AGREEMENT BETWEEN THE GOVERNMENT OF THE UNITED STATES OF AMERICA AND THE GOVERNMENT OF CANADA RELATING TO THE AM BROADCASTING SERVICE IN THE MEDIUM FREQUENCY BAND

OTTAWA, 1984

AGREEMENT BETWEEN THE GOVERNMENT OF THE UNITED STATES OF AMERICA AND THE GOVERNMENT OF CANADA RELATING TO THE AM BROADCASTING SERVICE IN THE MEDIUM FREQUENCY BAND

The Government of Canada and the Government of the United States of America, desiring to continue their mutual understanding and cooperation in the matter of AM broadcasting, to protect the broadcasting stations in the two countries and to improve the utilization of the frequency band 535 to 1605 kHz allocated to this service, have agreed as follows:

Article I

Definitions

For the purpose of this Agreement, the following terms shall have the meanings defined below:

<u>Administration</u>: The Federal Communications Commission of the United States and the Department of Communications of Canada, respectively;

<u>Plan</u>: The frequency assignment plan defined in Annex 1 to the Agreement and the modifications introduced as a result of the application of the procedure of Article III of the Agreement;

<u>Agreement</u>: This Agreement and its Annexes.

Rio de Janeiro Plan: The frequency assignment plan defined in the Regional Agreement for the Medium Frequency Broadcasting Service in Region 2 (Rio de Janeiro, 1981).

Article II

Adoption of the Plan

The Plan set out in Annex 1 to the Agreement consists of assignments with technical characteristics agreed upon by the two Administrations. Broadcasting stations shall be brought into service only when in conformity with Annex 1 or any modification of it resulting from the application of Article III.

Article III

Modification Procedure

3. When an Administration proposes to modify the Plan i.e.:

to change the characteristics of a frequency assignment to a station shown in the Plan, whether or not the station has been brought into use, or

to introduce a new assignment into the Plan, or

to bring into use a new station, or

to cancel a frequency assignment to a station,

the following procedure shall be applied simultaneously with or prior to the notification to the IFRB for modification to the Rio de Janeiro Plan.

Proposals for changes in the characteristics of an assignment, for the introduction of a new assignment or for the bringing into use of a new station

An Administration proposing to change the characteristics of an assignment in the Plan, introduce a new assignment or bring into use a new station shall seek the agreement of the other Administration.

Any assignment in conformity with the Agreement shall be considered as adversely affected when appropriate calculations based on Annex 2 indicate that objectionable interference would occur as a result of a proposed modification to the Plan. In the event that a proposed modification to the Plan by one Administration is adversely affected by a proposed modification from the other Administration, the proposal bearing the earlier notified transmittal date shall prevail, unless it is found to cause objectionable interference to other assignments in the Plan.

3.2.3 If an affected Administration considers that a proposed modification is acceptable, it shall signify its agreement as soon as possible to the other Administration and shall inform the IFRB accordingly. If an affected Administration considers that a proposed modification to the Plan is unacceptable, it shall communicate its reasons to the notifying Administration within 60 days from the date of notification. If no comment has been received within that 60 day period, the notifying Administration may proceed with its assignment and advise the IFRB that the agreement of the other Administration has been obtained.

3.2.4 The agreement referred to in section 3.2.1 is not required for a proposed change in the characteristics of an assignment in conformity with the Agreement if it entails no increase in the radiated field strength in any direction and, if a change in the site of the station is involved, this change is limited to the greater of 3 km or 5% of the distance to the nearest point on the border of the other country up to a maximum of 10 km. The distance is calculated from the site first registered in the Plan or subsequently registered in the Plan as a result of the application of the provisions of section 3.2. In any event, such site change shall not result in a groundwave contour overlap prohibited under section 4.10.4.2 of Annex 2 to the Agreement. However, no protection will be required beyond the level of protection which was already accepted before the proposed move.

3.3 <u>Cancellation of an assignment</u>

When an Administration decides to cancel an assignment in conformity with the Agreement, it shall immediately notify the other Administration. Simultaneously with such cancellation, the Administration may notify a new assignment to substitute for the cancelled assignment, provided that the new assignment would not cause objectionable interference at a level in excess of that caused by the cancelled assignment and which had been previously accepted.

Article IV

Format of Notification

The information required for the notifications referred to in Article III shall be provided in conformity with Annex 1 to the Agreement. In the case of a modification of technical characteristics, there shall be an indication of which parameter is modified. In order to facilitate the verification of the data, directional antenna parameters shall be supplemented by sample values of calculated radiation in 5 azimuths and vertical angles pertinent to the specific protection requirements involved.

Article V

Technical Criteria

The Administrations shall apply, in carrying out the Agreement, the technical criteria contained in Annex 2, as may be amended from time to time pursuant to Article XI.

Article VI

Groundwave Field Strength Measurements

6.1 The technical criteria contained in the Agreement provide for protection from groundwave interference through the use of theoretical calculations based on the values of ground conductivity as included in Appendix 1 to Annex 2. Nevertheless, it is recognized that in some situations such calculations may not properly reflect actual conditions where the conductivity along a specific path differs from the value shown on the conductivity map.

Therefore, field strength measurements made within a station's own country in accordance with Appendix 6 to Annex 2 may be employed in these situations to justify an assignment based on measured conductivity values.

If a station whose parameters were accepted on the basis of measurements submitted in accordance with this Article is found to cause interference within the range of azimuths covered by the data submitted, then the station shall reduce its radiation in the pertinent directions to the levels permitted by calculations using the conductivity map, or to such levels as may be mutually agreed upon by both Administrations.

Resolution of interference complaints

6.4.1 When it is believed that a station is experiencing objectionable interference above the level previously accepted from a station in the other country, its Administration shall be informed and, after verification, shall refer the interference complaint to its counterpart. The station believed to be the cause of the interference shall be required immediately to verify its authorized operation (including measuring field strength at permanent monitoring points if appropriate) and make any adjustments necessary to resume its authorized operation. The station shall, within 10 days of receipt of the complaint, advise its Administration of the action taken. The responsible Administration shall immediately advise its counterpart of the station's status including corrective measures taken. If, after completion of the above steps, the complaining station is still experiencing objectionable interference above the level previously accepted anywhere within its protected contour, field strength measurements shall be taken in accordance with Appendix 6 to Annex 2.

6.4.2 The Administration responsible for the complaining station shall review the field strength measurement data and, if satisfied that it is well founded, shall forward the complaint to the other Administration. If that Administration is not satisfied that the complaint is valid, it shall advise the other Administration of the reasons therefor, in order to facilitate discussions. If the Administration which receives the complaint is satisfied that it is valid on the basis of the referred data, it shall:

a) evaluate the measurement data as promptly as possible, but in no event later than 20 days after receipt;

b) forward the measurement data to the station causing the interference;

c) notify the station to take any necessary action to eliminate the interference or to prove that it is operating as authorized. The station shall comply as soon as possible within a time period not to exceed 30 days;

d) if necessary corrective action has not been taken within 30 days, order the interfering station to reduce its power at once by any amount necessary, including cessation of operation, to eliminate the interference;

e) refuse authority to resume normal operation until the necessary action specified in c) and d) above has been taken.

6.4.3 Since actual ground conductivities over specific paths may vary from the values indicated in the ground conductivity maps included in Appendix 1 to Annex 2, interference may be experienced even if the station causing the interference is operating in accordance with notified parameters. In such circumstances, except as noted in section 6.3, no action will be required as long as the station can demonstrate that it is operating as authorized. However, each Administration shall endeavor, in cooperation with the other, to mitigate such interference.

Article VII

Extended Hours of Operation

7.1 Scope. "Extended hours of operation" refers to the operation of AM radio broadcasting stations during nighttime hours which occur between 6:00 am and two hours past sunset local time, with protection requirements determined in accordance with Appendix 7 to Annex 2. Operation during this period shall be with daytime or nighttime facilities adjusted as necessary to meet the requirements of this Article.

7.2 Protection.

7.2.1 During extended hours of operation, a station shall provide protection to each co-channel station in the other country in accordance with the method described in Appendix 7 to Annex 2.

7.2.2 A station authorized for extended hours of operation shall not receive protection for that operation.

7.2.3 In applying section 7.2.1, the hours of sunrise and sunset for each month shall be determined as of the 15th day of each month and adjusted to the nearest quarter-hour.

7.2.4 Power radiated during extended hours of operation shall not exceed the highest power that provides the required protection.

7.2.5 Notified nighttime operation has priority over extended hours of operation. Thus, the power used during extended hours of operation shall be adjusted downward as necessary to provide requisite protection to duly notified and accepted nightime assignments, whenever they may be notified.

Notification. Proposed extended hours of operation by stations meeting the requirements of this Article are deemed to be acceptable. Each such proposal shall be notified in accordance with Articles III and IV. The notification shall include the exact operating characteristics of each station proposing extended hours of operation.

Article VIII

Critical Hours of Operation

Scope. "Critical hours of operation" refers to the operation of Class B and C AM radio broadcasting stations of either country, assigned to channels on which the other country has a Class A station listed in Part VI of Annex 1, during those daytime hours specified in Appendix 8 to Annex 2.

Protection

8.2.1 The Class A stations referred to in section 8.1 shall be protected during their critical hours of operation in accordance with the criteria specified in Appendix 8 to Annex 2.

8.2.2 No assignment previously accepted by both Administrations, or subsequent modifications thereto, shall be required to reduce radiation to comply with section 8.2.1.

Notification. Proposed critical hours of operation by stations meeting the requirements of this Article are deemed to be acceptable. Each such proposal shall be notified in accordance with Articles III and IV. The notification shall include the exact operating characteristics of each station proposing critical hours of operation.

Article IX

Termination of Previous Agreements

9.1 This Agreement supersedes all previous agreements, arrangements and understandings between Canada and the United States relating to the AM broadcasting service, including the provisions of the North American Regional Broadcasting Agreement, 1950 (NARBA) insofar as that agreement relates to mutual undertakings of Canada and the United States. The Agreement also prevails over provisions of the Regional Agreement for the Medium Frequency Broadcasting Service in Region 2, (Rio de Janeiro, 1981), wherever the two agreements are inconsistent, insofar as mutual relations between Canada and the United States are concerned.

9.2 Proposed assignments previously notified pursuant to NARBA, and still pending on the date of entry into force of the Agreement, shall be deemed to be notified under this Agreement, taking into account understandings already reached concerning them.

Article X

Periodic Review

Recognizing that the Agreement is intended to remain in effect for an indefinite period, the Parties agree that, no later than five years after the date of the entry into force of the Agreement pursuant to Article XII, and no later than the expiration of each successive five-year period thereafter, each Party shall designate and notify to the other those of its assignments in the Plan not yet brought into use that it wishes to retain in the Plan. Assignments which have remained unused for at least five years, and which are not so designated and notified shall lapse and be automatically deleted from the Plan at the end of each such five-year period.

Article XI

Amendment of the Annexes

Except for modifications to the Plan, which are governed by Article III, the Annexes hereto may be amended by exchange of letters directly between the Administrations. The adoption of such amendments shall be notified to the Department of External Affairs of Canada and the Department of State of the United States of America by the Administration of each country.

[redacted]

Article XII

Entry into Force and Termination

The Agreement shall enter into force on the date of its signature and shall remain in force thereafter until terminated upon twelve months' notice given in writing by one of the Parties to the other.

IN WITNESS WHEREOF, the undersigned, duly authorized by their respective Governments, have signed this Agreement.

DONE in duplicate at Ottawa, this 17th day of January, 1984, in the English and French languages, each version being equally authentic.

(signed): FRANCIS FOX

PAUL H. ROBINSON, JR.

For the Government of Canada

For the Government of the United States

ANNEX 1

to the Agreement

INFORMATION TO BE CONTAINED IN LISTINGS AND IN FORMS FOR NOTIFICATION PURPOSES

1. Parts I through V describe the data to be notified and the forms to be used in notification. Part VI lists the Class A stations to be protected during critical hours of operation. The Plan, a listing of all assignments and their technical parameters, is contained in Part VII.

2. An administration wishing to submit the equivalent information on magnetic tape or by other electronic means, shall submit such data only in the format accepted by the other administration.

3. Five forms and 2 listings are provided; each of which corresponds to the following information:

I	General information on the transmitting station.
PART II	Information on directional antennas consisting of vertical conductors.
PART III	Additional information for directional antennas with augmented (modified expanded) patterns.
PART IV	Supplementary information for top-loaded or sectionalized towers used for omnidirectional and directional antenna systems.
V	Supplementary information for extended hours of operation.
PART VI	Class A stations (formerly NARBA Class I-A) protected during critical hours of operation.
PART VI-A	Class A stations (formerly NARBA Class I-B).
PART VII :	The Plan

4. Administrations shall use only these forms or reproductions thereof.

5. The administration receiving the notification may return forms which have not been completed correctly.

6. When known, the IFRB Serial Number shall be inserted on each form by the notifying administration. Otherwise, the space provided shall be left blank.

PART I

GENERAL INFORMATION ON THE TRANSMITTING STATION

Instructions for completing the forms

Variable No.
or
Box No.

00 IFRB Serial Number (Indicate only once a Serial No. has been received from IFRB).

01 Administration

Indicate the name of the administration, the sheet number and the date on which the form was completed.

02 Assigned frequency (kHz)

03 Name of the transmitting station

Indicate the name of the locality or the name by which the station is known. Limit the number of letters and numerals to a total of 14.

04 Call sign

This information is optional. Limit the number of letters and numerals to a total of 7.

05 Additional identification

Indicate any additional information which may be considered essential for complete identification. Where this information is not essential, this box may be left blank.

06 Station Class (A, B or C)

Insert A, B or C according to the station classes defined in Chapter 1 of Annex 2.

07 Operational status

Enter O for a station already in operation or for a change of characteristics in accordance with 3.2.4 of the agreement, and enter P for a station to be brought into operation, or for any other change of characteristics.

08 Country

Indicate the name of the country or geographical area in which the station is located. Use the symbols in Table 1 of the Preface to the International Frequency List.

Variable No.
or
Box No.

09 **Geographical coordinates for 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. If no seconds are indicated, a value of 0 will be used.

11 **Indicate the reason for the application of Article III**

a) New assignment;

b) Modification of the characteristics of an assignment recorded in the Plan for Region 2;

c) Cancellation of an assignment.

12 Indicate whether the modification is of the type specified in section 3.2.4 of Article III of the Agreement.

13 In the case of a new station, indicate the date of bringing into service. In the case of a change in the characteristics of a station already recorded in the Plan, indicate the date of start of operation with the modified characteristics or the date of cessation of operation.

14 Indicate extended hours (E) or critical hours (C) operation. (If extended hours complete Part V).

DAYTIME OPERATION

21 **Station power (kW)**

Indicate the carrier power supplied to the antenna for daytime operation (to the second decimal position for powers less than 1 kW).

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

26 **Antenna type**

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

A - Simple omnidirectional antenna

B - Directional antenna (complete Part II)

1 - Top-loaded omnidirectional antenna (complete Part IV)

2 - Sectionalized omnidirectional antenna (complete Part IV)

Variable No.
or
Box No.

27 **Simple vertical antenna electrical height**

Indicate here the electrical height, in degrees, for a simple vertical antenna in use for daytime operation. In the case of an antenna type other than A, this box should be left blank.

NIGHTTIME OPERATION

31 Station power (kW)

Indicate the carrier power supplied to the antenna for night-time operation (to the second decimal position for powers less than 1 kW).

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

36 Indicate the antenna type used for night-time operation (for symbols, see 26)

37 (See 27)

44 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.

Coordination under Article III

Country - Indicate the name of the countries which may be affected and with which coordination is considered necessary, using the symbols in Table I of the Preface to the International Frequency List.

In progress - Add an "X" if coordination is under way with these countries.

Acceptance obtained - Indicate with an "X" if coordination has been successful.

(00) IFRB Serial No.

FORM FOR THE APPLICATION OF ARTICLE 4 OF THE AGREEMENT
CHARACTERISTICS OF A REGION 2 BROADCASTING STATION IN THE BAND 535 - 1 605 kHz

PART I GENERAL INFORMATION

(01) Administration ______ FORM No. ______ Date ______

Assigned frequency (kHz)		(02)	
TRANSMITTING STATION	Name of the station	(03)	
	Call sign	(04)	
	Additional Identification	(05)	
	Station class	(06)	
	Operational Status	(07)	
Country		(08)	
Geographical coordinates of the transmitting station		(09)	W ° ' " N ° ' "

(11) a) New assignment ☐ b) Modification of characteristic of an assignment recorded in the Plan ☐ c) Cancellation of an assignment ☐

(12) Modification under Article 3.2.4 (Region 2 Agr. Sec. 4.2.14) Yes ☐ No ☐

(13) Date of bringing into service or cessation of operation ______ Year Month Day

(14) Extended/Critical hours of operation ☐

STATION PARAMETERS	DAYTIME OPERATION	NIGHT-TIME OPERATION
Station power (kW)	(21)	(31)
r.m.s. value of radiation for station power (mV/m at 1 km)	(25)	(35)
Antenna type	(26)	(36)
Simple vertical antenna electrical height (degrees)	(27)	(37)

(44) **Remarks**	COORDINATION UNDER ARTICLE III:							
	COUNTRY							
	IN PROGRESS							
	ACCEPTANCE **OBTAINED**							

PART II

INFORMATION ON DIRECTIONAL ANTENNAS CONSISTING OF VERTICAL CONDUCTORS

Instructions for completing the form

Variable No.
or
Box No.

00 IFRB Serial Number (only once a Serial No. has been received from IFRB).

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 1 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. The symbol C shall be used to indicate critical hours of operation. When the same operation is used for more than one time period, enter the 2 or 3 applicable symbols.

04 Indicate the total number of towers constituting the array.

Column No.

05 Indicate 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 orientation are shown with respect to a common reference point which is generally the first tower.

1 = where the spacing and orientation are shown with respect to the previous tower.

Column No.

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

12 Tower structure

Indicate the structure of each tower using the following code:

0 = simple vertical antenna
1 = top-loaded antenna
2 = to 9 = sectionalized antenna

Codes 1 to 9 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 3 and 5 to Annex 2.

Variable No.
or
Box No.

14 r.m.s. value of radiation (mV/m at 1 km)

15 Type of pattern : T = theoretical
E = expanded
M = augmented (modified expanded).

16 Special quadrature factor for expanded and augmented (modified expanded) patterns in mV/m at 1 km (to replace the normal expanded pattern quadrature factor when special precautions are taken to ensure pattern stability).

17 Supplementary information.

FORM FOR THE APPLICATION OF ARTICLE 4 OF THE AGREEMENT

CHARACTERISTICS OF A REGION 2 BROADCASTING STATION

IN THE BAND 535 - 1605 kHz

IFRB Serial No. (00) [ ]

PART II

DESCRIPTION OF A DIRECTIONAL ANTENNA CONSISTING OF VERTICAL CONDUCTORS

Form No. [ ] Date [ ]

(01) Name of transmitting station

(02) Country

(03) Hours of operation

(04) Total number of towers

(05) Tower No.	(06) Tower field ratio	(07) Phase difference of the field (± degrees)	(08) Electrical tower spacing (degrees)	(09) Angular tower orientation (degrees)	(10) Definition point indicator	(11) Electrical height of tower (degrees)	(12) Tower structure
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

(Use a supplementary sheet in cases where there are more than 10 towers.)

(14) r.m.s. value of theoretical radiation	(15) Type of pattern (T, E or M)	(16) Special quadrature factor
mV/m at 1 km		mV/m at 1 km

(17) SUPPLEMENTARY INFORMATION

PART III

ADDITIONAL INFORMATION FOR DIRECTIONAL ANTENNAS WITH AUGMENTED (MODIFIED EXPANDED) PATTERNS

1. Part II contains the information for directional antenna systems operating with theoretical and expanded patterns. However, some stations 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. Part III 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 Box 15 of Part II contains the symbol "M" for "augmented (modified expanded)".

Box No.

00 IFRB Serial Number (Indicate the IFRB Serial No. only once one has been received from IFRB).

01 Indicate the name of the transmitting station

02 Country. Indicate the country in which the station is located, using the symbols in Table I 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 period respectively. The symbol C shall be used to indicate critical hours of operation. When the same operation is used for more than one time period, enter the 2 or 3 applicable symbols.

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

Column No.

05 Indicate the serial number of the augmentations, as they will be described in columns 06, 07 and 08 (see section 2 of Attachment A, Appendix 3 to Annex 2).

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.

Box No.

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. If a supplementary sheet has been used for further augmentations, please indicate in this box.

(00)

FORM FOR THE APPLICATION OF ARTICLE 4 OF THE AGREEMENT

CHARACTERISTICS OF A REGION 2 BROADCASTING STATION IN THE BAND 535 - 1605 kHz

PART III

ADDITIONAL INFORMATION FOR DIRECTIONAL ANTENNAS WITH

AUGMENTED (MODIFIED EXPANDED) PATTERNS

TO BE SUBMITTED WHENEVER THE SYMBOL M IS ENTERED IN PART II BOX 15

Form No. - Date

(01) Name of transmitting station

(02) Country

(03) Hours of operation

(04) Total number of augmentations

(05) Augmentation No.	(06) Radiation at central azimuth of augmentation (mV/m at 1 km)	(07) Central azimuth of augmentation (degrees)	(08) Total span of augmentation (degrees)
01			
02			
03			
04			
05			
06			
07			
08			
09			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

(Use a supplementary sheet in cases where there are more than 20 augmentations.)

(09) SUPPLEMENTARY INFORMATION

PART IV

SUPPLEMENTARY INFORMATION FOR TOP-LOADED OR SECTIONALIZED TOWERS USED FOR OMNIDIRECTIONAL AND DIRECTIONAL ANTENNA SYSTEMS

1. Where an omnidirectional antenna is top-loaded or sectionalized, a 1 or a 2 will have been entered in Part I Box 26 and/or 36. Proceed as for a single tower of a directional antenna.

2. When an antenna tower of a directional antenna is either top-loaded or sectionalized, column 12 of Part II will contain either a 1 for top-loaded or 2 to 9. This numeral describes the particular type of top-loaded or sectionalized antenna used, as described below:

Box No.

00 IFRB Serial Number (Indicate the Serial No. only once one has been received from IFRB).

01 Name of the station

02 Country. Indicate the country or geographical area in which the station is located, using the symbols in Table I 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. The symbol C shall be used to indicate critical hours of operation. When the same operation is used for more than one time period, enter the 2 or 3 applicable symbols.

Column No.

04 Tower number

Columns 5 to 8 contain 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 for which a value is given in the column. (These values are used in the equations given in Appendices 3 and 5)
1	Electrical height of the antenna tower (degrees)
2	Height of lower section (degrees)
3	Height of lower section (degrees)
4	Height of lower section (degrees)

	5	Height of lower section (degrees)
	6	Total height of tower (degrees)
	7	Height of lower section (degrees)
	8	Height of lower section (degrees)
	9	Height of centre of bottom dipole (degrees).
06	<u>Code used in Col. 12</u> (Part II)	<u>Description of the characteristic for which a value is given in the column. (These values are used in the equations given in Appendices 3 and 5)</u>.
	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).
	3	Blank
	4	Blank
	5	Height of upper section (degrees)
	6	Height of lower section (degrees)
	7	Total height of antenna (degrees)
	8	Height of upper section (degrees)
	9	Height of centre of top dipole (degrees).
07	<u>Code used in Col. 12</u> (Part II)	<u>Description of the characteristic for which a value is indicated in the column. (These values are used in the equations contained in Appendices 3 and 5)</u>
		Blank
	2	Total height of antenna (degrees)
	3	Blank
	4	Blank
	5	Current distribution factor
	6	Blank
	7	Ratio of loop currents in the two elements
	8	Scaling factor so that f (θ) is 1.0 in the horizontal plane
	9	Blank

Code used in Col. 12 (Part II)	Description of the characteristics for which a value is indicated in the column. These values are used in the equations entered in Appendices 3 and 5
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)
3	Blank
4	Blank
5	Ratio of maximum current in the top section to maximum currrent in the bottom section
6	Blank
7	Blank
8	The absolute value of the ratio of the real component of current to the imaginary component of current at the point of maximum amplitude
9	Blank

I.F.R.B. Serial

(00) [ ]

FORM FOR THE APPLICATION OF ARTICLE 4 OF THE AGREEMENT
CHARACTERISTICS OF A REGION 2 BROADCASTING STATION IN THE BAND 535 - 1605 kHz

PART IV

SUPPLEMENTARY INFORMATION FOR TOP-LOADED OR SECTIONALIZED TOWERS USED FOR:

A) DIRECTIONAL ANTENNA SYSTEMS FOR TOWERS ENTERED IN PART II AS TOP-LOADED OR SECTIONALIZED (COLUMN 12), OR

B) NON-DIRECTIONAL ANTENNA TOWERS ENTERED IN PART I AS TOP-LOADED OR SECTIONALIZED (COLUMN 26 OR 36).

Form No. [ ] Date [ ]

(01) [ ] Name of transmitting station

(02) [ ] Country

(03) [ ] Hours of operation

(04) Tower number	(05) A	(06) B	(07) C	(08) D
	•	•	•	•
	•	•	•	•
	•	•	•	•
	•	•	•	•
	•	•	•	•
	•	•	•	•
	•	•	•	•
	•	•	•	•
	•	•	•	•
	•	•	•	•

PART V

SUPPLEMENTARY INFORMATION FOR EXTENDED HOURS OF OPERATION

Instructions for completing the form

1. Information in boxes 02, 03, 04 and the IFRB Serial No. should coincide with information on the station previously notified.

2. If the station is new or if previously notified parameters are being modified, this sheet should be attached to IFRB Form Part I (as well as Parts II, III or IV where appropriate) as described in Annex 3 to the Agreement.

3. This sheet is to be submitted only when modified daytime (sunrise-to-sunset at the local site) or night time (sunset-to-sunrise at the local site) parameters are to be used at other than the previously authorized local times.

4. Fill in the remaining data in the following manner:

Box No.

41 The month and day when the operation in that column (boxes 41 to 46) commences.

42 The month and day when the operation ceases.

43 The hour in UTC (Universal Co-ordinated Time) when the parameters described in that column commence.

44 The hour in UTC when these parameters cease to be used.

45 Carrier power supplied to the antenna (to the second decimal position) in kW.

46 r.m.s. value of radiation, in mV/m at 1 km, for the power in box 45.

47 Antenna system used for extended hours: Indicate Day or Night system.

51-56 Similar to 41-46 for the dates and times indicated.

61-66 as 51-56

5. If more than one sheet is necessary to describe the operation, fill in the sheet number and the total sheets in the boxes provided.

(00) IFRB Serial No.

FORM FOR THE APPLICATION OF ARTICLE 4 OF THE AGREEMENT

CHARACTERISTICS OF A REGION 2 BROADCASTING STATION IN THE BAND 535-1605 kHz

PART V

SUPPLEMENTARY INFORMATION FOR EXTENDED HOURS OF OPERATION

(02) FREQ. kHz (03) CITY. STATE/PROV.

(04) CALL SIGN FORM NO. DATE YR MO DAY

SHEET OF SHEETS

Dates of the year inclusive From: To:	(41) (42) Mo Day	(51) (52) Mo Day	(61) (62) Mo Day
Hours of Extended Operation (UTC) From: To:	(43) (44)	(53) (54)	(63) (64)
Station Power in kW during these hours	(45)	(55)	(65)
R.m.s. value of radiation for station power (mV/m at 1 km)	(46)	(56)	(66)
Antenna system used for extended hours	(47) DAY NIGHT		
Remarks: (add any other pertinent information)			

PART VI

Class A Stations (formerly NARBA Class I-A)

Protected During Critical Hours of Operation

Channel kHz	Call Sign	Location	Country
540	CBK	Watrous, Sask.	Canada
640	KFI	Los Angeles, Cal.	U.S.A.
650	WSM	Nashville, Tenn.	U.S.A.
660	WNBC	New York, N.Y.	U.S.A.
670	WMAQ	Chicago, Ill.	U.S.A.
690	CBF	Montreal, Que.	Canada
700	WLW	Cincinnati, Ohio	U.S.A.
720	WGN	Chicago, Ill.	U.S.A.
740	CBL	Toronto, Ont.	Canada
750	WSB	Atlanta, Ga.	U.S.A.
760	WJR	Detroit, Mich.	U.S.A.
770	WABC	New York, N.Y.	U.S.A.
780	WBBM	Chicago, Ill.	U.S.A.
820	WBAP	Fort Worth, Tex.	U.S.A.
830	WCCO	Minnesota, Minn.	U.S.A.
840	WHAS	Louisville, Ky.	U.S.A.
860	CJBC	Toronto, Ont.	Canada
870	WWL	New Orleans, La.	U.S.A.
880	WCBS	New York, N.Y.	U.S.A.
890	WLS	Chicago, Ill.	U.S.A.
990	CBW	Winnipeg, Man.	Canada
1010	CBR	Calgary, Alta.	Canada
1020	KDKA	Pittsburgh, Pa.	U.S.A.
1030	WBZ	Boston, Mass.	U.S.A.
1040	WHO	Des Moines, Ia.	U.S.A.
1100	WWWE	Cleveland, Ohio	U.S.A.
1120	KMOX	St. Louis, Mo.	U.S.A.
1160	KSL	Salt Lake City, Utah	U.S.A.
1180	WHAM	Rochester, N.Y.	U.S.A.
1200	WOAI	San Antonio, Tex.	U.S.A.
1210	WCAU	Philadelphia, Pa.	U.S.A.
1580	CBJ	Chicoutimi, Que.	Canada.

PART VI - A

Class A Stations (formerly NARBA Class I-B)

Channel kHz	Call Sign	Location	Country
640	CBN	S. John's, Nfld.	Canada
680	KNBR	S. Francisco, Calif.	U.S.A.
710	WOR	New York, N.Y.	U.S.A.
	KIRO	Seattle, Wash.	U.S.A.
810	KGO	S. Francisco, Calif.	U.S.A.
	WGY	Schenectady, N.Y.	U.S.A.
850	KOA	Denver, Colo.	U.S.A.
940	CBM	Montreal, Que.	Canada
1000	WCFL	Chicago, Ill.	U.S.A.
	KOMO	Seattle, Wash.	U.S.A.
1060	KYW	Philadelphia, Pa.	U.S.A.
1070	CBA	Moncton, N.B.	Canada
	KNX	Los Angeles, Calif.	U.S.A.
1080	WTIC	Hartford, Conn.	U.S.A.
	KRLD	Dallas, Texas	U.S.A.
1090	KAAY	Little Rock, Ark.	U.S.A.
	WBAL	Baltimore, Md.	U.S.A.
1110	KFAB	Omaha, Neb.	U.S.A.
	WBT	Charlotte, N.C.	U.S.A.
1130	CKWX	Vancouver, B.C.	Canada
	KWKH	Shreveport, La.	U.S.A.
	WNEW	New York, N.Y.	U.S.A.
1140	WRVA	Richmond, Va.	U.S.A.
1170	KVOO	Tulsa, Okla.	U.S.A.
	WWVA	Wheeling, W. Va.	U.S.A.
	WOWO	Fort Wayne, Ind.	U.S.A.
	KEX	Portland, Ore.	U.S.A.
	WTOP	Washington, D.C.	U.S.A.
	KSTP	S. Paul, Minn.	U.S.A.
	WLAC	Nashville, Tenn.	U.S.A.
	KGA	Spokane, Wash.	U.S.A.
	WKBW	Buffalo, N.Y.	U.S.A.
	KOMA	Oklahoma City, Okla.	U.S.A.
	KFBK	Sacramento, Calif.	U.S.A.
	WCKY	Cincinnati, Ohio	U.S.A.
1540	KXEL	Waterloo, Ia.	U.S.A.
1550	CBE	Windsor, Ont.	Canada
1560	WQXR	New York, N.Y.	U.S.A.
	KPMC	Bakersfield, Calif.	U.S.A.

PART VII

THE PLAN

1. The Plan in its entirety shall consist of:

a) the assignments notified, coordinated and accepted by both Administrations pursuant to agreements and arrangements previously in force between them, as they appear in their respective records; and

b) the list of assignments which appears in this Part.

Since it was not possible to attach a complete, accurate list of assignments to this Agreement, the Administrations undertake to exchange their respective lists and to verify them with a view to producing a mutually agreed consolidated version of the Plan for the application of the Agreement, as soon as possible. This version of the Plan shall be adopted by an exchange of notes between the two governments.

2. The assignments in the Plan on 1230, 1240, 1340, 1400, 1450 and 1490 kHz reflect agreement that the night-time power of assignments notified and accepted when the Agreement is signed, on channels hitherto classified as "local" channels, may be increased to 1 kW or, in some individual cases, to other indicated levels. The effective dates of such power increases will be established by exchange of letters between the Administrations. Stations on the above-listed channels which are in operation when the Agreement is signed will be permitted to increase power during daytime hours if they provide protection mutually accepted by both Administrations.

ANNEX 2

to the Agreement

TECHNICAL CRITERIA

To be used in the application of the Agreement

CHAPTER 1

Definitions and symbols

1. Definitions

In addition to the definitions given in the Radio Regulations, the following definitions and symbols apply to this Agreement.

Broadcasting channel (in 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 centre.

1.2 Objectionable interference

Interference caused by a signal exceeding the maximum permissible field strength within the protected contour, in accordance with the values derived from this Annex.

