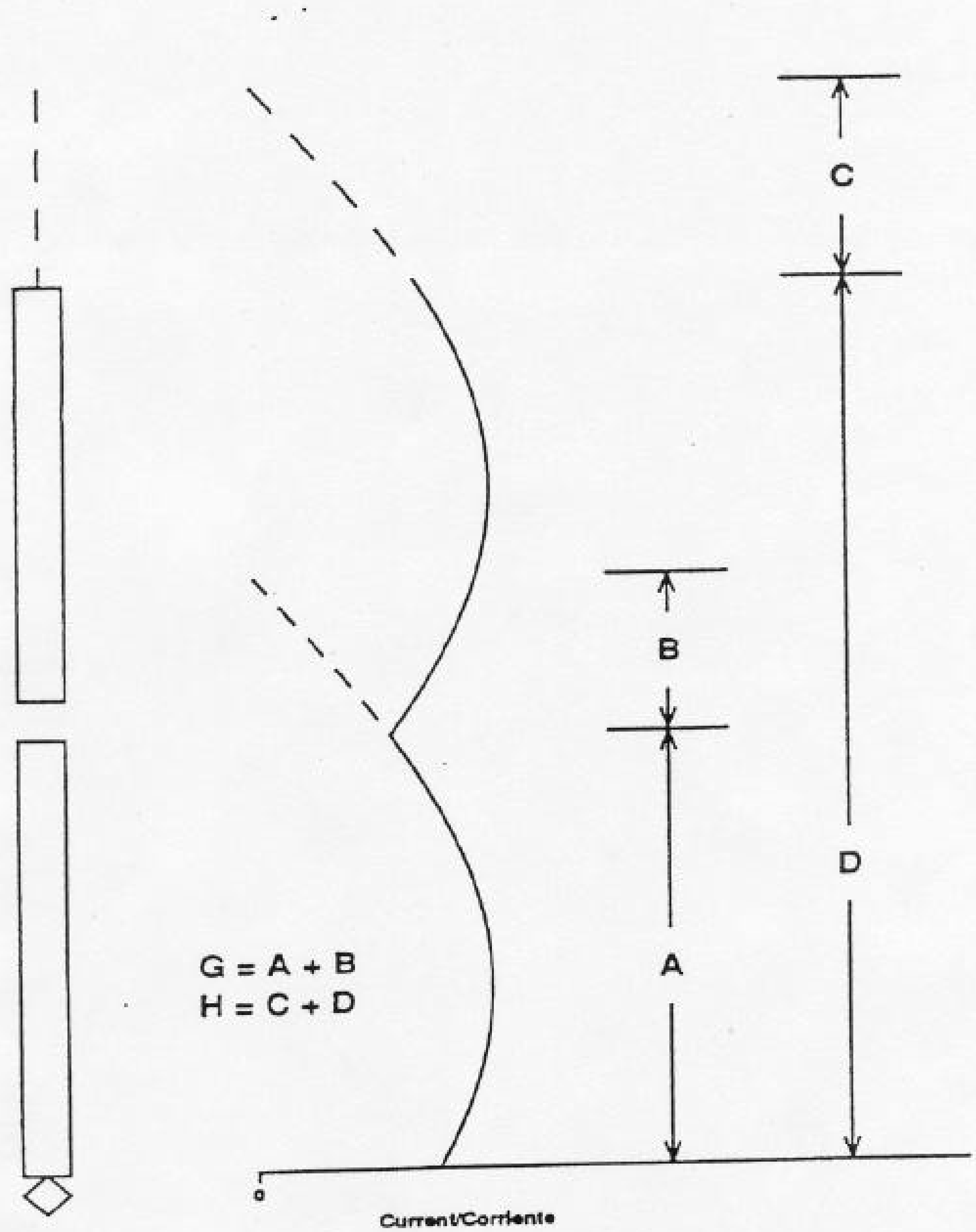
D : diferencia entre la altura eléctrica aparente (basada en la distribución de la corriente) de la totalidad de la torre y su altura eléctrica real total (C);

θ : ángulo de elevación con respecto al plano horizontal.