Protected contour

Continuous line that delimits the area of primary or secondary service which is protected from objectionable interference.

1.4 Primary service area

Service area delimited by the contour within which the calculated level of the groundwave field strength is protected from objectionable interference in accordance with the provisions of Chapter 4.

Secondary service area

Service area delimited by the contour within which the calculated level of the field strength due to the skywave field strength 50% of the time is protected from objectionable interference in accordance with the provisions of Chapter 4.

Nominal usable field strength (E_{nom})

Agreed minimum value of the field strength required to provide satisfactory reception, under specified conditions, in the presence of atmospheric noise, man-made noise and interference from other transmitters. The value of nominal usable field strength has been employed as the reference for planning.

1.7 Usable field strength (E_u)

Minimum value of the field strength required to provide satisfactory reception under specified conditions in the presence of atmospheric noise, man-made noise, and interference in a real situation (or resulting from a frequency assignment plan).

1.8 Audio-frequency (AF) protection ratio

Agreed minimum value of the audio-frequency signal-to-interference ratio corresponding to a subjectively defined reception quality. This ratio may have different values according to the type of service desired.

1.9 Radio-frequency protection ratio

The desired radio-frequency signal-to-interference ratio which, in well-defined conditions, makes it possible to obtain the audio-frequency protection ratio at the output of a receiver. These specified conditions include various parameters such as the frequency separation between the desired carrier and the interfering carrier, the emission characteristics (type and percent modulation etc.), levels of input and output of the receiver and its characteristics (selectivity, sensitivity to intermodulation, etc.).

1.10 Class A station (see Note 1 to Section 4.6)

A station intended to provide coverage over extensive primary and secondary service areas, and which is protected against interference accordingly.

Class B station

A station intended to provide coverage over one or more population centres and the contiguous rural areas located in its primary service area, and which is protected against interference accordingly.

1.12 Class C station

A station intended to provide coverage over a city or town and the contiguous suburban areas located in its primary service area, and which is protected against interference accordingly.

Daytime operation

Operation between the times of local sunrise and local sunset.

1.14 Night-time operation

Operation between the times of local sunset and local sunrise.

1.15 Synchronized network

Two or more broadcasting stations whose carrier frequencies are identical and which broadcast the same programme simultaneously.

In a synchronized network the difference in carrier frequency between any two transmitters in the network shall not exceed 0.1 Hz. The modulation delay between any two transmitters in the network shall not exceed 100 μs, when measured at either transmitter site.

1.16 Station power

Unmodulated carrier power supplied to the antenna.

Groundwave

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

Skywave

Electromagnetic wave which has been reflected by the ionosphere.

Skywave field strength, 10% of the time

The skywave field strength during the reference hour which is exceeded for 10% 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.

1.20 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.

1.21 Characteristic field strength(E_c)

The field strength, at a reference distance of 1 km in a horizontal direction, of the groundwave signal propagated along perfectly conducting ground for 1 kW station power, taking into account losses in a real antenna.

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

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

where E_c is in units of mV/m.

b) The effective monopole radiated power (e.m.r.p.) is given in dB(1 kW) by the following equation:

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

where P_t is the station power in kW

1.22 Symbols

Hz	: hertz
kHz	: kilohertz
W	: watt
kW	: kilowatt
mV/m	: millivolt/metre
μV/m	: microvolt/metre
dB	: decibel
dB (μV/m)	: decibels with respect to 1 μV/m
dB (kW)	: decibels with respect to 1 kW
mS/m	: millisiemens/metre

CHAPTER 2

Groundwave propagation

2.1 Ground conductivity

2.1.1 The Atlas of Ground Conductivity forms Appendix 1 to this Annex. It contains the information communicated to the IFRB following a decision of the First Session (Buenos Aires, 1980), the modifications introduced during the Second Session (Rio de Janeiro, 1981) and the modifications submitted in accordance with 2.1.3 below.

2.1.2 The Atlas is recorded as follows:

2.1.2.1 Large-scale maps of ground conductivity in Canada and the United States.

2.1.2.2 A digitized version maintained in a computer data base by the IFRB.

2.1.2.3 The data used in the preparation of the Atlas was digitized from the values contained in the official ground conductivity maps of the two administrations. In the case of discrepancies or errors due to the digitizing process, the values of the official maps of each administration shall prevail. Whenever an administration detects such discrepancies or errors, it shall so inform the other administration and the IFRB as soon as possible.

2.1.3 When an administration notifies to the IFRB data intended to modify the Atlas, the IFRB so informs all administrations having assignments in Region 2. After 90 days from the date on which this information is communicated by the IFRB, the IFRB modifies the Atlas and communicates the modifications to all administrations.

2.1.4 No assignment in the Plan shall at any time be required to be modified as a result of the incorporation of these data.

2.1.5 A proposal to modify the Plan shall be evaluated on the basis of the values in the Atlas on the date the proposal was received by the other administration, except as specified in Article VI of the Agreement.

1	540 - 560
2	570 - 590
3	600 - 620
4	630 - 650
5	660 - 680
6	690 - 710
7	720 - 760
8	770 - 810
9	820 - 860
10	870 - 910
11	920 - 960
12	970 - 1 030
13	1 040 - 1 100
14	1 110 - 1 170
15	1 180 - 1 240
16	1 250 - 1 330
17	1 340 - 1 420
18	1 430 - 1 510
19	1 520 - 1 610

2.3 Calculation of groundwave field strength

2.3.1 Homogeneous paths

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

The distance in kilometres is shown on a logarithmic scale on the abscissa. The field strength is shown on a logarithmic scale on the ordinate in m/Vm. Graphs 1 to 19 are 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 the following equations:

$$E = \frac{E_0 \times E_c \times \sqrt{P}}{100}$$ if field strengths are expressed in mV/m, and

$$E = E_0 + E_c - 100 + 10 \log P$$ if field strengths are expressed in dB (μV/m).

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

$$E = \frac{E_0 \times E_R}{100}$$ if field strengths are expressed in mV/m, and

$$E = E_0 + E_R - 100$$ if field strengths are expressed in dB (μV/m).

Where
- E resulting field strength
- E_0 : field strength read from graphs 1 to 19
- E_R : actual radiated field strength at a particular azimuth at 1 km
- E_c : characteristic field strength
- P station power in kW.

Graph 20 consists of a pair of scales to be used with the other graphs of Appendix 2. The pair contains one scale labelled in decibels and another in millivolts per metre. The pair 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 metre, and are used to make graphical determinations of field strengths. Other methods of making calculations on graphs 1 to 19 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 discussed 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 the following equations:

$E_R = E_C\sqrt{P}$ if field strengths are expressed in mV/m, and

$E_R = E_C + 10 \log P$ if field strengths are expressed in dB (μV/m).

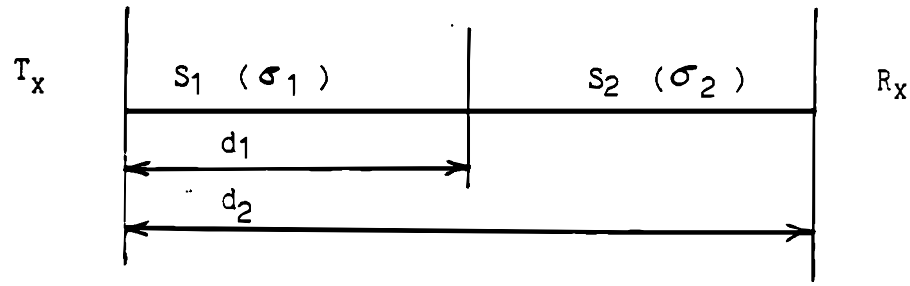
To determine the field strength at a given distance, the scale is placed at the given distance with the 100 m/Vm point of the scale resting on the appropriate conductivity curve. The value of E_R is then found on the scale; the point on the underlying graph (which lies underneath the E_R point of the 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 appropriate graph. The scale is then moved horizontally until the 100 m/Vm point of the scale coincides with the applicable conductivity curve. The distance may then be read from the abscissa of the underlying graph.

2.3.2 Non-homogeneous paths

In this case, the equivalent distance or Kirke method is to be used. To apply this method, graphs 1 to 20 can also be used.

Consider a path whose sections S_1 and S_2 have endpoint lengths corresponding to 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 the graph corresponding to the operational frequency.

b) As the field strength remains constant at the soil discontinuity, the value immediately after the point of 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 note of the corresponding curve for conductivity σ_2 similar to that obtained at equivalent distance $d + (d_2 - d_1)$.

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

CHAPTER 3

Skywave propagation

3. The calculation of skywave field strength shall be conducted in accordance with the provisions which follow. (No account is taken in this Agreement of sea gain or of excess polarization coupling loss).

List of symbols

- d : short great-circle path distance (km)
- E_c : characteristic field strength, mV/m at 1 km for 1 kW
- $f(\theta)$: radiation as a fraction of the value $\theta = 0$ (when $\theta = 0$, $f(\theta) = 1$)
- f : frequency (kHz)
- F : unadjusted annual median skywave field strength, in μV/m
- F_c : field strength read from Figure 4 or Table III for a characteristic field strength of 100 mV/m
- F(50): skywave field strength, 50% of the time, in μV/m
- F(10): skywave field strength, 10% of the time, in 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 known either from design data or, if the actual design data are not available, from Figure 1

Elevation angle, θ, is given by

$$\theta = \arctan\left(0.00752 \cot \frac{d}{444.54}\right) - \frac{d}{444.54} \text{ degrees} \quad (1)$$

$$0 \leqslant \theta \leqslant 90^\circ$$

While Table I and Figure 2 are included for convenience, formula (1) above is controlling.

The radiation $f(\theta)$ expressed as a fraction of the value at $\theta = 0$ at a pertinent elevation angle θ can be determined from Figure 3 or Table II.

The product $E_c f(\theta) \sqrt{P}$ is determined for both omnidirectional and directional antennas with the field strength at 1 km determined at the appropriate elevation angle from Figure 2 and the pertinent azimuth.

The unadjusted skywave field strength F is given by:

$$F = F_c \left[\frac{E_c f(\theta) \sqrt{P}}{100} \right] \mu V/m$$

where F_c is the direct reading from the field strength curve in Figure 4 or Table III.

Note : Values of F_c in Figure 4 and Table 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 4,250 km, it should be noted that F_c can be expressed by:

$$F_c = 10^x \quad \mu V/m \qquad (3)$$

$$\text{where} \quad x = \left(\frac{\left[\frac{231}{3+d/1000} \right] - 35.5}{20} \right)$$

3.3 Skywave field strength, 50% of the time

This is given by:

$$F(50) = F \qquad \mu V/m$$

3.4 Skywave field strength, 10% of the time

The skywave field strength exceeded 10% of the time is given by:

$$F(10) = F(50) \times 2.5118 \quad \mu V/m \qquad (5)$$

3.5 Nocturnal variation of skywave field strength

Hourly median skywave field strengths vary during the night and at sunrise and sunset. Figures 5a and 5b show the skywave diurnal factors with respect to sunrise and sunset at the midpoint of the transmission path These figures shall be applied in determining field strengths of signals of stations engaging in extended operations under Article VII of this Agreement, for the purpose of determining whether such extended operations protect co-channel stations in the other country. (ref. Appendix 7)

3.6 Sunrise and sunset time

To facilitate the determination of the local time of sunrise and sunset, Figure 6 gives the times for various geographical latitudes and for each month of the year. The time is the local meridian time at the point concerned and should be converted to the appropriate standard time.

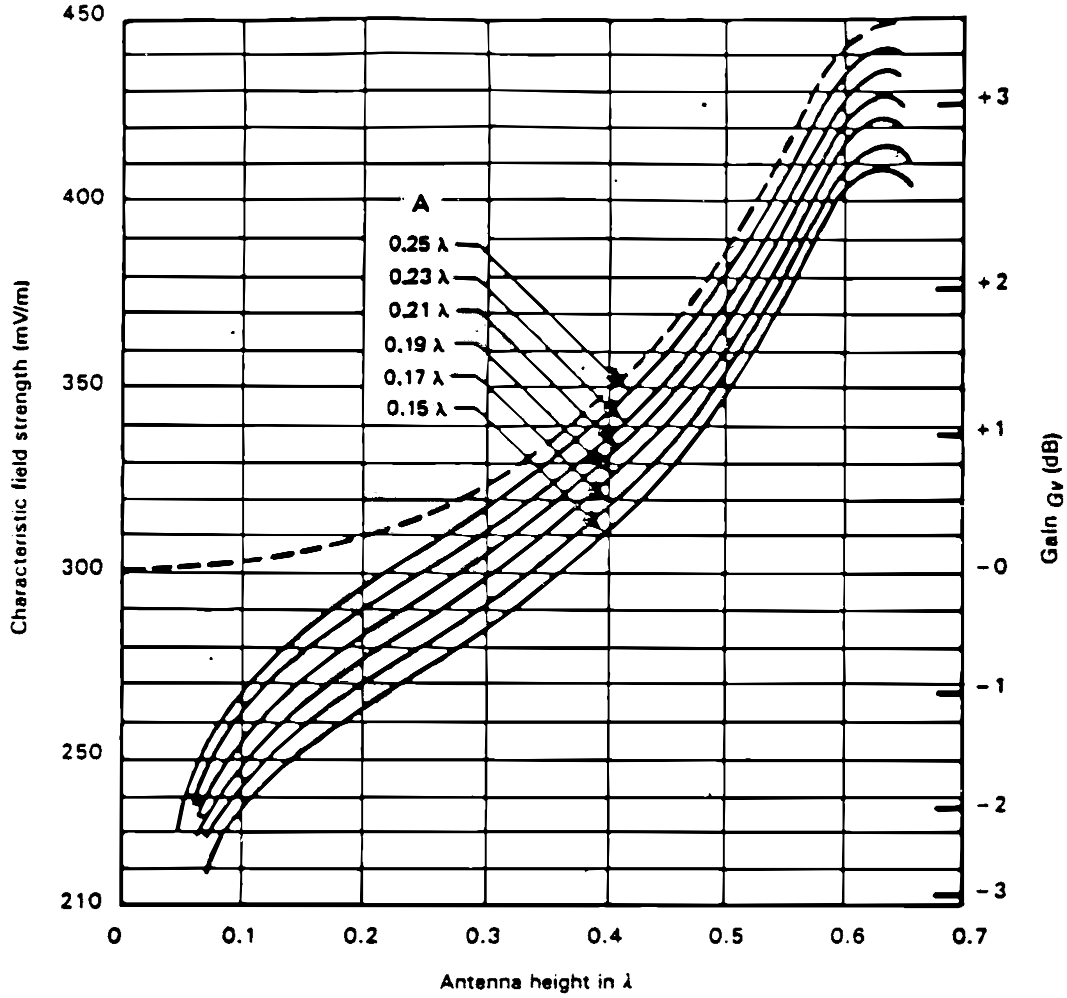


FIGURE 1 - Characteristic field strengths for simple vertical antennas, using 120-radial ground systems

A : radius of ground system

Full lines : real antenna correctly designed

Dashed line : ideal antenna on a perfectly conducting ground

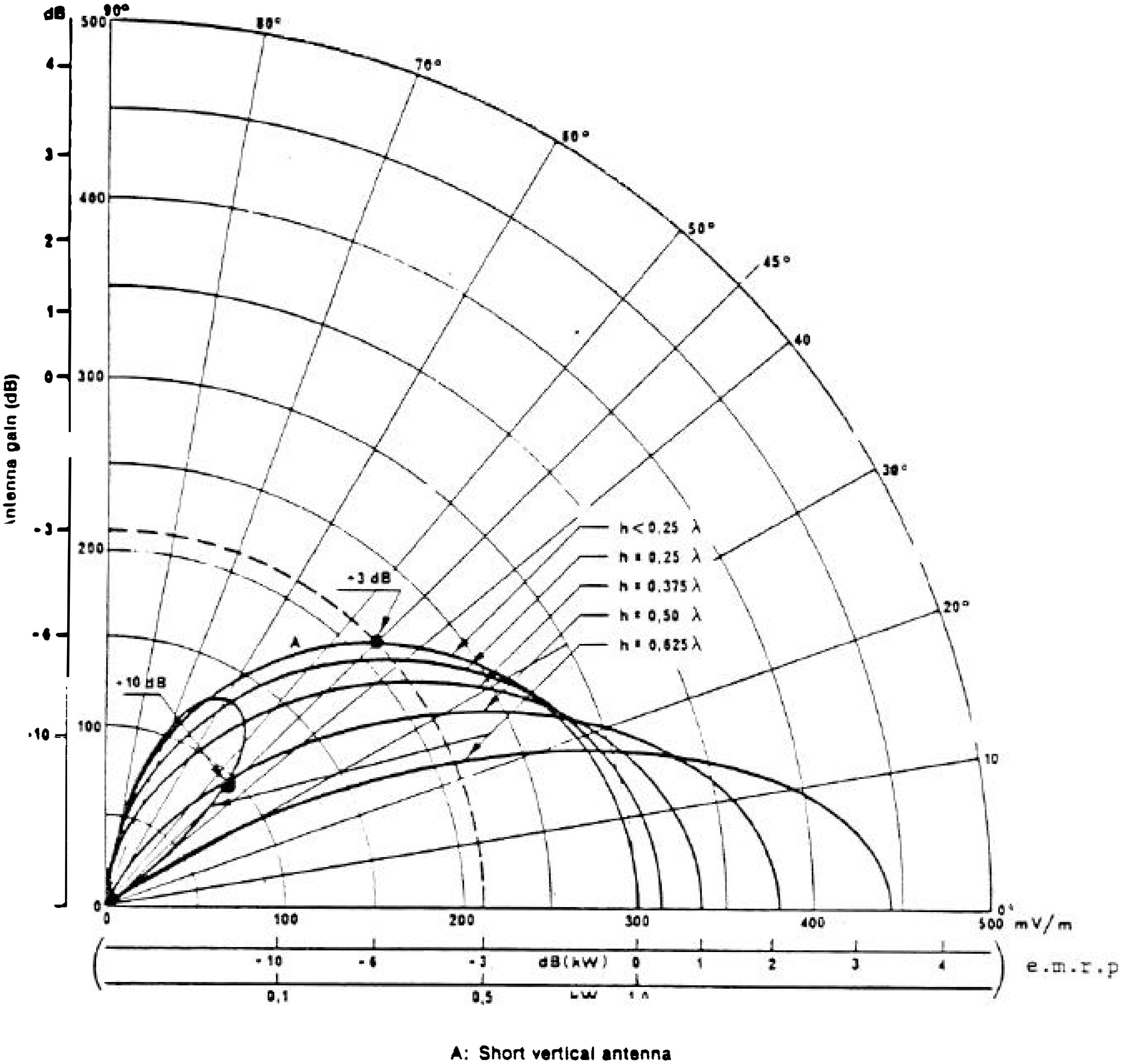
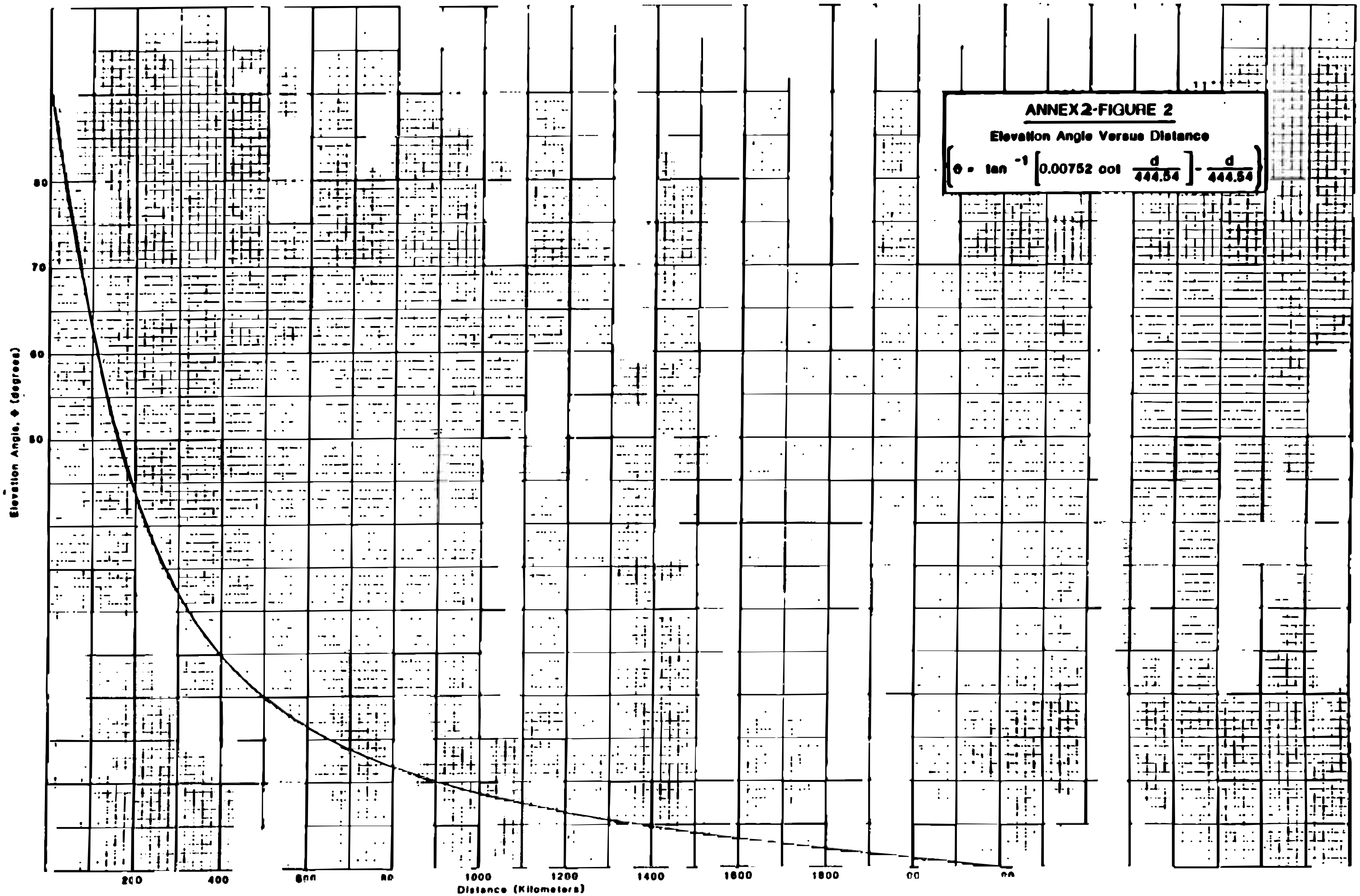


FIGURE 1a - Effective monopole radiated power (e.m.r.p.) and field strength at a distance of 1 km as a function of elevation angle, for different heights of vertical antennae assuming a transmitter power of 1 kW

TABLE I - Elevation angle vs distance

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


ANNEX 2-FIGURE 2
Elevation Angle Versus Distance
$\left\{\Phi = \tan^{-1}\left[0.00752 \cot \frac{d}{444.54}\right] - \frac{d}{444.54}\right\}$
Elevation Angle, Φ (degrees)
80
70
60
50
200
400
1000
1200
1400
1800
Distance (Kilometers)

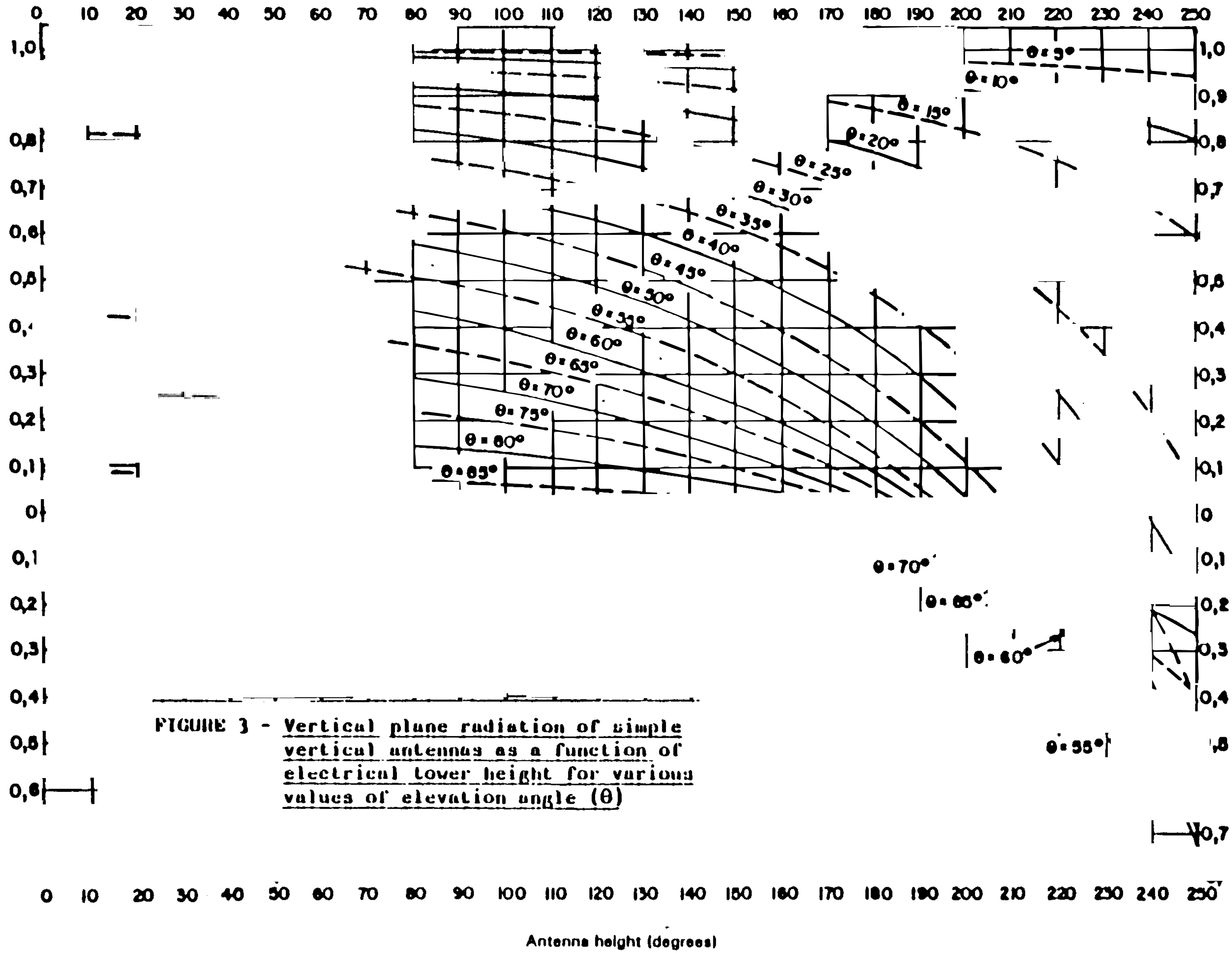


FIGURE 3 - Vertical plane radiation of simple vertical antennas as a function of electrical tower height for various values of elevation angle (θ)

TABLE II - f(θ) values for simple vertical antennas

Elevation angle (degrees)	f(θ)					
	0.11λ	0.13 λ	0.15λ	0.17λ	0.19λ	0.21λ
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	0.923
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	0.796	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	0.726	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	0.565	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

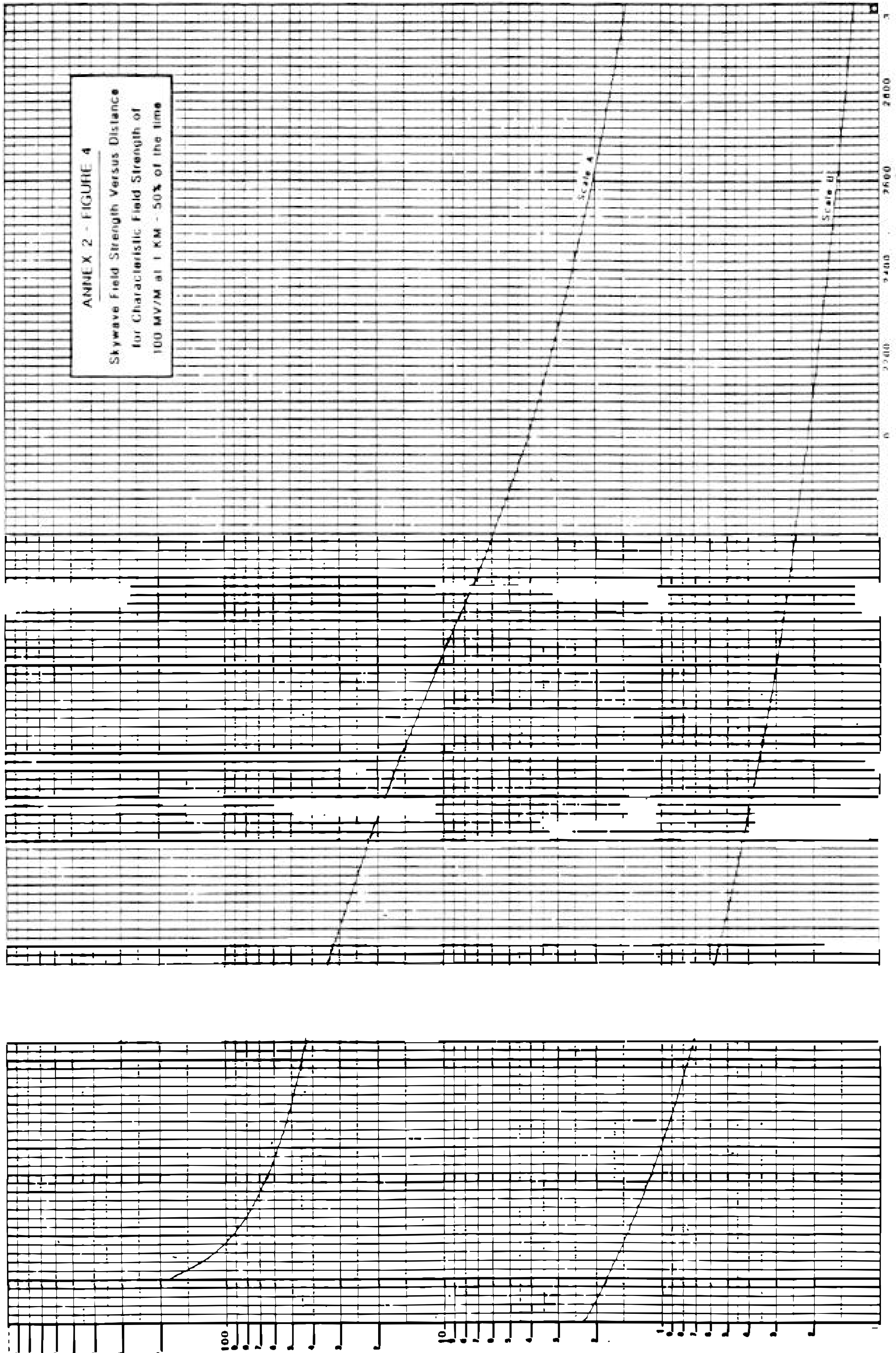
TABLE II (continued θ) values for simple vertical antennas

Elevation angle (degrees)	f(θ) 0.23 λ	0.25 λ	0.27 λ	0.29 λ	0.311 λ	0.35 λ
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	9.932	0.981	0.980	0.978	0.975
10	0.979	0.978	0.977	0.975	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	0.851
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	0.833	0.830	0.820	0.809	0.785
30	0.825	0.816	0.807	0.797	0.784	0.768
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 II (continued) - f(θ) values for simple vertical antennas

Elevation angle (degrees)	f(θ)					
	0.40λ	0.45λ	0.50λ	0.528λ	0.55λ	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	0.999
2	0.998	0.998	0.998	0.997	0.997	0.996
3	0.997	0.996	0.996	0.994	0.993	0.989
4	0.994	0.992	0.990	0.989	0.988	0.981
5	0.981	0.988	0.986	0.983	0.981	0.970
6	0.986	0.983	0.979	0.976	0.972	0.957
7	0.932	0.977	0.971	0.967	0.962	0.941
8	0.976	0.970	0.982	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	0.936	0.923	0.903	0.889	0.876	0.807
14	0.929	0.912	0.889	0.872	0.857	0.778
15	0.918	0.899	0.873	0.855	0.837	0.748
16	0.908	0.886	0.867	0.836	0.816	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	0.667	0.510
24	0.805	0.763	0.705	0.666	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	0.369	0.085
36	0.617	0.545	0.450	0.383	0.321	0.025
38	0.584	0.509	0.409	0.340	0.276	-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	0.221	0.162	-0.170
46	0.457	0.372	0.262	0.187	0.117	-0.205
48	0.427	0.341	0.230	0.135	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	0.316	0.232	0.126	0.055	-0.010	-0.300
58	0.289	0.208	0.106	0.037	-0.026	-0.304
60	0.265	0.186	0.087	0.021	-0.039	-0.304
62				0.008	-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				-0.025	-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 of f(θ) from the Table.