3. Las administraciones que proyecten utilizar otros tipos de antenas deberán facilitar detalles de sus características y un diagrama de radiación.



FIGURE/FIGURA 1



FIGURE/FIGURA 1

ANNEX 2

Criteria For Implementation of the Allotment Plan and Assignments

CHAPTER 1

CRITERIA TO DETERMINE THE ACCEPTABILITY OF A NOTIFIED STATION

1. Standardized parameter values

1.1 Station power:

(a) Allotment: 10 kW day; 1 kW night;

(b) Non-allotment: 1 kW day; 1 kW night.

1.2 A non-directional antenna with an electrical height of 90 degrees;

1.3 A characteristic field strength of 310 mV/m at 1 km;

2. Separation distances for assignments and allotments.

2.1 Standardized co-channel separation distances:

(a) between allotments*: 450 km

(b) between allotments and non-allotted assignments: 450 km

(c) between non-allotted assignments and non-allotted assignments: 330 km

2.2 Standardized first adjacent channel separation distances:

(a) between allotments*: 80 km

(b) between allotments and non-allotted assignments: 80 km

(c) between non-allotted assignments and non-allotted assignments: 53 km

2.3 Standardized second adjacent channel separation distance: 53 km

2.4 Siting tolerance and minimum separation distances: See 1.1.12 of Annex 1.

* Assignments deriving from allotments will consider the same distance separation as its corresponding allotment.

CHAPTER 2

CRITERIA TO DETERMINE THE ACCEPTABILITY OF AN ASSIGNMENT ARISING FROM AN ALLOTMENT AT A LOCATION INSIDE ITS ZONE OF ALLOTTED COVERAGE AND OUTSIDE ITS SITE TOLERANCE

1. The assignment shall not exceed the values of its standard parameters and shall be located outside the site tolerance corresponding to the allotment and inside its zone of allotted coverage (a radius of 225 km from the allotment center point), at whatever location inside its territory.

2. The assignment shall comply with the criteria relative to the distance separations which are indicated in Chapter 1 of this Annex.

3. Administrations giving notice of assignments under the conditions of this chapter shall decide within a period of twelve months either to maintain the original allotment corresponding to a moved assignment or to establish an assignment at the new location. During the twelve month period, both the assignment and corresponding allotment are protected. In whatever case, after the period of twelve months mentioned above, the other administration shall, in accordance with the decision of the initiating administration provide protection either to the allotment or to the displaced assignment. Should the administration responsible for the assignment not give notice that it will retain the displaced assignment, that assignment shall not be protected by the other administration but protection shall revert back to the original allotment.

4. In the event in which the displaced station is to be coupled to a zone where there exists an operating or an authorized station not derived from an allotment, then the minimum distances between corresponding stations must be maintained either to the allotments or to greater or equal distances to those corresponding to the non-allotted assignments.

5. Only one assignment may be established per allotment.

6. In whatever case, it will only be acceptable for an assignment proposed by an administration to be displaced one single time.

CHAPTER 3

CRITERIA USED TO DETERMINE WHEN THE SERVICES OF THE OTHER ADMINISTRATION ARE AFFECTED

1. Assignments beyond the coordination distance

Assignments operating with standard facilities are permitted. An assignment using non-standard facilities shall adjust its operation so as not to exceed at the border the field strength that would result from a station using standardized parameters located at the standardized distance from the allotment area being considered for protection.

2. Use of non-standardized parameters by assignments to allotments

In the application of Article 5, an administration is affected if the skywave or groundwave field strength in any part of its allotment area on the same channel, calculated using notified characteristics, exceeds the field strength that would result from a station using standardized parameters located at the standardized distance from the allotment area being considered for protection. Additionally, the 25 μV/m daytime groundwave contour shall not extend further into the other country than would the 25 μV/m contour of a standardized parameter station located at any point along the border.