ANNEX 2 - FIGURE 4

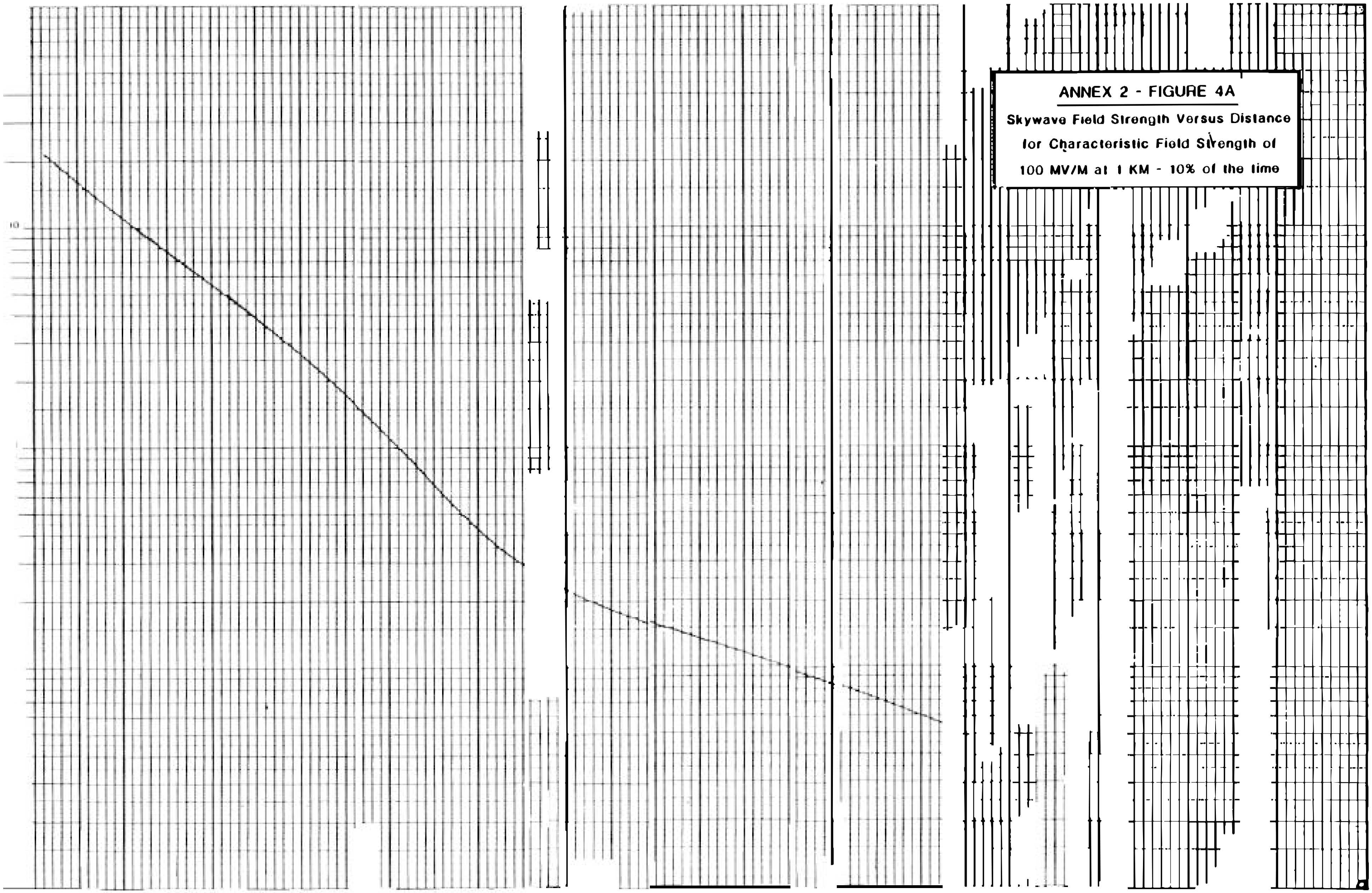
Skywave Field Strength Versus Distance for Characteristic Field Strength of 100 MV/M at 1 KM - 50% of the time

TABLE III - Skywave field strength vs distance for a characteristic field strength of 100 mV/m

d(km)	F_c (μV/m) 50%
100	179.11
150	117.18
200	92.06
250	77.54
300	68.82
350	62.06
400	57.08
450	52.86
500	49.45
550	46.78
600	44.36
650	41.95
700	39.54
750	36.81
800	34.40
850	32.30
900	29.39
950	27.63
1000	25.54
1050	23.56
1100	21.84
1150	19.91
1200	18.30
1250	16.78
1300	15.32
1350	13.97
1400	12.71
1450	11.55
1500	10.50
1550	9.53
1600	8.57
1650	7.72
1700	6.98
1750	6.34
1800	5.80
1850	5.32
1900	4.89
1950	4.49
2000	4.14
2100	3.61
2200	3.18
2300	2.79
2400	2.45
2500	2.26
2600	2.03
2700	1.85
2800	1.69
2900	1.55

TABLE III (continued)

d(km)	F_c (µV/m) 50%
3000	1.43
3100	1.33
3200	1.13
3300	1.15
3400	1.07
3500	1.00
3600	0.94
3700	0.88
3800	0.83
3900	0.79
4000	0.75
4100	0.71
4200	0.67
4300	0.64
4400	0.61
4500	0.58
4600	0.55
4700	0.53
4800	0.51
4900	0.48
5000	0.46
5100	0.45
5200	0.43
5300	0.41
5400	0.40
5500	0.38
5600	0.37
5700	0.36
5800	0.34
5900	0.33
6000	0.32
6200	0.30
6400	0.28
6600	0.27
6800	0.25
7000	0.24
7200	0.23
7400	0.22
7600	0.21
7800	0.20
8000	0.19
8200	0.18
8400	0.17
8600	0.17
8800	0.16
9000	0.15
9200	0.15
9400	0.14
9600	0.14
9800	0.13
10000	0.13



ANNEX 2 - FIGURE 4A

Skywave Field Strength Versus Distance for Characteristic Field Strength of 100 MV/M at 1 KM - 10% of the time

TABLE III-A - Skywave field strength vs distance for a characteristic field strength of 100 mV/m

d(km)	F_c (uV/m) 10%
50	211.266
100	198.115
150	179.210
200	162.249
250	145.831
300	132.032
350	119.611
400	109.185
450	99.537
500	90.548
550	83.555
600	76.962
650	70.105
700	64.934
750	59.953
800	55.296
850	50.930
900	46.529
950	42.776
1000	39.178
1050	35.779
1100	32.665
1150	29.706
1200	26.846
1250	24.081
1300	21.601
1350	19.347
1400	17.279
1450	15.478
1500	13.740
1550	12.228
1600	10.938
1650	9.682
1700	8.626
1750	7.660
1800	6.758
1850	6.048
1900	5.327
1950	4.782
2000	4.310
2050	3.909
2100	3.555
2150	3.269

TABLE III-A (continued

d(km)	F_c (uV/m) 10%
2200 1367	3.023 4.8 = 3
2250	2.797
2300	2.626
2350	2.472
2400	2.331
2450	2.189
2500	2.087
2550	1.983
2600	1.890
2650	1.804
2700	1.721
2750	1.643
2800	1.566
2850	1.508
2900	1.444
2950	1.392
3000	1.343
3050	1.295
3100	1.247
3150	1.198
3200	1.152
3250	1.107
3300	1.068
3350	1.029
3400 2113	0.991 1.6 = 1
3450	0.952
3500	0.914
3550	0.885
3600	0.843
3650	0.809
3700	0.778
3750	0.752
3800	0.719
3850	0.687
3900	0.657
3950	0.628
4000	0.598
4050	0.570
4100	0.543
4150	0.517
4200 2610	0.500 .8

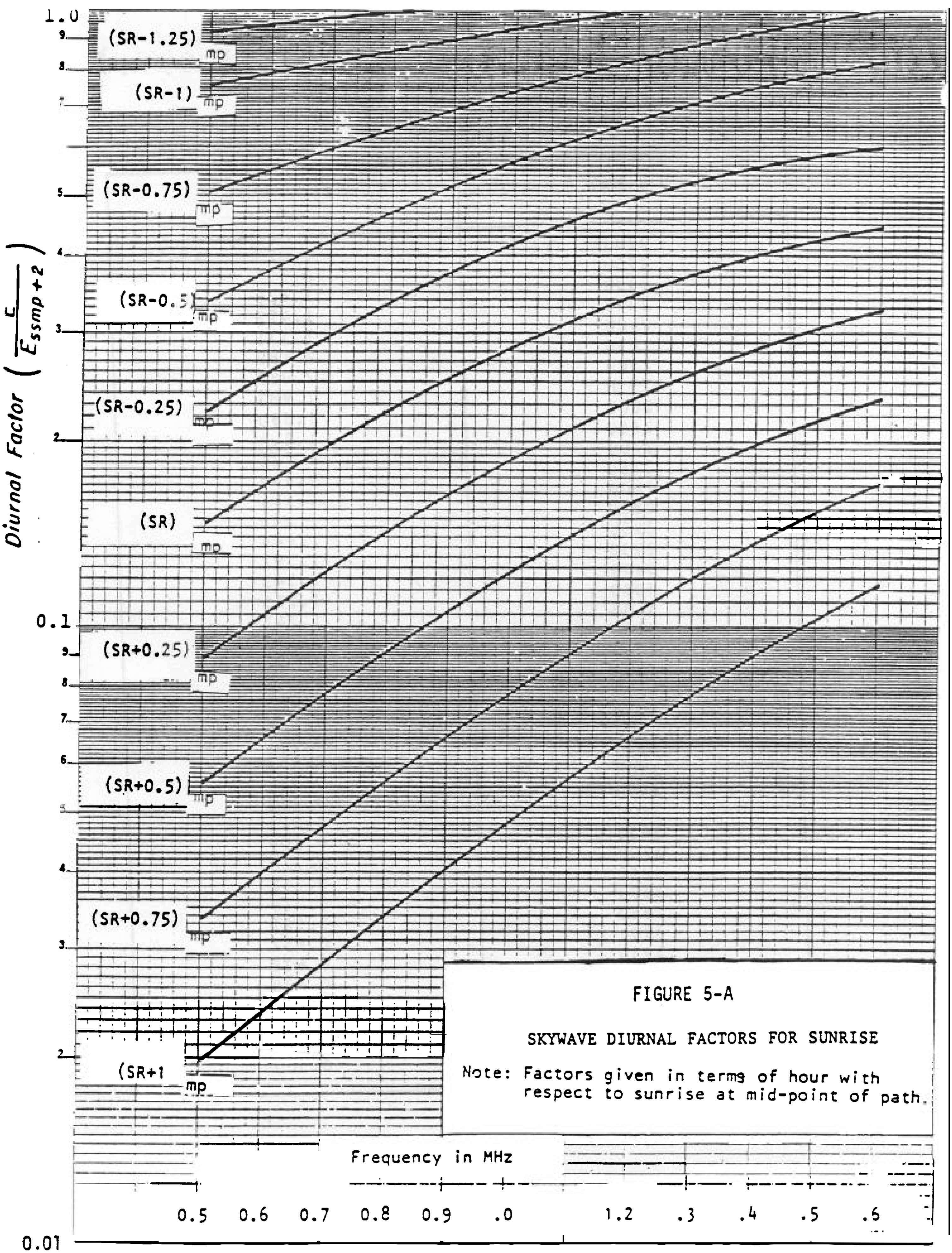


FIGURE 5-A

SKYWAVE DIURNAL FACTORS FOR SUNRISE

Note: Factors given in terms of hour with respect to sunrise at mid-point of path.

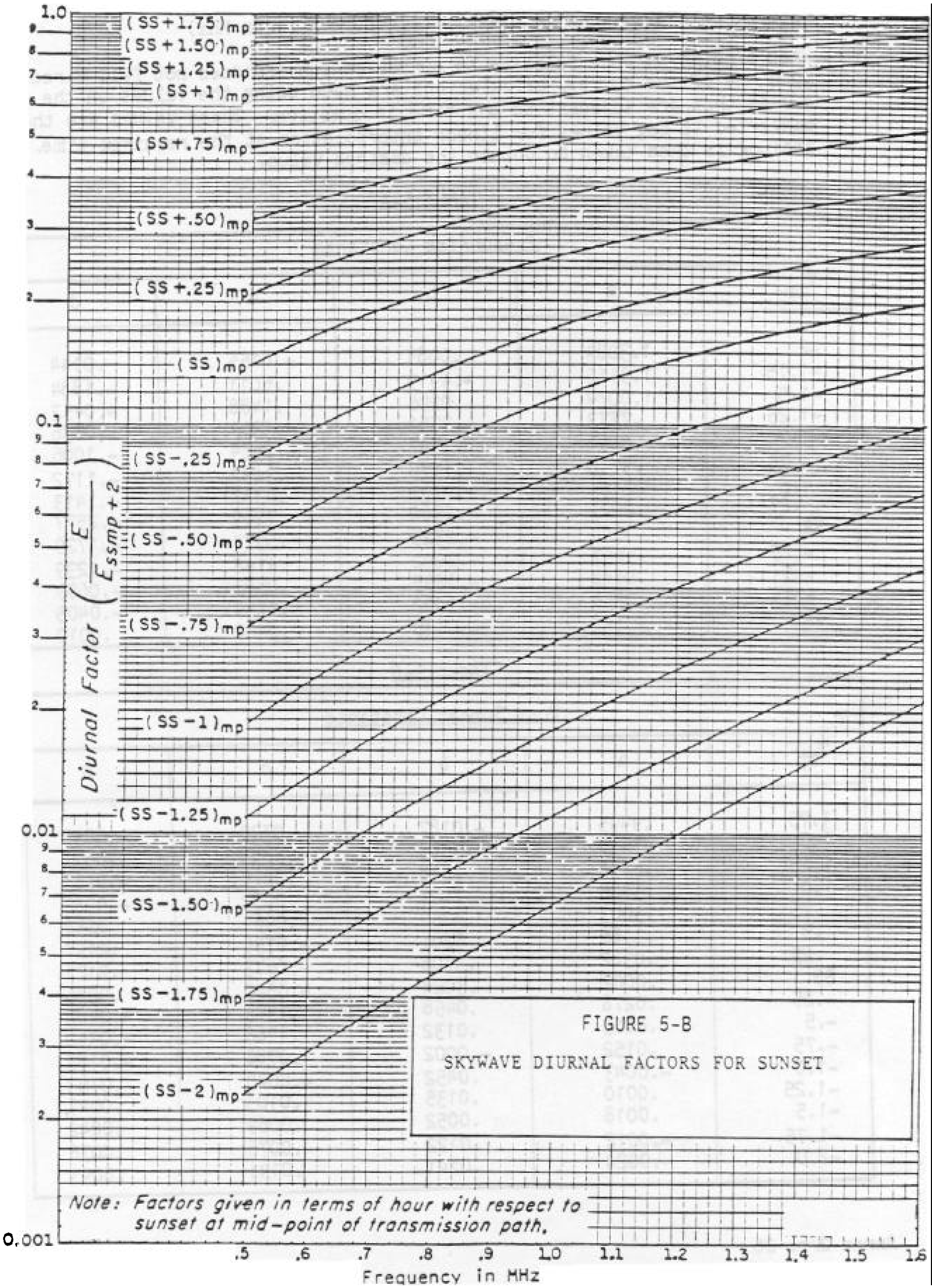


FIGURE 5-B

SKYWAVE DIURNAL FACTORS FOR SUNSET

Formula for diurnal curves of Figures 5A and 5B

$F_{diurnal} = a + bX + cX^2 + dX^3$ (where X is in MHz)

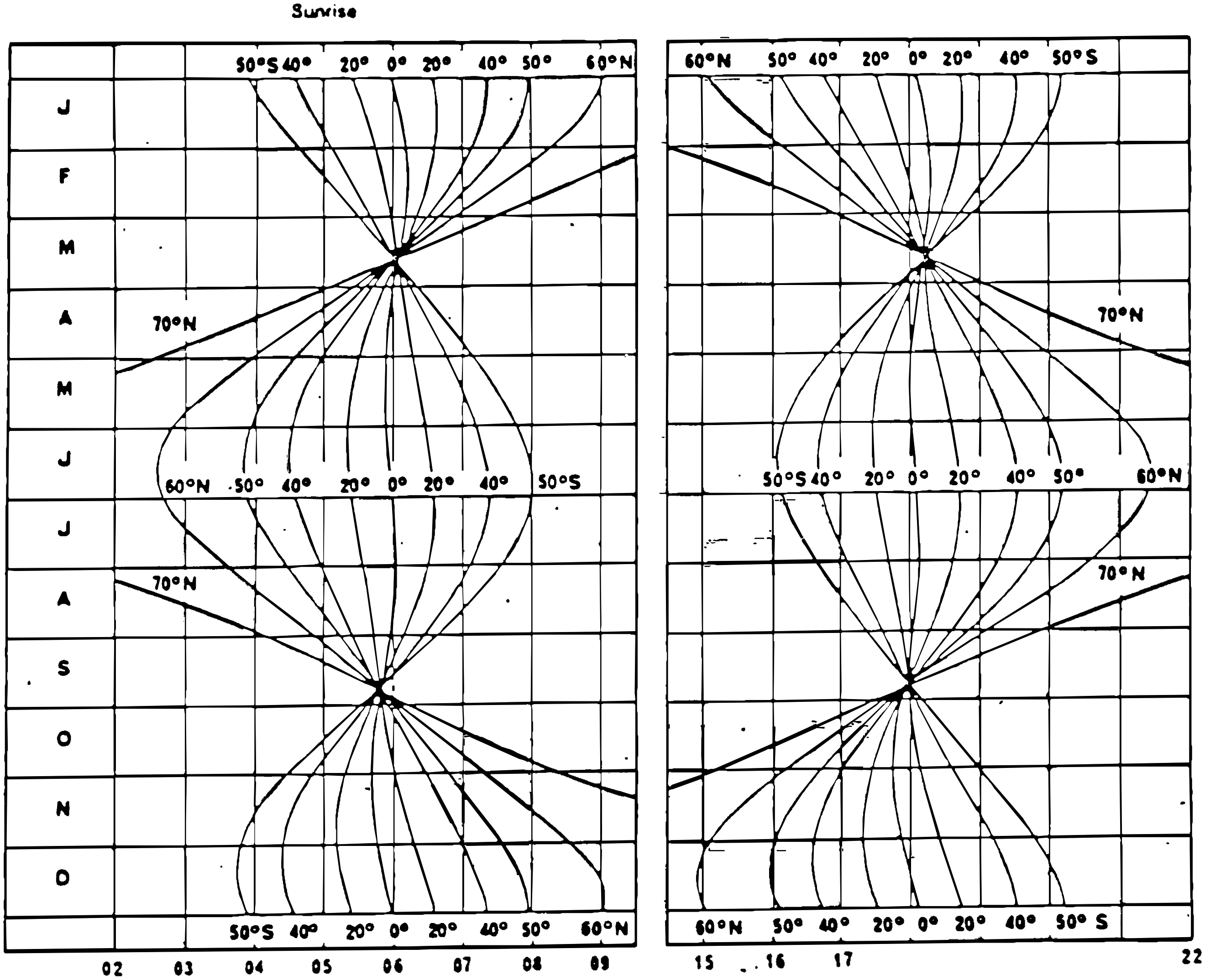
When a point in time relative to sunset or sunrise does not fall directly upon one of the curves, calculations are made using the values on the curves that are adjacent to the time in question. These values are then converted to Log values for linear interpolation at the required time. The antiLog is then taken to obtain the desired value.

TABLE 5-A

Presunrise Constants				
T_{mp}	a	b	c	d
-2	1.3084	.0083	-.0155	.0144
-1.75	1.3165	-.4919	.6011	-.1884
-1.5	1.0079	.0296	.1488	-.0452
-1.25	.7773	.3751	-.1911	.0736
-1	.6230	.1547	.2654	-.1006
-.75	.3718	.1178	.3632	-.1172
-.5	.2151	.0737	.4167	-.1413
-.25	.2027	-.2560	.7269	-.2577
SR	.1504	-.2325	.5374	-.1729
+.25	.1057	-.2092	.4148	-.1239
+.5	.0642	-.1295	.2583	-.0699
+.75	.0446	-.1002	.1754	-.0405
+1	.0148	-.0135	.0462	.0010

TABLE 5-B

Post Sunset Constants				
T_{mp}	a	b	c	d
1.75	.9495	-.0187	.0720	-.0290
1.5	.7196	.3583	-.2280	.0611
1.25	.6756	.1518	.0279	-.0163
1.0	.5486	.1401	.0952	-.0288
.75	.3003	.4050	-.0961	.0256
.5	.1186	.4281	-.0799	.0197
.25	.0382	.3706	-.0673	.0171
SS	.0002	.3024	-.0540	.0086
-.25	.0278	.0458	.1473	-.0486
-.5	.0203	.0132	.1166	-.0340
-.75	.0152	-.0002	.0786	-.0185
-1.0	-.0043	.0452	-.0040	.0103
-1.25	.0010	.0135	.0103	.0047
-1.5	.0018	.0052	.0069	.0042
-1.75	-.0012	.0122	-.0076	.0076
-2.0	-.0024	.0141	-.0141	.0091



Local time at reflection point (hours)

FIGURE 6 - Times of sunrise and sunset for various months and geographical latitudes

CHAPTER 4

Broadcasting Standards

4.1 The Plan is based on a channel spacing of 10 kHz and carrier frequencies which are integral multiples of 10 kHz, beginning at 540 kHz.

4.2 Class of emission

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

Classes of emission other than A3E, for instance to accomodate stereophonic systems, could also be used on condition that the energy level outside the necessary bandwidth does not exceed that normally expected in A3E emission and that the emission is receivable by conventional receivers employing envelope detectors without increasing appreciably the level of distortion.

Bandwidth of emission

The Plan assumes a necessary bandwidth of 10 kHz, for which only a 5 kHz audio bandwidth can be obtained. While this might be an appropriate value for some administrations, others have successfully employed wider bandwidth systems having occupied bandwidths of the order of 20 kHz without adverse effects.

Station Power

4.4.1 Class A

- The maximum station power shall be 50 kW.

4.4.2 Class B

- The maximum station power shall be 50 kW.

4.4.3 Class C

The maximum station power shall be 1 kW.

provided that the protection criteria given in section 4.9 are met.

4.5 Skywave interference calculations

The values of interfering skywave signals shall be calculated on the basis of 10% of the time, in the manner prescribed in section 3.4.

4.6 TABLE IV - Nominal usable field strength

4.6.1	Class A station[1] Groundwave Daytime : co-channel 100μV/m adjacent channel 500μV/m Night-time : 500μV/m Skywave 500μV/m, 50% of the time
4.6.2	Class B station[2] Groundwave Daytime : 500μV/m Night-time : 2500μV/m
4.6.3	Class C station[2] Groundwave Daytime : 500μV/m Night-time : 4000μV/m

Note 1 : The night-time contour, groundwave or skywave, whichever is the more distant, is to be protected in the case of Class A stations.

Note 2 : The protected contour during night-time operation for Class B and C stations shall be the higher of the groundwave contour in 4.6.2 and 4.6.3 respectively, or the groundwave contour corresponding to the usable field strength of the station as defined in 4.7.

Use of the root sum square (RSS) method to determine the usable field strength resulting from the weighted interfering signals

General

The overall usable field strength E_u due to two or more individual interference contributions is calculated on an RSS basis, using the expression:

$$E_u = \sqrt{(a_1E_1)^2 + (a_2E_2)^2 + \ldots(a_iE_i)^2 \ldots} \qquad 1)$$

where:

E_i is the field strength of the ith interfering transmitter (in μV/m);

a_i is the radio-frequency protection ratio associated with the ith interfering transmitter, expressed as a numerical ratio of field strengths.

4.7.2 50% exclusion principle

4.7.2.1 The 50% exclusion principle allows a significant reduction in the number of calculations.

4.7.2.2 According to this principle, the values of the individual usable field strength contributions are arranged in descending order of magnitude. If the second value is less than 50% of the first value, the second value and all subsequent values are neglected. Otherwise an RSS value is calculated for the first and second values. The calculated RSS value is then compared with the third value in the same manner by which the first value was compared to the second and a new RSS value is calculated if required. The process is continued until the next value to be compared is less than 50% of the last calculated RSS value. At that point the last calculated RSS value is considered to be the usable field strength E_u.

4.7.2.3 Except as provided in section 4.7.2.4, if the contribution of a new station is greater than the smallest value previously considered in calculating the RSS value of assignments in the Plan, the contribution of the new station adversely affects assignments in conformity with this Agreement even if it is less than 50% of the RSS value. However, the new contribution does not adversely affect assignments in conformity with this Agreement if the RSS value determined by inserting the contribution of the new station in the list of contributors is smaller than the nominal usable field strength E_{nom}.

4.7.2.4 The contribution of a station engaging in extended operation under Article VII of the Agreement shall not be taken into account in the calculation of the E_u.

4.7.3 Other Region 2 Stations

In the above determination of usable field strengths, contributions from stations in other Region 2 countries, which were accepted by Canada or the U.S.A., as included in List A of the Rio de Janeiro Plan, shall be included.

4.8 (Reserved)

Channel protection ratios

4.9.1 Co-channel protection Ratio

The co-channel protection ratio is 26 dB.

4.9.2 adjacent channel protection ratio

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

4.9.3 Synchronized networks

In addition to the standards specified in the Agreement, the following additional standards apply to synchronized networks.

For the purpose of determining interference caused by synchronized networks, the following procedure shall be applied. If any two transmitters are less than 400 km apart, the network shall be treated as a single entity, the value of the composite signal being determined by the quadratic addition of the interfering signals from all the individual transmitters in the network. If the distances between all the transmitters are equal to or greater than 400 km, the network shall be treated as a set of individual transmitters.

For the purpose of determining skywave interference received by any one member of a network, the value of the interference caused by the other elements of the network shall be determined by the quadratic addition of the interfering signals from all of those elements. In any case, where groundwave interference is a factor it shall be taken into account.

The co-channel protection ratio between stations belonging to a synchronized network is 8 dB.

Application of protection criteria

4.10.1 Value of protected contours

Within the national boundary of a country, the protected contour shall be determined by using the appropriate value of nominal usable field strength, or as otherwise determined in Note 2 to paragraph 4.6 for class B and C stations.

4.10.2 Co-channel protection*

4.10.2.1 Daytime protection of all classes of stations

During the daytime the groundwave contour of class A, B and C stations shall be protected against groundwave interference. The protected contour is the groundwave contour corresponding to the value of the nominal usable field strength. The maximum permissible interfering field strength at the protected contour is the value of the nominal usable field strength divided by the protection ratio. The effect of each interfering signal shall be evaluated separately, and the presence of interference from other stations in excess of this permissible level shall not reduce the necessity to limit interference which would result from proposed modifications or assignments. Where the protected contour would extend beyond the boundary of the country in which the station is located, the maximum permissible interfering field strength at the boundary is the calculated field strength of the protected station along the boundary divided by the protection ratio.

4.10.2.2 Night-time protection of class A stations

The groundwave contour or the skywave contour 50% of the time, whichever is farther from the site of the protected class A station, shall be protected against skywave and possible groundwave interference during the night-time. The protected contour is the groundwave contour or skywave contour 50% of the time, whichever is farther from the station site, corresponding to the value of the nominal usable field strength. The maximum permissible interfering field strength at the protected contour is the value of the nominal usable field strength divided by the protection ratio. The effect of each interfering signal shall be evaluated separately, and the presence of interference from other stations in excess of the level permitted shall not reduce the necessity to limit interference which would result from proposed modifications or assignments. Where the protected contour would extend beyond the boundary of the country in which the station is located, the maximum permissible interfering field strength at the boundary is the calculated field strength of the protected station along the boundary divided by the protection ratio, using the value of the groundwave signal wherever the boundary crosses the primary service area and the value of the skywave signal outside the primary service area. In the case where the protected skywave contour would extend beyond the boundary, the groundwave contour shall also be protected up to the boundary. In applying 4.10.2.2, the nighttime contour of Class A stations not appearing in PARTS VI or VI-A of Annex 1 will be protected from interference calculated using Figure 4-A of Annex 2. In this case the maximum permissible interfering field strength at the protected contour shall be determined in accordance with 4.7.

* See the matrix in section 6 of Appendix 4 to Annex 2.

4.10.2.3 Night-time protection of class B and C stations

During the night-time, the groundwave contour of class B and C stations will be protected against skywave and possible groundwave interference. The protected contour is the groundwave contour corresponding to the value of the greater of the nominal usable field strength or the usable field strength resulting from the Plan as determined at the site of the protected station in accordance with 4.7. The maximum permissible interfering field strength calculated at the site of the protected station in accordance with 4.7 shall not be exceeded at the protected contour where the protected contour is located within the boundary of the country in which the station is located. Where the protected contour would extend beyond the boundary of the country in which the station is located, the protected contour shall follow that part of the boundary and have a value as calculated at the border. Where the maximum permissible interfering field strength is already exceeded at the protected contour by an existing station, any proposal for a change to that existing station shall not cause an increase in the interfering field strength at that portion of the protected contour.

4.10.2.4 Modification of assignments

If a station of one administration causes interference to a station of the other administration and such interference is permitted in accordance with the terms of this Agreement, then in the event of a modification being proposed to the assignment corresponding to the former station, it will not be necessary to protect the assignment corresponding to the latter station beyond the level provided before the proposed modification.

4.10.3 Adjacent channel protection*

During the daytime and night-time, the groundwave contour of class A, B and C station shall be protected against groundwave interference. The protected contour is the groundwave contour corresponding to the value of the nominal usable field strength determined as follows:

- for daytime protection of class A stations, the value specified in 4.6.1 for adjacent channel daytime groundwave;
- for night-time protection of class A stations, the value specified in 4.6.1 for night-time groundwave;
- for daytime and night-time protection of class B stations, the value specified in 4.6.2 for daytime groundwave;
- for daytime and night-time protection of class C stations, the value specified in 4.6.3 for daytime groundwave.

* See the matrix in section 6 of Appendix 4 to Annex 2.

The maximum permissible interfering field strength at the protected contour is the value of the nominal usable field strength divided by the protection ratio. The effect of each interfering signal shall be evaluated separately, and the presence of interference from other stations in excess of this permissible level shall not reduce the necessity to limit interference which would result from the proposed modifications or assignments.

Where the protected contour would extend beyond the boundary of the country in which the station is located, the maximum permissible interfering field strength at the boundary is the calculated field strength of the protected assignment along the boundary divided by the protection ratio.

If a station of one administration causes interference to a station of the other administration and such interference is permitted in accordance with the terms of this Agreement, then in the event of a modification being proposed to the assignment corresponding to the former station, it will not be necessary to protect the assignment corresponding to the latter station beyond the level provided before the proposed modification.

4.10.4 Protection outside national boundaries

4.10.4.1 No station has the right to be protected beyond the boundary of the country in which the station is established.

4.10.4.2 No broadcasting station shall be assigned a nominal frequency with a separation of 10, 20 or 30 kHz from that of a station in the other country if the 25 000 μV/m contours overlap.

4.10.4.3 In addition to the conditions described in 4.10.4.2, when the protected contour would extend beyond the boundary of the country in which the station is located, its assignment shall be protected in accordance with 4.10.2 and 4.10.3.

4.10.4.4 For protection purposes, the boundary of a country shall be deemed to encompass only its land area, including islands.

CHAPTER 5

Radiation Characteristics of Transmitting Antennas

5. In carrying out the calculations indicated in Chapters 2 and 3, the following shall be taken into account:

Omnidirectional antennas

Figure 1 of Chapter 3 shows the characteristic field of a simple vertical antenna as a function of its length and of the radius of the ground system. The characteristic field of an antenna with a loss-less ground system is also shown for comparison.

It is clear that the characteristic field strength increases as the loss in the ground system is reduced to zero and as the antenna height is increased up to 0.625 wavelengths.

The increased characteristic field strength for antenna lengths up to 0.625 wavelengths is obtained at the expense of radiation at high angles as shown graphically in Figure 1a and numerically in Table II of chapter 3.

5.2 Considerations of the radiation patterns of directional antennas

The procedures for calculating theoretical, expanded and augmented (modified expanded) directional antenna patterns are given in Appendix 3.

Top-loaded and sectionalized antennas

Calculation procedures are given in Appendices 3 & 5.

5.3.2 Many stations 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 is done to achieve desired coverage or to reduce interference.

5.3.3 An adminsitration using top-loaded or sectionalized antennas shall supply information concerning the tower structure of the antennas. Normally, one of the equations in Appendices 3 & 5 shall be employed to determine the vertical radiation characteristics of the antennas. Other equations may also be proposed by an administration and shall be used in determining the vertical radiation characteristics of the antennas of that administration, subject to the agreement of the other administration.