3. General provisions

3.1 In no case shall the power of a broadcasting station exceed 10 kW.

3.2 The effect of each interfering transmitter shall be evaluated separately, and interference from other transmitters shall not be taken into account in determining the maximum permitted signal strength from each transmitter.

ANNEX 3

DATA FOR THE NOTIFICATION OF BROADCASTING ASSIGNMENTS

ANNEX 3

PART I

Data for the notification of broadcasting assignments in application of Article 4

For the purposes of this Agreement, it is acceptable to notify using computer printout or files as long as the information below is provided in a mutually agreed format.

General Information on the Transmitting Station

Item No.

01 *Administration*

Indicate the name of the administration;

02 *Assigned frequency (kHz)*

03 *Name of transmitting Station*

Indicate the name of the locality or the name by which the station is known, and the allotment identifier associated with the assignment;

04 *Call sign*

05 *Country*

Indicate the name of the country or geographical area in which the station is located. Use the symbols in Table B1 of the Preface to the International Frequency List;

06 *Geographical coordinates of the transmitting station*

Indicate the geographical coordinates (longitude and latitude) of the transmitting antenna site in degrees, minutes and seconds. Seconds need to be entered only if available;

07 *Indicate the reason for the notification:*

a) New assignment;
b) Modification of the characteristics of an existing assignment;
c) Cancellation of an assignment;

08 *Indicate the date of bringing into service or the date of cessation of operation;*

DAYTIME OPERATION

09 *Station power (dBW)*

Indicate the carrier power supplied to the antenna for daytime operation;

10 *r.m.s. value of radiation (mV/m at 1 km) for daytime station power*

11 *Antenna type*

Indicate here the type of antenna used for daytime operation. Use the symbols as follows:

A -- Simple omnidirectional antenna;
B -- Directional antenna or non-simple omnidirectional antenna;

12 *Simple vertical antenna electrical height*

Indicate here the electrical height, in degrees, for a simple vertical antenna in use for daytime operation;

NIGHT-TIME OPERATION

13 *Station power (dBW)*

Indicate the carrier power supplied to the antenna for night-time operation;

14 *r.m.s. value of radiation (mV/m at 1 km) for night-time station power*

15 *Antenna type*

Indicate the type of antenna used for night-time operation (use the symbols in item No. 11 above);

16 *Simple vertical antenna electrical height*

Indicate here the electrical height, in degrees, for a simple vertical antenna in use for night-time operation;

17 *Remarks*

Indicate here any necessary additional information, such as the identification of the synchronized network to which the station belongs. If shared time operation is intended, indicate in this box and identify the other assignment involved;

PART II

Description of a directional antenna consisting of vertical conductors

Item No.

01 *Indicate the name of the transmitting station;*

02 *Country*

Indicate the country or geographical area in which the station is located. Use the symbols in Table B1 of the Preface to the International Frequency List;

03 *Indicate the hours of operation for which the given characteristics of the antenna are applicable. The symbols "D" or "N" shall be used to indicate that the station operates for the daytime or night-time period respectively. When the same operation is used for both daytime and night-time, enter the two symbols "D" and "N"*

04 *Indicate the total number of towers constituting the array;*

05 *This column shows the serial number of towers, as they will be described in columns 06 to 12;*

06 *Indicate here the ratio of the tower field to the field from the reference tower;*

07 *Indicate here, in degrees, the positive or negative difference in the phase angle of the field from the tower with respect to the field from the reference tower;*

08 *Indicate, in degrees, the electrical spacing of the tower from the reference point, defined in column 10;*

09 *Indicate, in degrees from True North, the angular orientation of the tower from the reference point indicated in column 10;*

10 *Define the reference point as follows:*

0: where the spacing and angular orientation are shown with respect to a common reference point which is generally the first tower;

1: where the spacing and angular orientation are shown with respect to the previous tower;

11 *Indicate the electrical height (degrees) of the tower under consideration;*

12 *Tower structure*

This column should contain a code from 0 to 2 to indicate the structure of each tower

0 = simple vertical antenna
1 = top-loaded antenna
2 = sectionalized antenna

Codes 1 and 2 are used in Part IV to indicate the characteristics of the various structures. They are also used for the identification of the appropriate formula for vertical radiation in Appendices 1 and 2 to Annex 1.