APPENDIX 1

(to Annex 2)

ATLAS OF GROUND CONDUCTIVITY*

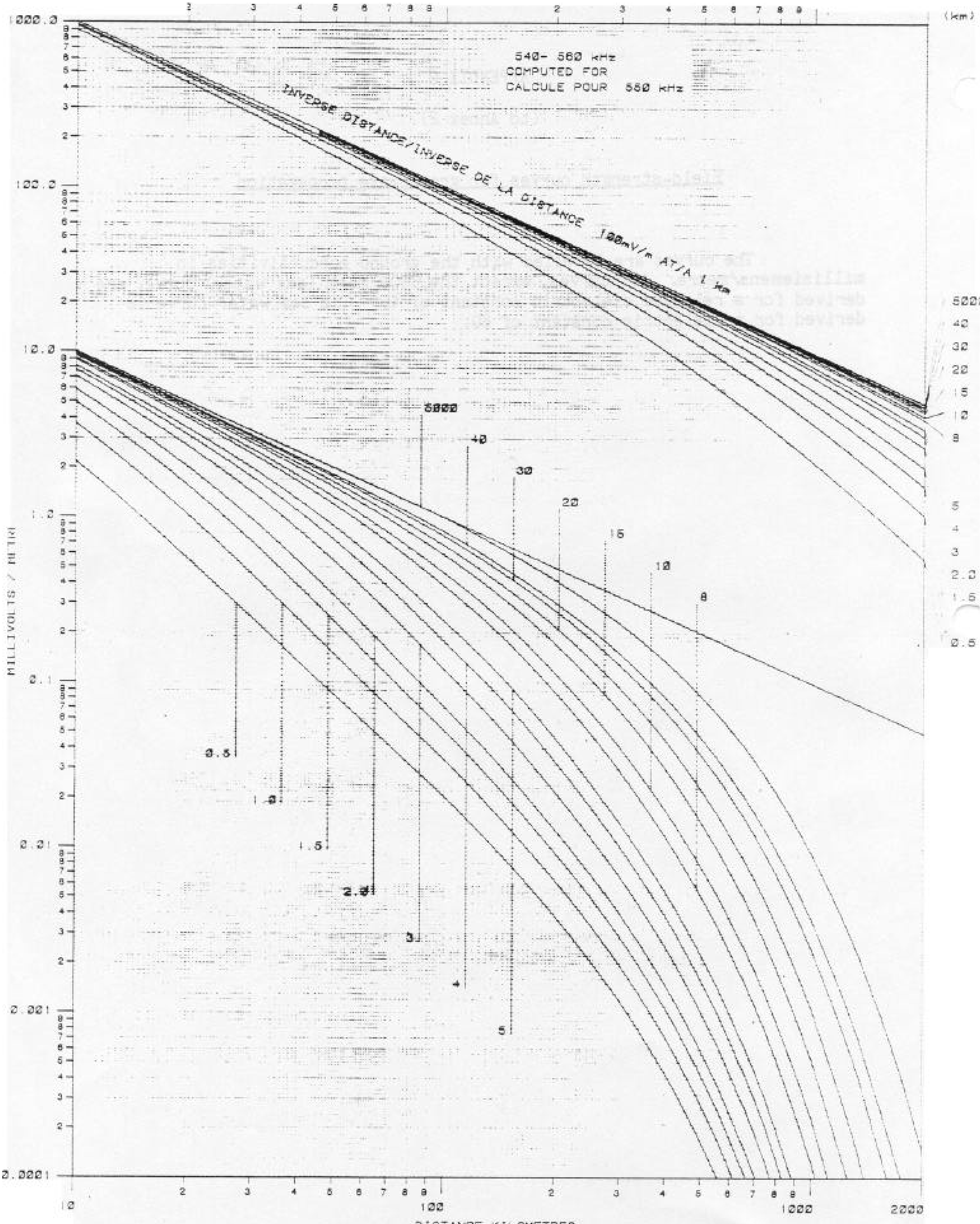
* See set of nine maps in the attached envelope

APPENDIX 2

(to Annex 2)

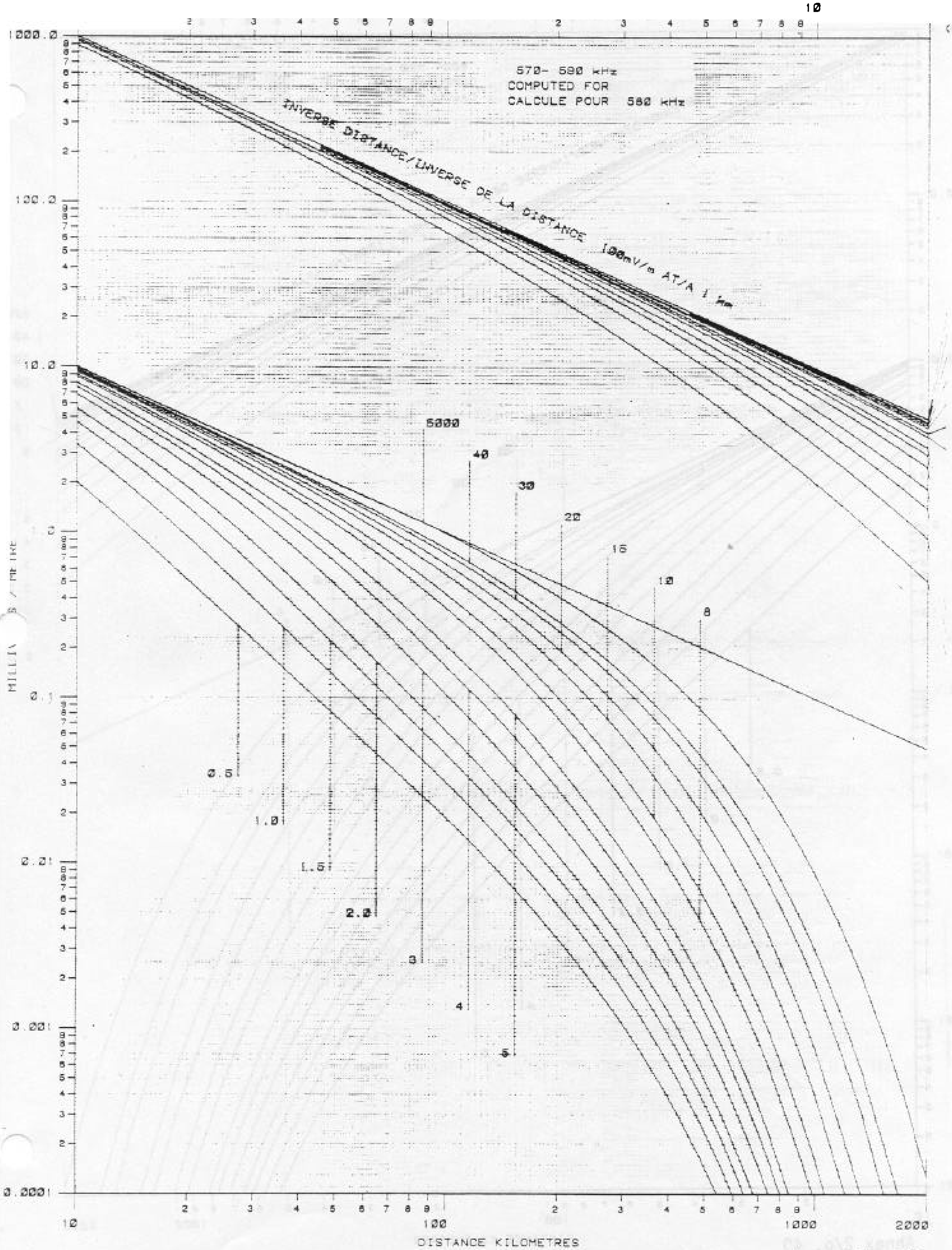
Field-strength curves for groundwave propagation

The curves are labelled with the ground conductivities in millisiemens/metre. 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 dielectric constant of 80.



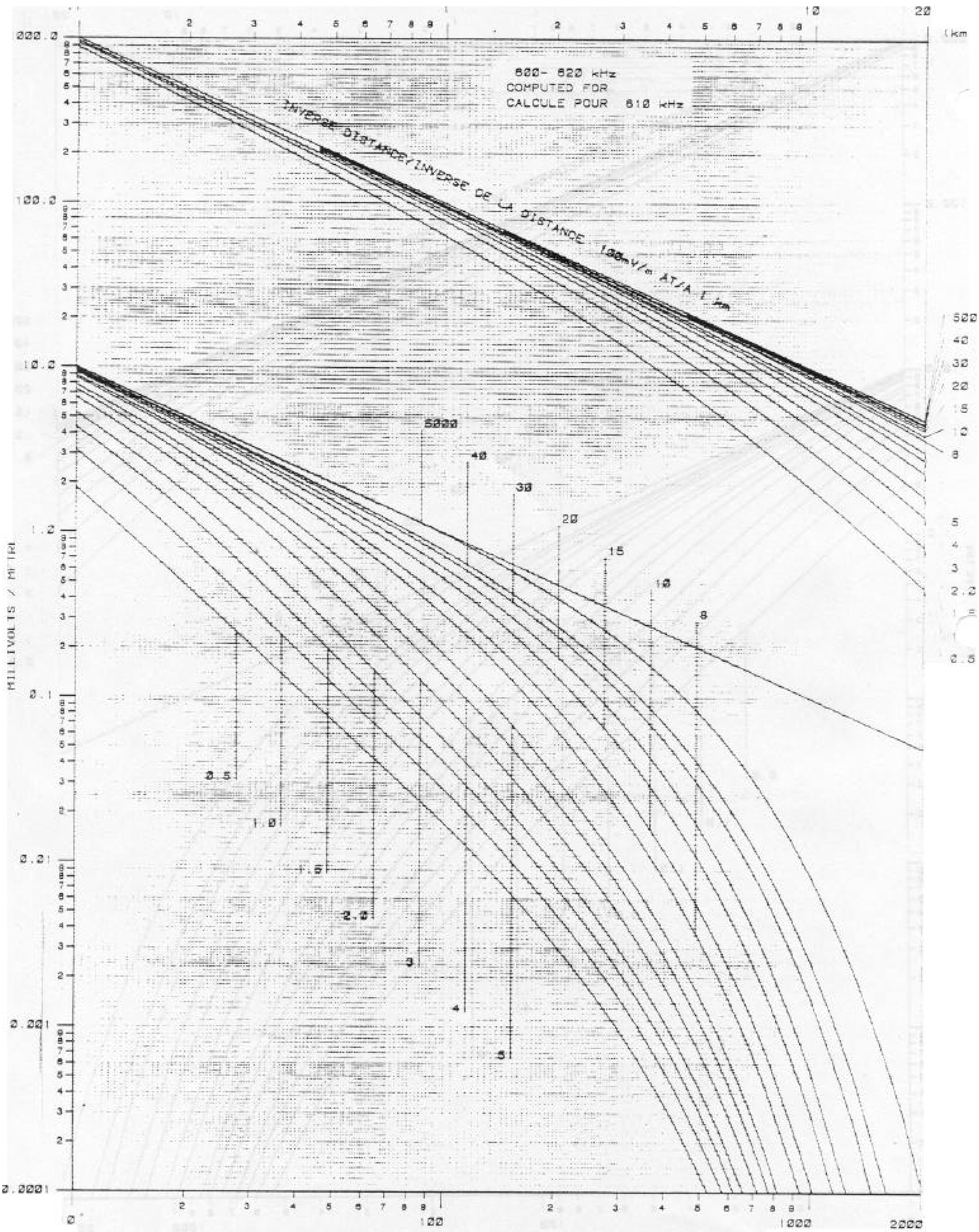
GRAPH 1 - GROUNDWAVE FIELD STRENGTH VERSUS DISTANCE

GRAPHIQUE 1 - CHAMP DE L'ONDE DE SOL EN FONCTION DE LA DISTANCE



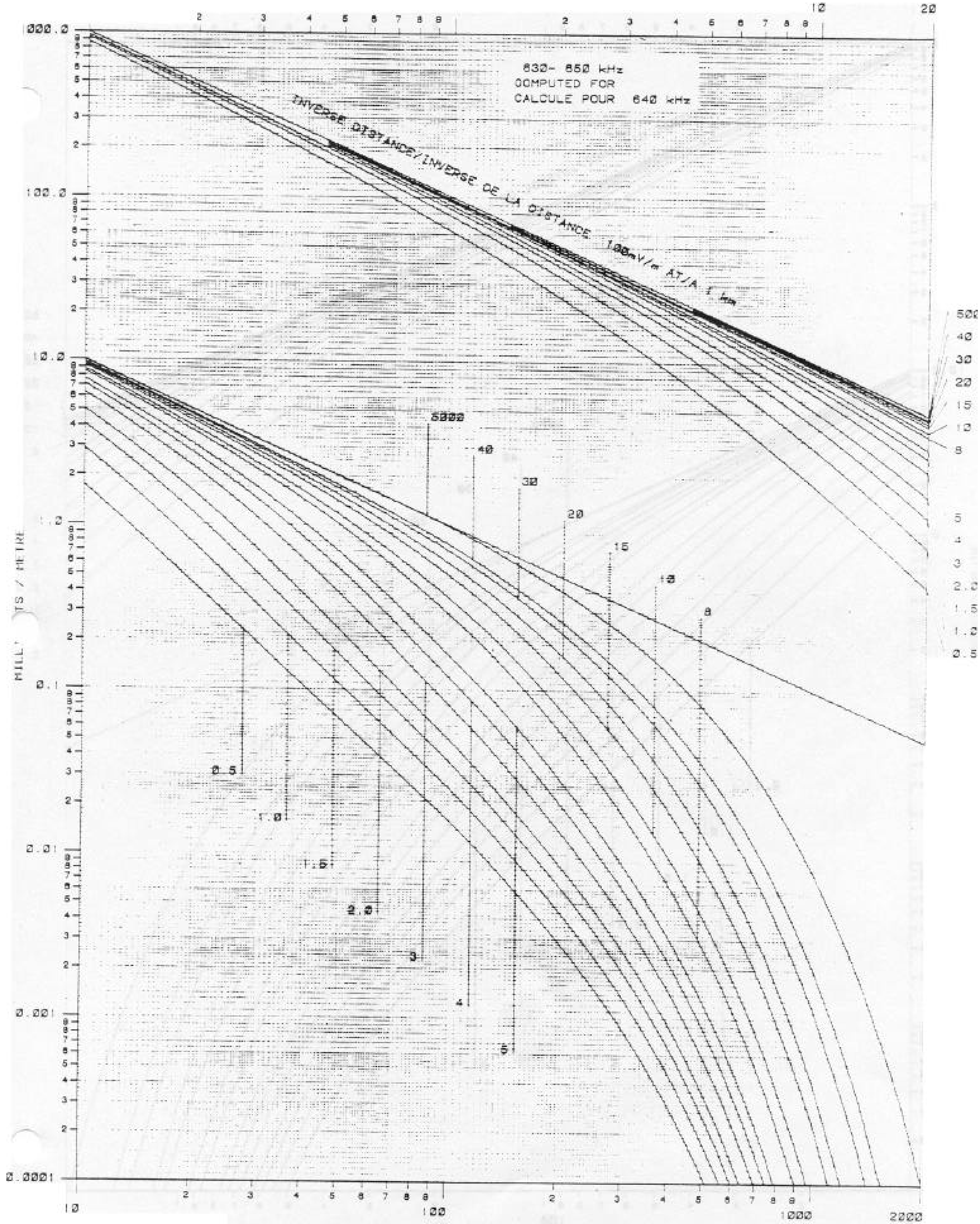
GRAPH 2 - GROUNDWAVE FIELD STRENGTH VERSUS DISTANCE

GRAPHIQUE 2 - CHAMP DE L'ONDE DE SOL EN FONCTION DE LA DISTANCE



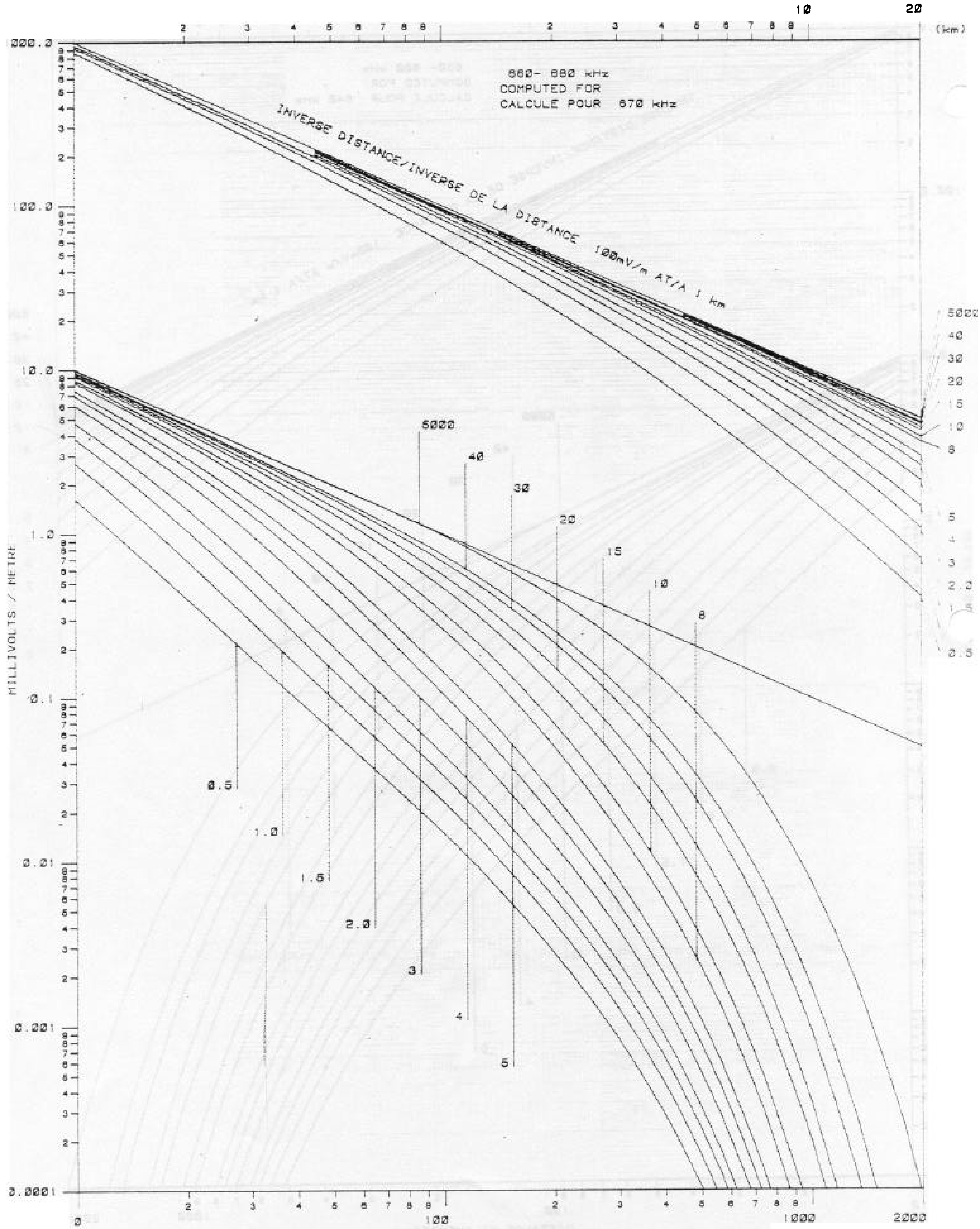
GRAPH 3 - GROUNDWAVE FIELD STRENGTH VERSUS DISTANCE

GRAPHIQUE 3 - CHAMP DE L'ONDE DE SOL EN FONCTION DE LA DISTANCE

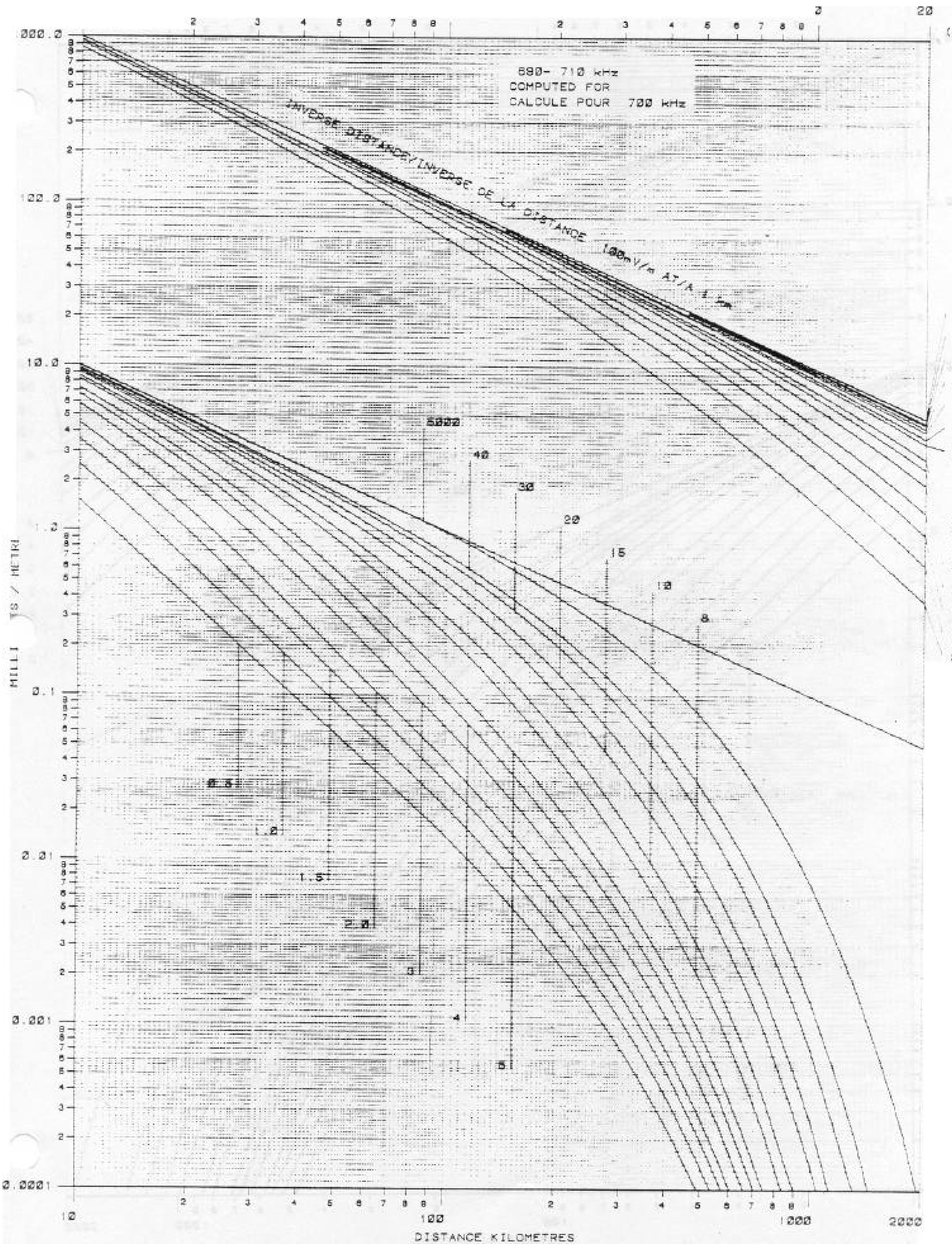


GRAPH 4 - GROUNDWAVE FIELD STRENGTH VERSUS DISTANCE

GRAPHIQUE 4 - CHAMP DE L'ONDE DE SOL EN FONCTION DE LA DISTANCE

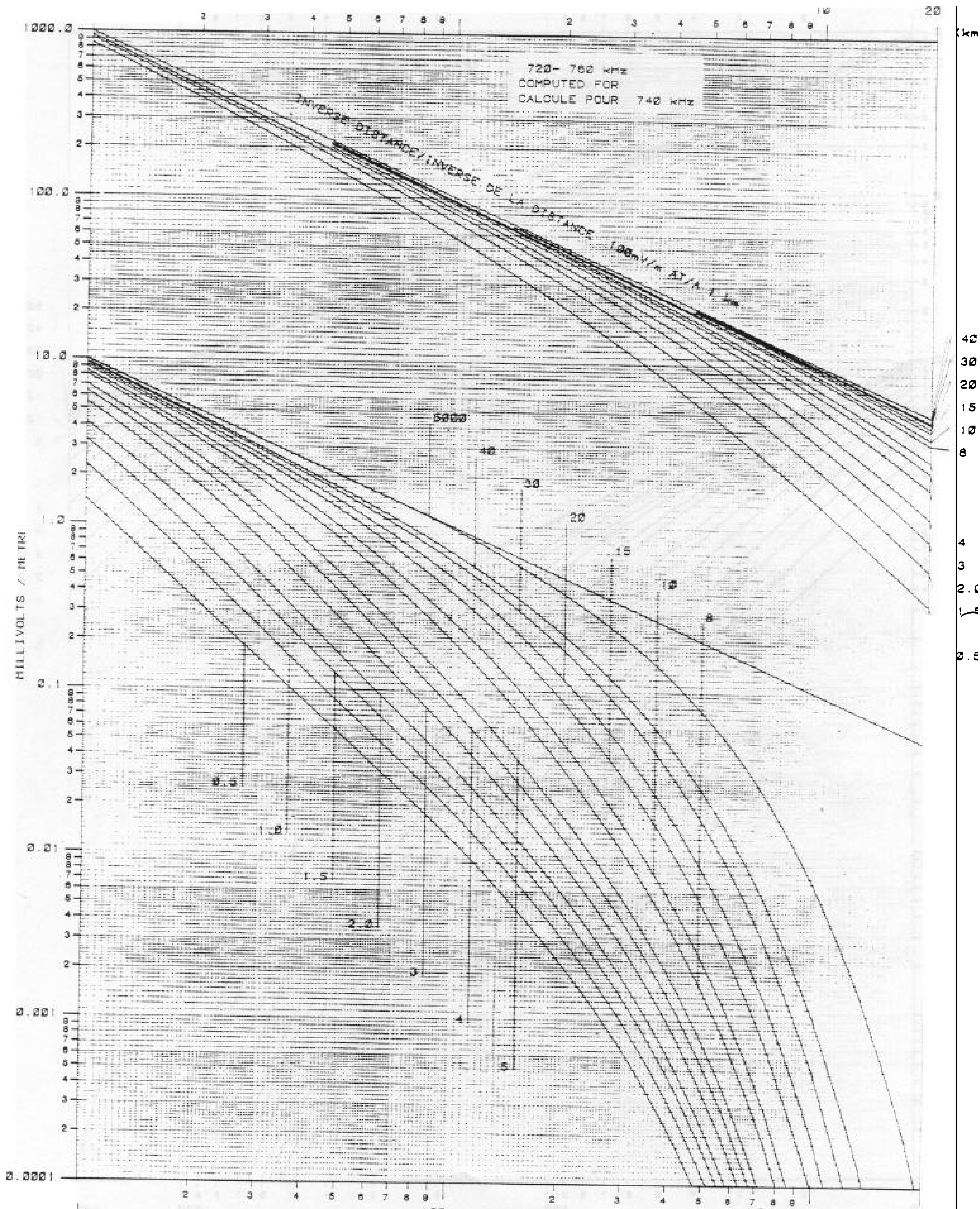


GRAPH 5 - GROUNDWAVE FIELD STRENGTH VERSUS DISTANCE



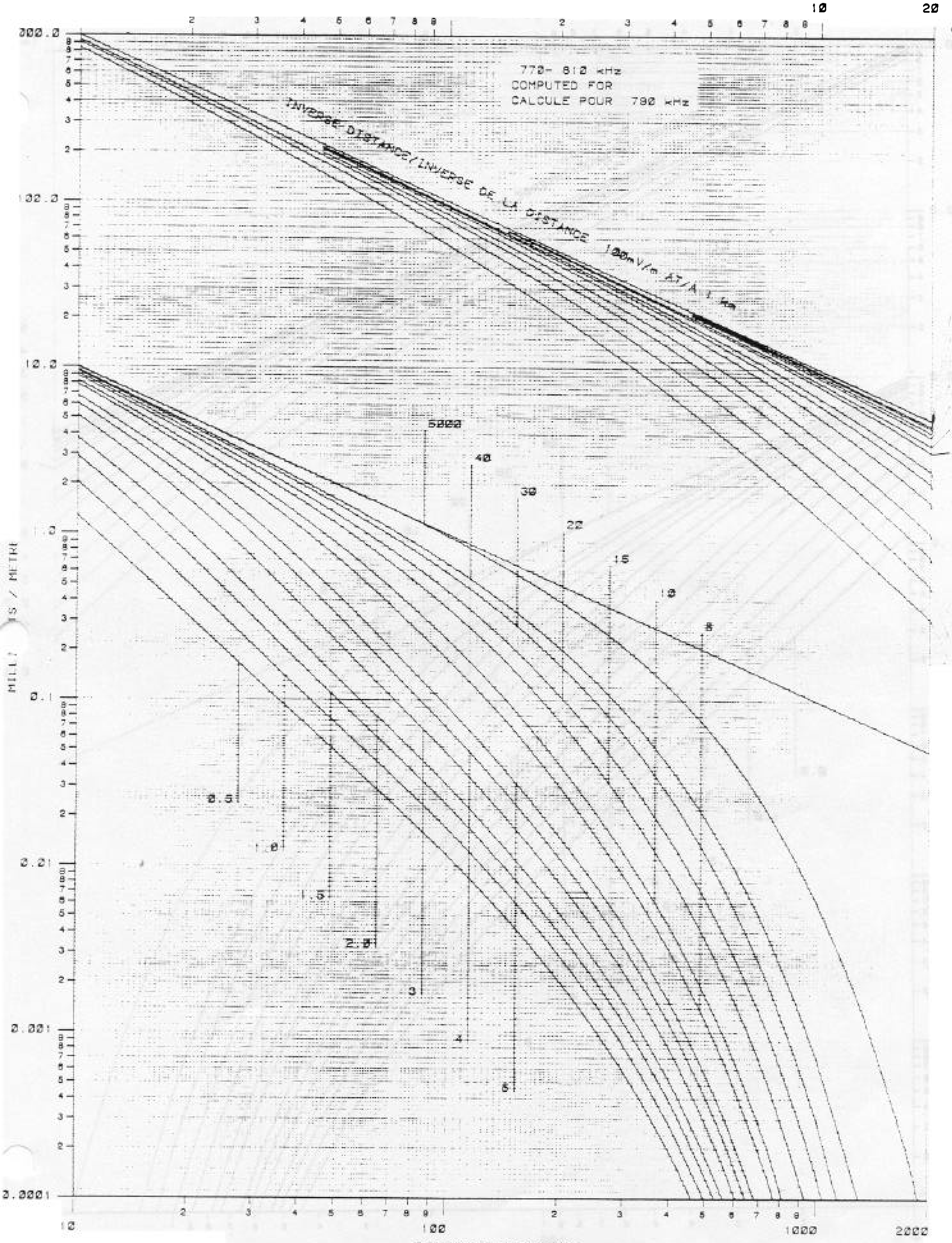
GRAPH 6 - GROUNDWAVE FIELD STRENGTH VERSUS DISTANCE

GRAPHIQUE 6 - CHAMP DE L'ONDE DE SOL EN FONCTION DE LA DISTANCE



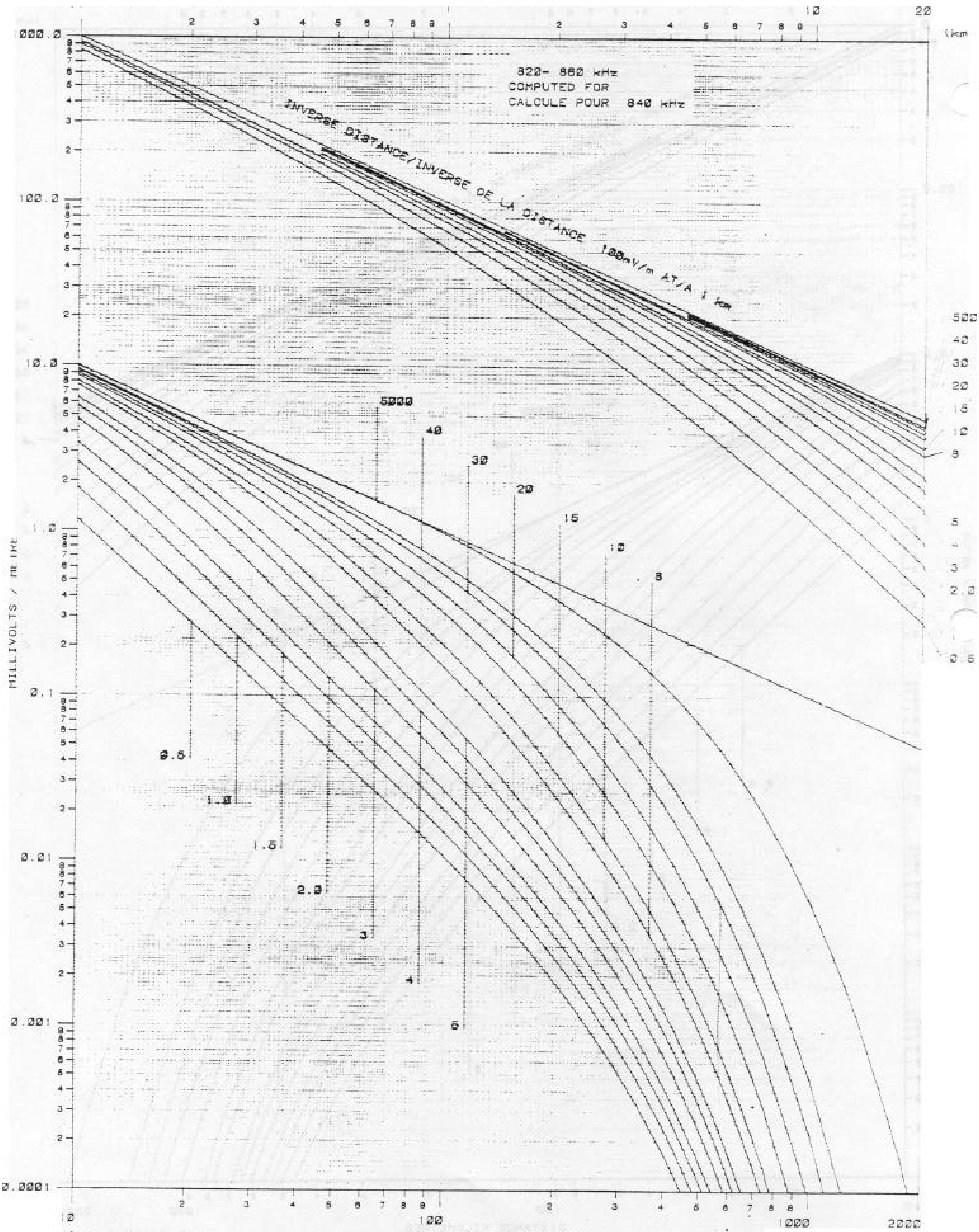
GRAPH 7 - GROUNDWAVE FIELD STRENGTH VERSUS DISTANCE

GRAPHIQUE 7 - CHAMP DE L'ONDE DE SOL EN FONCTION DE LA DISTANCE



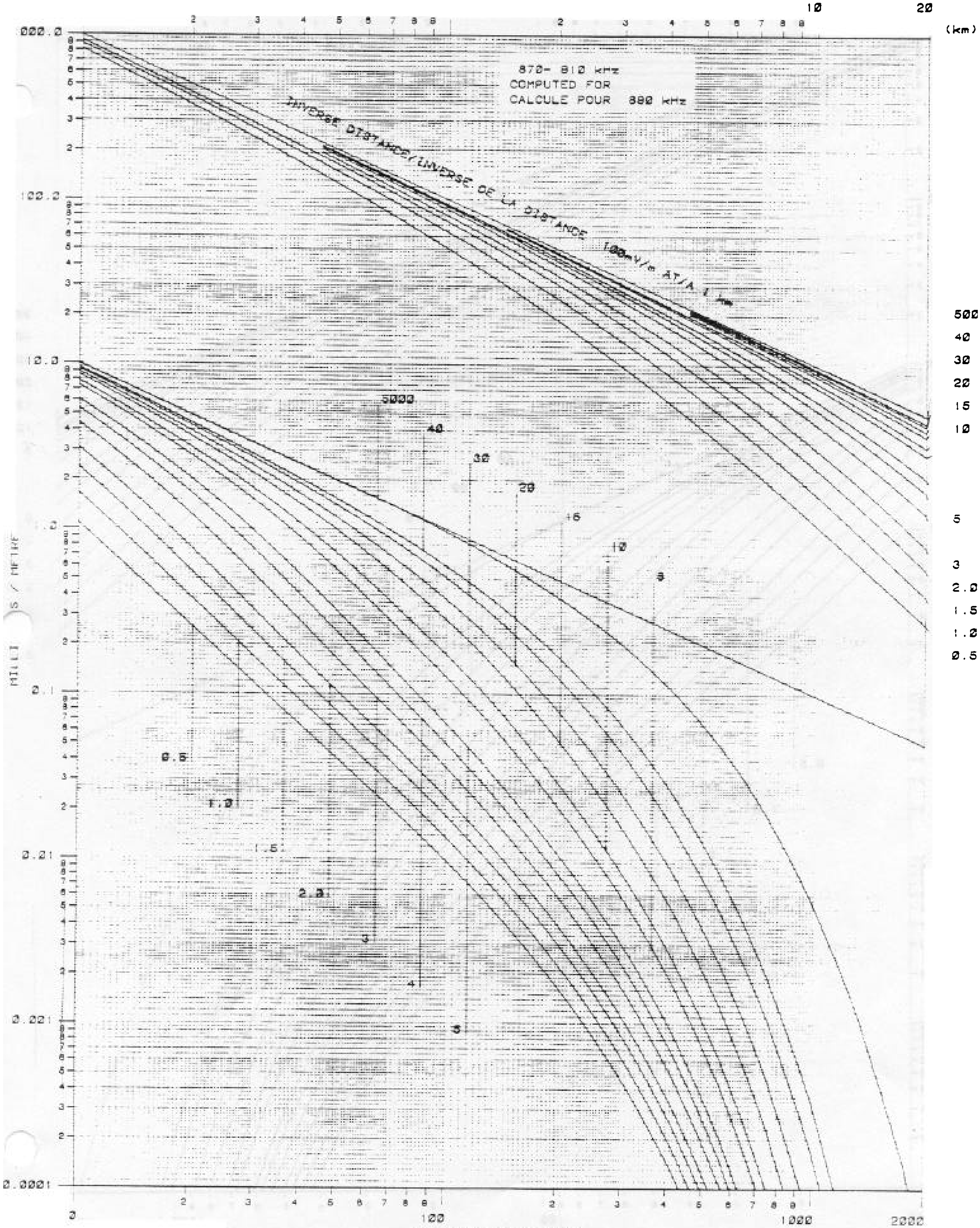
GRAPH 8 - GROUNDWAVE FIELD STRENGTH VERSUS DISTANCE

GRAPHIQUE 8 - CHAMP DE L'ONDE DE SOL EN FONCTION DE LA DISTANCE



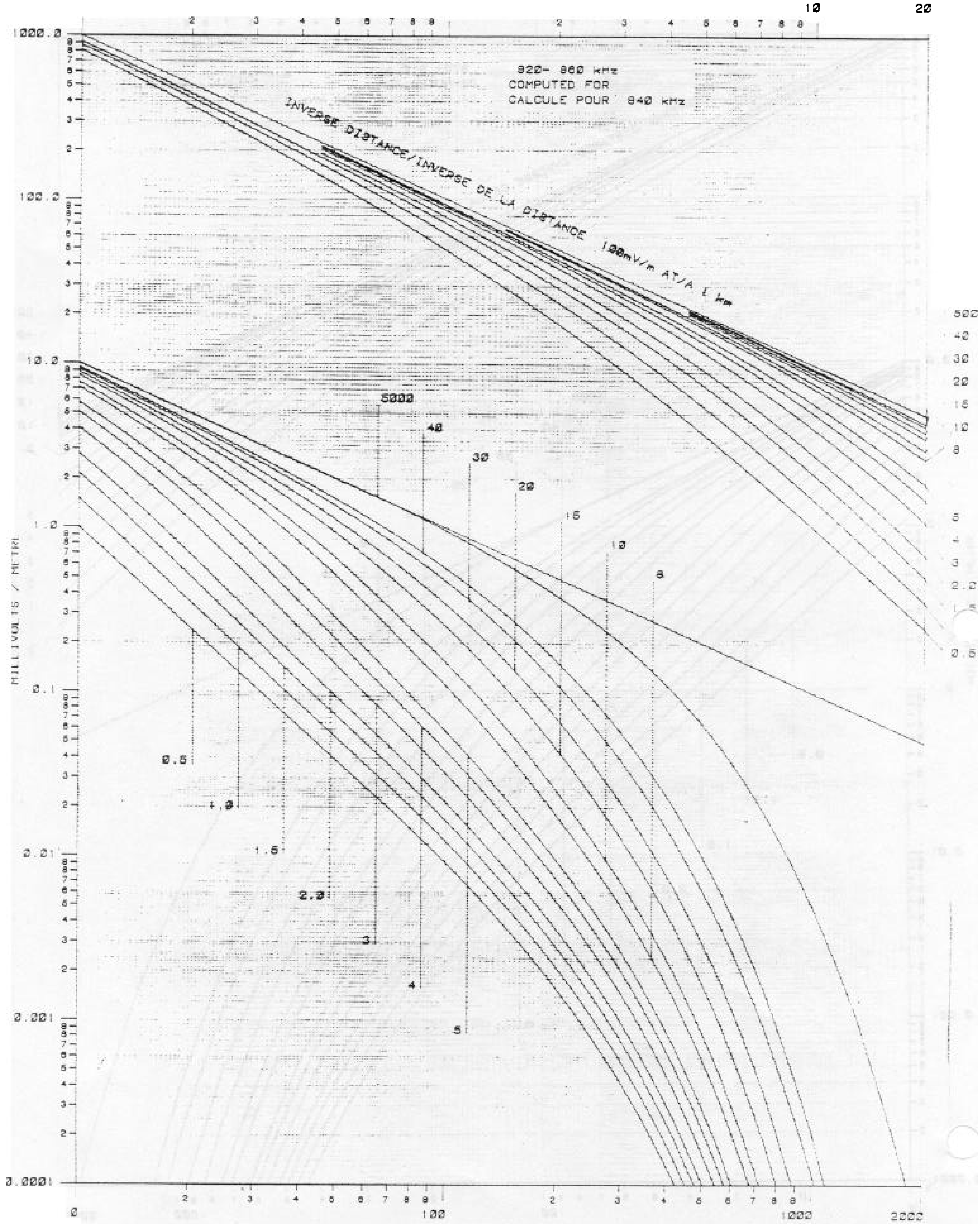
GRAPH 9 - GROUNDWAVE FIELD STRENGTH VERSUS DISTANCE

GRAPHIQUE 9 - CHAMP DE L'ONDE DE SOL EN FONCTION DE LA DISTANCE



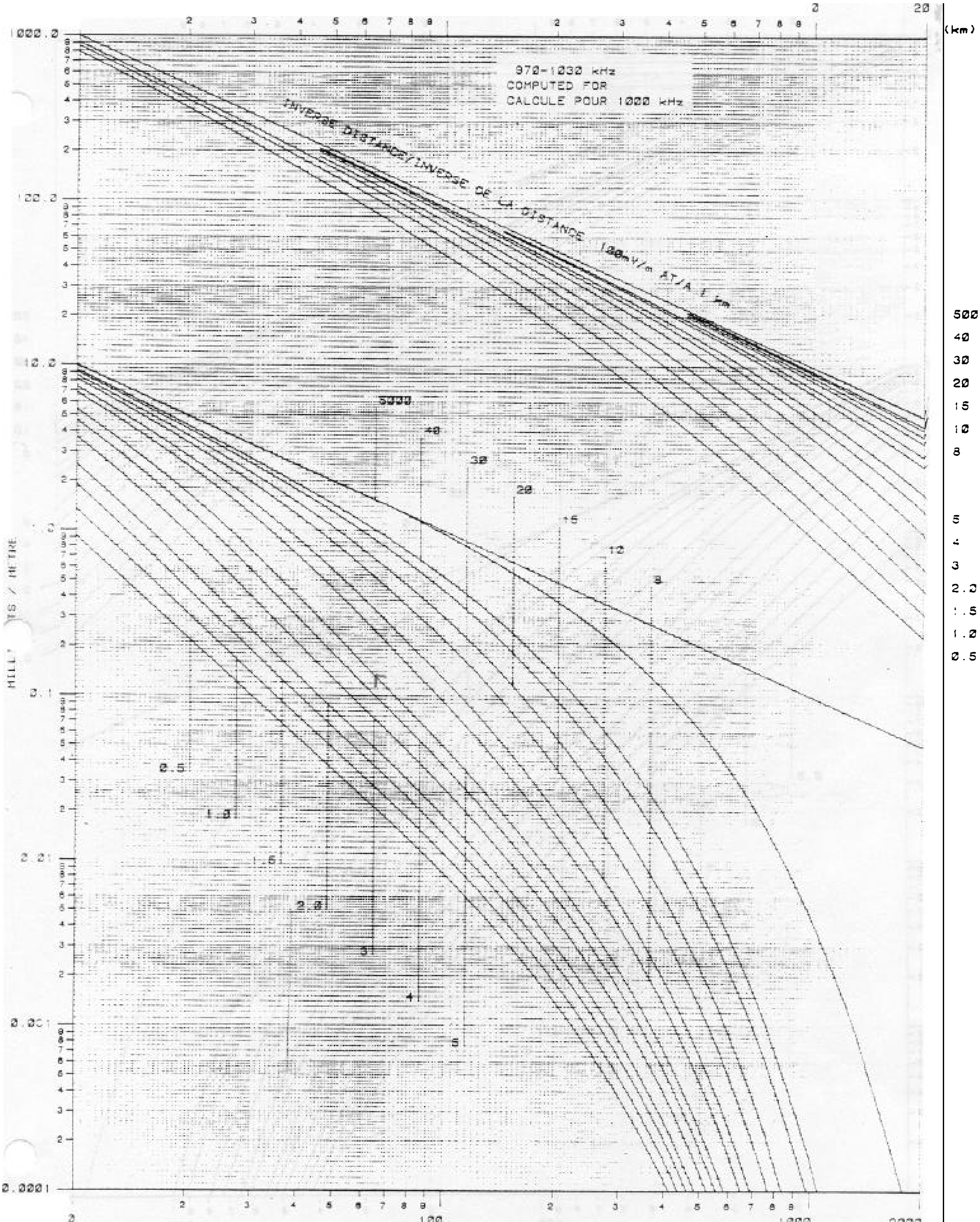
GRAPH 10 - GROUNDWAVE FIELD STRENGTH VERSUS DISTANCE

GRAPHIQUE 10 - CHAMP DE L'ONDE DE SOL EN FONCTION DE LA DISTANCE



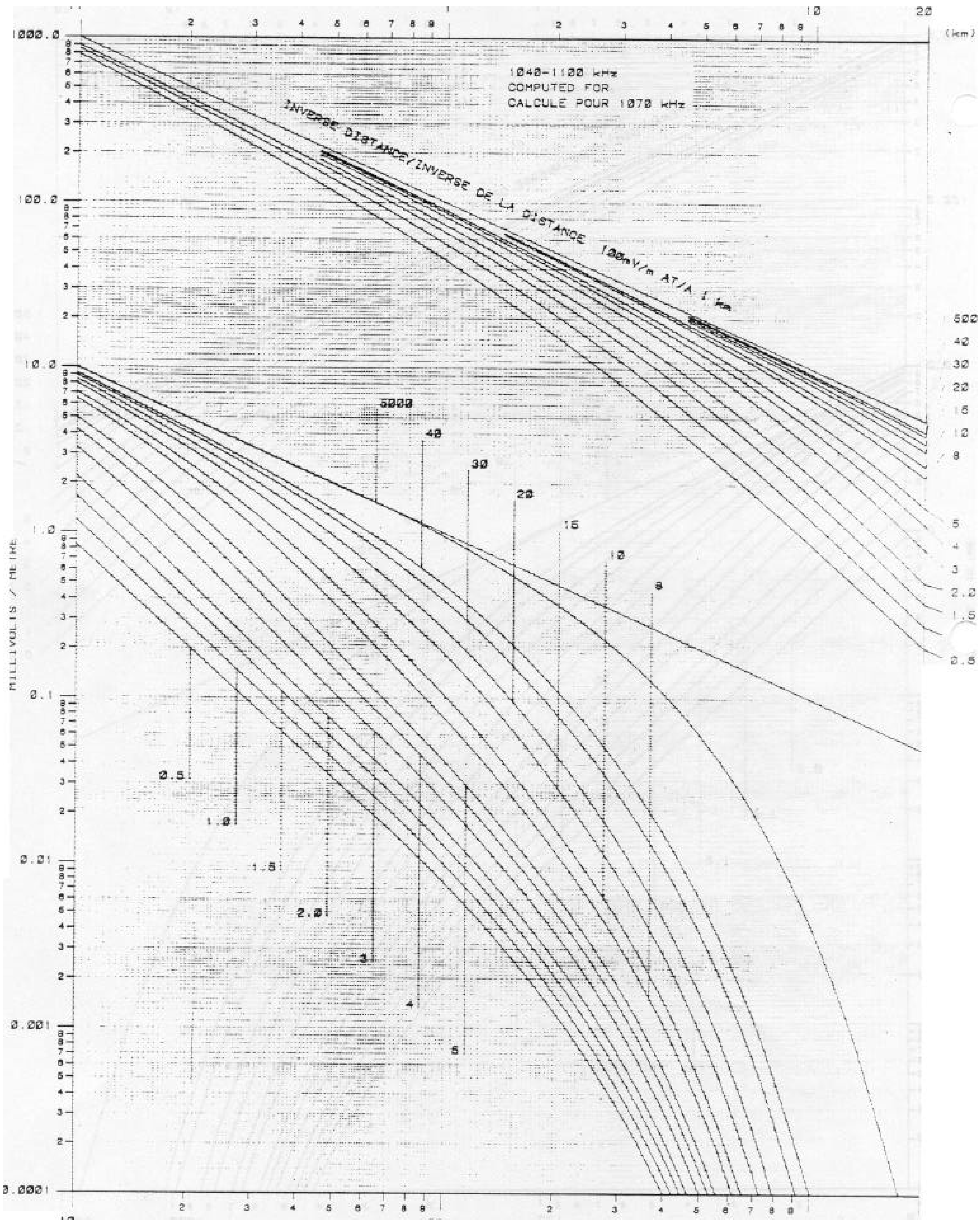
GRAPH 11 - GROUNDWAVE FIELD STRENGTH VERSUS DISTANCE

GRAPHIQUE 11 - CHAMP DE L'ONDE DE SOL EN FONCTION DE LA DISTANCE



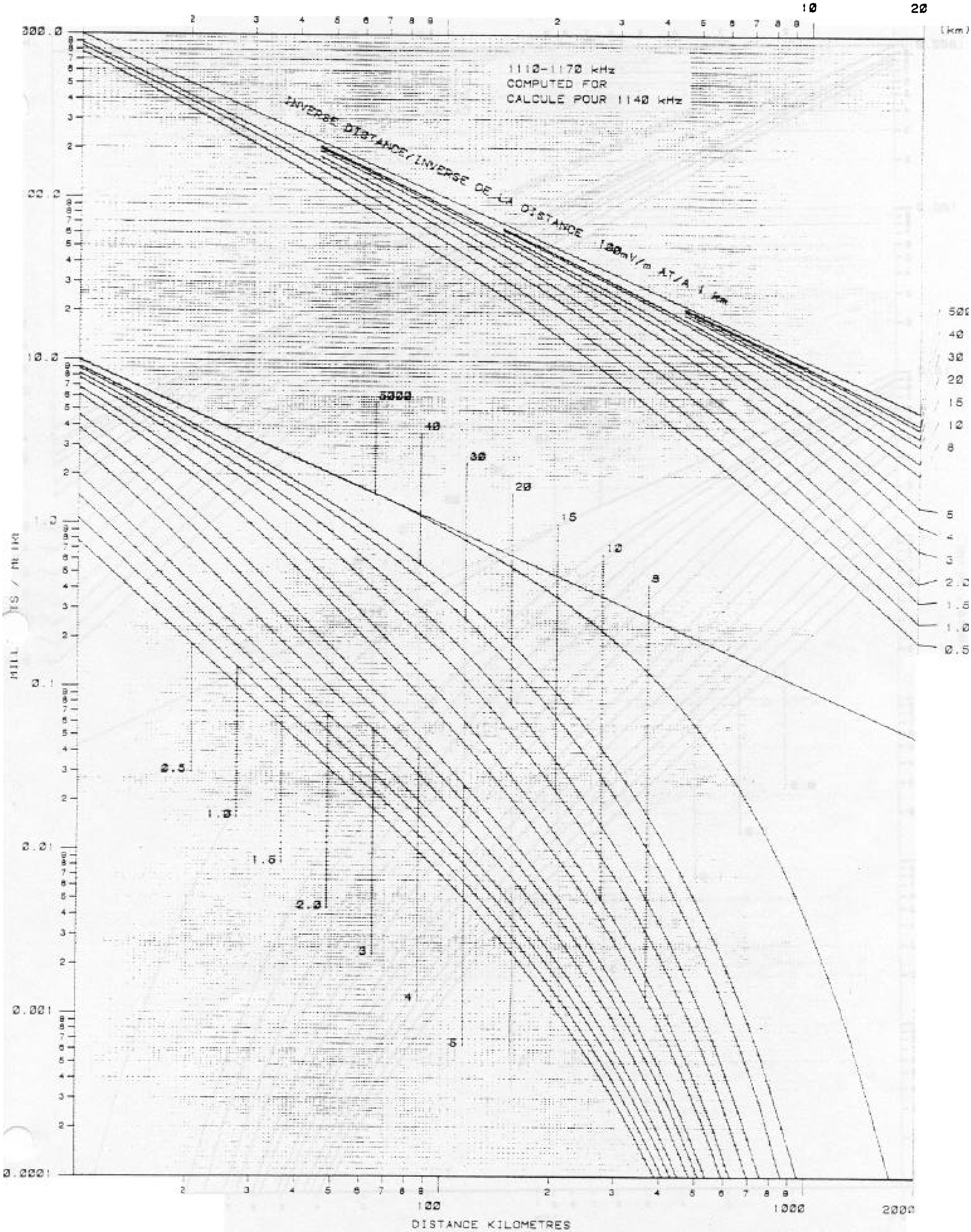
GRAPH 12 - GROUNDWAVE FIELD STRENGTH VERSUS DISTANCE

GRAPHIQUE 12 - CHAMP DE L'ONDE DE SOL EN FONCTION DE LA DISTANCE

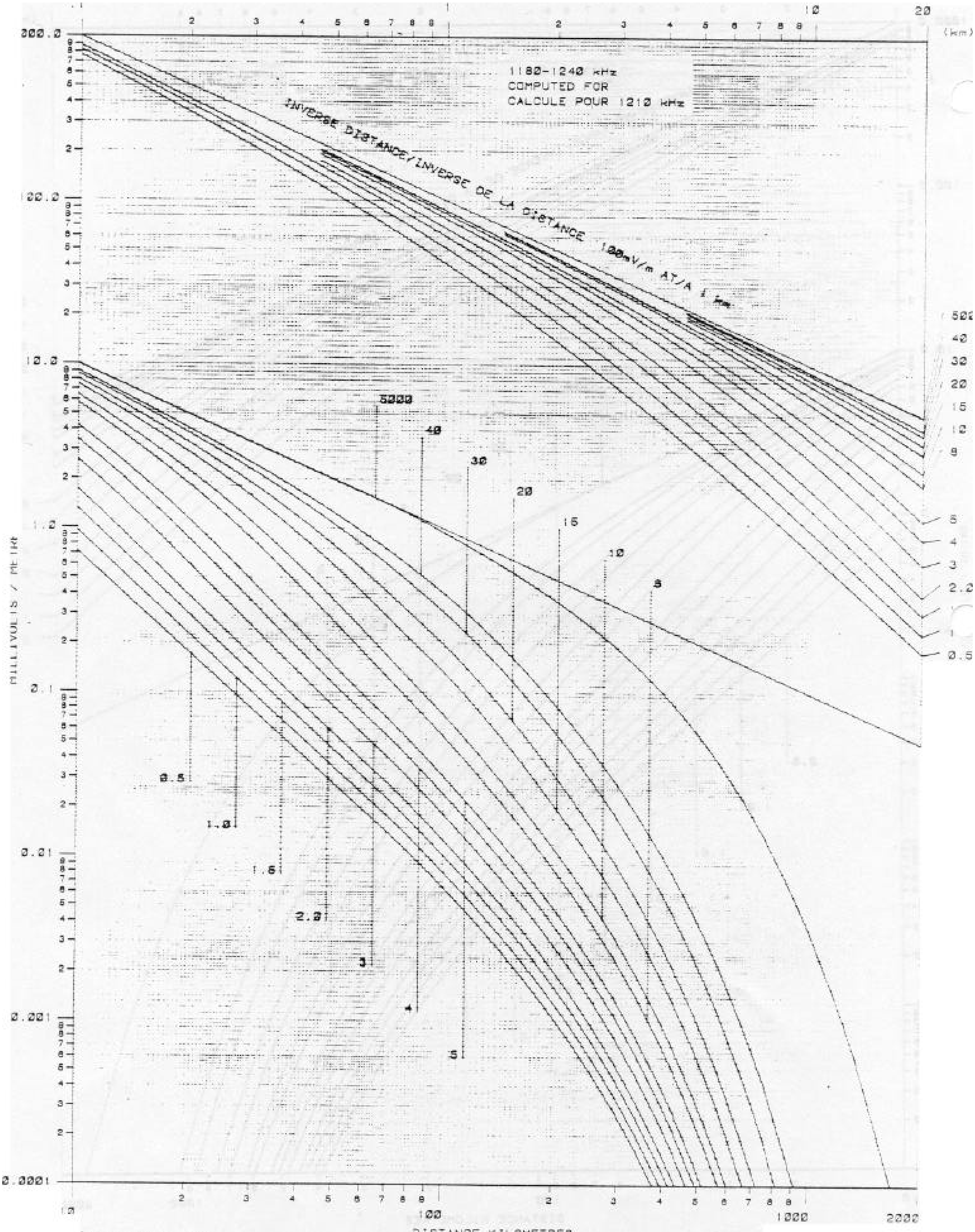


GRAPH 13 - GROUNDWAVE FIELD STRENGTH VERSUS DISTANCE

GRAPHIQUE 13 - CHAMP DE L'ONDE DE SOL EN FONCTION DE LA DISTANCE

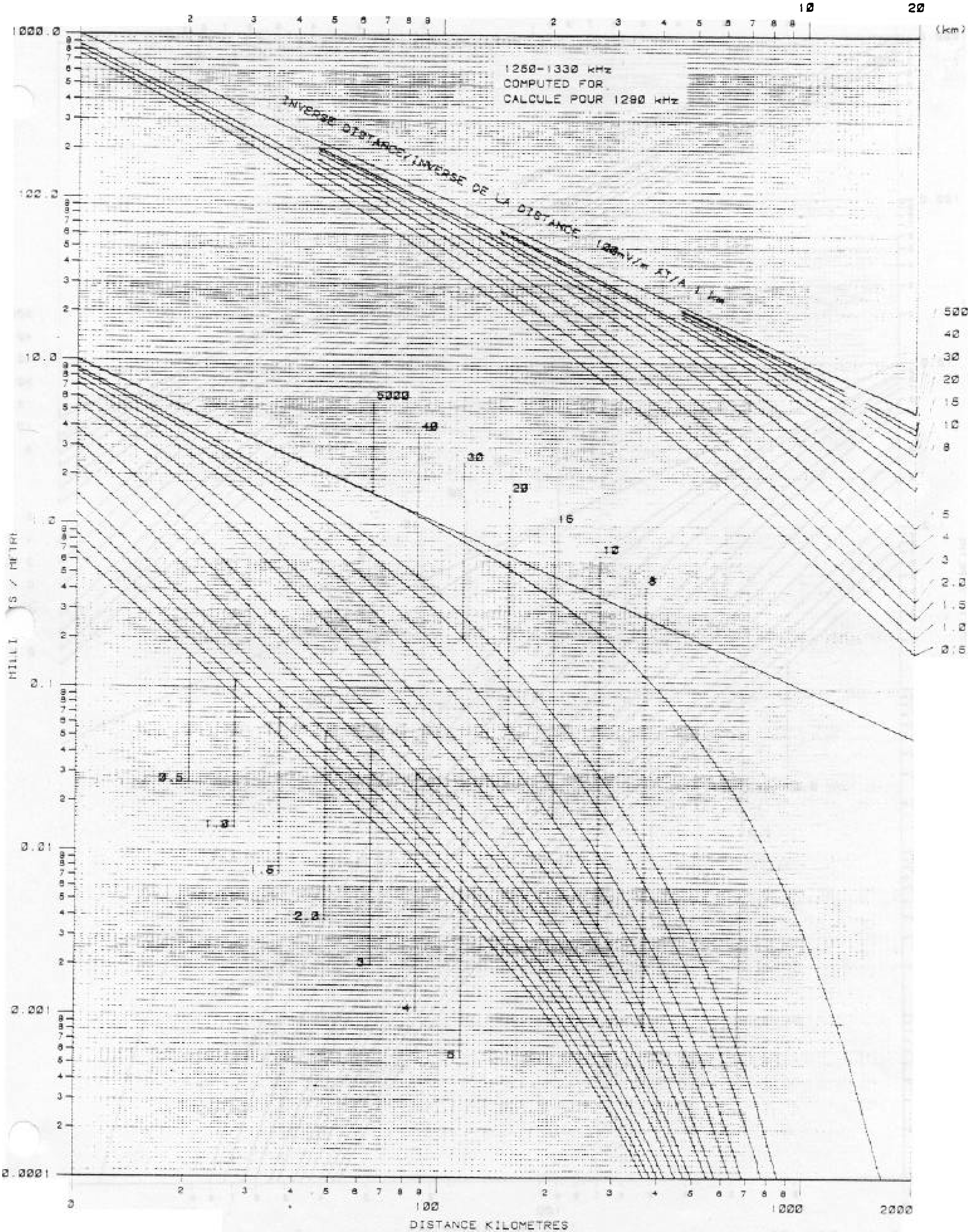


GRAPH 14 - GROUNDWAVE FIELD STRENGTH VERSUS DISTANCE
GRAPHIQUE 14 - CHAMP DE L'ONDE DE SOL EN FONCTION DE LA DISTANCE



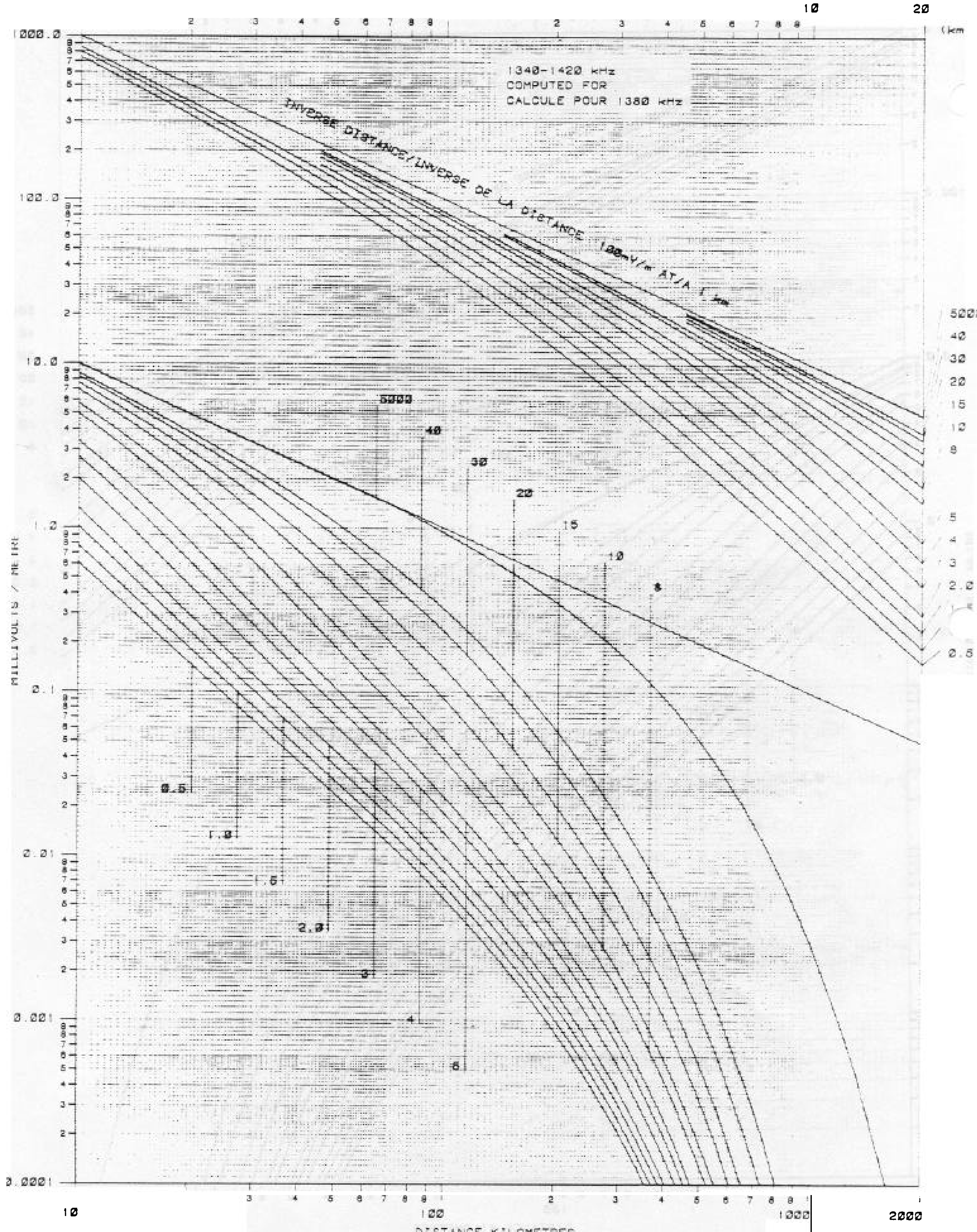
GRAPH 15 - GROUNDWAVE FIELD STRENGTH VERSUS DISTANCE