13 *r.m.s. value of radiation (mV/m at 1 km) (see Section 2.6 of Appendix 1 to Annex l);*

14 *Type of pattern:*

T = theoretical
E = expanded
M = augmented (modified expanded);

15 *Special quadrature factor for expanded and augmented (modified expanded) patterns in mV/m at 1 km (to replace the normally used expanded pattern quadrature factor when special precautions are taken to ensure pattern stability);*

16 *Supplementary information.*

PART III

Description of the parameters of directional antennas with augmented (modified expanded) patterns

1. Part II of this Annex contains the information for directional antenna systems operating with theoretical and expanded patterns. However, some stations may operate with augmented (modified expanded) directional antenna patterns. In these cases, additional calculations are performed, once the expanded radiation is calculated, to determine the radiation from the augmented (modified expanded) directional antenna pattern. This Part contains the additional parameters required for augmented (modified expanded) patterns.

2. If Part III is submitted, a corresponding Part II must also be submitted.

3. Part III should be submitted only if item 15 of Part II contains the symbol M for "augmented (modified expanded)".

Item No.

01 *Indicate the name of the transmitting station;*

02 *Country*

Indicate the country or geographical area in which the station is located, using the symbols in Table B1 of the Preface to the International Frequency List;

03 *Indicate the hours of operation for which the antenna characteristics given are applicable. The symbols "D" or "N" shall be used to indicate that the station operates for the daytime and night-time. When the antenna characteristics are the same for both daytime and night-time, enter the two symbols "D" and "N";*

04 *Indicate the total number of augmentations which are used. It must be 1 or greater than 1;*

05 *Indicate the serial number of the augmentations;*

06 *Indicate the radiation at the central azimuth of augmentation. This value should always be equal to or greater than the value from the theoretical pattern;*

07 *Indicate the central azimuth of augmentation. This is the centre of the span;*

08 *Indicate the total span of the augmentation. Half of the span will be on each side of the central azimuth of augmentation. Spans may overlap; if so, augmentations are processed clockwise according to the central azimuth of augmentations;*

09 *Supplementary information. Indicate any supplementary information concerning augmented (modified expanded) patterns.*

PART IV

Supplementary information for toploaded or sectionalized towers used for omnidirectional and directional antennas

When an antenna tower of a directional antenna is either toploaded or sectionalized, Column 12, Part II will contain either a figure 1 or a figure 2. These numerals describe the particular type of top-loaded or sectionalized antenna used, as described below:

Item No.

01 *Name of the station*

02 *Country*

Indicate the country or geographical area in which the station is located, using the symbols in Table B1 of the Preface to the International Frequency List;

03 *Indicate the hours of operation for which the given characteristics of the antenna are applicable. The symbols "D" or "N" shall be used to indicate that the station operates for the daytime or night-time period respectively. When the same operation is used for both daytime and night-time, enter the two symbols "D" and "N";*

04 *Tower number*

Columns 5 to 8 show the values of four characteristics of the elements constituting a top-loaded or sectionalized antenna. Each of these columns may contain a figure representing the value of a given characteristic as described below:

05 *Code used in Col. 12 (Part II)*	*Description of the characteristic the value of which is given in the column (these values are used in the equations given in Appendix 2 to Annex 1)*
1	Electrical height of the antenna tower (degrees):
2	Height of lower section (degrees);