GRAPHIQUE 15 - CHAMP DE L'ONDE DE SOL EN FONCTION DE LA DISTANCE



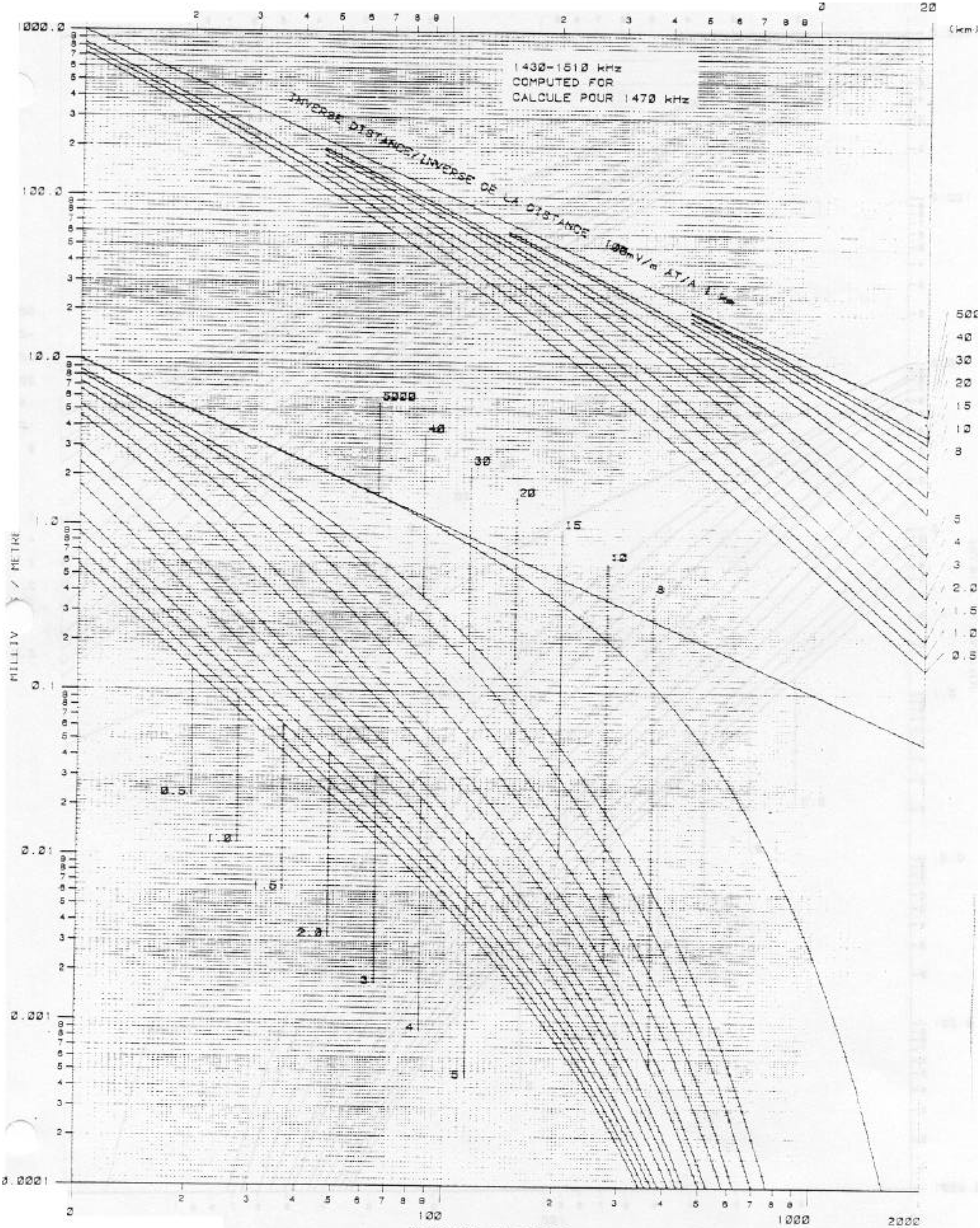
GRAPH 16 - GROUNDWAVE FIELD STRENGTH VERSUS DISTANCE

GRAPHIQUE 16 - CHAMP DE L'ONDE DE SOL EN FONCTION DE LA DISTANCE



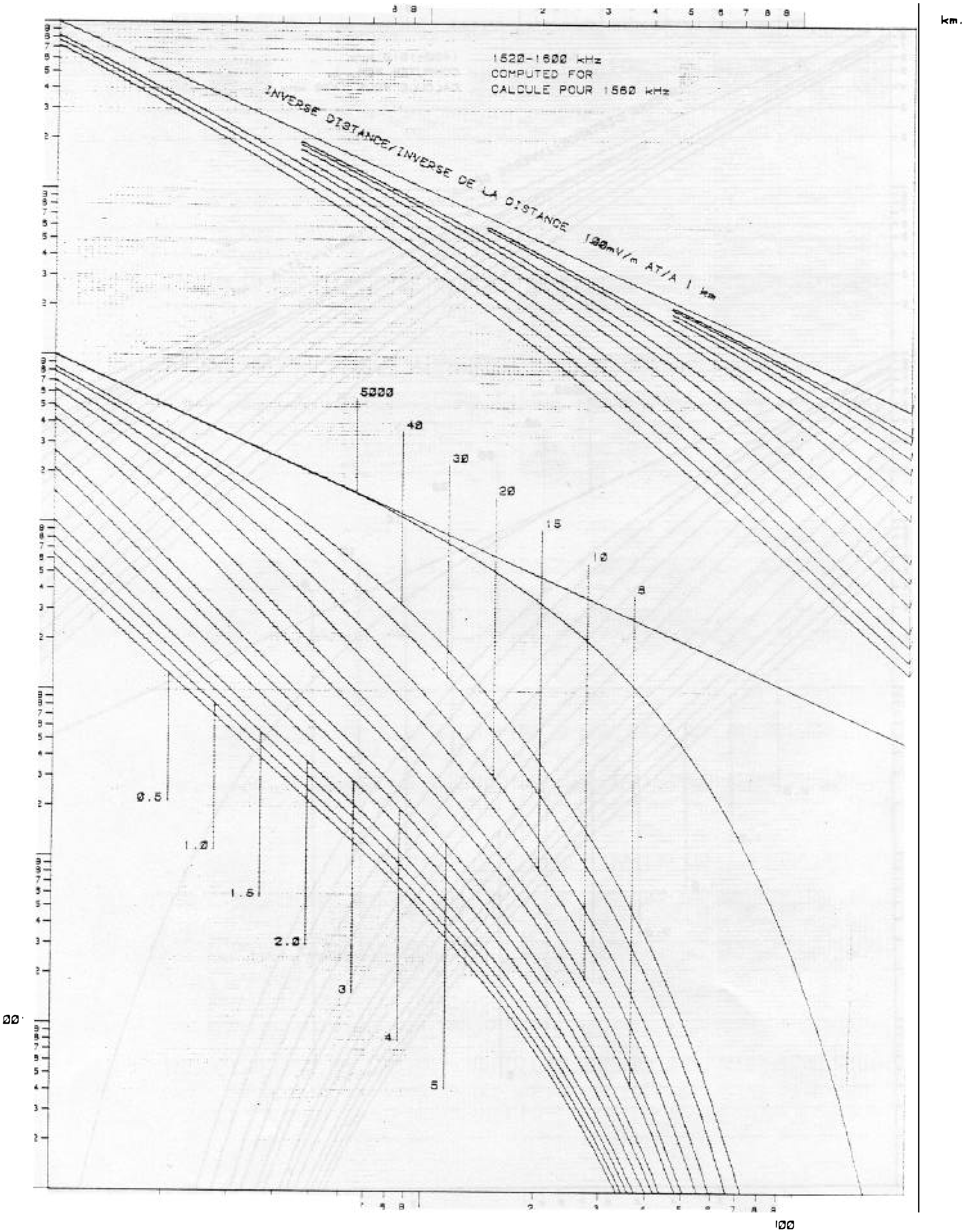
GRAPH 17 - GROUNDWAVE FIELD STRENGTH VERSUS DISTANCE

GRAPHIQUE 17 - CHAMP DE L'ONDE DE SOL EN FONCTION DE LA DISTANCE



GRAPH 18 - GROUNDWAVE FIELD STRENGTH VERSUS DISTANCE

GRAPHIQUE 18 - CHAMP DE L'ONDE DE SOL EN FONCTION DE LA DISTANCE



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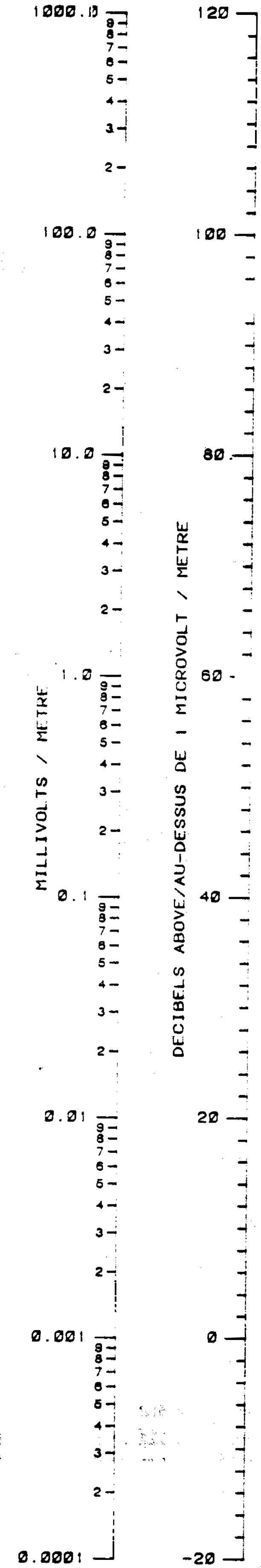


GRAPH 20 - SCALE FOR USE WITH GROUND WAVE FIELD STRENGTH GRAPHS 1-19

GRAPHIQUE 20 - ECHELLE A UTILISER POUR LES GRAPHIQUES DU CHAMP DE L'ONDE DE SOL 1-19

APPENDIX 3

to Annex 2)

Calculation of Directional Antenna Patterns

This Appendix contains the method for calculating radiation for directional antenna systems in order to determine the presence or absence of objectionable interference between stations in the two countries.

1 Definitions

The terms Theoretical Pattern, Expanded Pattern and Modified Pattern refer to directional antenna radiation patterns as defined in Attachment A to this Appendix.

2. Use of expanded patterns or modified patterns

The expanded pattern or the modified pattern shall be used for all stations with directional antenna systems for calculating values of field intensities, limits, contours and permissible values of radiation for the determination of the presence or absence of objectionable interference.

3. Coordination procedure for cases of reduced design tolerance

Assignments involving radiation patterns with reduced design tolerance as defined in Attachment A shall be coordinated between the administrations in advance of formal notification. In the coordination of such proposed assignments, the information required in Attachment B shall be submitted in addition to the information required for notification purposes in paragraph 5. Protection from objectionable interference from subsequent assignments (or proposals to modify the Plan) shall begin on the date this information is transmitted. The criteria for determining acceptable values of reduced tolerance of such proposals are defined in Attachment C which may be amended by exchange of letters directly between the administrations as prediction techniques improve. Attachment C also defines the time frame within which the coordination will be effected dependent upon the complexity of the system. If an objection to a proposal is filed within the time frame specified, the proposal shall not be notified until suitably revised and recoordinated, although protection from subsequent assignments shall be retained for up to 120 days pending revision.

4. Adjustment and maintenance of radiation patterns

The administrations shall ensure that the radiation emitted from directional stations does not exceed notified values of radiation (Expanded or Modified Patterns) in any direction toward the other country. At the time of initial adjustment, and as often as necessary thereafter, sufficient field strength measurements shall be made on each directional station to establish that it has been properly adjusted. In addition, each station shall follow a routine monitoring program whereby periodic measurements of pertinent array parameters (including field strength measurements if required by Attachment B) are made to demonstrate that the array is maintained within authorized values.

5. Notification of technical information

The description of the directional antenna notified using the appropriate part of Annex 1 shall include all technical data necessary to calculate the Theoretical Pattern, Expanded Pattern, or Modified Pattern. It shall also include (5) values of radiation and azimuth and vertical angle to permit verification of the pattern, as well as values of the theoretical RMS radiation and "Q".

Notification of an operation with a reduced "Q" shall be clearly identified and shall include additional information in accordance with Attachment B, or shall clearly identify, by reference, any additional information previously submitted.

FORMULAE FOR CALCULATION OF RADIATION FROM DIRECTIONAL ANTENNA SYSTEMS

1. Theoretical Pattern

$$E(\phi,\theta)_{th} = K\sum_{i=1}^{n} F_i \; f(\theta)_i \; \angle\, S_i \cos\theta \cos(\phi_i - \phi) + \psi_i$$

$$E_{rss} = K \sum_{i=1}^{n} F_i^{2}$$

where

$E(\phi,\theta)_{th}$ is the theoretical inverse distance field radiation (mV/m) produced by the array at the horizontal angle ϕ measured from a reference aximuth and at the vertical angle θ measured from the horizontal.

is the theoretical root - sum - square of field intensities.

n is the number of towers in the array.

K is a pattern sizing constant related to the notified theoretical RMS radiation of the array.

F_i is the ratio of the field produced by tower i, with respect to the field produced by a reference tower in the array.

S_i is the spacing in electrical degrees of tower i from a reference point.

ϕ_i is the horizontal angle measured from the reference direction clockwise to a line passing through the reference point and tower i.

ψ_i .... is the electrical phase angle in degrees of the current in tower i with respect to the phasing of current in a reference tower.

G_i is the height in electrical degrees of tower i.

is the vertical radiation characteristic for tower i where sinusoidal current distribution is assumed.

a) For a typical uniform cross-section vertical radiator,

$$f(\theta)_i = \frac{\cos (G_i \sin \theta) - \cos G_i}{(1 - \cos G_i) \cos \theta}$$

b) for a top-loaded vertical radiator,

$$f(\theta)_i = \left\{\cos B \cos (A \sin \theta) - \sin \theta \sin B \sin (A \sin \theta) - \cos (A + B)\right\} + \left\{\cos \theta \left[\cos B - \cos (A + B)\right]\right\}$$

where:

A is the physical height of the radiator, in electrical degrees.

B is the difference, in electrical degrees, between the apparent electrical height G, (based on current distribution) and the actual physical height of the radiator.

G is the apparent electrical height: A + B.

See Figure 1.

c) for a sectionalized vertical radiator, (tower structure code 2)

$$f(\theta) = \sin \Delta \ (\cos B \cos (A \sin \theta) - \cos G)$$
$$+ \sin B \ (\cos D \cos (C \sin \theta)$$
$$\sin \theta \sin D \sin (C \sin \theta)$$
$$- \cos \Delta \cos \ (A \sin \theta)$$
$$+ \left\{\cos \theta \left[(\sin \Delta \ (\cos B - \cos G)\right.\right.$$
$$\left.\left. + \sin B \ (\cos D - \cos \Delta)\right]\right\}$$

where:

A is the physical height in electrical degrees, of the lower section of the radiator,

B is the difference between the apparent electrical height (based on current distribution) in electrical degrees of the lower section of the radiator and the physical height of the lower section of the radiator.

C is the physical height of the entire radiator, in electrical degrees,

D is the difference between the apparent electrical height of the radiator (based on current distribution of the upper section) and the physical height of the entire radiator. D will be zero if the sectionalized tower is not top-loaded.

$G = A + B$

$H = C + D$

$\Delta = H - A$

See Figure 2

d) Alternative formulas for use in computing $f(\theta)$ for top-loaded and sectionalized towers may be employed provided they are accompanied by a complete derivation and sample calculations, or are included in Appendix 5.

2. Expanded Radiation Pattern

$$E(\phi,\theta)_{exp} = 1.05 \sqrt{E(\phi,\theta)^2_{th} + Q^2}$$

Q is normally $0.025\ g(\theta)\ E_{rss}$ or $10.0 g(\theta)\sqrt{P_{kW}}$

whichever is greater, where P_{kW} is the station power. A lower value of Q may be notified if the criteria for reduced design tolerance in Attachment B are met. One kW will be used for stations operating with less than one kW.

If antenna height (G) is less than 180 degrees, $g(\theta) = f(\theta)$ where $f(\theta)$ is calculated using the shortest tower in the array. If antenna height (G) is equal to or greater than 180 degrees,

$$g(\theta) = \sqrt{\frac{f(\theta)^2 + 0.0625}{1.030776}}$$

where $f(\theta)$ is calculated using the shortest tower in the array.

Note: The vertical radiation formula for high towers and the shortest tower method for unequal towers apply only in the calculation of Q.

3. Modified Radiation Pattern

The Modified Pattern is a pattern developed by augmentation of the Expanded Pattern by increasing the Theoretical Pattern RMS radiation and/or by sector expansion by use of:

$$E(\phi,\theta)_{Mod} = \sqrt{E(\phi,\theta)_{Exp}^2 + A\left[g(\theta)\ \cos\ \frac{(180\ dA)}{S}\right]^2}$$

where

$E(\phi,\theta)_{Exp}$...... is the Expanded Pattern radiation at a particular azimuth and elevation, before augmentation.

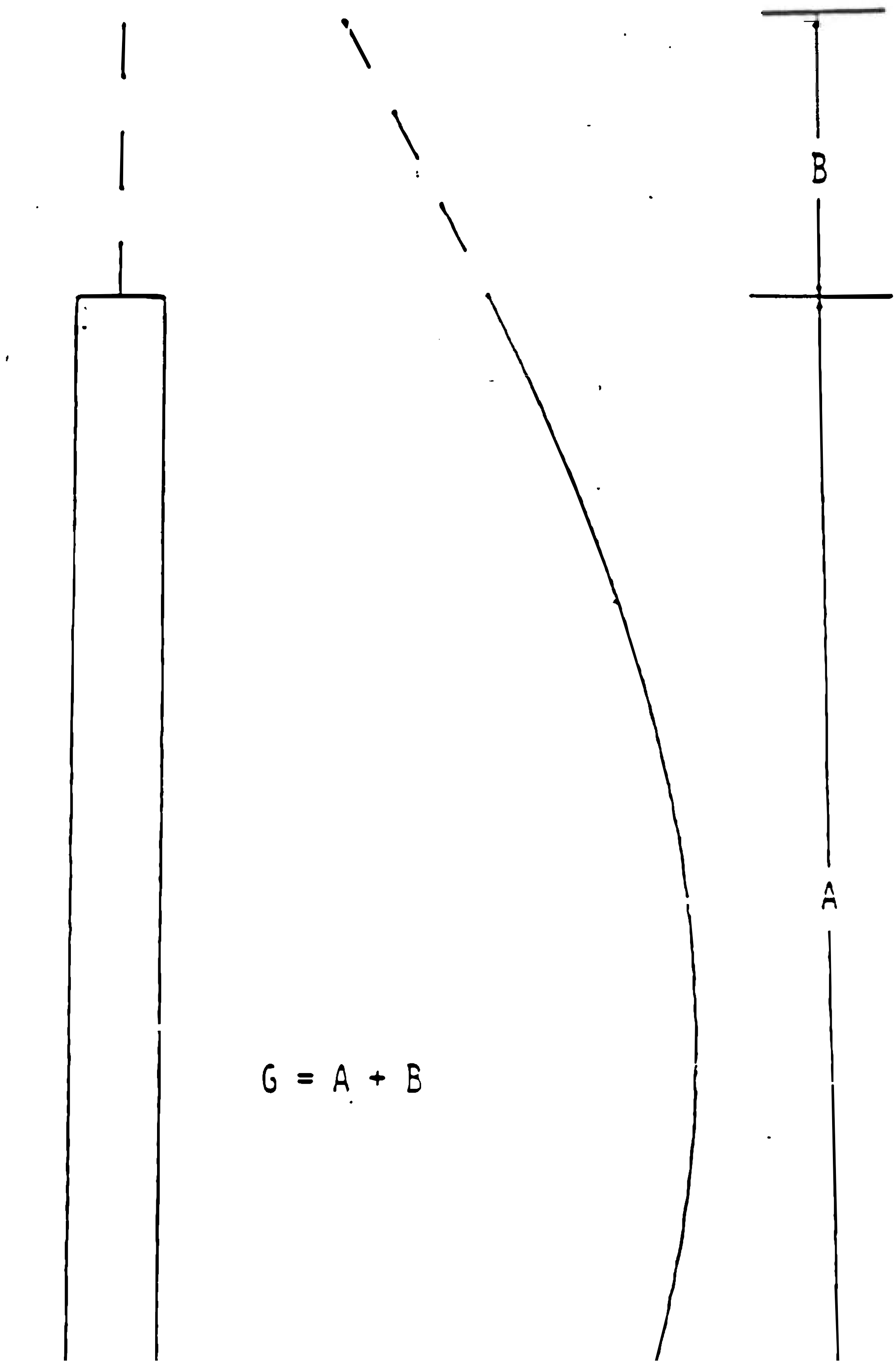
$E(\phi,\theta)_{Mod}$...... is the radiation in the direction specified in $E(\phi,\theta)_{Exp}$, after augmentation.

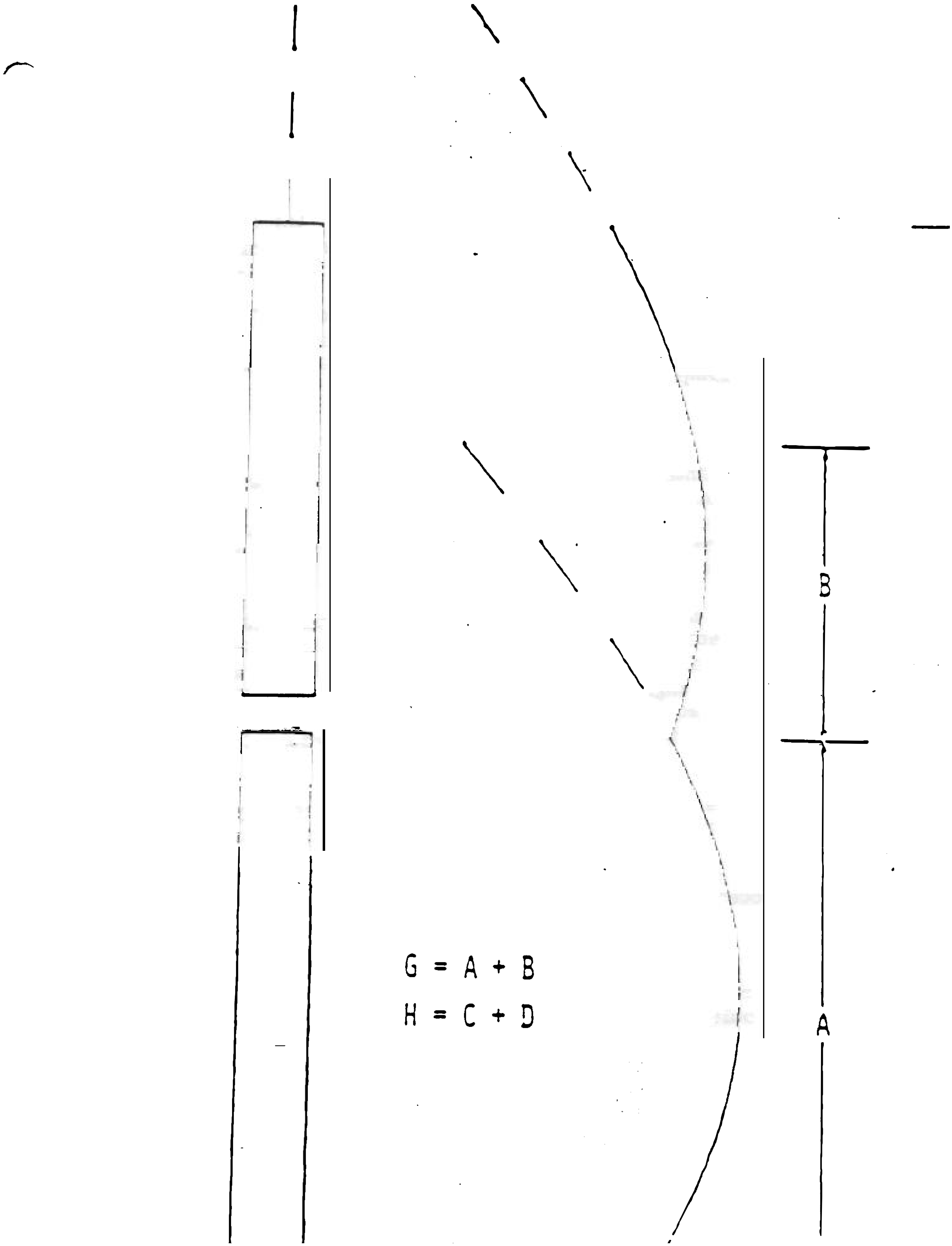
$A = E(\phi,\theta)^2_{Mod} - E(\phi,\theta)^2_{Exp}$ where $E(\phi,\theta)_{Mod}$ and $E(\phi,\theta)_{Exp}$ are fields in the horizontal plane at the main azimuth of augmentation (θ = zero degrees)

S .... is the angular range or span over which augmentation is applied, with the span centered over the main azimuth of augmentation. Overlap of spans of augmentation is permitted.

dA ... is the absolute value of the horizontal angle between the azimuth at which the augmented pattern value is computed, and the main azimuth or center of span of augmentation. dA cannot exceed $\frac{S}{2}$.

Negative augmentation will be permitted only for the purpose of pattern conversion and shall not reduce augmented radiation below theoretical radiation.


B
A
G = A + B


B
A
G = A + B
H = C + D

Attachment B

Criteria for Reduced Design Tolerance

1. The normally notified parameters of the array, the reduced tolerance Q and the accuracy of the current and phase monitoring systems in detecting change shall be submitted, except as provided for in Attachment C

2. Proposed radiation fields requiring consideration of a reduced tolerance (Q) below that provided for in Attachment A shall be approved onl when the notifying administration has given assurance that the following precautions would be taken:

Site

The proposed antenna site must be suitable in all respects for establishment of the antenna system so that scattering or residual re-radiation from structures on or near the site would be of sufficiently low magnitude so as not to preclude the adjustments of the measured radiation pattern to within the proposed pattern.

Topographical maps of sufficient scale to reveal detailed terrai features within the immediate vicinity of the proposed transmitter site shall be submitted. Aerial photographs, taken in clear weather at appropriate altitudes and angles or photographs taken in eight different directions from an elevated position on the ground, enabling clear identification of all structures in the vicinity of the proposed site shall be submitted.

In addition, a description must be included of the physical terrain, of all metal structures, towers, transmitting facilities, power lines, railroad tracks, etc. within 2 km of the site. On highly directional arrays, distances beyond 2 km shall be considered. The details of all proposed detuning procedures shall be provided.

Array

An analysis to demonstrate that the electrical and physical design of the array would ensure the necessary stability to maintain the notified pattern is required. Such designs would require specialized equipment and components. Moreover, the design should avoid electrical parameters known to present instability problems such as operating resistances between -5 and +5 ohms, antennas other than base fed, tower spacings less than 70 degrees, and ratios of E_{rss}/E_{RMS} greater than 2.

The description of the ground system, including special features such as counter-poises if employed, would also be supplied.

A description should be included of any special methods to counteract or minimize the effects of climatic changes on the pe of the array.

2.3 Monitoring Systems and Adjustment of the Array

A description of the proposed current and phase monitori system, including the electrical components and physical design det a specific evaluation of the ultimate accuracy of the system in det changes in current amplitudes or phase relationships, specifically, phase/current sampling lines for the antenna monitor have identical and electrical characteristics, a low temperature/phase coefficient equal lengths subject to the same environmental conditions is requi

In particular, the manufacturer, model number, resolutio accuracy of the antenna monitor shall be specified. Sample current used to feed the antenna monitor shall be installed at or near the maximum of each tower of the array. A statement should be included specifying the tolerance limits within which the operation parameter (amplitude and phase) will be maintained.

An analysis to determine what levels of system deviation cause radiation to exceed notified values in any direction toward th country must be submitted.

The monitoring system must be capable of detecting system deviations equal to or less than half of those which would result in radiation which would exceed the proposed or notified values.

The proposed procedure for monitoring the radiation patte the field shall be described and the location of the monitoring poin be specified. Monitoring points shall be located mainly at azimuths minimum radiation (nulls) and shall have to adequately monitor the a radiation pattern of the proposed station toward the other country. on the proof of performance, maximum limits of measured field streng these monitoring points should be established to assure maintenance actual radiation pattern within notified radiation limits toward the country. The frequency of measurements at these monitoring points sh at least weekly during the first month of station operation and at l monthly thereafter.

When monitoring point field strength or operating paramet values in excess of the tolerance limits described above are observe station concerned shall immediately reduce power or readjust the arr restore radiation to within authorized limits. Except for emergency operation, testing, maintenance or other temporary operation, full po operation shall not resume until the array has been properly readjust

2.4 Proofs of Performance

A complete proof of performance shall be conducted on all installations and on existing ...

locations for both the nondirectional and directional modes shall be identical and located along a sufficient number of radials corresponding tc pattern nulls and maximums (three or more radials per major lobe) to accurately establish the radiation pattern. Where practicable, measurement along each radial should be taken at intervals of approximately two-tenth k up to three km from the antenna excluding points obviously within the induction field of the antenna system, at intervals of approximately 1 km from three to ten km and at intervals of approximately 3 km from ten to 30 km from the antenna. The results should be carefully analyzed utilizing th ground wave field strength curves from Annex 2 for the appropriate frequency.

Attachment C

Guidelines for the Co-ordination of Proposed AM Broadcasting Sta

Involving Reduced Design Tolerance

1. Time Frame to Effect Co-ordination

Except for systems rated as "slightly below standard tol the time frame to respond may vary from 60 to 150 days depending on complexity of the proposed system. A method to rate systems by deg complexity shall be developed. In the meantime, the administration submitting the proposal will estimate the time required to reply. estimated time period may be extended by mutual consent at the requ the other administration if further information is required or if t of study required has been underestimated.

2. Submission of Information

Except for systems rated as "slightly below standard tol the information referred to in attachment B paragraph 1 shall be transmitted.

3. Determination of Acceptable Values of Reduced Tolerance

In cases involving values of radiation less than those pr by the expanded pattern, expected values of radiation above theoreti radiation values shall be calculated using the two computer routines currently used in both administrations which calculate "stability ra patterns" for a given variance of phase angles and field ratios. Th of variation used in the routines shall be at least twice the expect resolution of the antenna monitoring system. For systems rated "sli below standard tolerance", the values of variation will be one degre phase and one per cent in field ratios. Grounds exist for objection whenever using either routine, the resultant value of radiation in t pertinent directions exceeds that notified.

4. Systems Slightly Below Standard Tolerance

A system is considered slightly below standard tolerance if the reduced quadrature component Q in the horizontal plane is less than $10 \sqrt{P_{kW}}$, but greater than $0.025 \ E_{rss}$, as these terms are defined in Attachment A, and there would be no interference calculated with a one degree variation in phase and a one per cent variation in field ratios. These systems would be expected to be sited at locations relatively free from sources of re-radiation, to have adequate precautions taken to minimize effects of temperature variation, and to undertake satisfactory monitoring. However, the approval of the system and the assurance of maintenance within tolerance shall be the responsibility of the notifying Administration only and the submission of the information referred to in attachment B will not be required. The data specified in Part II of Annex 1, plus the reduced Q, shall be referred at least 30 days in advance of notification. If the administration receiving the proposal does not concur with the "slightly below standard tolerance" rating, it shall advise the notifying administration by telex or telephone, providing the reason for its opinion and requesting a different rating. If the notifying administration is unable to show that the "slightly below standard tolerance" rating is appropriate, it shall: provide information as in Attachment B, or provide a revision to make the rating appropriate or withdraw the proposal.

APPENDIX 4

(to Annex 2)

Additional Technical Information

This Appendix contains additional technical material and examples of methods of calculation which may be of assistance.

1. Examples of field strength calculations for homogeneous paths (see paragraph 2.3.1 of Annex 2)

a) Determination of the electrical field strength at a given distance from a station

Consider a station with a power of 5 kW at 1 240 kHz. The antenna has a characteristic field strength for 1 kW of 306 mV/m.

The field strength at a distance of 40 km is to be determined for a conductivity of 4 mS/m throughout the path.

From graph 15 (1 180 - 1 240 kHz) we obtain a field strength of 45.5 dB (μV/m) which corresponds to 188 μV/m from the curve corresponding to 4 mS/m.

Therefore

$$E = E_O \times \frac{E_C}{100}\sqrt{P} = \frac{188 \times 306}{100}\sqrt{5} = 1286\ \mu V/m \text{ or } 62.2\ dB\ (\mu V/m)$$

b) Determination of the distance at which a given field strength is obtained

On the basis of the data from the preceding example, at what distance can a field strength of 500 μV/m or 54 dB (μV/m) be obtained?

Since the antenna involved has a characteristic field strength for 1 kW of 306 m/Vm and the station power is 5 kW, i.e. conditions different from those of graphs 1 to 19 (100 mV/m at 1 km), the field strength value must be determined before referring to the corresponding graph.

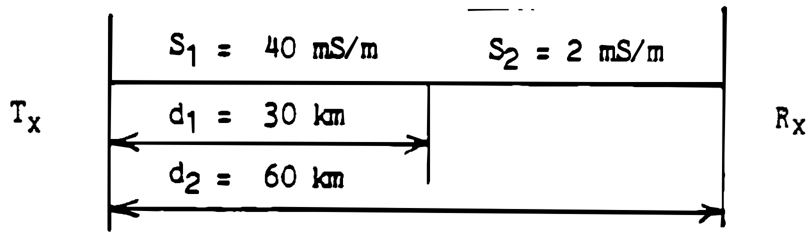
The calculated value is

$$E_o = \frac{100E}{E_c\sqrt{P}} = \frac{100 \times 500}{306 \times \sqrt{5}} = 73.1\ \mu V/m \text{ or } 37.3\ dB\ (\mu V/m)$$

Taking the corresponding curve at 4 mS/m in graph 15, we arrive at 37.3 dB (μV/m) at 62 km.

2. <u>Example of a field strength calculation for non-homogeneous paths</u> (see section 2.3.2 of the technical data)

Consider the following path:



a) For a 25 kW station at 1 000 kHz and an antenna with a characteristic field strength of 100 mV/m, what field strength is obtained at 60 km?

In graph 12 we obtain on the 40 mS/m curve a field strength of 69 dB (μV/m) or 2.8 mV/m at the point of discontinuity (30 km).

We obtain the same field strength at 9.5 km (d=9.5 km) on the 2 mS/m curve.

The equivalent distance for d_2 = 60 km, is $d + (d_2 - d_1) = 9.5 + (60-30) = 39.5$ km.

From the 2 mS/m curve, we obtain a field of 43 dB (μV/m) for 1 kW or 141 μV/m at 39.5 km.

Lastly, we calculate the field strength:

$$E = E_0 \times \frac{E_c}{100}\sqrt{P} = 141 \times \frac{100}{100} \times \sqrt{25} = 705\ \mu V/m$$

b) Taking the preceding example, at what distance will the 500 μV/m contour be?

First we determine the field strength:

$$E_0 = \frac{100E}{E_c\sqrt{P}} = \frac{100E}{100\sqrt{25}} \times 500 = 100\ \mu V/m$$

Following the 40 mS/m curve of graph 12, we note that at 30 km the field strength is 69 dB (μV/m) or 2.8 mV/m. This value is higher than the one we seek (0.1 mV/m) and therefore we shall have a distance greater than 30 km.

The equivalent distance for a 2 mS/m conductivity is 9.5 km.

following the 2 mS/m curve, we find the 100 μV/m or 40 dB (μV/m) contour at 46 km giving us the equivalent distance. The true distance is 46 + (30 - 9.5) km = 66.5 km.

3. Path parameters

If a_T and b_T respectively are the latitude and longitude of the transmitting terminal, and a_R and b_R are those of the receiving terminal, the parameters of the short great-circle path may be calculated. The North and East coordinates are considered positive and the South and West coordinates negative.

3.1 Great-circle path distance

$$d = 111.18 \times d^o \quad \text{km}$$

where

$$d^o = \text{arc cos} \left[\sin a_T \sin a_R + \cos a_T \cos a_R \cos (b_R - b_T) \right]$$

3.2 Azimuth of the path from either terminal

For the transmitting terminal, for example,

$$\alpha_T = \text{arc cos} \frac{\sin a_R - \cos d^o \sin a_T}{\sin d^o \cos a_T}$$

determined such that $0^o \leq \alpha < 180^o$. The geographical bearing in degrees East of North to the receiving terminal is α_T if $\sin (b_R - b_T) \geq 0$ or is $(360^o - \alpha_T)$ if $\sin (b_R - b_T) < 0$. The same equation, with the latitudes reversed, is used for the receiving terminal.

3.3 Coordinates of a point on a given great-circle path at a distance, d, from a transmitter:

$$a = \text{arc sin} \left[\sin a_T \cos d^o + \cos a_T \sin d^o \cos \alpha_T \right]$$

$$b = b_T + k$$

where

$$d^o = \frac{d}{111.18} \quad \text{km}$$

$$k = \text{arc cos} \left(\frac{\cos d^o - \sin a_T \sin a}{\cos a_T \cos a} \right), \text{ if } \sin (b_R - b_T) \geq 0$$

$$k = - \text{arc cos} \left(\frac{\cos d^o - \sin a_T \sin a}{\cos a_T \cos a} \right), \text{ if } \sin (b_R - b_T) < 0$$

Note that the transmitting location was used in these equations for a and b, but alternatively the receiving location may be used.

4. Example illustrating the application of the 50% exclusion principle (see section 4.7.2)

Interfering signal (1)	Interfering signal field strength (µV/m)	Protection ratio (dB)	Individual interference contribution (µVm)	Calculated RSS (µV/m)	Remarks
A	140	26	2800		
C	130	26	2600	3821	$\sqrt{A^2 + C^2}$
B	125	26	2500	4555	Individual contribution greater than 50% of $\sqrt{A^2 + C^2}$ therefore $\sqrt{A^2 + C^2 + B^2}$
D	65	26	1300		Individual contribution less than 50% of $\sqrt{A^2 + C^2 + B^2}$ therefore disregard
E	52	26	1040		idem

(1) In descending order of individual interference contribution

5. Receiver image frequency considerations

For planning purposes, an Administration, in seeking the frequency most appropriate for use by a new station, may consider an additional groundwave protection consideration, i.e. the receiver image frequency constraint, to minimize the risk of interference due to the characteristics of receivers when the service areas of several stations overlap.

However, in areas where there are few available channels, administrations may decide to disregard this constraint.

If an administration wishes to ensure this protection, it must ensure that the field strength of a station with a frequency 900 to 920 kHz higher than the frequency of the station to be protected does not exceed by more than 29.5 dB the field strength corresponding to the protected contour of the station. The protection level thus required is the same as for the second adjacent channel.

6. The following matrix shows the conditions of application of the protection criteria as indicated in sections 4.10.2 and 4.10.3

Section number	4.10.2.1	4.10.2.2	4.10.2.3	4.10.3	4.10.3	4.10.3
Channel relationship	co-channel	co-channel	co-channel	adjacent channel	adjacent channel	adjacent channel
Time	daytime	night-time	night-time	daytime	night-time	day and night
Class of protected station	A, B, C,	A 10% criterion	B, C,	A	A	B, C,
Protected from	groundwave	skywave	skywave	groundwave	groundwave	groundwave
Protected contour	groundwave E_{nom}	E_{nom}*	groundwave contour corresponding to the greater of E_{nom} or E_u	groundwave E_{nom}	Groundwave E_{nom}	groundwave contour corresponding to value of daytime E_{nom}
Value to be protected	E_{nom}	E_{nom}	greater of E_{nom} or E_u	Adjacent channel daytime groundwave E_{nom}	night-time groundwave E_{nom}	daytime groundwave E_{nom}
How E_u is calculated	Not applicable	Not applicable	4.7	Not applicable	Not applicable	Not Applicable
Where E_u is calculated	Not applicable	Not applicable	Station site	Not applicable	Not applicable	Not applicable
How protection is applied	$\frac{E_{nom}}{\text{Protection ratio}}$ applied separately	$\frac{E_{nom}}{\text{Protection ratio}}$ applied separately	using 4.7 the maximum permissible field strength at the station site is not to be exceeded at the protected contour	$\frac{E_{nom}}{\text{Protection ratio}}$ applied separately	$\frac{E_{nom}}{\text{Protection ratio}}$ applied separately	$\frac{E_{nom}}{\text{Protection ratio}}$ applied separately

* groundwave or 50% skywave contour, whichever is farther from he site.

APPENDIX 5

(to Annex 2)

METHOD USED FOR CALCULATING SECTIONALIZED ANTENNA RADIATION CHARACTERISTICS

(The columns referred to below are those of Part II of Annex 1 to the Agreement)

1. Sectionalized tower, when the value entered in column 12 is 3.

$$f(\theta) = \frac{2\cos(90\sin\theta)\cos\left[(A+90)\sin\theta\right] + \cos(A\sin\theta) - \cos A}{\cos\theta\,(3 - \cos A)}$$

Where:

A = electrical height of bottom section

θ = elevation angle

2. Sectionalized tower, when the value entered in column 12 is 4.

$$f(\theta) = \frac{\cos(A\sin\theta)\left[\cos(A\sin\theta) - \cos A\right]}{\cos\theta\left[1 - \cos A\right]}$$

Where:

A = electrical height of bottom section

θ = elevation angle

3. Sectionalized tower, when the value entered in column 12 is 5.

$$f(\theta) = \frac{\dfrac{\cos(A\sin\theta) - \cos A}{\cos\theta} + \dfrac{CD\cos\theta\left\{\cos(A\sin\theta) + \cos\left[(A+B)\sin\theta\right]\right\}}{C^2 - \sin^2\theta}}{1 + \dfrac{2D}{C} - \cos A}$$

Where:

A = electrical height of bottom section

B = electrical height of top section

C = current distribution factor

D = ratio of maximum current in top section to maximum current in bottom section

θ = elevation angle.

4. Sectionalized tower, when the value entered in column 12 is 6.

$$f(\theta) = \frac{\cos(A \sin\theta) - \cos(A-B)\cos(B \sin\theta) + \sin\theta \sin(A-B)\sin(B \sin\theta)}{\cos\theta \left[1 - \cos(A-B)\right]}$$

Where:

A = total electrical height of tower

B = electrical height of lower section

θ = elevation angle.

5. Sectionalized tower, when the value entered in column 12 is 7.

$$f(\theta) = \frac{C\cos(A \sin\theta) - \cos A + \cos(B \sin\theta) - \cos(B-A)\cos(A \sin\theta) + \sin(B-A)\sin\theta \sin(A \sin\theta)}{C\left[1 - \cos A\right] + \cos\theta \left[1 - \cos(B-A)\right]}$$

Where:

A = electrical height of lower section

B = total electrical height of antenna

C = ratio of the loop currents in the two sections

θ = elevation angle.

6. Sectionalized tower, when the value entered in column 12 is 8

If $\theta = 0$, $f(\theta) = 1$

If $\theta > 0$:

$$f(\theta) = \frac{\sqrt{\text{real component}^2 + \text{imaginary component}^2}}{C}$$

The real component is equal to:

$$\left[\frac{2.28 \cos 0}{1.14^2 - \sin^2\theta}\right]\left\{- \cos\left[1.14\,(B-A)\right] + 2\cos(1.14B)\cos(A\sin\theta) - \cos\left[(A+B)\sin\theta\right]\right\}$$

The imaginary component is equal to:

$$D\cos\theta\left\{\frac{\sin\left[(A+B)\sin\theta\right]}{\sin\theta} + \frac{1.14}{1.14^2 - \sin^2\theta}\left[\sin\left[1.14(B-A)\right] - 2\sin(1.14B)\cos(A\sin\theta) + \frac{\sin\theta\,\sin\left[(A+B)\sin\theta\right]}{1.14}\right]\right\}$$

Where:

A = electrical height of lower section of tower

B = electrical height of upper section of tower

C = scaling factor so that $f(\theta)$ is 1 in horizontal plane

D = absolute ratio of the real component of current to the imaginary component of current at the point of maximum amplitude

θ = elevation angle.

<u>Note</u>: 1.14 is the ratio of velocity of light to propagation velocity along radiator.

7. Sectionalized tower, when the value entered in column 12 is 9.

$$f(\theta) = \frac{\cos(A\sin\theta)\left[\cos(B\sin\theta) + 2\cos(A\sin\theta)\right]}{3\cos\theta}$$

Where:

A = electrical height of centre of bottom dipole

B = electrical height of centre of top dipole

θ = elevation angle.

APPENDIX 6

(to Annex 2)

Groundwave Field Strength Measurements

1. This Appendix describes the groundwave field strength measurement method to be used in the application of Article VI of the Agreement.

2. The protected contour of an assignment shall be as defined in conformity with Annex 2 unless specifically agreed otherwise.

3. General Measurement Criteria

3.1 Measurements must be made during daytime hours only. Care must be taken to avoid measurement of skywave signals during early morning and late afternoon hours.

3.2 Measurement data along a radial will be considered to be representative of conductivity through an arc not to exceed ±10 degrees from the azimuth of the radial. Conditions of irregular terrain or other factors indicating a probable difference in conductivity over the arc may require radials every few degrees, unless a showing is made that the radials measured would reasonably be expected to have higher conductivity than other nearby terrain (e.g., a mountainside would be expected to have a lower conductivity than would an adjacent valley).

3.3 All measurement points must be on-radial to the extent possible. Any off radial measurements shall be accompanied by a showing that they are valid for the intended purpose. Off-radial directional measurements will not be considered in a radial analysis unless the directional antenna pattern shows nearly constant radiation.

4. Measurements to determine the presence of interference

4.1 Interference shall be deemed to exist if the measured field strength of the interfering signal at or within the predicted location of the protected contour of an assignment does not meet the protection requirements of Annex 2 or any other protection requirements specifically agreed upon for this assignment.

4.2 Field strengths shall be measured in accordance with good engineering practice along pertinent radials originating from the station believed to be the cause of the interference.

4.3 There shall be a sufficient number of measurements to make an adequate showing of interference. This shall include at least 10 measurements not less than 1 km apart along each radial, within the protected contour.

5. Measurements to justify an assignment based on conductivity values differing from the official map

5.1 Field strengths shall be measured in accordance with good engineering practice. In particular:

5.1.1 There shall be at least one radial in each sector in which it is intended to establish that no interference will be caused.

5.1.2 At least 30 points shall be measured out to a distance of 30 km. At least 15 of these measurement points shall be located within 3 km of the transmitter site, in order that both inverse field and soil conductivity may be determined by best-fit curve analysis. Within each of these ranges, the points measured shall be spaced as nearly equally as possible. Beyond 30 km measurements shall be taken at intervals not exceeding 20% of the distance between the interfering station and the protected contour. In any event, sufficient measurements shall be taken to support the finding required under 4.1 above.

6. Presentation of Measurement Data

The following data shall be presented in support of measurements:

6.1 A tabulation of field strength values, with distance from the transmitter and time each measurement was taken. Also, a general statement as to climate and terrain conditions (damp, dry, hot, cold, marshy, rocky, ets.);

6.2 Maps showing measurement locations in sufficient detail to show elevations, natural and man-made obstructions or formations, and terrain condition;

6.3 The calculation of permissible radiation shall be based on the values of ground conductivity determined from the plotted points for each radial, plus, beyond the boundary, or the end of each radial, the values of conductivity found on the pertinent conductivity maps.

6.4 Description of the instrument used to take the measurements and certifications as to field-strength meter calibration and of operator compliance with manufacturer's instructions for making measurements, along with operator qualifications and experience in making measurements; and

6.5 Description of the transmitter, antenna system, and relevant operating parameters in use by the station when the measurements were taken.

APPENDIX 7

(to Annex 2)

METHOD FOR EXTENDED HOURS OF OPERATION

CALCULATIONS USING DIURNAL FACTORS

1. This Appendix contains the method to be used when applying diurnal factors during periods of extended hours of operation under Article VII of the Agreement. Procedures for calculating nighttime interference on a site-to-site or site-to-contour basis are based on propagation conditions occuring two hours after sunset as a standard reference.

To calculate interference during extended hours of operation periods, the nighttime interference can be calculated and then modified taking into account the diurnal factor. Diurnal factors are calculated from the formulas contained in Tables 5A and 5B of Annex 2, and are represented graphically in Figures 5A and 5B of Annex 2. They are expressed as a ratio of the skywave field strength at any time during the pre-sunrise or post-sunset period to the skywave field strength occuring during the reference hour of two hours past sunset at path mid point.

The following illustration describes the application of the diurnal curves when calculating required protection to the 0.5 mV/m 50% contour of a Class A station from a daytime-only station operating during the post-sunset period. A similar procedure may be used for the pre-sunrise period.

2. Post-Sunset Operations Providing Nighttime Protection

Evaluate the nighttime interference that would be produced by the daytime operation of the station requesting post-sunset authority to points along the protected 0.5 mV/m 50% contour of Class A nighttime co-channel stations. The permissible interfering 10% signal from post-sunset operations is less than 0.025 mV/m at any point along the protected contour of a Class A station. Identify all points on the 0.5 mV/m 50% contour toward which the permissible interfering signal is exceeded. From these calculations the maximum which is permissible can be determined. In many cases full nighttime protection will be quite restrictive and it may be advantageous to apply the diurnal curves.

3. Determine the Diurnal Factor

In order to apply the diurnal curves, it is necessary to determine the time of sunset at the path mid-point. Subtract the sunset time at the path mid-point from the local sunset time (assumed in this illustration to be 6:00 pm). With this time difference, enter the diurnal factor curves, Figure 5B of Annex 2, with the appropriate frequency, interpolate linearly between the diurnal curves and read the diurnal factor.

Example: A hypothetical station is located in Denver, CO, proposing post-sunset operation on 1130 kHz, and a path being analyzed has a mid-point located at N 39° 36' 36", W 97° 02' 15". The sunset time at the path mid-point is calculated to be 4:04. p.m. MST. Assuming that the station in Denver is permitted post-sunset operation until 6:00 p.m. MST, it would be operating 1.93 hours (6:00 p.m. - 4:04. p.m.) beyond sunset at the path mid-point.

Entering Figure 5B with SS + 1.93 on 1130 kHz results in a diurnal factor of approximately 0.99. It should be noted that a diurnal factor greater than 1.0 is never used.

4. <u>Apply the Diurnal Factor for Modified Power</u>

Divide the permissible interfering 10% skywave signal toward the Class A station on the path selected by the diurnal factor. This produces the worst case interfering signal adjusted by the diurnal factor along this path from the daytime operation to the protected contour of the Class A station during the post-sunset operating period. With the proposed interfering signal increased by the diurnal factor, the proposed post-sunset power may be increased by direct ratio (using the square root of the power). This increased power would be permitted for this particular path.

<u>Example</u>: From the previous example, the diurnal factor was determined to be 0.99. For the hypothetical case of the station in Denver, suppose that the permissible antenna radiation for the selected path that provides full nighttime protection is 75 mV/m.

Applying the diurnal factor for this path, the permissible radiation becomes 75 ÷ 0.99 = 75.76 mV/m. If it is necessary to reduce the daytime power to 260 watts to provide full nighttime protection, application of the diurnal factor would permit a modified power of 265.28 watts ($260 \times 75.76^2 \div 75^2$ or 260 watts $\div .99^2$).

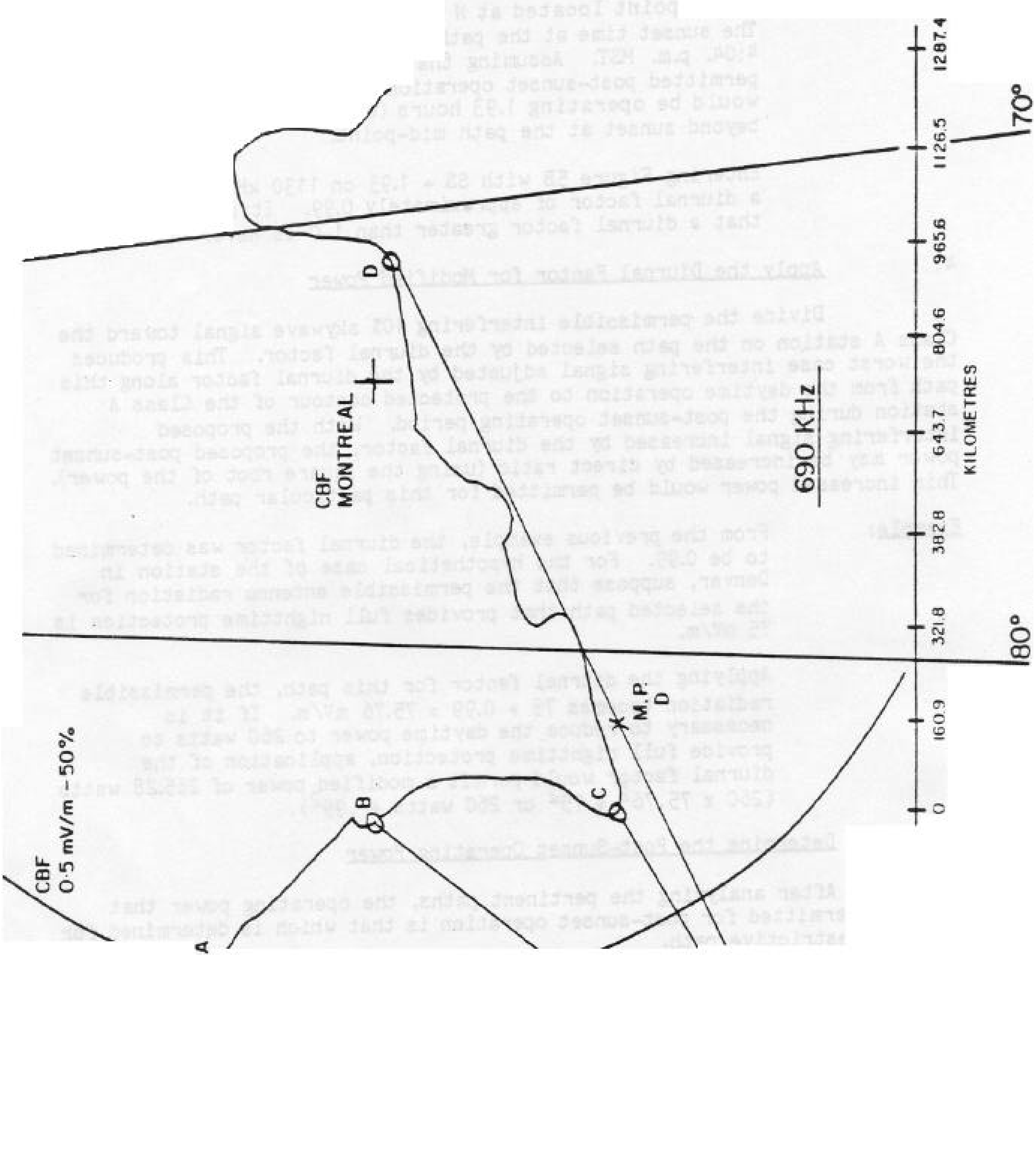
5. <u>Determine the Post-Sunset Operating Power</u>

After analyzing the pertinent paths, the operating power that would be permitted for post-sunset operation is that which is determined for the most restrictive path.

6. <u>Additional Example</u>

The example which follows is more detailed than the above example and illustrates the proposed diurnal calculation method using a Canadian Class A station and a U.S. Class B station as shown on Figure 7A.

FIGURE 7-A


CBF
MONTREAL
690 KHz
KILOMETRES
0
160.9
321.8
382.8
643.7
804.6
965.6
1126.5
1287.4
70°
80°
CBF
0·5 mV/m - 50%
A
B
C
D
M.P.
D

Assume Points A, B, C and D are points on the border. A, B and C are within the 0.5 mV/m -50% contour. Point D is within the 0.5 mV/m groundwave contour. Determine the mid-point latitude and longitude from the proposal to each point.

Mid-Points	Mid-Point Latitude	Mid-Point Longitude
M.P. A	N 42.9°	W 88.7°
M.P. B	N 41.9°	W 87.2°
M.P. C	N 40.4°	W 86.8°
M.P. D	N 42.0°	W 80.9°

Calculate the earliest time of sunset during the year at each mid-point. Note that St. Louis is in the Central Standard Time Zone.

Entering Figure 7B with Latitude N 42.9° of Mid-Point A, sunset time is approx. 4:25 p.m. CST along standard meridian 90° W. Next, a correction is made for the longitude correction from the standard meridian for Mid-Point A. This correction is + 4 minutes of time per degree West, or -4 minutes of time per degree East of the standard meridian.

Long. of M.P.A. - Std. Meridian = 88.7° - 90° = -1.3°

Time Correction = -1.3° x 4 = -5.2 minutes

The sunset at M.P.A. = 4:25 - 0:05.2 = 4:19.8 p.m. CST

At Latitude of M.P.B., sunset along standard meridian is approx. 4:27 p.m.

Long. of M.P.B. - Std. Meridian = 87.2° - 90° = -2.8°

Time Correction = 2.8° x 4 = -11.2 minutes

The sunset at M.P.B. = 4:27 - 0:11.2 = 4:15.8 p.m. CST

At Latitude of M.P.C., sunset along standard meridian is approx. 4:33 p.m.

Long. of M.P.C. - Std. Meridian = 86.8° - 90° = -3.2°

Time Correction = -3.2° x 4 = -12.8 minutes

The sunset at M.P.C. equals 4:33 - 0:12.8 = 4:20.2 p.m. Central Std. time.

At Latitude of M.P.D., sunset along standard meridian is approx. 4:29 p.m.

Long. of M.P.D. - Std. Meridian = 80.90 - 90° = -9.1°

Time Correction = -9.1° x 4 = -36.4 minutes

The sunset at M.P.D. = 4:29 - 0:36.4 = 3:52.6 p.m. CST.

Mid-Point	SS at M.P.	time = Local Sunset (6:00pm assumed)-SS at M.P.	Diurnal Factor (Figure 5-B)
A	4:19.8	1:40.2	.93
B	4:15.8	1:44.2	.96
C	4:20.2	1:39.8	.93
D	3:52.6	2:07.4	1.00

At Point	Assumed Protected Contour	Assumed permissible radiation to provide full Nighttime Protection
A	0.5 mV/m -50%	25 mV/m
B	1.0 mV/m -50%	35 mV/m
C	0.8 mV/m -50%	30 mV/m
D	0.6 mV/m groundwave	80 mV/m

The permissible radiation to provide full nighttime protection is adjusted in each case by the diurnal factor, to produce the permissible radiation toward each point during the post sunset operating period, i.e.

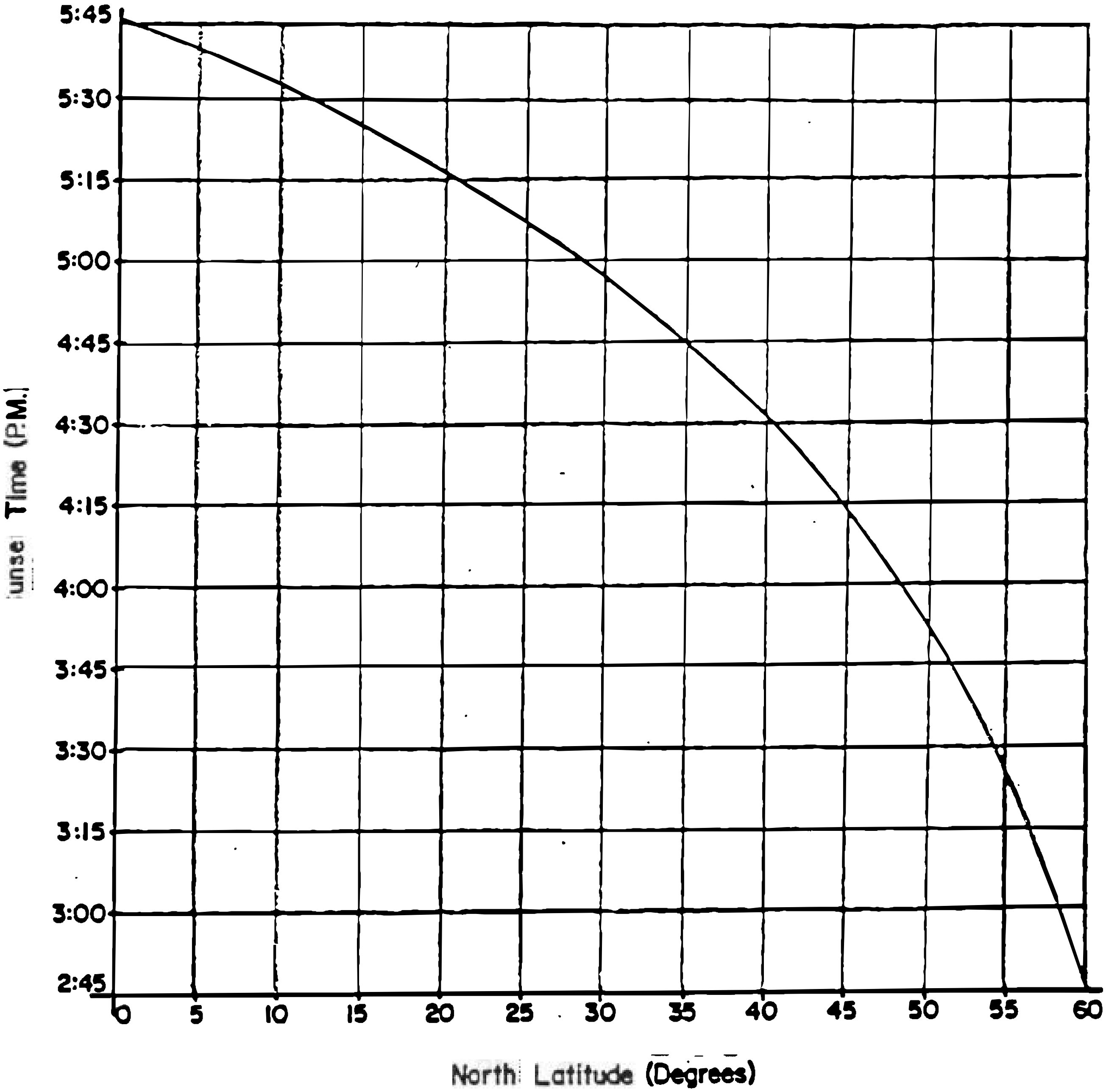
To Point	Diurnal Factor	Permissible Full-Night Radiation	Permissible Post Sunset Radiation
A	.93	25 mV/m	25+.93 = 26.88 mV/m
B	.96	35 mV/m	35+.96 = 36.46 mV/m
C	.93	30 mV/m	30+.93 = 32.26 mV/m
D	1.00	80 mV/m	80+1.00 = 80 mV/m

Thus, for post sunset operation, the station would have to adjust its power so that protection would be provided in all directions toward points A through D, so that actual radiation would not exceed the permissible Post Sunset radiation.

Although this example shows protection to a Class A station, the same procedure would apply to Class B stations as follows:

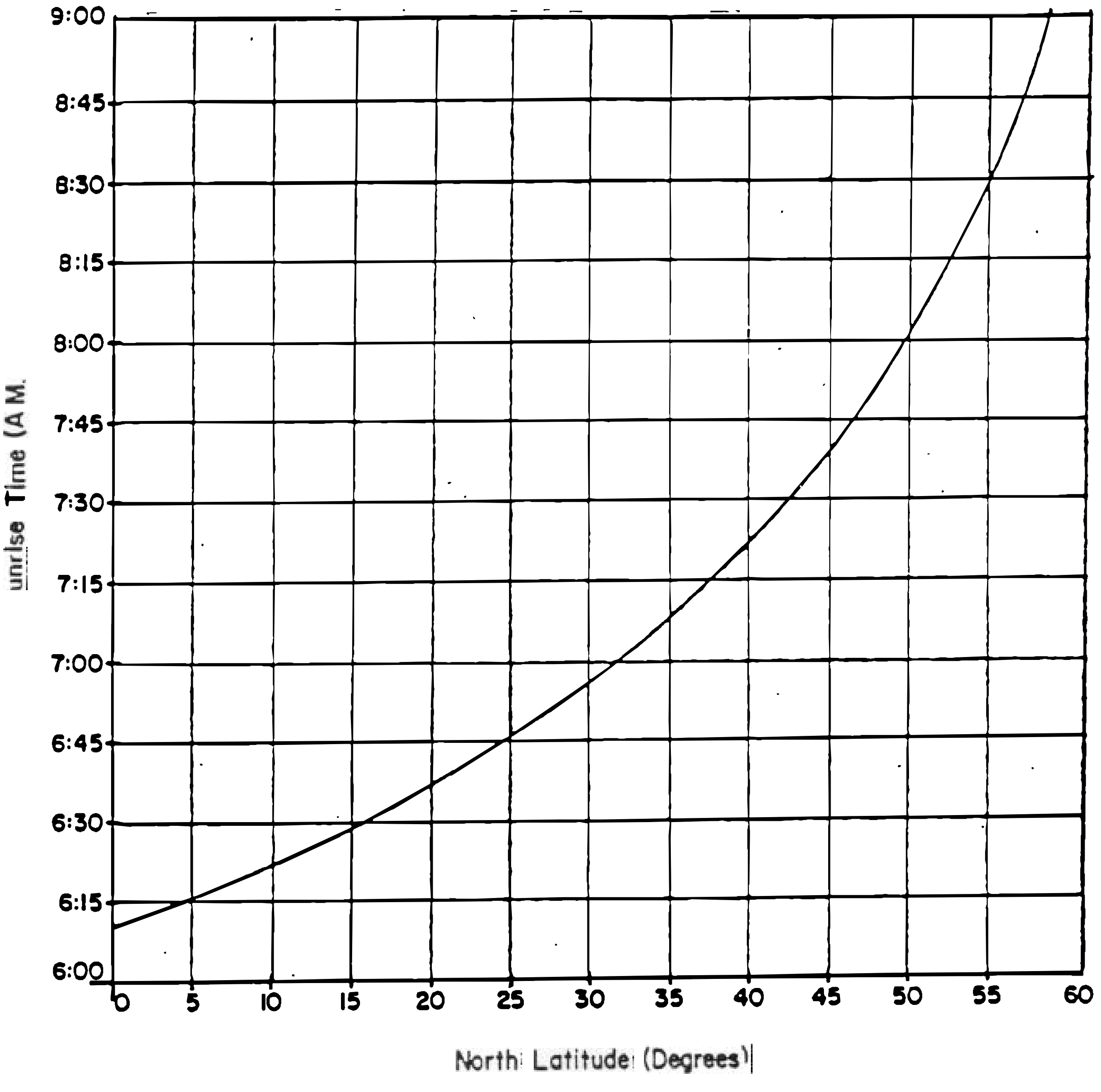
Assume that each point A, B, C and D is a separate Class B station. Calculate the existing R.S.S. for each station and determine the values of permissible radiation for full nighttime protection toward each station, and apply the diurnal factors to produce the permissible Post Sunset Radiation toward each station. Then adjust the power of the station operating during the post sunset period so that the permissible post sunset radiation values are not exceeded.