06 *Code used in Col. 12 (Part II)*	*Description of the characteristic the value of which is given in the column (these values are used in the equations given in Appendix 2 to Annex 1)*
1	Difference between apparent electrical height (based on current distribution) and actual height (degrees);

2	Difference between apparent electrical height of lower section (based on current distribution) and actual height of lower section (degrees);
07 *Code used in Col. 12 (Part II)*	*Description of the characteristic the value of which is indicated in the column (these values are used in the equations contained in Appendix 2 to Annex 1)*
1	Blank;
2	Total height of antenna (degrees);
08 *Code used in Col. 12 (Part II)*	*Description of the characteristic the value of which is indicated in the column (these values are used in the equations entered in Appendix 2 to Annex 1)*
1	Blank;
2	Difference between apparent electrical height (based on current distribution) of the total tower and the actual height of the total tower (degrees).

Annex 4 / Anexo 4

City Ciudad	State Estado	Country Pais	Latitude Latitud	Longitude Longitud	Frequency Frecuencia
Nogales	SO	MX	31 19 49	110 56 42	1610
Ojinaga	CH	MX	29 33 53	104 25 23	1610
Palm Springs	CA	US	33 51 29	116 29 39	1610
Laredo	TX	US	27 32 57	99 22 21	1610
Cd. Juarez	CH	MX	31 44 19	106 29 15	1620
Anahuac	NL	MX	27 11 57	100 07 02	1620
San Luis Rio	SO	MX	32 14 00	114 46 30	1620
Tijuana	BN	MX	32 29 11	116 57 23	1630
Cd. Acuna	COAH	MX	29 19 33	100 55 51	1630
Matamoros	TA	MX	25 52 45	97 31 09	1630
Tolleson	AZ	US	33 26 42	112 15 54	1630
Alamagordo	NM	US	32 54 00	105 57 00	1630
El Centro	CA	US	32 47 25	115 33 35	1640
Nogales	AZ	US	31 20 00	110 56 00	1640
McAllen	TX	US	26 18 02	98 12 38	1640
Presidio	TX	US	29 33 36	104 22 18	1640
Guerrero	COAH	MX	28 20 05	100 23 08	1650
Puerto Penasco	SO	MX	31 17 41	113 34 36	1650
Long Beach	CA	US	33 47 54	118 14 47	1650
El Paso	TX	US	31 54 56	106 23 33	1650
Agua Prieta	SO	MX	31 19 42	109 33 44	1660
Yuma	AZ	US	32 39 00	114 39 00	1660
Brownsville	TX	US	25 54 00	97 30 00	1660
Del Rio	TX	US	29 25 46	100 54 18	1660
Janos	CH	MX	30 54 15	108 10 22	1670
Reynosa	TA	MX	26 05 50	98 16 42	1670
Phoenix	AZ	US	33 28 44	112 00 06	1670
San Diego	CA	US	32 43 17	117 04 11	1670
Fort Stockton	TX	US	30 52 37	102 53 30	1670
Heroica Caborca	SO	MX	30 41 29	112 10 14	1680
Piedras Negras	COAH	MX	28 42 25	100 31 02	1680
Las Cruces	NM	US	32 19 00	106 47 00	1680
Thousand Palms	CA	US	33 51 04	116 23 36	1680
Nuevo Laredo	TA	MX	27 29 48	99 30 01	1690
Manuel Benavides	CH	MX	29 04 48	103 56 20	1690
Mexicali	BN	MX	32 40 00	115 27 00	1690
Douglas	AZ	US	31 22 08	109 31 45	1690
Praxedis Guerrero	CH	MX	31 22 18	105 58 31	1700
Ocampo	COAH	MX	27 19 27	102 21 49	1700
Tecate	BN	MX	32 34 02	116 37 45	1700
Tucson	AZ	US	32 15 11	110 57 44	1700
Harlingen	TX	US	26 15 11	97 44 49	1700