Figure 7B



Earliest Sunset Time
along a
Standard Meridian

Figure 7.C



Latest Sunrise Time
along a
Standard Meridian

APPENDIX 8

(to Annex 2)

Criteria for Critical Hours of Operation

1. This Appendix specifies the criteria required in the application of Article VIII of the Agreement.

2. Critical hours of operation are defined as follows:

2.1 Beginning at local sunrise at the transmitting antenna site of the Class B or C station, and ending one and one-half hours after the time of sunrise at the geographic midpoint between the transmitting antenna site of the Class B or C station and that of the Class A station.

2.2 Beginning one and one-half hours before the time of sunset at the geographic midpoint between the transmitting antenna site of the Class B or C station and that of the Class A station, and ending at local sunset at the transmitting antenna site of the Class B or C station.

2.3 These periods are established for each month on the basis of sunrise and sunset times for the fifteenth day of the month adjusted to the nearest quarter-hour.

3. The Class A stations shall be protected to their calculated 100 uV/m daytime contour. Where the protected contour would extend beyond the boundary of the country in which the Class A station is located, the protected contour shall follow that part of the boundary.

4. During the critical hours of operation defined in section 2, the maximum permissible radiated field strength of the Class B or C station toward each point on the protected contour of the Class A station, over the vertical arc specified in section 4.2, shall be determined by the distance from the transmitting antenna site of the Class B or C station to the protected point in question in accordance with the following equation which is graphically illustrated in Fig. 8:

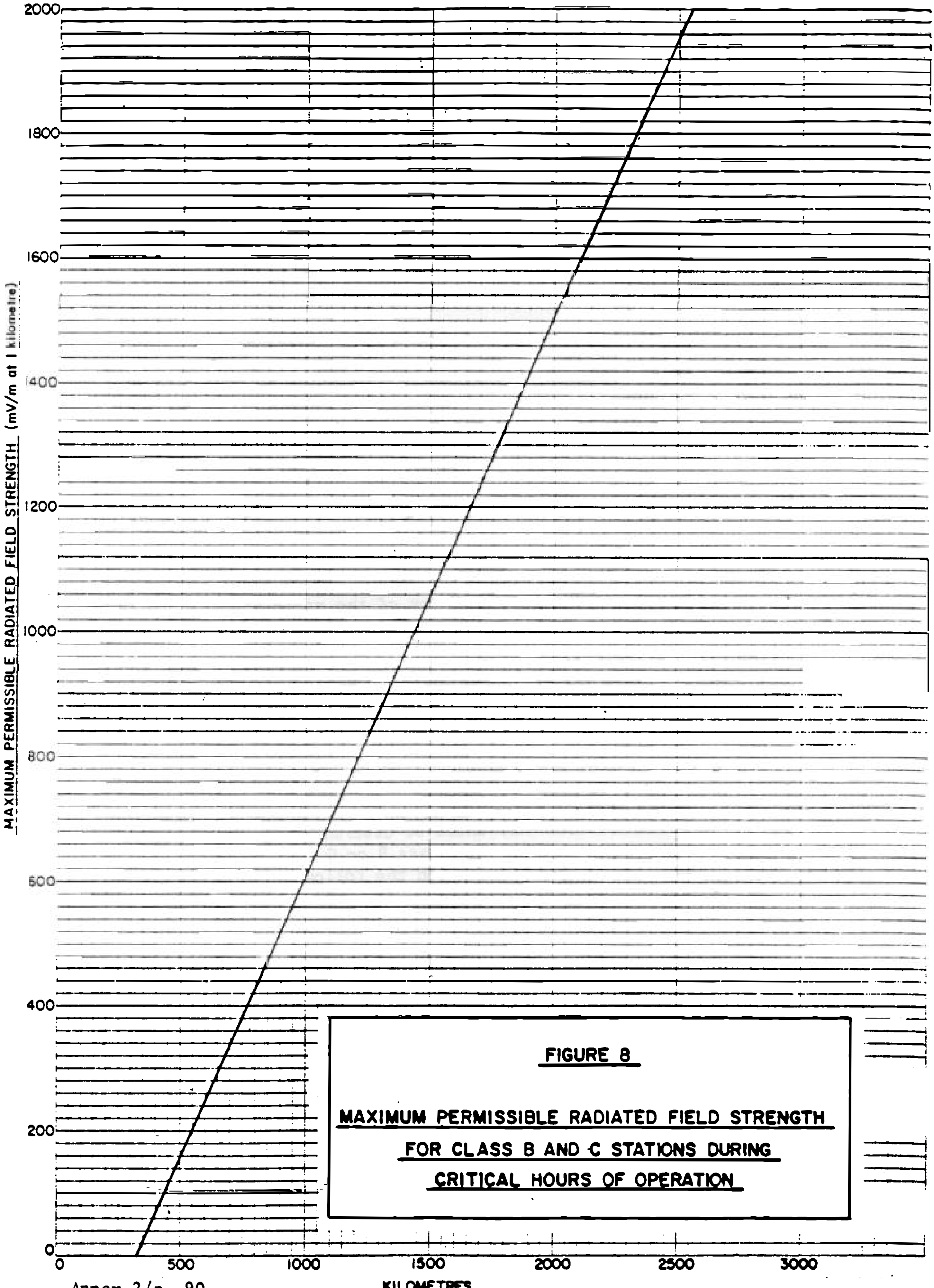
4.1 $F = 0.9\,D - 290$

where:

F Maximum permissible radiated field strength of the Class B or C station in mV/m at one kilometre toward the point on the protected contour of the Class A station.

D = Distance in kilometres from the transmitting antenna site of the Class B or C station to the same point as above.

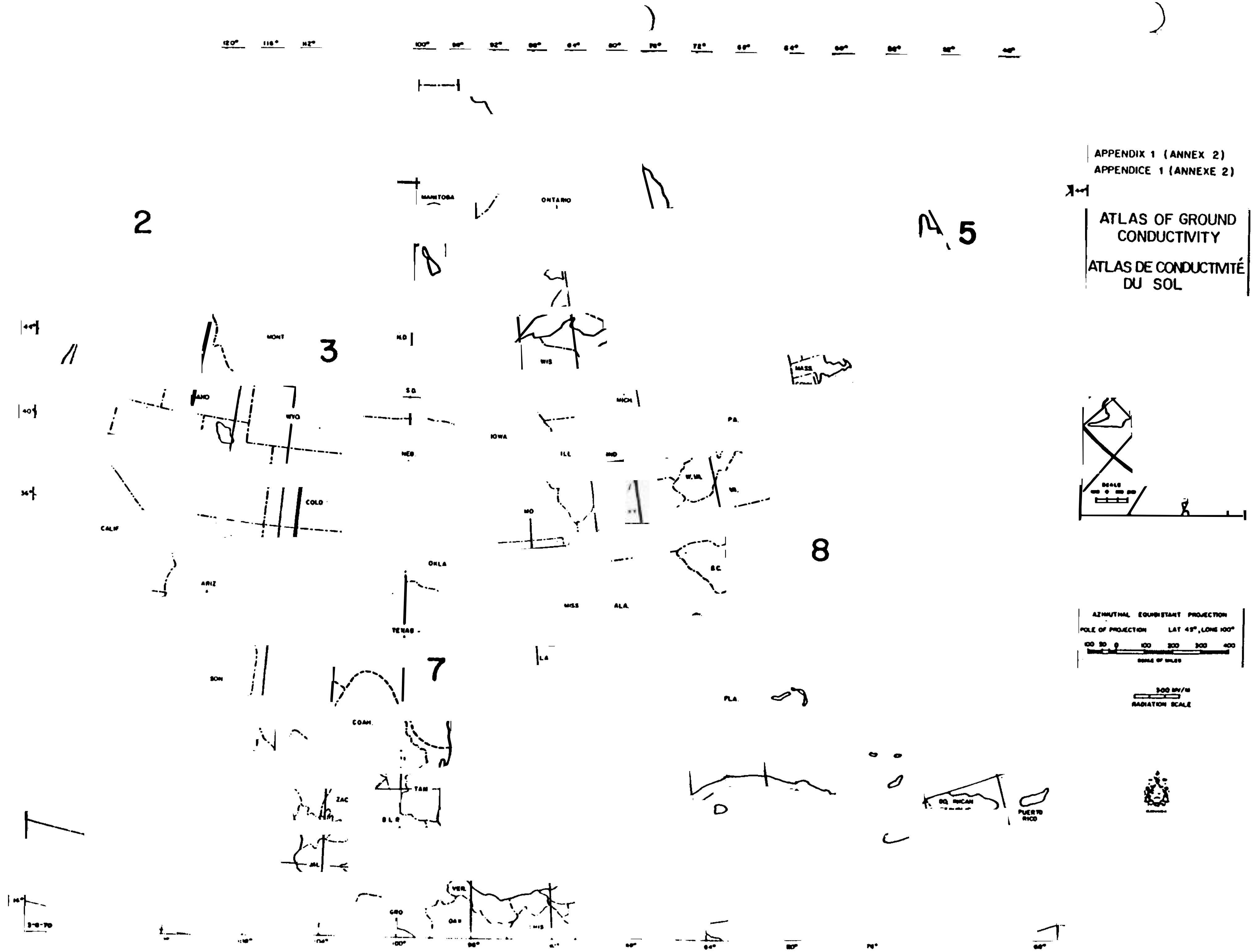
4.2 The vertical arc for the maximum permissible radiated field strength shall be the arc from the horizontal plane to the elevation angle specified in the Curve of Figure 2 of Annex 2.


2000
1800
1600
1400
1200
1000
800
600
400
200
0
MAXIMUM PERMISSIBLE RADIATED FIELD STRENGTH (mV/m at 1 kilometre)
0
500
1000
1500
2000
2500
3000
KILOMETRES
FIGURE 8
MAXIMUM PERMISSIBLE RADIATED FIELD STRENGTH FOR CLASS B AND C STATIONS DURING CRITICAL HOURS OF OPERATION

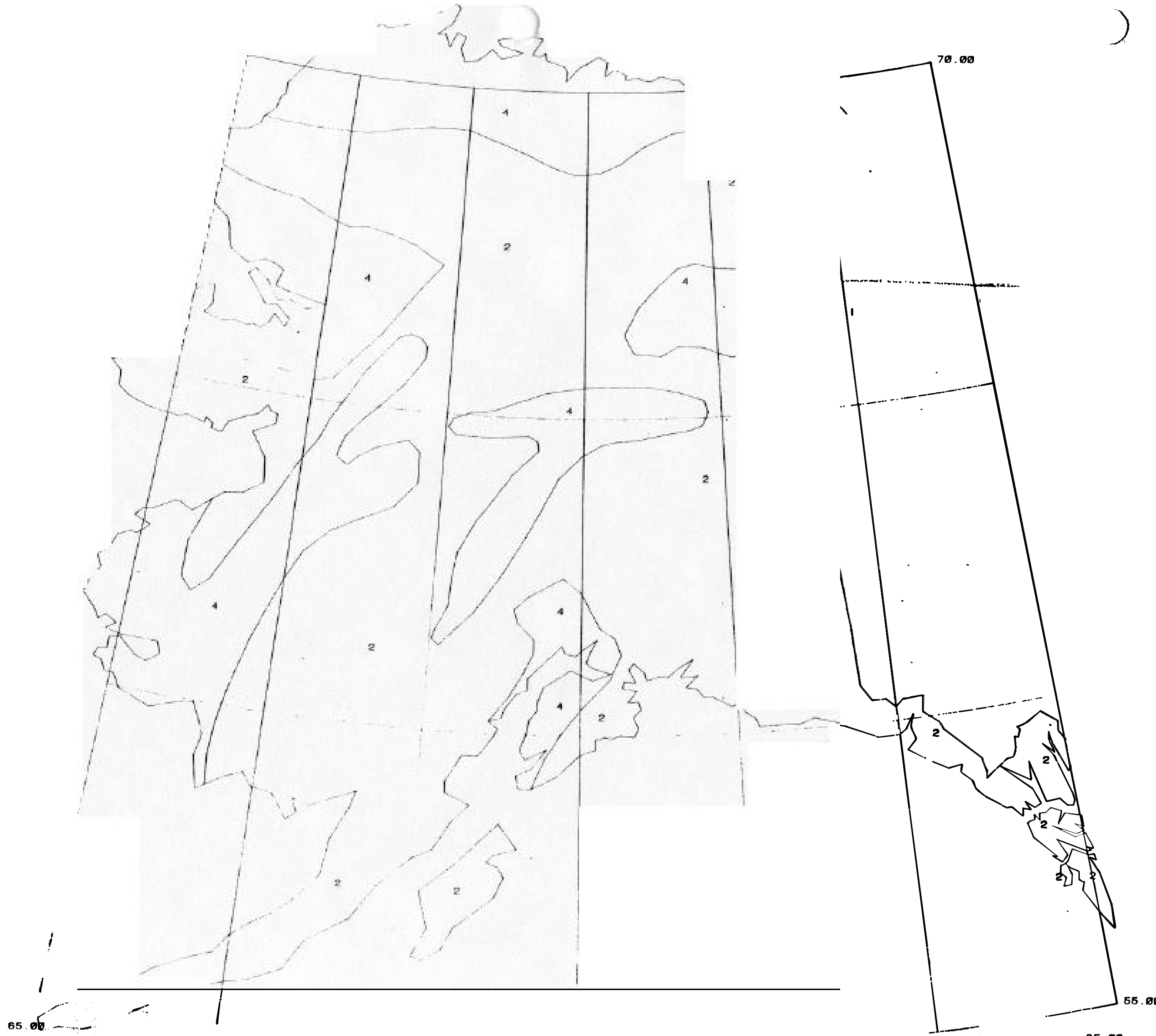
Note: The nine maps on the following pages were reduced from the larger maps that had been placed in the "attached envelope" referred to at the foot of page 36 to Annex 2.

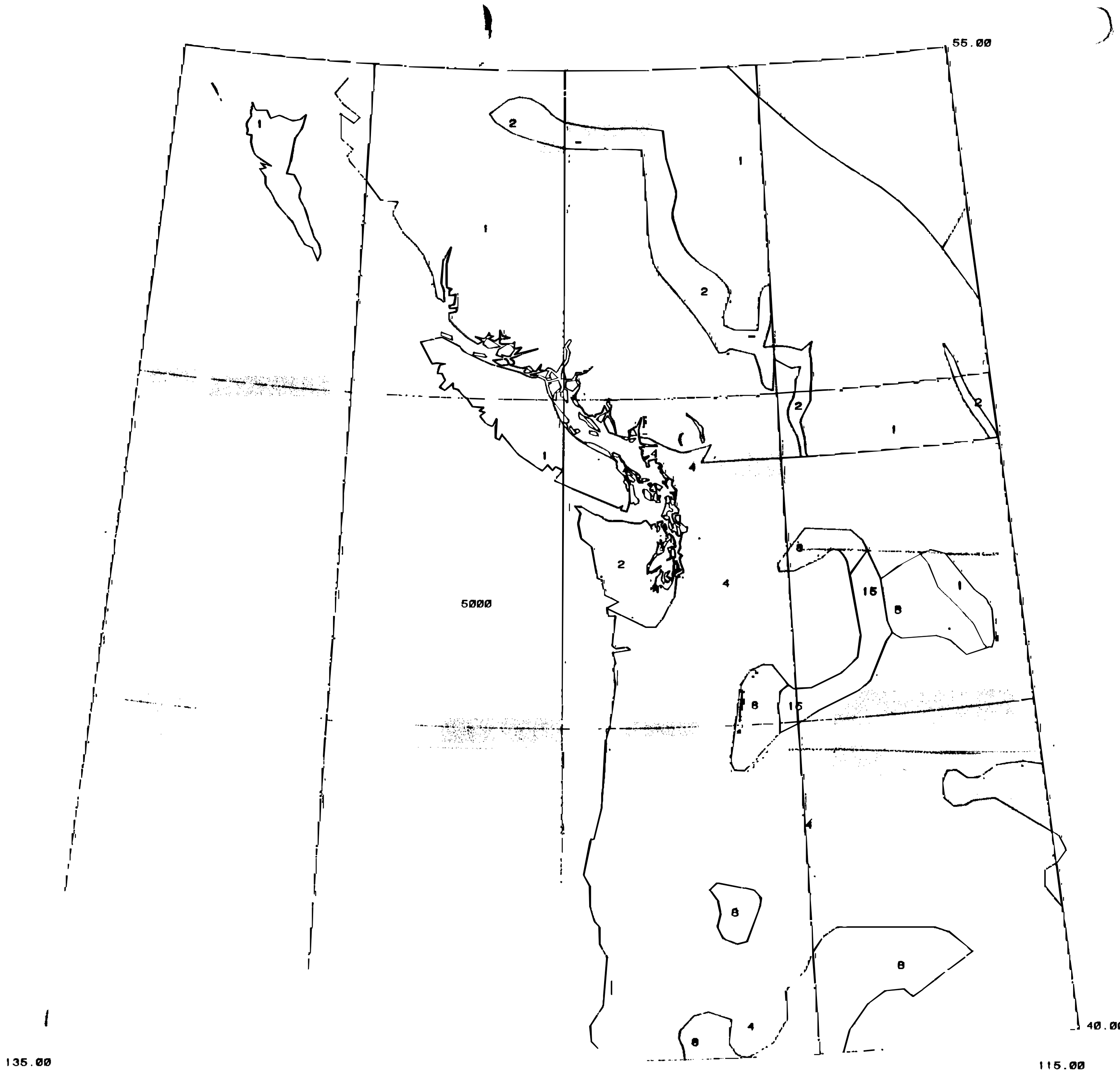
APPENDIX 1 (ANNEX 2)
APPENDICE 1 (ANNEXE 2)

ATLAS OF GROUND CONDUCTIVITY
ATLAS DE CONDUCTIVITÉ DU SOL

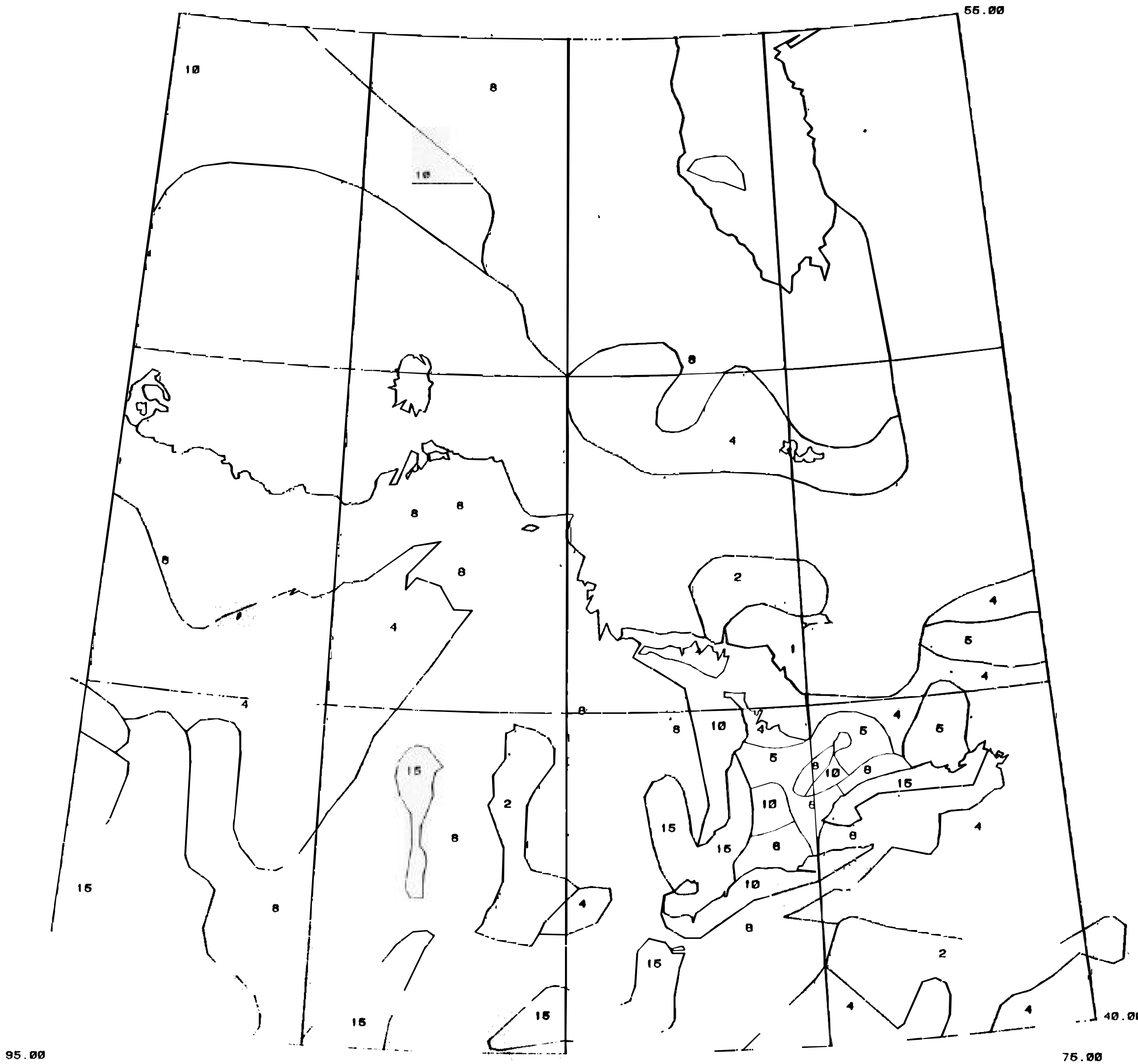


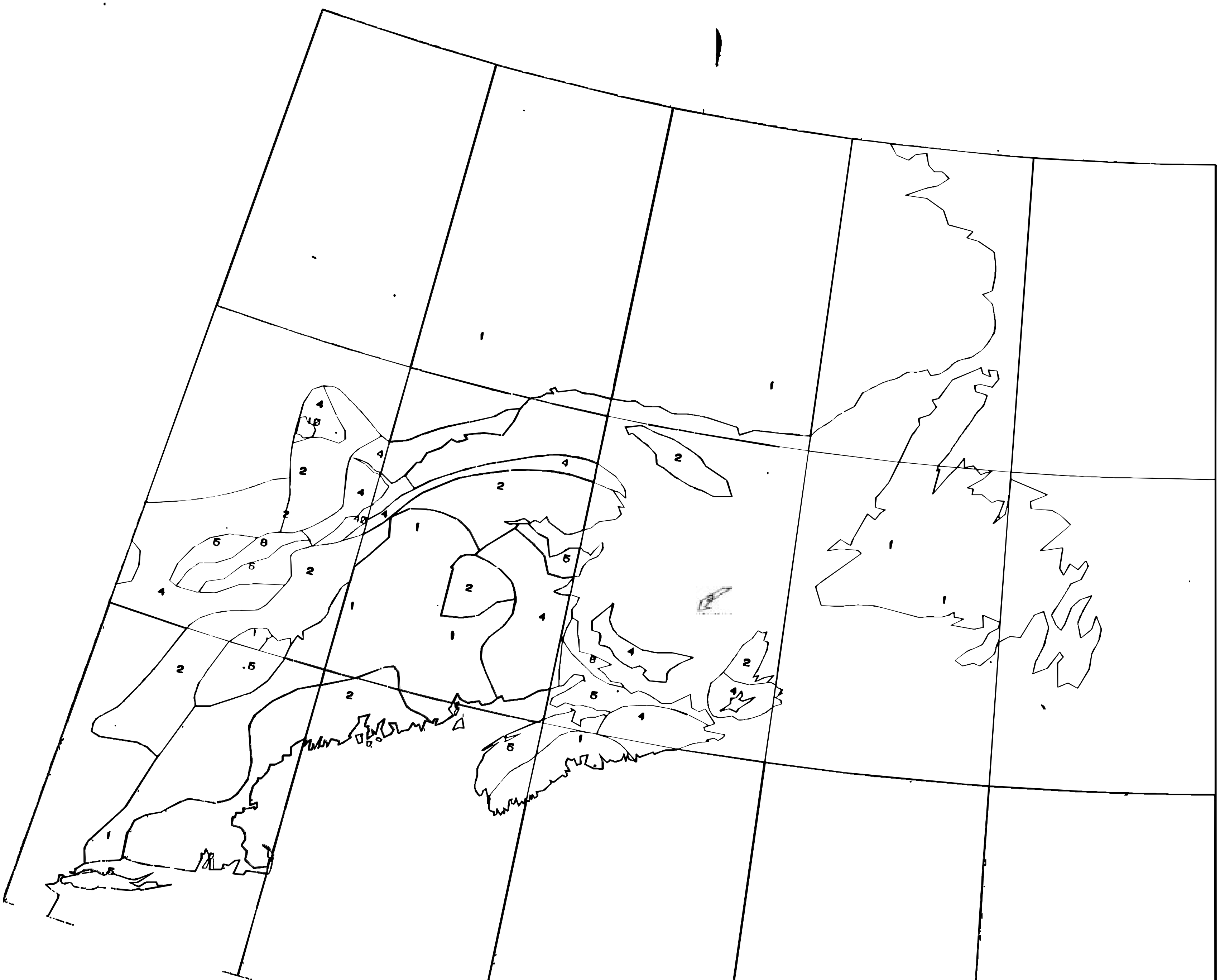
IMITES/LIMITS 55.
LOC/BLOCK 1




55.00
40.00
135.00
115.00
5000

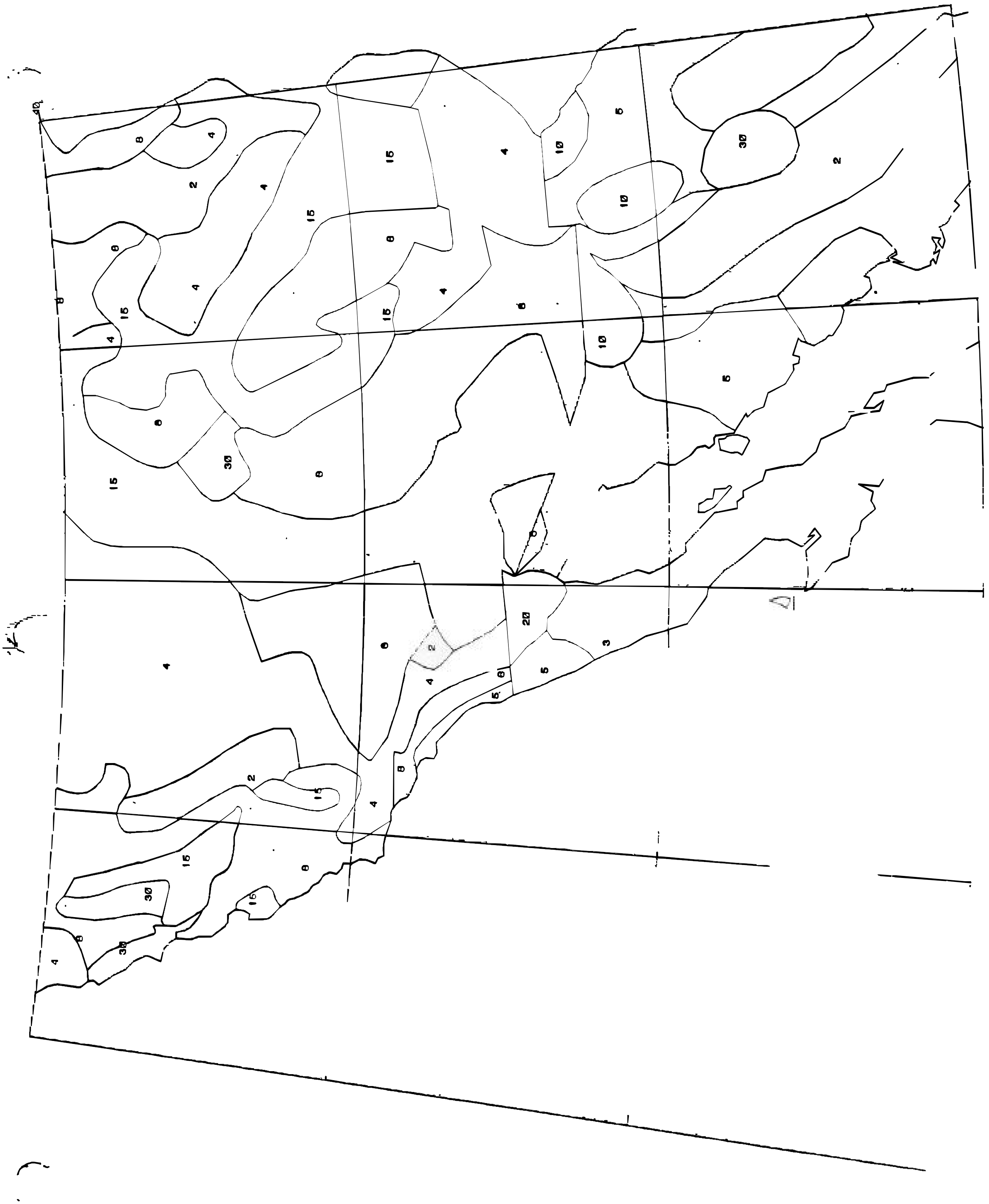
LIMITES/LIMITS 40.° 55.° 75.° 95.°



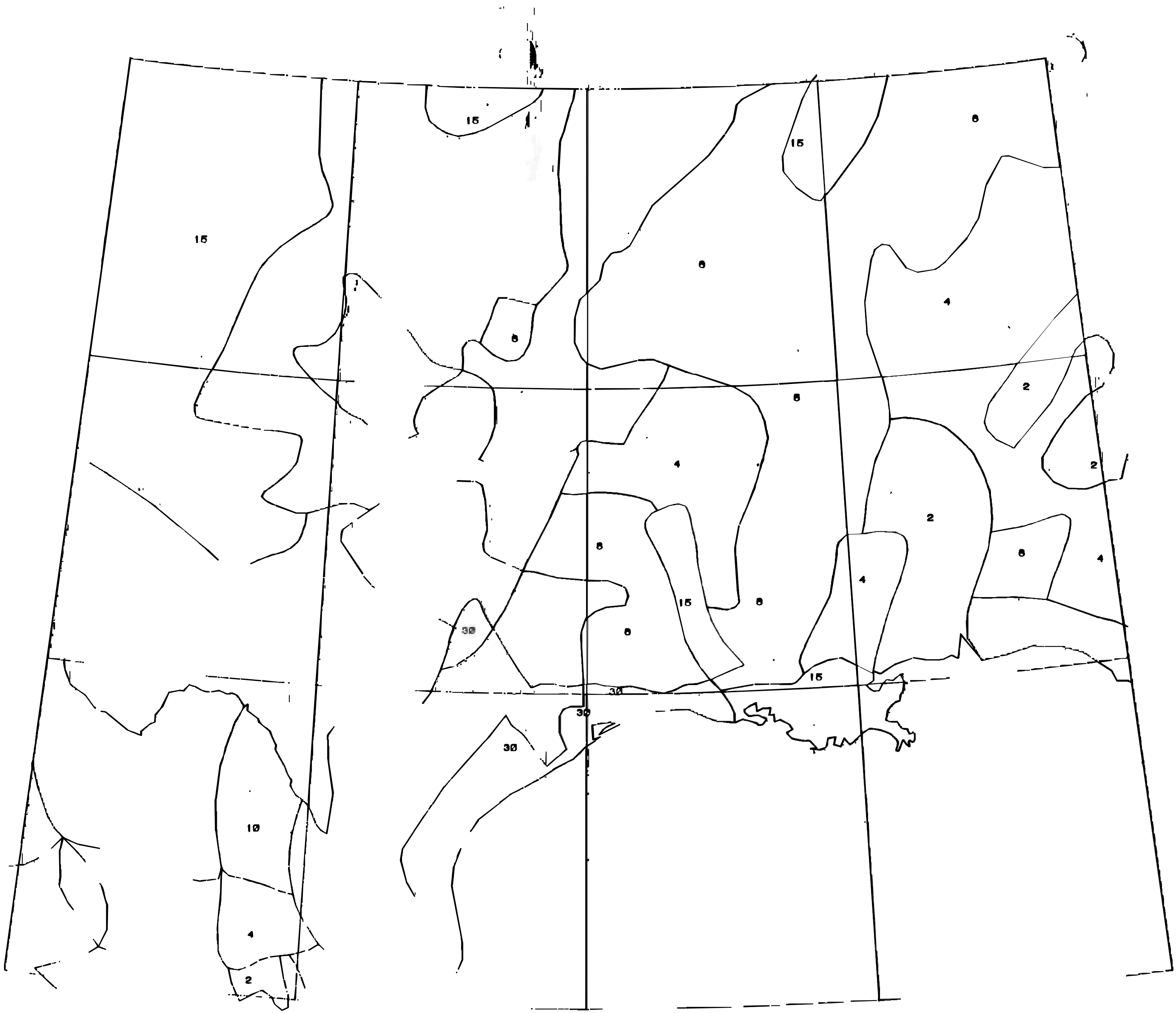


75.1

ECT ON CONIQUE CONF



ILOC/BLOCK



BLOCK 8